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Saint Lawrence/Champlain Valley (STL) Aquatic Community Classification, "Heritage Approach"

Background Information, Explanation and Justification

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(Riverine Communities: March 14, 2000; Lacustrine Communities: May 3, 2000)

Final Draft: January 12, 2003; David Hunt, Ecological Intuition & Medicine

Saint Lawrence/Champlain Valley (STL) Aquatic Community Working Group

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List of Tables, Figures, Appendices and Other Attachments.

GLOSSARY OF CLASSIFICATION UNITS

Ecological Alliance (= **Biotic Alliance**)
A biotic classification unit representing an aggregated group of ecological associations of somewhat dissimilar taxa which repeatedly occur in close geographic proximity, clustered in a mosaic. This unit often occurs at relatively large spatial scales, usually corresponding to a single regional macrohabitat (entire lake or segment of stream systems), and is generally restricted to a geographic region.

Ecological Association (=**Biotic Association**)
A biotic classification unit representing an aggregation of species assemblages of different taxonomic groups, especially resident species, which repeatedly occur in close geographic proximity, clustered in a mosaic. This unit occurs at relatively small spatial scales, usually corresponding to regional microhabitats (portions of lakes or portions of stream reaches) and is generally restricted to a geographic region. The term "**plant association**" follows a similar concept: "a plant community of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions" (Anderson et al., 2000).

Ecological Community
"A variable assembly of interacting plant and animal populations that share a common environment" distinguished by features such as ecological structure, physiognomy, the composition of resident organisms, and ecological processes. (Reschke, 1990)

Macrohabitat Type (=**Basic Macrohabitat Type**; **Generalized Macrohabitat Type**)
A relatively large-scale community classification unit that is primarily physiochemically based and thus repeatable over large geographic regions, theoretically worldwide. Defined in part by their unique combination and abundance of microhabitat types. Biotically, these units might be differentiated by broad patterns of biota at very high taxonomic levels, as opposed to regional macrohabitats that are based on regional difference in biota at lower taxonomic levels.

Macrohabitat (=**Regional Macrohabitat**; =**Specific Macrohabitat**)
A community classification unit that is primarily physiochemically based and generally confined to specific geographic regions (especially ecoregions). This unit is based on regional differences in biota at low taxonomic levels, and is thus taxonomically finer in scale than basic macrohabitat types.

Microhabitat Type (=**Basic Microhabitat Type**)
A community classification unit that is primarily physiochemically based and generally represents discrete physical habitats within macrohabitats with relatively uniform physical properties, especially for flow, light regime, water chemistry and thermal patterns.

Microhabitat (=**Regional Microhabitat**; =**Specific Microhabitat**)
A community classification unit that is primarily physiochemically based and generally confined to specific geographic regions (especially ecoregions). This unit is based on regional differences in biota at low taxonomic levels, and is thus taxonomically finer in scale than basic microhabitat types.

Species Assemblage
A distinct biological collection of (taxonomically similar) species which recur under similar habitat conditions and ecological processes. (Vermont's Aquatic Classification Work Group, 1998; slightly annotated)

Table 1. **Tally of Aquatic Community Units in First Iteration STL Classification**

Part 1. Abiotic Units Known, Suspected & Potential from STL.

Ecoregion Units: 3

characteristic:	1 (STL)
peripheral:	2 to 3 (NAP, GL, "Acadian")

Microhabitat Types:	12	
Flow Microhabitat Types:	3	
Depth/Substrate Microhabitat Types:		5
Light Regime Microhabitat Types:		4

A. RIVERINE

Basic Macrohabitat Types:		9 (known/suspected)	
Regional Macrohabitats:			25
known/suspected:		16	
characteristic STL types:		8	
peripheral NAP types:		4	
peripheral GL types:		4	
potential:	9		
peripheral NAP types:		5	
peripheral GL types:		4	
total STL types:		8	
total NAP types:		9	
total GL types:		8	

Regional Microhabitats:

total known/suspected/potential from STL: ca. 30 to 50

B. LACUSTRINE

Basic Macrohabitat Types:		13 (known/suspected)	
Regional Macrohabitats:			25
known/suspected:		14	
characteristic STL types:		10	
peripheral NAP types:		2	
peripheral GL types:		2	
potential:	11		
peripheral NAP types:		7	
peripheral GL types:		4	
total STL types:		10	
total NAP types:		9	
total GL types:		6	

Regional Microhabitats:

total known/suspected/potential: ca. 40 to 60

Table 1. (continued)

Part 2. Biotic Units Known, Suspected & Potential from STL and NAP.

A. RIVERINE

Species Assemblages:		43
characteristic STL:	30	
suspected in STL:		39
Plants:	15	
characteristic STL:		10
characteristic NAP:		10
suspected in STL:		14
Macroinvertebrates:		16
characteristic STL:		11
characteristic NAP:		5
suspected in STL:		16
Fish:		9
characteristic STL:		7
characteristic NAP:		2
suspected in STL:		7
Herptiles:		2
characteristic STL:		2
suspected in STL:		2
Aquatic Alliances:		16*
Aquatic Associations:		ca. 30 to 40**

B. LACUSTRINE

Species Assemblages:		67
characteristic STL:		43
suspected in STL:		59
Plants:	26	
characteristic STL:		18
suspected in STL:		23
Vascular Plant Dominated:		11
characteristic STL:		4
characteristic NAP:		5
characteristic GL:	2	
suspected in STL:		9
Macroscopic Non-Vascular Plant Dominated:		7
characteristic STL:		7
Phytoplankton:	8	
characteristic STL:		7
characteristic NAP:	1	
suspected in STL:		7
Macroinvertebrates:		24
characteristic STL:		11
characteristic NAP:		13
suspected in STL:		21
Fish:		8
characteristic STL:	7	
characteristic NAP:	1	
suspected in STL:		7
Zooplankton:	7	
characteristic STL:		6
characteristic NAP:		1
suspected in STL:		6
Herptiles:		2

characteristic STL: 1
characteristic NAP: 1
suspected in STL: 2

Aquatic Alliances: 14*

Aquatic Associations: ca. 100 to 200***

* Under the hypothesis that these correspond 1:1 with regional macrohabitats.
** Under the hypothesis that these correspond 1:1 with regional microhabitats.
** Under the hypothesis that there is on average about 3 associations per macrohabitat-microhabitat combination.

Table 2. List of Aquatic Macrohabitat Types of New York

RIVERINE SYSTEM (9 types)

- **Riverine Cave Community**
- **Intermittent Stream**
- **Spring**
- **Backwater Slough**
- **Rocky Headwater Stream**
- **Marsh Headwater Stream**
- **Confined River**
- **Unconfined River**
- **Deepwater River**

LACUSTRINE SYSTEM (17 types)

- **Salt Pond***
- **Lacustrine Cave Community**
- **Pine Barrens Vernal Pond**
- **Vernal Pool**
- **Sinkhole Pond**
- **Oxbow Pond**
- **Flow Through Pond**
- **Meromictic Lake****
- **Bog Lake**
- **Acidic Pond****
  - Coastal Pond (provisional subtype)*
  - Tarn Pond (provisional subtype)**
- **Acidic Dimictic Lake****
  - Oligotrophic Acidic Dimictic Lake (provisional subtype)
  - Eutrophic Acidic Dimictic Lake (provisional subtype)
- **Winter-Stratified (Monomictic) Lake**
- **Alkaline Pond**
- **Marl Pond**
- **Summer-Stratified (Monomictic) Lake**
  - Deepwater Lake (provisional subtype)
- **Eutrophic Alkaline Dimictic Lake**
- **Oligotrophic Alkaline Dimictic Lake**

* Not suspected from either STL or NAP.
** Not suspected in STL, but suspected from NAP.

Note: all others are known or strongly suspected from STL.

Table 3. List of Aquatic Macrohabitats Targeted for STL Portfolio

A) **Riverine Macrohabitats** (23 regional macrohabitats)

STL Spring
NAP Spring
GL Spring
STL Subterranean Stream
STL Backwater Slough
NAP Backwater Slough
GL Backwater Slough
STL Intermittent Stream
NAP Intermittent Stream
GL Intermittent Stream
STL Rocky Headwater Stream
NAP Rocky Headwater Stream
GL Rocky Headwater Stream
STL Marsh Headwater Stream
NAP Marsh Headwater Stream
GL Marsh Headwater Stream
STL Confined River
NAP Confined River
GL Confined River
STL Unconfined River
NAP Unconfined River
GL Unconfined River
GL Deepwater River

Additional estuarine macrohabitats likely from Quebec STL (6)
Acadian Freshwater Tidal River
Acadian Brackish Tidal River
Acadian Marine Tidal River
Acadian Freshwater Tidal Creek
Acadian Brackish Tidal Creek
Acadian Marine Tidal Creek

B) **Lacustrine Macrohabitats** (18 regional macrohabitats)

STL Subterranean Lake
STL Vernal Pool
NAP Vernal Pool
GL Vernal Pool
NAP Pine Barrens Vernal Pond
STL Sinkhole Pond
STL Oxbow Pond
NAP Oxbow Pond
GL Oxbow Pond
STL Flow-Through Pond
NAP Flow-Through Pond
NAP Bog Lake
STL Alkaline Pond
GL Marl Pond

STL Eutrophic Alkaline Dimictic Lake
STL Oligotrophic Alkaline Dimictic Lake
STL Winter-Stratified Monomictic Lake
STL Summer-Stratified Monomictic Lake

Table 4. List of Aquatic Macrohabitats Known or Strongly Suspected from NY/VT STL*

A) Riverine Macrohabitats (18 regional macrohabitats)

- STL Intermittent Stream
- NAP Acidic Intermittent Stream
- NAP Calcareous Intermittent Stream
- STL Spring
- NAP Spring
- STL Rocky Headwater Stream
- NAP Rocky Headwater Stream
- STL Marsh Headwater Stream
- NAP Marsh Headwater Stream
- STL Confined River
- NAP Confined River
- STL Unconfined River
- NAP Unconfined River
- STL Backwater Slough
- NAP Backwater Slough
- STL Subterranean Stream
- NAP Subterranean Stream
- GL Deepwater River

B) Lacustrine Macrohabitats (14 regional macrohabitats)

- STL Subterranean Lake
- STL Vernal Pool
- NAP (GL/STL/LNE) Pine Barrens Vernal Pond
- STL Sinkhole Pond
- NAP Bog Lake
- STL Alkaline Pond
- GL Marl Pond
- STL Oxbow Pond
- STL Flow-Through Pond
- STL Winter-Stratified Monomictic Lake
- STL Oligotrophic Alkaline Dimictic Lake
- STL Eutrophic Alkaline Dimictic Lake
- STL Summer-Stratified Monomictic Lake
- GL Summer-Stratified Monomictic Lake

* See Appendices 1 and 2 for:
a) other types less certain to be present in and potentially peripheral in NY/VT STL
b) types known or strongly suspected from Quebec STL

Types listed here are only those with fully developed descriptions in Appendices 1 and 2.

Table 5. Microhabitat Type Hierarchy used in STL Aquatic Community Classification

Flow Microhabitat Types:

- Riffle
- Run
- Pool

Depth/Substrate Microhabitat Types:

- Pelagic
  - pelagic-epilimnion
  - pelagic-hypolimnion
- Benthic
  - benthic-littoral
  - benthic-sublittoral
  - benthic-profundal

Light Regime Microhabitat Types:

- Subterranean
  - subterranean-dark
  - subterranean-twilight
  - subterranean-entrance
- Above ground-light

Table 6. Species Assemblage Hierarchy for STL Aquatic Community Classification

FLORA (Vegetation Assemblages)

- Vascular Plant Assemblages (Aquatic Macrophytes)
- Non-Vascular Plant Assemblages
  - Macroscopic Non-Vascular Plant Assemblages
    - Bryophytes Assemblages
    - Macroalgae Assemblages
  - Microscopic Non-Vascular Plant Assemblages
    - Phytoplankton Assemblages

FAUNA (Faunal Assemblages)

- Vertebrate Assemblages
  - Fish Assemblages
  - Herptile Assemblages
- Invertebrate Assemblages
  - Macroinvertebrate Assemblages
  - Zooplankton Assemblages

Figure 1.

VISUAL KEY TO NON-TIDAL RIVERINE MACROHABITAT TYPES OF NEW YORK
(Applied to STL Classification)

FLOWING COMMUNITY=**Riverine System**

Light Regime
above ground
subterranean

1. **Riverine Cave Community**

(above ground streams)

Flow Longevity
perennial
intermittent

2. **Intermittent Stream**

(perennial streams)

Flow Connection
upstream and downstream
downstream only

(standard stream types)

Sequential Position/Groundwater Flow
non-headwater/horizontal flow
headwater/vertical flow

3. **Spring**

4. **Backwater Slough**

Sequential Position/Stream Order
non-headwater/high order
headwater/low order

(headwater streams)

(rivers)

Substrate/Slope
marshy/flat
rocky/steep

5. **Rocky Headwater Stream**

6. **Marsh Headwater Stream**

Depth Regime
no profundal zone
profundal zone

7. **Deepwater River**

(standard river types)

Substrate/Slope
marshy/flat
rocky/steep

8. **Confined River**

9. **Unconfined River**

Figure 2.

VISUAL KEY TO NON-TIDAL LACUSTRINE MACROHABITAT TYPES OF NEW YORK
(Applied to STL Classification)

PONDED COMMUNITY=**Lacustrine System**

Salinity:
freshwater
(freshwater lakes)

saline
(saline lakes)
1. **Salt Pond**

Light Regime:
above ground
(above ground lakes)

subterranean
2. **Lacustrine Cave Community**

Water Permanence:
perennial
(perennial lakes)

intermittent
(intermittent lakes)

Substrate pH/texture:
calcareous/clay
5. **Sinkhole Pond**

acidic/sand
3. **Pine Barrens Vernal Pond**

variable pH/loam
4. **Vernal Pool**

Genesis:
lacustrine
(standard lake types)

fluvial
(fluvial lakes)

Landscape Setting:
main channel
7. **Flow Through Pond**

river oxbows
6. **Oxbow Pond**

Meromixis:
no chemocline
(holomictic lakes)

chemocline
7. **Meromictic Lake**

Alkalinity:
alkaline
(alkaline lakes)

acidic
(acidic lakes)

Trophy:
oligotrophic
(clear acidic lakes)

dystrophic
8. **Bog Lake**

Depth/Stratification:
deep/dimictic
10. **Acidic Dimictic Lake**

shallow/monomictic
9. **Acidic Pond**

Depth/Stratification: shallow/monomictic
deep/summer stratified
(shallow alkaline lakes)
(deep alkaline lakes)

Surface Area: large
small
11. **Winter-Stratified Monomictic Lake**
(alkaline ponds)

Alkalinity: high
moderate
xx. **Marl Pond**
12. **Alkaline Pond**

Surface Area/Stratification: large/monomictic
small/dimictic
11. **Summer-Stratified Monomictic Lake**
(alkaline dimictic lakes)

Trophy: oligotrophic
eutrophic
12. **Oligotrophic Alkaline Dimictic Lake**
13. **Eutrophic Alkaline Dimictic Lake**

INTRODUCTION.

A. Goal of Aquatic Community Classification.

Ecoregional planning for The Nature Conservancy (TNC) has as one of its major goals to conserve all species representative of an ecoregion and uses protection of enough examples of all natural communities in the ecoregion as one tool to achieve this goal. Communities are generally perceived by TNC and the Heritage Network as "**coarse filters**" for common species. Many aquatic species of the Saint Lawrence/Champlain Valley Ecoregion (STL) may occur only in aquatic communities (i.e., "obligate aquatic species"). Thus, our group, the STL Aquatic Community Working Group (David Hunt, Mark Anderson, and Eric Sorenson), was charged to develop a classification of aquatic community types throughout the ecoregion to serve as a coarse filter for such aquatic species and to reflect the **greatest natural biological differences between aquatic community types** (Hunt, 2000b). We applied this classification to known and suspected aquatic sites in the ecoregion to design the first iteration of a portfolio of occurrences important in conserving the aquatic biodiversity of the U.S. portion of the ecoregion. Our multi-year effort spanned from 1999 to 2002.

B. Overview of Our Approach.

For the first iteration of the STL Ecoregion plan, the Aquatic Community Team used a dual approach focused on community element classifications and community element occurrences (EOs) documented by natural heritage programs (the "**Heritage Approach**") in conjunction with a parallel approach based on remote data analyzed by TNC staff through Geographic Information System software (GIS) (the "**Aquatic Systems Approach**"). We attempted to carefully document our efforts throughout this collaborative process. Our team's vision for **addressing heritage-documented information on aquatic communities** was to set up an approach that would work in the long term for the STL Ecoregion and potentially other ecoregions as more aquatic community occurrences are documented throughout the ecoregion and the Heritage Network. David's belief has been that the two approaches being taken for aquatic community classification by 1) the Heritage Network, focused on macrohabitat types that fall within a top-down abiotic hierarchy while at the same time are derived from bottom-up aggregation of biotic information, and 2) other ecoregion teams of TNC, using remote GIS analyses as a predictive tool for community variation across a selected set of physical features, are compatible, can mutually enhance one another, and may in the long term converge into one powerful unified approach. David has also been a strong advocate of hoping that the standard, well-proven heritage methodologies for community classification can be brought into ecoregional plans to strengthen them, especially for aquatic communities, especially at the community occurrence (e.g., aquatic macrohabitat) level, and especially as a supplement to system level targets that have generally been the focus of TNC efforts in recent years. According to Mark Bryer, this was a novel approach and should be made available for consideration in planning efforts for other TNC ecoregions.

1. The Heritage Approach.

David took the lead in addressing ecological community-level features, attempting to integrate natural heritage program classifications and methodology for aquatic communities with recent TNC efforts in aquatic biodiversity conservation. In applying "more orthodox methods" of classifying heritage-documented aquatic community occurrences (EOs), we took an approach similar to that used to evaluate the ecoregion classification for non-aquatic community targets in the Northern Appalachians Ecoregion (NAP) and link, where feasible and to the greatest degree possible, similar Heritage Network and TNC methods.

This document details an approach for classifying biologically-anchored aquatic communities (ideally macrohabitats with unique ecological alliances) in ecoregional plans using field-based data on community occurrences (EOs), ideally heritage-documented EOs (Hunt, 2000b). Because of the generally sparse nature of aquatic community EOs in heritage databases nationally at the time of our efforts, other ecoregional plans have relied heavily or solely upon GIS-based data to remotely predict the presence of, assess and select aquatic community occurrences for ecoregional portfolios. According to Mark Bryer of TNC's Freshwater Institute, the very few aquatic community EOs documented outside of New York as of 2002 were globally rare and usually associated with rare species, such as the desert springs of Nevada. New York Heritage Program is reportedly exceptional among heritage programs in currently having many aquatic community occurrences documented, with 20 riverine occurrences and 35 lacustrine occurrences documented statewide as of April 15, 2002 and about 30 more riverine occurrences that were in progress at that time from Year 2000 and 2001 surveys. Only a few of these occurrences are from STL. However, as part of the 1995 to 1998 "Adirondack Exemplary Community Project", David conducted interviews with over 100 community experts to obtain information on the "best examples" of all aquatic community macrohabitat types present throughout the Adirondack TNC area, which encompasses about 70% of the New York part of STL. Although few fully documented EOs were applicable to the Heritage Approach in this iteration, we did have good preliminary information from these numerous aquatic community leads which we considered in our classification and portfolio development. VT DEC staff also had ready access to field data and sufficient first-hand knowledge of numerous aquatic community occurrences in Vermont which could be crosswalked to our classification. Thus, between these two sources, information on numerous aquatic community EOs was available from which to apply any preliminary ecoregion-wide classification.

While only very few aquatic community EOs from STL had been documented in the databases of New York Natural Heritage Program (NYHP) and Vermont Natural Heritage Program (VTHP) at the time of our efforts, we wanted to set up a long-term model for classification that is expected and intended to become increasingly relevant to heritage program data as more EOs get in the databases, complete with quantitative descriptions of biota (abundance, community structure), hydrological features, and substrate features that support and help refine the classification. The power of the approach lies hopefully in future iterations of the ecoregional plan, after more EOs become fully documented through standard heritage methodology. For now, one hope for this iteration was that it would steer inventory priorities towards more precise information and increased heritage documentation as a field-tested examination of any comprehensive community classification.

2. The Aquatic System Approach.

For the first iteration of the STL plan, Mark Anderson and Arlene Olivero of TNC's Eastern Conservation Science office (ECS) worked on the development of a surrogate GIS-derived classification of aquatic communities as a remotely predicted top-down approach to assessing physical variability in these communities across the ecoregion. This landscape-based classification approach was used 1) as a comparison to the Heritage Approach for designating regional aquatic macrohabitats and 2) as a supplement to the crosswalking of existing state element occurrence records (EORs) and leads from experts in the site selection process, serving to fill in gaps where inventory data has not yet become available to heritage programs. Because of time constraints and the time intensive process needed to assemble data layers and develop GIS analyses, ECS classification efforts were apparently completed only for large river types and no attempts were made to propose a similar GIS-based lake classification. ECS staff intended to document this Aquatic System Approach as a separate reference.

C. Classification Models and References.

Many models exist in both the Heritage Network and TNC for classification of aquatic communities at various scales. The aforementioned Heritage and TNC approaches to riverine and lacustrine community classification may differ in 1) the taxonomic hierarchy of different levels of classification units, 2) the number of classification units, 3) the parameters used to differentiate classification units and the taxonomic prioritization associated with these parameters, and 4) the thresholds used to differentiate each classification unit. Our Heritage Approach was modelled upon that of 1) terrestrial community classifications for TNC ecoregions throughout the NE U.S., 2) state aquatic community classifications of state heritage programs from New York to Maine in existence since the late 1980s, 3) TNC attempts at aquatic community classification during ecoregional planning efforts, especially that for the Great Lakes Basin, 4) other regional and state classifications of rivers and lakes, especially Vermont's Aquatic Classification Work Group 1998 classification of separate, but apparently correlated, vascular plant, fish, and macroinvertebrate species assemblages for both rivers and lakes throughout Vermont and Widoff's regional lake classification of 1986, and 5) New York Heritage Program's "state" specifications for aquatic communities. Some of these approaches detail 1) different hierarchical levels of aquatic community classification, 2) the partitioning process for community types, 3) concise definitions of communities including "type descriptions", and 4) threshold values for each community. Thus, between these various sources, information on numerous aquatic community types was available from which to build a good preliminary ecoregion-wide classification. While much of the detail of these general approaches is repeated in this document (see Results Section) to minimize potential confusion and to integrate and "synthesize" multiple historic approaches, more detail can be found in some of the original documents.

<u>Heritage Program Classifications & TNC's Ecoregional Classifications for Terrestrial Associations.</u> The classification model for ecological communities in natural heritage programs is based on the relatively standard concept of ecological communities. For instance, NYHP defines

ecological communities as "variable assemblages of interacting plant and animal populations that share a common environment", are "repeatable across the landscape", and are "similar within a given range of variability" (Reschke, 1990). Ideally, we sought communities with all of these characteristics for the STL ecoregional plan. **Individual communities are distinguished by features such as community structure, physiognomy, the composition of resident organisms, and ecological processes** (cf. Reschke, 1990). At least at NY Natural Heritage Program, this model for community classification has been applied since the start of the program in the early 1980s (Carol Reschke, pers. com.) and thus has been well tested. Community descriptions and preliminary community specifications documented at NYHP (Hunt, 1999d; NYHP, 2002) for both generalized community systems (Riverine and Lacustrine Systems) and specific community types (aquatic macrohabitat types) were available at the time of our efforts for nearly all of the riverine and lacustrine communities designated for the STL Ecoregion.

We considered the association concept for the finest scale biotic aquatic community unit in our classification. The term "**plant association**", standardly used in TNC's ecoregional classifications for terrestrial communities, follows a concept similar to, but apparently narrower in scope than, the term ecological community: "a plant community of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions" (Anderson et al., 2000).

<u>Ecoregional Classifications for Aquatic Systems</u>. At the time of our efforts, documented ecoregional classifications for rivers and lakes were available only for the Great Lakes Basin (Higgins et al., 1998) and were reportedly under evaluation and formation for a few other TNC ecoregions. These included classifications of large streams in the Chesapeake Bay Ecoregion and possibly the Lower New England (LNE) Ecoregion and High Alleghany Plateau (HAL) Ecoregion. TNC's Freshwater Initiative and TNC's Eastern Conservation Science (ECS) staff have been developing rigorous quantitative analyses for classification of rivers, including modelling classification units based on different watershed and "stream system" characteristics. "**Stream systems**" represent a network of numerous physically-connected aquatic macrohabitats within one watershed. Parameters used in these classifications and their application to watersheds are documented in Higgins et al. (1998) or in detailed documents pending completion by ECS staff.

D. Basic Taxonomic Units.

The "National Aquatic Classification" (NAC) framework and hierarchy follows that presented by Higgins et al. (1998) for the Great Lakes Basin and in TNC's Geography of Hope, update #6: "Including Aquatic Targets in Ecoregional Portfolios: Guidance for Ecoregional Planning Teams" (Higgins et al., 1999). These references include definitions of standard aquatic community classification units that were used in our STL classification: **ecoregional units**, **macrohabitats**, **microhabitats**, **alliances**, and **associations** (see also Glossary). The relationships among the major abiotic and biotic classification units are depicted in Attachment 1 copied from Higgins et al. (1998). Similarly, the "National Vegetation Classification" (NVC) framework and hierarchy follows that presented by Anderson et al. (1998). This reference includes definitions of the vegetation classification units: **groups**, **formations**, **alliances**, and **associations**. "**Species Assemblages**", as defined by Vermont's Aquatic Classification Work Group (1998) (see Glossary), were also used as major components of our aquatic community classification. Aquatic macrophyte, macroinvertebrate and fish assemblages, among others, were considered in our approach.

Having carefully compared the classifications of both "terrestrial" (i.e., non-aquatic) and aquatic communities, in David's opinion classification of aquatic communities is more complex because of the greater number of scales one has to consider to capture the dynamic patterns of diversity (Note: New York Natural Heritage Program ecologist Tim Howard has debated this interpretation and thinks that aquatic communities are, in fact, simpler than their terrestrial counterparts). Additionally, for heritage ecologists (the "prime keepers" of the classification systems traditionally used to document the occurrences for which TNC takes conservation action), who have typically had more familiarity with terrestrial communities than aquatic communities, the biota and descriptive terminology for aquatic communities can be quite challenging at first. Given this audience, we attempted to summarize definitions of many terms critical to the aquatic community classification process here. We do not cover much of the basic terminology associated with aquatic community structure and function, as definitions of these terms are available through general aquatic ecology references (e.g., Barnes and Mann, 1980; Caduto, 1985; Hauer and Lamberti, 1996; Lampert and Sommer, 1997; Maxwell et al., 1995) or the New York Natural Heritage Program aquatic community field form instructions (Hunt, 1999b).

E. Evaluation of Classification Units as Conservation Targets.

We adopted much of the terminology for abiotic and biotic classification units from TNC's NAC framework (Higgins et al., 1999). The biotic unit on which we focused as a community-level conservation target is the "**Aquatic Alliance**". Note that "Alliance" in NAC represents a different concept than "Alliance" in NVC (thus probably adding to the terminological confusion). In the NVC, an alliance is a group of taxonomically related associations which occur in different ecoregions and share a few similar dominant species but differ by several regional indicator species. In the NAC, an alliance is apparently a group of ecological associations of somewhat dissimilar taxa which occur in close geographic proximity, clustered within a mosaic, similar to the ecological land type (ELT), "landscape complex", or "ecological system" concepts used in community analyses of plans for ecoregions such as NAP and under scrutiny in 2002 for national standardization by the Heritage Network.

The correlated abiotic unit on which we focused as a community-level conservation target is the "**Aquatic Macrohabitat**". We distinguished between the terms "**macrohabitat type**", which are broad physiochemically-defined units repeating across ecoregions (perhaps the aquatic equivalent of "ecological alliance" in the NVC), and "**macrohabitat**" (perhaps the aquatic equivalent of "ecological association" in the NVC), which often translates to a unique combination of macrohabitat type and ecoregion (i.e., a "regional variant") and corresponds spatially to a specific ecological alliance (e.g., a STL Rocky Headwater Stream; i.e., Rocky Headwater Stream is the macrohabitat type, the STL variant of this type constitutes a specific regional macrohabitat).

We developed a classification system for both river and lake **macrohabitats**, intending to be comprehensive for the New York and Vermont portion of STL and also include all or most of the suspected community types in the Canada portion of STL. The basic classification was modelled after the coarse-scale units and associated names of the New York Natural Heritage Program classification. It was intended to represent all major abiotic variation in aquatic macrohabitats ("**basic macrohabitat types**"), then stratify each basic macrohabitat type across geographic regions where large breaks in biotic composition and ecological structure were known or suspected into "**regional macrohabitats**", typically characteristic of one ecoregion or one ecological drainage unit (EDU) and supporting a unique ecological alliance. For support of these aquatic macrohabitats, extensive documentation was also prepared which classifies known and suspected aquatic community components smaller than macrohabitats from which the macrohabitat classification was constructed. These units include **species assemblages** for fishes, macroinvertebrates, and aquatic macrophytes.

F. Purpose of This Document.

This report presents our methodology for 1) choosing an appropriate scale (i.e., a specific level of the community classification hierarchy) for conservation targets in ecoregional planning efforts, 2) the consensus reached among the STL Aquatic Community Team for specific aquatic classification units, especially macrohabitat types, and 3) preliminary detailed descriptions of regional macrohabitats known or strongly suspected from STL. Although the 36-page river macrohabitat-alliance classification document (Appendix 1), the 27-page lake macrohabitat-alliance classification document (Appendix 2), and their associated species assemblage classification documents, a 13-page document for rivers (Appendix 3) and a 19-page document for lakes (Appendix 4), are meant to stand alone and be fairly self explanatory, the basis for their formation is rather complex and probably many of our decisions could be extensively and indefinitely debated, as with most classification schemes. Thus, this document was also intended to present many of the hypotheses and assumptions that went into the formation of those classifications: 1) to allow reviewers of the classification to follow our logic and choices, 2) to justify our approach, in case its validity is questioned, 3) to allow ease in making refinements during future iterations of the STL ecoregion plan, and 4) to serve as a potential model for other ecoregions, if an ecologically holistic classification is sought. The extensive justification for and explanation of the STL river and lake community classifications provided in this document represent an update to two preparatory documents used to assist with classification decisions during our team meetings: one for rivers entitled "NAP/STL Riverine Crosswalk. Background Information, Explanation and Justification; March 14, 2000" and one for lakes entitled "NAP/STL Lacustrine Community Crosswalk. Background Information, Explanation and Justification; May 3, 2000".

METHODOLOGY.

A. General Approach.

The classification component of our work for the first iteration of the STL Ecoregion plan included 1) choosing aquatic community classification units for conservation targets, 2) describing them and crosswalking them to various existing classifications, then 3) applying these units at a minimum to the few existing heritage-documented EOs in the ecoregion and other well-known and suspected examples from the literature and expert interviews. Following standard heritage methodology, we sought to classify, taxonomically delineate, and characterize macrohabitat types and macrohabitats across their rangewide distribution. For each regional aquatic macrohabitat we sought to provide at a minimum 1) a basic definition and 2) a crosswalk and comparison to any existing heritage and TNC classifications.

B. Characteristics of our Heritage Classification Approach.

A comprehensive aquatic community classification for the entire New York-Vermont portion of STL Ecoregion was not available at the time of our efforts, especially for biologically-anchored "regional macrohabitats", and "official" global specifications (i.e., rangewide specifications) were not available for any aquatic communities of this area to apply the classification to known EOs. Lacking such an official global classification as a starting point, we were charged with the challenge of developing in a relatively short time frame as comprehensive a classification as possible.

<u>Rigor of our Efforts.</u> Our attempt involved a combination of ecological intuition, field experience and literature review among a small group of state, regional and national heritage and TNC ecologists to suggest a rangewide classification and rangewide specifications that would cover all aquatic macrohabitats throughout the New York and Vermont portions of STL, hoping that this level of intensity would be sufficient for the first iteration of the ecoregion plan. The intensity of our efforts 1) paralleled, and was thus consistent with, attempts at classification conducted for terrestrial communities during the early evolution of TNC ecoregional planning in the mid to late 1990s and 2) seemed totally appropriate for aquatic communities during 1999 to 2002, given the status of organizational knowledge at that time on aquatic systems within the Heritage Network and TNC.

<u>Taxonomy: A Science or An Artform?</u> Note that some, or perhaps much, of the classification hypotheses and decisions presented in the Results Section may be debatable, speculative or subjective (based on numerous conversations, debates and feedback from various academic and field scientists), yet the approach we sought was **holistic in nature** and we propose it to be most **effective at conserving biodiversity** because of its focus on **multiple geographic and taxonomic scales**. Where appropriate, we arrayed information into "facts" (essentially undisputed scientific information) and "hypotheses" (speculative and possibly debatable scientific inferences based partly on David's intuition, grounded with observations from aquatic community field work and literature review). These facts and hypotheses were combined in our thought process to eventually reach conclusions about what are the most appropriate units from which to construct an ecoregional aquatic

community classification. Whenever the opportunity arose, we debated the original recommendations and working hypotheses from David. Generally, we were able to reach consensus on each issue, perhaps sometimes through mutual agreement, sometimes through partial ignorance about the concepts.

C. Characteristics of Our Classification: Scope & Framework.

We sought a classification that was both **ecologically holistic** and **taxonomically comprehensive** in scope and **multi-tiered** in its framework. To formulate or choose an aquatic community classification at the geographic and taxonomic scales appropriate for biodiversity conservation (i.e., **conservation targets**), our team set out to first adequately understand then evaluate abiotic (i.e., physiochemical) and biotic aquatic classification units and their components and relationships. We attempted to biologically anchor two types of abiotic classification units ("**macrohabitats**" and "**microhabitats**") by ecologically linking them to three spatially-corresponding biotic units ("**alliances**", "**associations**", and "**species assemblages**") (see Glossary for definitions). To do this, we considered the relationship between multiple published classifications and two ongoing classification initiatives within TNC. These included: TNC's National Aquatic Community Classification framework as of 2000 and the National "Terrestrial" Community Classification framework as of 2000.

<u>Ecologically Holistic Units.</u> We sought to review and assess existing heritage and TNC classification models and integrate units from the two together into a single "**ecologically holistic classification**" for STL that would hopefully stand the test of time. We did this by focusing on **"biologically-anchored physical habitat units"**, seeking 1) biologically repeating community units that share a common and distinct physical habitat and 2) physical habitats that support distinctly different biological alliances. Our venture involved attempts to mesh vegetation-focused and fauna-based aquatic classification efforts, learning from the experiences of species specialists who helped with our group effort and shared their expertise, while we helped to educate them with the complexities of general classification efforts associated with ecoregional planning within TNC and the Heritage Network.

<u>Taxonomic Comprehensiveness.</u> Following Higgins et al. (1999), we sought to take the "most detailed approach" to an aquatic community classification for STL, creating a "wall-to-wall" classification by addressing **all "aquatic" features** in the classification, communities with a prominent aquatic component present at least intermittently during an average year. This includes both intermittent water bodies and subterranean water bodies, community types that are addressed in the community classifications of heritage programs of the NE U.S. (e.g., Reschke, 1990 for NYHP) but are often overlooked in classifications that focus on or are limited to the **more "charismatic" larger community types** such as TNC's classification for the Great Lakes Basin (Higgins et al., 1998). We divided the classification into the two standard aquatic taxonomic systems used by heritage programs: **Riverine** (flowing water) and **Lacustrine** (ponded water) communities. We included in our classification **only natural aquatic communities** (sensu the definition of "natural" used in Reschke, 1990), **not cultural aquatic communities**, which are defined as having been substantially modified from their original structure and/or composition by

anthropogenic disturbances.

Multi-Tiered Framework. We also found it desirable, if not necessary, to use a multi-tiered approach to aquatic community classification, following the framework model of the National Aquatic Classification (Higgins et al., 1998, 1999) depicted in Attachment 1, with 3 to 4 abiotic levels and 2 to 3 biotic levels. Multiple aquatic community classification units of different hierarchical levels were considered and crosswalked. We described and assessed the **coherency** (apparent break points in the classification) and **repeatability** (across the New York and Vermont region) of several biotic and abiotic components in an attempt to ultimately characterize and designate correlated **macrohabitat-alliance** units as the focus for our STL aquatic community classification within this multi-level hierarchy.

D. Choosing the Appropriate Taxonomic Scale for Conservation Targets: Macrohabitats & Alliances versus Microhabitats & Associations.

Instead of going into the detail of comparing all aquatic macrohabitats, microhabitats, alliances and associations across the New York-Vermont state boundary, we decided it was best to first choose the most appropriate classification unit(s) for the focus of our conservation efforts, then determine if there was additional time remaining to address other units. As one basis for selecting an appropriate taxonomic scale, we evaluated how to best treat the largest aquatic community occurrences in the study area, the St. Lawrence River for a riverine community and Lake Champlain for a lacustrine community, both large macrohabitats which represent a complex mosaic of large embedded patches with numerous types of microhabitats and associations.

We thought that our **conservation targets** should occur at **geographic scales useful and practical for conservation purposes** (Hunt, 2000a). There is strong evidence in the literature that several aquatic species occur only in specific ecological associations. There is also strong evidence in the literature that some aquatic associations occur only in specific regional macrohabitats. By inference, we assessed macrohabitats to be the prime surrogate unit to conserve aquatic associations and aquatic species and thus, relied on them as a coarse filter for associations (Hunt, 2000b). We especially sought to identify as a unique community type all macrohabitats that have at least one unique association as the foundation for comprehensively conserving aquatic species.

Thus, our team consensus on the scale most appropriate for an aquatic community conservation target, and consequently occurrence inventory, our classification focus, and a surrogate for conservation efforts for aquatic associations and aquatic species is the **macrohabitat-alliance level**. We also agreed that targeting microhabitat-associations for conservation efforts is generally less practical, especially given the current state of knowledge of TNC and its partners on STL aquatic communities, with little or no biological data on many associations at this time. Partial rationale for our consensus for the first iteration was based on the following: 1) a comprehensive classification of macrohabitats was feasible whereas such a classification for associations may not be achievable from existing data for STL, 2) field mapping of macrohabitats is relatively easy, whereas that for associations is time-consuming and not many examples were expected to have been mapped yet by heritage programs, state agencies, or others, 3) most macrohabitats are easily mapped from remote techniques whereas associations are not easily mapped from such techniques, and 4) the most effective aquatic community management and protection efforts may be best suited to protecting entire water bodies or segments of water bodies (i.e., macrohabitats) rather than small-scale aquatic features such as benthic associations and microhabitats. Our choice of macrohabitats and alliances as the primary conservation target is also in accord with the model of Higgins et al. (1998; see p. 11) which recommends this classification level as the "basic mapping unit" of TNC's aquatic community classification.

Many examples of smaller aquatic microhabitats, debatably the aquatic equivalents of logs, boulders, and seeps in the terrestrial community classification, and their corresponding ecological associations may occur at scales too small to be practical and effective in conserving the full array of biodiversity in aquatic systems. A microhabitat-association classification for STL would have many more classification units than a macrohabitat-alliance classification. Our estimate was about 200 to 400 units in rivers and lakes of STL, relative to the 50 river and lake macrohabitat-alliance units of this region, thus requiring greater time and effort and greater precision of raw information to adequately crosswalk. From our team's experience (see also Vermont's Aquatic Classification Work Group, 1998), species assemblage and association locations can vary year to year, especially in riverine communities, correlated with the longitudinal movement and lateral migration of flow microhabitats (runs, riffles and pools), whereas macrohabitat locations are thought to be stable over much longer periods of time, especially for lakes and especially along the long axis of an entire river course. Microhabitats in rivers can and often do change geographic positions at relatively frequent intervals (e.g., the interchange of pools and riffles via pool formation from a fallen log impoundment or conversion of pool to riffle when the log dam breaks up). In contrast, such smaller scale units (microhabitats and associations) in lakes may be more practical as conservation targets than those in rivers. Each association within a given lacustrine macrohabitat is generally correlated with one microhabitat or even finer scale physical division (what might be termed "submicrohabitats") such as a specific substrate type within a given depth zone, and are generally much more temporally stable than their riverine equivalents. Several bays of Lake George were mapped in 1999 for lake associations (see Hunt, 1999a) and comparison with literature on the historic positions of some of these associations suggested only slight movement over a period of about 20 years. Lastly, a given microhabitat and association may be potentially distributed across many macrohabitats, making their distribution and location harder to predict with remote tools such as GIS than those for macrohabitats, thus suggesting that microhabitats generally may be less practical as conservation targets than macrohabitats.

For the largest aquatic communities in STL, Lake Champlain and St. Lawrence River; however, we agreed that there was conservation value in targeting both the entire macrohabitat (for watershed and hydrological issues) and smaller embedded features (for local benthic issues) (see Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002b for more information on the latter targets). As "primary targets", these macrohabitats are targeted in entirety as the sole examples in STL of unusual macrohabitat types (Hunt, 2000b). In addition, we went beyond the basic classification and also had in our site selection process as primary targets certain "embedded features" that might not be fully conserved via the coarser scale targeting approach, but we did this only for these large macrohabitats. We also designated secondary targets such as shoreline associations and unusual deeper water associations to check the effectiveness of primary targets in conserving smaller scale features.

E. Formation of the Classification: Deriving and Describing Macrohabitats and Correlated Alliances.

1. Information Aggregation.

We agreed that the description of correlated macrohabitat-alliance units is best done via a **"bottom-up" aggregation** from the **structure and composition of microhabitat-association units within a given macrohabitat**. This implied a data intensive approach which, done "exhaustively", would have required much greater time investment than we had available. However, given the time constraints to derive and apply a classification and seeking a balance between **academic rigor** and the **environmental urgency** to derive an applied tool in response to the biodiversity crises omnipresent in the natural world, we took a "**stream-lined approach**" using only readily available and mostly summary-type information for STL and NAP (e.g., "synthesized classifications"). It should be noted that such an approach came under harsh criticism from a couple zoologists (Jonathan Higgins and Paul Novak) who persistently suggested that we follow a rigorous "**academic-type approach**" during this first iteration; however our intent was made very clear from the start of STL planning efforts to adopt a stream-lined approach for the first iteration, as had typically been done for classification and crosswalking efforts for terrestrial and aquatic communities in all TNC ecoregional plans of the NE U.S. We also made it clear at the start that a more rigorous evaluation of our first iteration hypotheses, complete with eventual consultation of additional academic experts, specialists and existing databases, was desirable, and thus, we recommended this approach as more appropriate for the 2nd to 3rd iteration of the STL plan.

2. Classification Framework.

In contrast to and balanced with the bottom-up approach to classification of macrohabitats, we deemed that a comprehensive classification of "macrohabitat types" for a region is best done in a **"top-down" manner**, specifically by analyzing **major breaks in the microhabitat type and biological composition of macrohabitat types**. We proceeded to construct a diagnostic taxonomic key to macrohabitat types thought to be broad ranging (see Results Section), then compile descriptions of regional variants (i.e., regional macrohabitats) in the regions of focus. While in the long term, a comprehensive classification of all microhabitats/associations applicable to water bodies throughout STL may be desirable, in the short term we decided to stop our comprehensive treatment at the macrohabitat/alliance level due to time constraints and the status of our knowledge of biota at finer scales. However, the species assemblage descriptions we compiled for STL go a long way towards a preliminary description of the more well-known and charismatic associations of this region.

Despite our choice to focus conservation targets on macrohabitats and their associated ecological alliances, we did acknowledge that it is important to survey microhabitats and correlated associations during heritage inventories for both community classification, occurrence ranking, and site selection purposes. For example, microhabitats and their associated biota can suggest the identity of the corresponding macrohabitat/alliance; additionally, EO rank generally increases with greater microhabitat diversity within a given macrohabitat.

3. Role of Information Sources.

To formulate specific units in the first iteration drafts of the New York-Vermont STL riverine and lacustrine community classifications, much review of **"primary and secondary sources of information"** was conducted. Information from NYHP's field surveys (especially those from 1996 to the present) represent the most integrated data source, quantifying both composition and structure of ecological associations, usually with one reference example per macrohabitat type.

To supplement the primary sources of information (i.e., EO data from heritage field surveys), numerous documents of secondary data were casually to rigorously scanned to make general inferences. Many of these secondary source references are cited and discussed in more detail in the Results Section of this document. Generally, we borrowed from the ecologically holistic classifications of heritage programs from four NE U.S. states, one holistic regional heritage classification of lakes, TNC ecoregional and national classification efforts, and classifications of species assemblages and holistic units in the general aquatic literature. Vermont's Aquatic Classification Work Group reference (1998) was extremely useful for species assemblage types in both rivers and lakes of STL. Widoff's (1986) macrohabitat type classification framework was also a key document for lakes. All secondary source documents which 1) summarize macrohabitat types and species assemblage types in the region and 2) were readily available at NYHP or obtained through our planning efforts were considered and crosswalked into our integrated community classification. While much of our STL classification follows the classification framework in the general aquatic ecology and limnology literature, there are a myriad of general to specific aquatic community references available elsewhere (see Results Section), and much more productive review could have been conducted given more time for research. Such tasks are recommended for the second iteration of the STL plan.

We attempted to adhere to the NAC and NVC classification frameworks as much as possible in deriving classification units. It was not easy reconciling the scale differences between the NAC framework and the existing classifications of state heritage programs for the region: the river community framework of NAC appears much finer and the lake community framework of NAC much broader than the framework of heritage programs. Thus, a recommendation for the second iteration of the plan is to better reconcile the differences in these general classification methods which guided our approach for STL. The community specifications of NYHP were used to guide the derivation of community descriptions and thresholds in our classification. Specifications were not available from other state heritage programs but were reportedly under development, at least for one program. A recommendation for the second iteration of the STL plan is to reconcile with NYHP specifications any specifications of other heritage programs that are developed or become available subsequent to the first iteration of the plan. Lastly, much of the refinement of classification units for STL came from lengthy review and analyses of raw data and the expertise of our team members. The most specific classification units, regional macrohabitats and species assemblages, were formed primarily from an integration of the synthesis of NYHP EOs and NYHP-designated community elements by David with the synthesis of VT DEC data and VT ACWG-designated community elements by 3 VT DEC staff specializing in aquatic features: Steve Fiske, Richard Langdon, and Susan Warren.

F. Contribution of TNC's Approach to the Heritage Approach.

We attempted to iteratively compare the Heritage Approach to aquatic community classification and TNC's GIS-based approach to aquatic system classification in a team effort to supplement and strengthen each other. The complementary GIS-based approach of TNC ECS staff involved a model similar to that of Higgins et al. (1998) for the Great Lakes Basin. A fully developed classification for river systems of STL by TNC-ECS staff using GIS analyses was presented rather late in the ecoregional planning process. Due to the lateness of access to the results of these GIS analyses in our team efforts, we ran out of time for a sufficiently collaborative review of the similarities and discrepancies between the Heritage and TNC approaches to classification for 1) the number of classification units, 2) parameters used to derive classification units, and 3) thresholds between classification units. We recommend such a review and careful comparison of these methods for the second iteration of the STL plan, and we advocate for an essentially seamless and consistent convergence of the two methodologies, linking the aquatic community/macrohabitat scale with the landscape-aquatic system scale targets.

The power of GIS in assisting community classification efforts is limited by the availability of data. Many currently available types of instream and in-lake data important in heritage community classification efforts have apparently been compiled in a piecemeal fashion, are inconsistent in format and content from database to database and region to region, or are not comprehensive throughout an ecoregion. Several categories of data, mostly applicable to these instream and in-lake features, are difficult to obtain and apparently have not been included in GIS modelling analyses of ecoregions by TNC, at least neither for the Great Lakes Basin nor the STL Ecoregion. Information on biotic composition, heavily factored into the classification of our Heritage Approach, appears most difficult to obtain on GIS. Data layers for selected important parameters such as lake depth, alkalinity, and other water chemistry variables are apparently available on a local basis within New York or Vermont, especially for lakes (e.g., Adirondack Lake Survey data for all of the New York-Adirondack NAP region; VT DEC data for all of Vermont). Although we discussed the possibility of NYHP and VTHP staff helping to track down such data layers, especially ones such as lake depth that could help ECS towards building a GIS-based lacustrine classification, we ran out of time and did not have sufficient staff capacity to help advance this research. ECS staff also ran out of time to research the availability of such data, and we left these tasks as recommendations for the second iteration.

One of our initial objectives was to hopefully apply attributes analyzed through GIS procedures from ECS to the heritage classification system, especially to help with more precise characterization of specific classification units. For rivers, ECS analyses provided a useful tool which at least quantified watershed size and slope for different macrohabitat types. Upon further review and synthesis of available New York and Vermont field data, it is suspected that this tool will be invaluable in helping show correlations between regional macrohabitats and underlying geological features. Because a GIS classification of lakes was not undertaken, we did not have the benefit of such a tool to more rigorously characterize lake macrohabitat types and regional macrohabitats derived from our Heritage Approach.

Other TNC models for aquatic community classification in ecoregions other than the Great Lakes Basin (namely Chesapeake Bay, Lower New England, and High Alleghany Plateau) were being developed at the time of our efforts, but unfortunately we did not have the benefit of access to any related documentation for comparison. We thus recommended for the second iteration of the STL plan a comparison and reconciliation of 1) our heritage-based approach with general classification methods outlined in other ecoregional plans and 2) specific STL classification units with those in any and all classifications constructed for ecoregions adjacent to STL, especially for regional macrohabitats. Further development of the TNC GIS approach to classification may come from efforts of TNC's National Aquatics Working Group, and these information could also be pulled into future iterations of the STL plan to improve the Heritage Approach taken here.

G. Geographic Area of Focus.

The STL Aquatic Community Team started our ecoregional efforts in 1999, striving to derive a joint STL and NAP aquatic community classification, at least for the New York-Vermont portions of these ecoregions. After having made good "initial" progress on both river and lake macrohabitats and species assemblages for both STL and NAP, we began to run short on time, so we narrowed the focus of our remaining efforts down to the STL Ecoregion and brought our work for that ecoregion to completion, placing less emphasis on NAP. During the whole process, however, we attempted a **comprehensive macrohabitat type classification** that would work not only throughout STL and NAP but also across the entire states of both New York and Vermont and theoretically far beyond. We also thought that our regional macrohabitat and/or assemblage classifications for STL could serve as a model and be considered for other ecoregions in the Northeastern U.S, especially NAP for which many of the units have already been taxonomically delineated through our efforts and had detailed descriptions started.

Northern Appalachian Community Types. We made good progress on the derivation and description of aquatic communities characteristic of NAP, many of which are peripheral within STL, among our team members and cooperators. The status of their classification is as follows: 1) the river and lake macrohabitat classifications are essentially complete; 2) the river and lake species assemblage classifications are essentially complete; 3) preliminary descriptions of regional macrohabitats and species assemblages are essentially complete for rivers, having had much group discussion and consensus; and 4) preliminary descriptions of several but not all regional macrohabitats and species assemblages of lakes have been compiled. Descriptions of most macrohabitats of common lake types and those known to spill over into STL as peripheral are essentially complete, however, those for other specialized lake types absent from STL (e.g., Tarn Pond) and those that are only potentially suspected to be in STL are skeletal. Most descriptions of NAP-characteristic lake macrohabitats presented here (see Appendix 2) need final group discussion and consensus among a regional team (e.g., NYHP and VTHP ecologists). Ideally, additional discussion and consensus for all NAP aquatic community units involving experts from all NAP states (including MEHP and NHHP ecologists) is desirable. Such a meeting may be part of the second iteration efforts for the NAP ecoregion plan scheduled to be completed in 2003. A review of the delineation of all NAP-characteristic classification units and supplementation of their descriptions are recommended, especially pulling in additional secondary references from New Hampshire and Maine that were not available to our team. A careful review of aquatic communities in the Boreal Lowlands part of NAP and the fish and mollusk assemblages from the Atlantic Drainage is recommended for potential recognition of additional regional macrohabitats that might be absent from the New York and Vermont portion of NAP and have not been included in our STL classification.

Great Lakes Community Types. Similarly, our efforts involved preliminary delineation and description of some regional macrohabitats characteristic of the Great Lakes (GL) Ecoregion. Generally, while we did provide placeholders for many Great Lakes-type macrohabitats in our classification, descriptions of very few of these are essentially complete, perhaps limited to 2 specialized types known to be peripheral in STL. Descriptions of other GL types known to be or potentially peripheral within STL are not well developed. Divisions between STL and GL macrohabitats and assemblages appear to be much more subtle than those between NAP and STL, and differences between community entities in STL versus GL did not start to emerge until near the end of our team efforts (see Results Section below). A more careful evaluation of similarities and potential taxonomic splits between these types is needed. Reconciliation of all macrohabitats and assemblages characteristic of GL in our classification with those of the existing Great Lakes Basin classification is strongly recommended, possibly in conjunction with the next iteration of the GL ecoregion plan.

H. Application of the Classification to Community Occurrences.

The first step in assessing element occurrences (EOs) for an ecoregional portfolio is to classify them. The classification presented here provides guidelines for identifying aquatic communities in STL, through use of a taxonomic key to macrohabitat types in conjunction with characterizations of regional macrohabitats. By applying community specifications for macrohabitat types such as those at NYHP (Hunt, 1999d; NYHP, 2002), possibly in conjunction with the taxonomic key, EOs are next geographically delineated based on 1) characteristic thresholds for distinguishing patches of one community type from related and/or associated community types, allowing mapping of the EOs and determination of their size. More detail on the assessment of EOs for the purposes of inclusion in the STL ecoregional portfolio is provided in the Viability Assessment document of our team (Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002a).

RESULTS

A. Synopsis of the Five Major Classification Units.

1. Overview of Classification Framework.

A detailed synopsis of the five major aquatic community classification units used in our STL classification is presented below: namely **3 abiotic levels** (macrohabitat types, regional macrohabitats, and microhabitats) and **2 biotic levels** (ecological alliances and ecological associations). Species assemblages are also discussed as components of ecological associations. For each unit, a definition of the type is presented, along with the status of its use in existing classifications relevant to STL, the formation of our classification for that unit, and the descriptive documentation of that type in our characterization appendices. Several less precisely defined or more spatially amorphous "embedded features" do not fit well into our classification framework and are discussed briefly at the end of the Results Section.

2. Tallies of Number of Community Types.

A tally of the number of community types for the various classification units for the St. Lawrence/Champlain Valley Ecoregion (STL) and/or Northern Appalachians Ecoregion (NAP) considered in the 1st iteration of the STL aquatic community classification is shown in Table 1. This table is arrayed into four parts representing combinations of riverine and lacustrine settings with abiotic and biotic classification units. Abiotic units are tallied for ecoregions, macrohabitat types, regional macrohabitats, microhabitats, and regional microhabitats for all types known, suspected or potential for STL. Biotic units are tallied for species assemblages, ecological alliances, and ecological associations for all types known, suspected or potential from the combination of STL and NAP. Many tallies are subdivided as to 1) whether they represent community types characteristic of STL or types peripheral to STL and more characteristic of other ecoregions such as NAP or Great Lakes (GL) and 2) whether or not they are present in STL. The number of microhabitats and associations were roughly estimated rather than tallied, because they were numerous and their equivalency from macrohabitat to macrohabitat is uncertain. These tallies of community types were used to guide the selection of the most appropriate scale for aquatic community conservation targets in the ecoregional plan (see Methodology Section).

B. Community Characterization.

Each aquatic community classification unit was taxonomically delineated based on a relatively consistent set of characters or **"classification parameters"**. Parameters considered in the general classification to distinguish individual aquatic communities included: 1) biota, 2) habitat types, 3) hydrological features, 4) ecological processes, and 5) ecological regions. Biota characters include: species assemblage features, species diversity, dominant species, species of restricted habitats, regionally or globally rare species, and faunal concentration areas (spawning, feeding, nursery and overwintering areas). Habitat type characters include: depth and substrate regimes (including benthic and pelagic features) and flow and light regime microhabitats. Hydrological features include: water depth, water volume, water permanence, and water chemistry. Ecological processes include: erosion, flood events, drawdown, nutrient flow, trophic interactions, and turnover/mixing of water column. More detail is provided under each individual classification unit below.

Characterization of the various aquatic community categories addressed in this document includes descriptions of many of the aforementioned classification parameters, as well as information on rangewide distribution, taxonomic synonymy in selected classifications, and reference sources. The distribution of individual communities is expressed in terms of 1) ecoregion and 2) a range category within that ecoregion. The four standard range categories typically used in ecoregional planning efforts are "restricted", "limited", "peripheral", or "widespread" (TNC, 1998). Community distribution is apparently generally less well known for aquatic communities than terrestrial communities, undoubtedly due in part to greater uncertainty in the aquatic community classification. In addition to this uncertainty, even the distribution categorization of terrestrial communities are sometimes viewed as being "arbitrary" or "in flux" depending on the concept of a community (e.g., narrowly defined or broadly defined). Thus, the distribution category for terrestrial communities can change from widespread to restricted with a small change in community concept (e.g., one broad ranging type with much regional variation versus several similar regional variants with subtle differences between each variant). To avoid this complication and until better rangewide information becomes available, we simplified our application of range categories to STL aquatic community units to two choices: 1) characteristic of an ecoregion or 2) peripheral to an ecoregion.

C. Synthesis of Raw Data.

Our efforts involved synthesis of much raw field data from New York and Vermont, either through direct examination of the data or through previous classification efforts using these data. Some raw data from Vermont state agencies were available to help our classification efforts and others had already been synthesized to form the basis for Vermont's Aquatic Classification Work Group (1998) classification of species assemblages and associated attempts to correlate these into higher taxonomic units: ecological alliances and their corresponding physical habitats (regional macrohabitats and macrohabitat types). River macroinvertebrate data for Vermont, overseen by Steve Fiske of VT DEC, has been collected at about 900 sampling sites, with sampling biased towards riffles in high gradient (i.e., riffle-dominated) perennial rivers. We were able to crosswalk river types between Vermont's applied macrohabitat type assignments and our classification (see Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002b). No raw data for fish or plants in rivers of Vermont were readily available to help with our efforts. For Vermont lakes, VT DEC has good data on lake occurrences including plant species and nutrient conditions which was applied to our lake classifications by Susan Warren of VT DEC. No raw data for fish or macroinvertebrates in lakes of Vermont were readily available to help with our efforts.

Much raw data from New York were available from NYHP surveys and databases to help with our classification efforts and were synthesized here, apparently for the first time, for various units relevant to STL. NYHP had conducted surveys of rivers and lakes through holistic sampling of fishes, macroinvertebrates and plants at various spatial scales, but possibly at a limited number of "sites" relative to the VT DEC efforts and probably similar NYS DEC efforts. Information covers a wide range of classification units spanning species assemblages to ecological alliances to regional macrohabitats to macrohabitat types. This information represents about 100 quantitatively detailed plots, roughly at a scale of 5 to 25 m^2 (only very few of which are in STL) and 1000s of semi-quantitative reconnaissance observation points (also with only few from STL). Much more of this field data was available for the Adirondack portion of NAP and for aquatic communities characteristic of NAP than for STL. Even more data were available elsewhere in the state (especially from the Tug Hill, Alleghany Plateau, and the Hudson River Valley) and were applicable to the STL classification mostly at the macrohabitat type scale rather than the regional macrohabitat scale.

D. Unfinished Data Synthesis and Major Future Initiatives.

It is known that sets of sampling data from New York similar to those of VT DEC are available from agencies such as NYS DEC Fisheries and NYS DEC Water, yet these data were apparently not as readily available to our team as well synthesized and as comparable to our STL classification as were the VT DEC data for Vermont. Since the start of our team efforts, it has been a strong recommendation for the second iteration of the STL plan to compile, interpret and assess these New York data for their use in evaluating, supplementing and refining our 1st iteration classification efforts.

We had hoped to get input on our STL aquatic community classification during "experts meetings" as part of the 1st iteration efforts, however we ran out of time to do so. Additional expert interviews more formal than those conducted on a 1-to-1 basis by David during 1995-1997 for the Adirondack TNC Chapter area are thus recommended to evaluate, strengthen and refine the STL classification during the second iteration of the ecoregion plan, especially for New York. One recommended approach for the second iteration is for an "Aquatic Working Group" to first review our working occurrence specifications (primarily those of NYHP) to ensure that they are sufficiently comprehensive and include accurate thresholds, then provide them to experts for review, then reevaluate the classification units after any feedback is received.

For future iterations of the STL plan, VTHP is not expected to actively inventory and document aquatic EOs for awhile (Eric Sorenson, pers. com.), thus allowing testing of the STL classification in Vermont. As of June 2002, several aquatic EOs in NY STL were expected or proposed to be inventoried and documented at a few selected sites using heritage surveys (e.g., the Boquet River system, the Ausable River system, the Deer River system, the Indian River system), however, more comprehensive regional studies, such as those to research and document benchmark occurrences and assess statewide variation for all NYHP-designated aquatic community types present in STL, may not be undertaken for awhile.

I. Classification Unit 1 (Abiotic): MACROHABITAT TYPES

A. Introduction.

The first (i.e., highest) hierarchical level in our abiotic aquatic community classification is the "**macrohabitat type**" or "**basic macrohabitat type**", representing broad physiochemically-defined aquatic community types that theoretically can occur anywhere on the globe (see also Glossary). The difference between "macrohabitat types" (Classification Unit #1) and "macrohabitats" (Classification Unit #2), as referenced in Higgins et al. (1999), may be confusing to some. Basically, macrohabitat type is the most broadly-defined abiotic classification unit, while macrohabitats represent regional variation in macrohabitat types typically correlated with biotic differences at the genus to species level. These two units are meant to be used in conjunction to reflect the hierarchy of our classification.

Aquatic macrohabitat types can be designated in several manners and different approaches appear to have been taken in recent applications of TNC's National Aquatic Classification and ecoregional planning efforts. Several physical factors are usually taken into consideration. Our objective for deriving an aquatic macrohabitat classification for STL was to first build upon the foundation of any existing macrohabitat type classifications for the region. The historical status of such aquatic community classifications used during our efforts is presented below. Our macrohabitat type classification was based largely on previous heritage program classifications, but we sought to integrate other regional attempts at classification and practical classifications outside of the Heritage Network. River macrohabitat types proposed for the STL classification are apparently comparable to the "**valley segments**" detailed in Higgins et al. (1998; p. 25), but most are likely to be larger in extent. Our classification of lake macrohabitat types in STL, appears to have been a novel approach among TNC ecoregional planning efforts which, for the most part, seem to have dismissed factors such as thermal stratification, lake depth, and water chemistry that have traditionally been used by heritage programs.

B. Current Status of Riverine Macrohabitat Type Classifications.

Several riverine classifications relevant to STL (and the adjacent parts of NAP) were examined and are discussed below, ranging from that of four state heritage programs, one state classification work group (Vermont), one TNC ecoregion (Great Lakes), and the general literature. NY Natural Heritage Program (NYHP) has had a published classification of riverine macrohabitat types since 1990 (Reschke, 1990). Other heritage programs of the NE U.S. have had riverine classifications in place for awhile including VTHP (Thompson, 1989; Vermont Nongame and Natural Heritage Program, 1996) in STL and NAP, and MEHP (Maine Natural Areas Program, 1991) and NHHP (Sperduto, 1992; NHHP, 1999) in neighboring NAP. TNC's Great Lakes Basin program attempted a very fine-scale macrohabitat type classification (Higgins et al., 1998) which differs somewhat in concept from those used by heritage programs in 1) the large number of classifications units, 2) the specific parameters used to distinguish types, and 3) the apparent independent treatment of the four parameters used to distinguish types. All of these classifications seem to have in common the allowance for several river macrohabitat types along a single river course or throughout a given "stream ecosystem" (cf. Maine Natural Areas Program, 1991). Aquatic ecology texts including Hauer and Lamberti's (1996) Stream Ecology and Rosgen's (1994) A Classification of Natural Rivers contain some especially useful quantitative distinctions between various generalized river macrohabitat types from a global perspective.

1. New York Natural Heritage Program.

NYHP has had a published classification of riverine macrohabitats since 1990 (Reschke, 1990; see Attachment 2), and it has the most detailed description of communities among the riverine classifications of the four state heritage programs in STL and NAP. This classification was intended to be and is consistently interpreted by NYHP ecology staff as comprehensive for New York State with broadly-defined, mutually exclusive (non-overlapping) categories that are temporally relatively stable at a given geographic location (e.g., not significantly changing identity and location year to year) and are mappable at a practical scale of 1:24,000. NYHP's classification was formed based on observable and repeating **correlations between and among many broad-scale physiochemical and biological features** into **ecologically coherent and holistic taxonomic units** termed "macrohabitats". This concept corresponds to "macrohabitat type" used by Higgins et al. (1998) in their classification of the Great Lakes Basin. Seven riverine communities are described from New York, 6 of which occur in NAP and STL, with all 6 interpreted as macrohabitat types. In addition to the riverine communities of NYHP's classification, one additional community type was assessed as having **riverine aquatic features** for our STL classification, examples of "Aquatic Cave Community" with flowing water, classified under the Subterranean System in Reschke (1990).

A revision and second edition of NYHP's community classification has been underway for 2002 publication and involved David's examination of much raw data for aquatic communities from which to evaluate the 1990 version of riverine macrohabitat type descriptions. David found that the classification is very stable statewide and only two new river macrohabitat types were proposed for addition in the draft: 1) Spring, as the smallest perennially flowing stream type, split from several former types, and 2) Deepwater River, a rare type with a profundal zone, split from Main Channel Stream. David also provided suggestions for physiochemical descriptions of most river types more detailed than those in the 1990 classification. Information on regional variation within macrohabitat types, including the taxonomic evolution of "regional variants" in the NYHP classification, is presented under Classification Unit #2 below.

While NYHP's aquatic community classification and approach seems to have been criticized and dismissed by some (e.g., Vermont's Aquatic Classification Working Group (1998), in which it was claimed that NYHP's classification had "not been tested", recent correspondence from NYHP program managers (Edinger, 2002) with George Schuler of TNC's Freshwater Initiative, who assessed the classification as "not broken down fine enough", and Higgins (2000a), who pointed out the "tentative" nature of the classification), it is thought that the nuances of the classification and its subsequent evolution are poorly understood by these critics. One complaint has been that the classification is not comprehensive as a macrohabitat type classification. In defense, the classification was designed and explicitly stated in Reschke (1990) as being comprehensive and the names were designated and explicitly stated as being **mere "labels"** and not intended to be narrowly and simple-mindedly interpreted. As the NYHP ecologist taking the lead on evaluating aquatic communities, David's assessment of NYHP's aquatic community classification was that it was essentially **comprehensive for New York at the practical broadly-defined level originally designed** (i.e., the macrohabitat type level) (Hunt, 2000b). The iterative NYHP "community specifications" that accompany each macrohabitat type (e.g., Hunt, 1999d) attempt to describe and document the full range of variation within each type far beyond the "type description" or "average condition" summarized in Reschke (1990) and to quantify the thresholds of this "seamless" classification (See Attachment 3 for a sample). For example, a "Rocky Headwater Stream" can occur on the upper slopes of the highest mountains of a region (i.e., typical "headwater" streams in the Adirondack High Peaks), as well as on very gentle rocky upper slopes of low and imperceptible divides of small watersheds where they flow directly into large rivers (i.e., a "feeder" variant of "headwater" streams near Lake Champlain and the St. Lawrence River) and can range from primarily bedrock substrate (i.e., "rocky") to sandy substrate (i.e., not "rocky"). If the classification has been criticized as being "not fine enough", it is probably because 1) it was not intended to be a classification of microhabitats (i.e., fine-scale physical units) and 2) "biologically finer" regional variants with consistent differences in fishes, macroinvertebrates and plants were not adequately known at the time of publication. Such suspected regional variants have been increasingly addressed in the evolution of the classification in recent years (see Classification Unit #2 below). Another criticism (Higgins, 2000a) has been that NYHP's classification is not a landscape-based classification. While admittedly these classification units are not at the scale of landscapes such as watersheds or matrix forests, all aquatic community types are influenced by landscape position and many landscape features are addressed in the NYHP text (Reschke, 1990).

New York Heritage Program has come a long way in evaluating aquatic communities since Reschke's (1990) statement of "tentativeness" and our work has been generally supporting her **expert-formulated classification** (e.g., NYHP has sampled about 90 plots in aquatic communities statewide and documented numerous EOs) (Hunt, 2000b). Data on New York aquatic community EOs (mostly macrohabitat EOs) have been collected and methods for surveying and assessing aquatic/riverine community EOs have been applied, documented and refined since 1996 to test many of the hypotheses and assumptions made in Reschke (1990) and presented in this document. Riverine community EOs in the NYHP database from the STL/NAP area number 14, all from NAP (i.e. with none from STL). Data were reviewed from about 230 additional leads for biologically significant river EOs in this area, primarily obtained from expert interviews during 1995-1996 and including many from STL (see Hunt, 2002a; Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002a). Detailed information from documented EOs is stored on field forms and in element occurrence records (EORs) at NYHP. Blank aquatic field forms are presented in Attachment 4 and completed samples are presented in Attachment 5. These forms quantify 1) the microhabitat composition of macrohabitats, 2) plant and animal structure and composition, 3) substrate composition, and 4) numerous hydrological parameters, and the information is collected from scales that range from microhabitats to large landscapes.

2. Other Northeastern U.S. Heritage Programs.

In community classifications for other NE U.S. state heritage programs the following number of community types are listed as riverine communities and, in parentheses, **verified as a riverine community in our STL classification**: VTHP = 6 (7) (see Attachment 6), NHHP = 5 (5) (see Attachment 7), MEHP = 9 (7) (see Attachment 8). Like the terrestrial community classifications in these three states and the aquatic community classifications of NYHP, the aquatic community classifications for these three heritage programs were formed through attempts to correlate the distribution of biota with physical environments. Thus, VTHP, NHHP and MEHP derived classifications mostly of **"generalized" macrohabitat types**, additional attempts besides that of NYHP apparently overlooked by Vermont's Aquatic Classification Work Group (1998) which claimed that "no known working classification exists for aquatic communities".

The generalized river types of these three heritage programs are remarkably similar to those of NYHP, suggesting a uniformity across NAP Ecoregion, and like NYHP, they generally assigned the same riverine community type across all ecoregions of their states (Hunt, 2000c; Bryer, 2000). Thus, like NYHP's 1990 classification, their classifications can be perceived as setting the **physical framework for a finer scale regional biological classification**. All of these heritage program riverine classifications are similar to that of NYHP in the use of stream size and gradient as key classification factors. While community descriptions for the other three state heritage programs are not as detailed as those for NYHP's classifications, brief preliminary descriptions are provided for VTHP and MEHP.

The VTHP classification attempted to include "all deepwater habitats" for Vermont, thus was intended to be comprehensive for the state, and, like Reschke (1990), mentioned the program's limited understanding of aquatic community classification at the time of publication and the use of provisional types to be refined at a later time based on a clearer understanding of the relationships of slope, temperature, nutrients, substrate and dissolved oxygen to aquatic biota. NHHP recognized river types in their 1992 classification with names similar to those of VTHP but lacking community descriptions. MEHP provided "skeletal descriptions" of each macrohabitat type, in comparison to those for the terrestrial (i.e., non-aquatic) community types in their classification; however, they are more detailed than those of VTHP and NHHP. The 1991 MEHP classification may present the most refined river macrohabitat type classification of NE U.S. heritage programs outside of New York, and this classification has many similarities to that of NYHP. Like NYHP, MEHP explicitly addressed the taxonomic split between "vegetated areas" (i.e., **palustrine types** with emergent or terrestrial vegetation) and "open water areas" (i.e., **true aquatic community types**) within any given stretch of river.

Spring, a community that spans the aquatic/palustrine taxonomic interface and was treated as a river macrohabitat type in our STL classification, was recognized in the VTHP river classification of 1989 (Spring Run Community), but was later apparently submersed into the palustrine community type Woodland Seep/Spring Run in the VTHP classification of 1996. Apparently neither MEHP nor NHHP recognize Spring as an ecological community. Similarly, the 1989 VTHP classification lists Subterranean Stream/Pool, treated as an aquatic macrohabitat type in our STL classification, under the Subterranean System. Without a description, it is uncertain if MEHP's Cave Community concept includes aquatic features. MEHP's Deadwater Community, classified as a river community, was assessed as better treated as a lake community in our STL classification and crosswalked to Flow-Through Pond. Lastly, MEHP's River Emergent Community, which we interpreted as a palustrine community, was not addressed in our aquatic classification and was likely addressed as part of recent NAP terrestrial classification efforts.

3. Vermont's Aquatic Classification Work Group.

Vermont's Aquatic Classification Work Group document (1998), while very detailed at the species assemblage level (Classification Unit #5), apparently did not explicitly focus on or propose a "consolidated" riverine macrohabitat type classification for the state. However, both macrohabitat types and macrohabitats (see Classification Unit #2 below) in Vermont were suggested, and macrohabitat types can be inferred especially from the documented physiochemical descriptions associated with the numerous species assemblages (see Classification Unit #5 below). Specific riverine macrohabitats were suggested as correlated with different species assemblages for macroinvertebrates and fish, but not for plants.

Fish assemblages were correlated with temperature and other variables such as elevation, discharge area, ANC, sediment composition, and microhabitat composition, and can be translated into macrohabitat types of different stream size and sediment composition. While 7 regional macrohabitats are perhaps suggested by the 7 separate fish species assemblages, no apparent attempt was made to aggregate these macrohabitats into macrohabitat types. Descriptions of the macroinvertebrate assemblages, which were also correlated with macrohabitats, provide good preliminary detail for physiochemical characteristics (pH, ANC, geomorphology, physical dimensions) and can also be translated into macrohabitat types of different stream size, gradient, and sediment composition. While 10 regional macrohabitats are perhaps suggested by the 10 separate macroinvertebrate species assemblages, no apparent attempt was made to aggregate these macrohabitats into generalized macrohabitat types, other than perhaps through mention of "major categories", of which there are two: 1) high gradient streams with coarse sediment and 2) low gradient streams with fine sediment. Other macrohabitat types with unique sets of macroinvertebrates were presented as "specialized habitats" (springs, lake outlets), correlated with localized physiochemical features. Three river categories have been assigned by VT DEC macroinvertebrate staff to field data, one corresponding to Rocky Headwater Stream, one to Confined River, and one apparently intermediate between these two types. Apparently, little or no Marsh Headwater Streams and Unconfined Rivers have been sampled, or else they have been artificially categorized into the three VT DEC types.

4. Great Lakes Basin.

A total of 300 riverine macrohabitat types were derived for the entire Great Lakes Basin, primarily using remote GIS analysis of four parameters: hydrological regime (water source), stream gradient, stream size (link number), and connectivity (number of connecting links)

(Higgins et al., 1998). Each parameter was stratified into several categories (see p. 46 of Higgins et al., 1998), then macrohabitat types were derived assuming total independence of the four parameters, thus producing numerous unique combinations of the many categories within these parameters. When broken down into drainage units, the following number of river "macrohabitat types" were predicted from the New York part of the Great Lakes Basin: 32 for the St. Lawrence/Champlain Valley (STL), 61 for the Adirondack Mountain Section (NAP), and 41 for the Tug Hill Plateau (NAP). Information was readily available neither for the description nor nomenclature of these types, so it was uncertain if they corresponded with our applied use of the term "macrohabitat type".

Later, the Great Lakes Basin ecoregional planning team presented a classification of "stream targets", apparently macrohabitats, during the portfolio assembly process (Great Lakes Basin, 2000). The classification included 8 river macrohabitats for the St. Lawrence Drainage Unit of New York, all of which occur in STL or NAP, and 12 river macrohabitats for the Eastern Lake Ontario Drainage Unit of New York, 8 of which are thought to occur in STL or NAP (see Classification Unit #2 below), (Attachment 9). These types are apparently defined, or at least characterized, by a mix of local physiography, geology, stream size, connectivity, and fish alliance, and thus, appear to share some features used by our team to distinguish macrohabitat types in STL.

In general, the scale and concept of specific units in the Great Lakes Basin (2000) river classification seems to vary substantially from drainage unit to drainage unit. For the STL portion of the Saint Lawrence Drainage Unit, several types specific to local geographic areas are thought to best correspond to our regional macrohabitats (see Classification Unit #2 below for more detail) or even more narrowly-defined types (e,g., Till Plain tributaries, Glacial Marine Plain tributaries, St. Lawrence Lake Plain tributaries, Lower Black River). The various river types of STL and NAP in this classification could theoretically be grouped into more broadly-defined units resembling our macrohabitat types, as reflected by parts of their names such as "midreaches", "mainstems", "headwaters", and backwater slough. The latter community, included in the Great Lakes Basin lake classification for the St. Lawrence Drainage Unit, perhaps comes the closest to one of our river macrohabitat types, apparently with STL and NAP variants within this drainage unit lumped together, and may be the only one of our STL river macrohabitat types that was treated separately in the Great Lakes Basin aquatic classification.

Similarly to rivers designated for STL, those from the Tug Hill (NAP) were thought to correspond more closely to our regional macrohabitats (see Classification Unit #2 below for more detail) or even more narrowly-defined types. In contrast with rivers of STL, the three river communities of the Adirondack portion of NAP appear defined at variable scales. One type, Adirondack Highland Streams, combines many of our river macrohabitat types; the other two types, Black River Headwaters and Eastern Tributaries of Black River, occur at much finer geographic ranges but coarser geomorphological ranges than our types.

C. Current Status of Lake Macrohabitat Type Classifications.

A few lake macrohabitat type classifications relevant to STL had been previously documented. A proposed lake classification for New England prepared for the Heritage Network in 1986 by Widoff (see Attachment 10 for excerpts) appears to have been one of the first attempts at a comprehensive classification for the region geared towards biodiversity conservation. NYHP has had a published classification of lacustrine macrohabitat types since 1990 (Reschke, 1990). Other state heritage programs have had lacustrine classifications in place for awhile including VTHP (Thompson, 1989; Vermont Nongame and Natural Heritage Program, 1996) in STL and NAP, NHHP (Sperduto, 1992; NHHP, 1999) and MEHP (Maine Natural Areas Program, 1991) in the remainder of NAP. TNC's Great Lakes Basin program attempted a very broad-scale lake macrohabitat type classification (Higgins et al., 1998) which differs somewhat in concept from those used by heritage programs in 1) the small number of classifications units, 2) the specific parameters used to distinguish types, and 3) the apparent independent treatment of the four parameters used to distinguish types. Aquatic ecology texts including Lampert and Sommer's (1997) Limnoecology contains some especially useful quantitative distinctions between various general lake macrohabitat types from a global perspective, and Maxwell et al. (1995) was useful for suggesting lake macrohabitat types from across a broad geographic range.

We did not have time to pursue research of several other reference sources, and review of information from these sources is recommended for the 2nd iteration of the STL plan. One reference in particular that was not made available to the team, but may be worth reviewing in future iterations of the classification, is a 217+ page text on "The Development of an Aquatic Habitat Classification System for Lakes" (Busch and Sly), available at ECS. The table of contents of this reference suggests a focus on the Great Lakes Basin, however, it is uncertain whether or not it addresses specific lake types within the STL Ecoregion. Higgins (2000b) suggested consideration of several other lake references (Lewis and Magnuson, 1998; Lewis et al., 1999; Schupp, 1992; Tonn et al., 1990; Tonn and Magnuson, 1982) for the design of our classification. Much field data are also available for review in New York for lakes characteristic of NAP from agencies such as Adirondack Lake Survey, Paul Smiths College Aquatic Institute, and Darrin Freshwater Institute from which to evaluate a lake macrohabitat type classification.

1. New York Natural Heritage Program.

NYHP has had a published classification of lacustrine macrohabitats since 1990 (Reschke, 1990; see Attachment 2), and it has the most detailed description of lacustrine communities among the classifications of the four state heritage programs in STL and NAP. Like NYHP's riverine classification, the lacustrine classification was intended to be and is consistently interpreted by NYHP ecology staff as being comprehensive for New York State, with broadly-defined, mutually exclusive (non-overlapping) categories that are temporally relatively stable at a given geographic location (e.g., not changing year to year) and are mappable at a practical scale of 1:24,000. NYHP's lake classification was also formed based on observable and repeating correlations between and among many broad-scale physiochemical and biological features into **ecologically coherent and holistic taxonomic units** thought to correspond to "macrohabitat type" used by Higgins et al. (1998) in their classification of the Great Lakes Basin. Of 16 community types under the Lacustrine System described from New York, about 12 fit well into the macrohabitat type concept of our STL

Classification.

One or two lake types in NYHP's classification seem to represent regional variants of macrohabitat types including Great Lakes Deepwater Community as a possible GL variant of Summer-Stratified Monomictic Lake. Two additional lacustrine communities, Great Lakes Aquatic Bed and Great Lakes Exposed Shoal, most closely correspond to ecological associations, occurring at scales even finer than microhabitat types, and they are mentioned below in Section X ("Other Classification Units Considered"). In addition to the communities in the Lacustrine System of NYHP's classification, up to four additional community types were assessed as having **lacustrine aquatic features** for our STL classification. These include examples of "Aquatic Cave Community" with ponded water, classified under the Subterranean System in Reschke (1990), and the aquatic portions of Vernal Pool, Sinkhole Wetlands, and Pine Barrens Vernal Pond, all classified under the Palustrine System.

A revision and second edition of NYHP's community classification has been underway for 2002 publication, and involved David's examination of much raw data for lacustrine communities from which to evaluate the 1990 version of lake macrohabitat type descriptions. No lake types were proposed for addition, although it was recommended that Vernal Pool be changed from the Palustrine System to the Lacustrine System. More detailed physiochemical descriptions of most lake types were also provided. Information on regional variants within macrohabitat types, including their taxonomic evolution in the NYHP classification, is presented under Classification Unit #2 below.

Criticisms of NYHP's lacustrine macrohabitat type classification parallel those of the riverine classification addressed above. Like criticisms of the latter classification, some were deemed to stem from misunderstanding of the range of variation within each macrohabitat type (i.e., well beyond that of the "type description" in Reschke, 1990) or the efforts of NYHP in collecting and analyzing information subsequent to 1990 (see discussion under river classification above).

Data on New York aquatic community EOs (i.e., macrohabitat EOs) have been collected and methods for surveying and assessing aquatic/ lacustrine community EOs have been applied, documented and refined since 1996 to test many of the hypotheses and assumptions made in Reschke (1990) and presented in this document. Lacustrine community EOs in the NYHP database from the STL/NAP area number 21 (19 from NAP and 2 from STL). The only STL EOs are Lake Champlain (a STL Summer-Stratified Monomictic Lake) and Perch Lake (a STL Winter-Stratified Monomictic Lake). Data were reviewed from about 210 additional leads for biologically significant lake EOs in this area, primarily obtained from expert interviews during 1995-1996 and including many from STL (see Hunt, 2002a). The same aquatic forms are used to describe both riverine and lacustrine communities at NYHP (Attachment 4).

2. Other Northeastern U.S. Heritage Programs.

In community classifications for other NE U.S. state heritage programs, the following number of community types are listed as lake communities and, in parentheses, **verified as a lacustrine community in our STL classification**: VTHP = 6 (8) (see Attachment 6), NHHP = 5 (7) (see Attachment 7), MEHP = 12 (9 to 14) (see Attachment 8). Like the riverine classifications in these three states, the lacustrine community classifications were formed through attempts to correlate the distribution of biota with physical environments and present mostly macrohabitat types. The generalized lake types of these three heritage programs were also remarkably similar to those of NYHP, suggesting a uniformity across NAP Ecoregion, and like communities of the NYHP classification, types were presumed to span all ecoregions of their states (Hunt, 2000c; Bryer, 2000). While community descriptions for the other three state heritage programs are not as detailed as those for NYHP's classifications, brief preliminary descriptions are provided for VTHP and MEHP.

The 1989 VTHP classification presents a relatively simplified division of 6 generalized lake communities statewide, corresponding to macrohabitat types (Attachment 6). Two to 3 of these communities are less common lake types, distinguished primarily by unique water chemistry and dominant substrate type and corresponding in our STL/NAP lake classification to Marl Pond, Tarn Pond, and Bog Lake. VTHP also recognizes three other shallow water aquatic communities as part of other community systems. Vernal Pool, a community that spans the aquatic/palustrine taxonomic interface and was treated as an aquatic community in our STL classification, was addressed as a palustrine community in the VTHP classifications of 1989 (Temporary Pool) and 1996 (Vernal Woodland Pool). Similarly, the 1989 VTHP classification lists Subterranean Stream/Pool, treated as an aquatic macrohabitat type in our STL classification, under the Subterranean System. Lastly, the 1996 VTHP palustrine community classification includes Outwash Pondshore Community, which has in its description mention of a "pond" thought to correspond to the Pine Barrens Vernal Pond of our STL classification.

NHHP recognized 6 lake communities in their 1992 classification, similar to those of VTHP and also including two relatively specialized lake types corresponding to our Tarn Pond and Bog Lake (Attachment 7). Community descriptions are lacking. Also similar to VTHP, the 1999 NHHP classification lists two types of Vernal Pools (Vernal Floodplain Pool and Vernal Woodland Pool) as palustrine communities.

The 1991 MEHP classification may present the most refined lake macrohabitat type classification of NE U.S. heritage programs outside of New York, and this classification has many similarities to that of NYHP. Maine's classification lists 12 lake communities arrayed into "ecosystems", 9 of which correspond to macrohabitat types (Attachment 8). Three lake communities in this classification were not treated as macrohabitat types in our STL classification, including one which we interpreted as an association (Lacustrine Shallow Bottom Community) and two which we treated as palustrine communities and do not address at all in our aquatic classification (Rush Bed Community and Lacustrine Emergent Community). The latter two communities were likely addressed as part of recent NAP terrestrial classification efforts. MEHP lake macrohabitat types are distinguished primarily by 1) water chemistry (trophy and alkalinity) and 2) light and thermal properties (including lake depth, stratification regime and turnover). Like descriptions of river communities, those for lacustrine macrohabitat types were presented as "skeletal" in comparison to those for the terrestrial (non-aquatic) community types in the classification; however, they are much more descriptive than those of VTHP and NHHP. Specialized lake types presented under community systems other than the lacustrine system in the MEHP classification include 1) Deadwater Community, classified as a river community but assessed as a lake community in our STL classification equivalent to Flow-Through Pond, and 2) Vernal Pool Community, classified as a palustrine community but also assessed as a lake community in our STL classification.

3. Vermont's Aquatic Classification Work Group (VT ACWG).

The VT ACWG document (1998), while very detailed at the species assemblage level (Classification Unit #5), apparently did not explicitly focus on or propose a "consolidated" lacustrine macrohabitat type classification for the state. However, macrohabitat types in Vermont were suggested or can be inferred from the documented physiochemical descriptions associated with the numerous species assemblages presented (see Classification Unit #5 below). Specific lake macrohabitat types were suggested as correlated with different species assemblages for aquatic macrophytes, macroinvertebrates, and fish, mostly cited as being based on the classification framework for macrophyte assemblages.

The 4 macrophyte and fish assemblages in lakes of Vermont were correlated with 4 lake communities, apparently representing macrohabitat types distinguished by elevation, acidic neutralizing capacity (ANC), water clarity, color, trophy, and phosphorus. Plant and fish assemblages in lakes were correlated with each other (see Table 1, p. 10-11 of VT ACWG, 1998), perhaps in an attempt to consolidate habitats for species assemblage into more holistic macrohabitat types. Numerous macroinvertebrate assemblages were correlated with 5 lake communities, apparently representing macrohabitat types distinguished by ANC, color, trophy, calcium, and pH. The one extra lake type stems from the difference in the number of trophy categories: a 2-parted split of oligotrophic and eutrophic-mesotrophic lakes for plants and fish, a 3-parted split of oligotrophic, mesotrophic and eutrophic lakes for macroinvertebrates. Two additional specialized lake macrohabitat types, Vernal Pool (i.e., "temporary palustrine systems") and subterranean areas, were thought likely to support unique aquatic macroinvertebrate assemblages.

4. Great Lakes Basin.

A total of 100 lake macrohabitat types were derived for the entire Great Lakes Basin, primarily using remote GIS analyses of four parameters: connectivity, lake surface area, shoreline complexity, and hydrologic regime (Higgins et al., 1998). Like river macrohabitat types, the parameters were stratified into several categories (see p. 52-53 of Higgins et al., 1998), then macrohabitat types were derived assuming total independence of the four parameters, thus producing numerous unique combinations of the many categories within these parameters. When broken down into drainage units, the following number of lake macrohabitat types were predicted from the New York part of the Great Lakes Basin: 9 for the St. Lawrence/Champlain Valley (STL), 39 for the Adirondack Mountain Section (NAP), and 19 for the Tug Hill Plateau (NAP). Information was readily available neither for the description nor nomenclature of these types.

Later, the Great Lakes Basin ecoregional planning team presented a classification apparently of regional macrohabitats during the portfolio assembly process (Great Lakes Basin, 2000). Unlike the river classification above, which presents several types in the STL drainage unit more specific than our macrohabitat types for STL, the lake classification apparently presented units much broader than our classification for all drainage units of the region, lumping several macrohabitat types into one. This classification included only 5 lake communities for the St. Lawrence Drainage Unit of New York, all of which occur in STL or NAP, and no additional unique lake types for the Eastern Lake Ontario Drainage Unit of New York (Attachment 9). These lake types were apparently defined, or at least characterized by, a mix of local physiography, connectivity, and fish alliances. One of these lake types, Backwater Slough, was treated under our riverine classification (see above). Only 2 of the remaining four types are apparently in STL: namely Oxbow Lakes and Saint Lawrence Lake Plain Lakes. These two lake types apparently represent a variable mix of one narrowly-defined macrohabitat type (i.e., Oxbow Lake), the only type with close correspondence to one of our lake macrohabitat units (STL Oxbow Pond) designated for the STL lake classification, and one much more broadly-defined type (i.e., the Saint Lawrence Lake Plain Lakes) which apparently combines several lake macrohabitat types of our STL classification, spanning a broad range of trophy and stratification regimes. Similarly, only two lake types were designated for the portion of the Great Lakes Basin within NY NAP: 1) Adirondack Headwater Lakes and Lake Outlets and 2) Adirondack Drainage Lakes. These both appear to be very broadly-defined types which combine several lake macrohabitat types in our STL/NAP classification, also spanning a broad range of trophy and stratification regimes.

5. Widoff's Regional Heritage Classification.

Widoff's (1986) classification framework for New England includes 125 theoretical lake types, corresponding closely to our concept of basic lake macrohabitat type and based on all possible combinations of 4 hydrological parameters: alkalinity (4 categories), color (5 categories), stratification (3 categories), and turnover/temperature (2 categories) (see Attachment 10 for sample). Although Widoff claimed that trophic state was chosen as a taxonomic character for her proposed classification, she apparently did not "use it as a direct means of classification since it is subject to drastic change". Widoff also dismissed pH as a factor in the classification, citing that "it is affected by a number of other factors". Some of the lake macrohabitat types in our STL classification such as Bog Lake (a dystrophic lake), were not explicitly addressed in Widoff's classification, but might be translatable from some of the combinations of parameters. It is also unclear whether or not Widoff's classification was arrayed into a hierarchy among the four parameters. If so, alkalinity appears to be the primary factor, followed by color then stratification.

D. General Approach to Choosing Basic Macrohabitat Type Units.

For the STL aquatic community classification, our attempts to choose and characterize macrohabitat types followed a three-step approach: 1) team consensus on which units we wanted in the classification, 2) construction of a key to delineate the taxonomic bounds of these units, then 3) documentation of these types as part of a more detailed classification description and crosswalk of regional variants. Because of the focus of our team's efforts on pre-existing heritage program classifications, which reportedly differed much from the approach of other TNC ecoregion planning efforts, justification is provided for our choices for river and lake macrohabitat types. We sought four major characteristics for individual macrohabitat type units (**part of a taxonomically comprehensive set, ecologically holistic, practical in scale, and representative of reference-level examples**), as detailed below.

1. Taxonomically Comprehensive Set of Units.

As an attempt at a taxonomically comprehensive macrohabitat type classification that could theoretically be applied to any ecoregion, we sought a classification that is comprehensive for all coarsely-defined freshwater river and lake macrohabitat types throughout the seven ecoregions of which New York is a part {NAP, STL, GL, HAL, LNE, WAP, NAC}. By doing this, we hoped to capture all the **coarsest levels of physical differences** in river and lake types in both New York and Vermont and both STL and NAP. Macrohabitat type units are apportioned to **correspond to all the coarsest levels of biological classification** (alliances or higher levels of biological aggregation), at least throughout the region. The STL Aquatic Community Team unanimously agreed that our macrohabitat type classification is **comprehensive for New York and Vermont STL**, as we intentionally allowed enough flexibility in each type to span a very broad range of physiochemical variation (Hunt, 2000b).

2. Ecologically Holistic Units.

We decided at the beginning of our team efforts in a "Classification Vision" (Hunt, 2000a) that macrohabitat types and regional macrohabitats should be classified as "**ecologically holistic units**", intentionally **integrating biotic and abiotic patterns**. We sought to derive macrohabitat types from direct holistic observations of aquatic communities in the field by team members or strongly suspected from secondary sources, rather than simply from those representing all theoretically possible combinations of several physical attributes such as done in the approach of the Great Lakes Basin classification (Higgins et al., 1998). Between David, Liz McLean (an assisting contractor whose aquatic community studies in northern New York were overseen by David) and several other team cooperators (especially VT DEC staff), we have probably seen all the proposed macrohabitat types in the field either in New York or Vermont and either in NAP or STL.

In general, there is apparently a strong correlation between many of the physiochemical attributes typically used to characterize river and lake systems in classifications (VT ACWG, 1998; Widoff, 1986; Mark Bryer, pers. com.), many of which are addressed below. We attempted to integrate as many of these correlations as possible into holistic units rather than treat these attributes as independent as done in the Great Lakes Basin classification (Higgins et al., 1998). For example, in rivers, stream gradient is generally strongly positively correlated with elevation and stream velocity while these features are inversely correlated with temperature, substrate fineness, stream depth, and distance from the stream source. Similarly for lakes, surface area is positively correlated with lake depth, average temperature, drainage area, and connectivity and inversely correlated with elevation. Likewise, there are often strong correlations between many water chemistry parameters: pH, alkalinity, ANC, trophy, transparency, dissolved oxygen, and color. When all these correlations are factored together, the number of relatively distinct river and lake macrohabitat types with substantial and repeatable biological differences are hypothesized to boil down to apparently only a few types, and these types are thought to approximate those in the classifications of heritage programs in the STL-NAP region.

Higgins et al. (1998; p. 80) suggested the option to lump finer scale macrohabitat types (e.g., biologically similar types with minor substrate differences) into coarser units, such as the 300 riverine macrohabitat types in the Great Lakes Basin classification. It is thought that these theoretical coarser units of such a classification can converge into the more holistic concepts of macrohabitat types presented rather consistently in the community classifications of heritage programs of New York (Reschke, 1990) and nearby states and chosen for our STL classification. For example, a "Rocky Headwater Stream" macrohabitat type with relatively uniform biota might cover a range of stream characteristics from high gradient/bedrock substrate streams to medium gradient/cobble substrate streams to slight gradient/gravel substrate streams.

Lacking a biological basis for abandoning the holistic approach to river and lake classifications in the NE U.S. that had been in place in the Heritage Network since 1986 (New England-1986, VT-1989, NY-1990, ME-1991, NH-1992), and modelling our general aquatic community classification approach on the ECS approach to terrestrial community classification that had been applied to TNC ecoregional planning since at least 1995, which revolves around crosswalking of classification unit names and concepts at existing state heritage programs, the STL river and lake macrohabitat type classifications proposed here were intended to represent a consolidation and next iteration of the aforementioned river and lake classifications. From our team's examinations of the biotic patterns of rivers and lakes in this region, the literature and field data apparently affirm the strength of these historically-used heritage program classifications. Despite the criticism of Jonathan Higgins that we were "recreating the wheel" by our STL classification, from our perspective, we saw no reason to "abandon the wheel" that had been created in the 1980s and has been functioning well as a classification tool for resident aquatic biota.

3. Practical Classification Units.

We sought to derive a **total number of macrohabitat types practical in scale and manageable for biodiversity conservation purposes**. Standard aquatic ecology references point out that a continuum of aquatic macrohabitat types exists, both for rivers and lakes, probably not unlike the continuum for matrix forests and other terrestrial communities, where each aquatic macrohabitat could, as an extreme exercise in taxonomy, represent its own macrohabitat type (i.e., in the **"most finely split" classification**). Our more **conservative classification** takes a standard top-down approach starting with the coarsest taxonomic splits, then creating units at successively finer scales until either the number of classification units gets unmanageable (i.e., impractical for heritage programs to track large number of community elements and/or having types so rare that all occurrences are deemed "**significant**" and thus meet criteria for being tracked in conservation databases) or until the biological and physiochemical differences become too subtle and fine to warrant recognition as **biologically distinct community types**. The taxonomic prioritization of various parameters in our river and lake classification hierarchies which guided our top-down choices for units is discussed separately below in the river and lake sections. It is thought that the geographic scale and number of macrohabitat types taxonomically delineated using the holistically assessed approach outlined above may consequently result in community units more practical than those of the Great Lakes Basin classification (Higgins et al., 1998), especially for river macrohabitat types, which are very finely split in that classification. Any residual variation not addressed directly by our river and lake macrohabitat type classifications is also addressed separately below in the river and lake sections.

Balanced with a top-down approach was the bottom-up aggregation of fine-scale units into coarser and coarser taxonomic units, until a practical number of units was achieved. Species assemblages (See Classification Unit #5) of multiple taxonomic groups (up to 7 types) were considered in the STL aquatic community classification, with 3 to 4 types dominant in rivers and 4 to 6 types dominant in lakes. We followed a general approach to seek correlations between species assemblages of different taxonomic groups and ascertain, whenever possible, instances where there are 1) poor spatial correlations and figure out how to resolve those discrepancies in our classification and 2) strong spatial correlations, which were used to solidify our choice and designation of community types. Similar decisions have been documented in previous community classifications for the region. For example, Widoff (1986) suggested that "macrophytic vegetation is only one biotic component of lake communities and should not form the overriding basis of a classification" and notes that "phytoplankton and zooplankton are the predominant life forms of all lakes". Our aggregation of smaller classification units into macrohabitat types basically followed a path from species assemblages into ecological associations, then in turn into ecological alliances which were spatially equated with regional macrohabitats, then taxonomic consolidation of physically similar regional macrohabitats into macrohabitat types. Some abiotic aquatic communities with unusual and unique biological characteristics were recognized as distinct or **"specialized" macrohabitat types**. Such communities are addressed separately below in the river and lake sections.

A review of the general aquatic literature suggests that there are more numerous and more complex gradients among lake macrohabitat types than among river macrohabitat types, with the addition of much more variation in the third dimension (depth). In general, river macrohabitat types seem relatively straight forward, mostly reflecting size differences along a river network continuum, whereas lakes macrohabitat types differ primarily in their combination of size, depth and water chemistry. This translates to a greater number of basic lake types in our classification of macrohabitat types for NAP and STL (16) and all of New York State (17) relative to basic river types for these regions (9) (See Table 2).

4. Units Based on Reference-Level Benchmarks.

We sought macrohabitat types that represent the **benchmark condition** in aquatic communities for **physical, chemical and biological features.** We recognized that aquatic communities are generally more disturbed and influenced by their landscape than terrestrial communities, those of STL not being an exception to this general rule, but that they may possess a greater capacity for natural recovery. Our designation of aquatic community types for STL parallels the approach used in heritage programs, at least historically at NYHP, where known or hypothesized **"benchmark examples"** or **"reference-level examples"** are used to represent the state of a community as close as possible to its unaltered or least-altered condition and other occurrences are assumed to have altered physiochemical and especially biological features.

We addressed the separation between a **classification factor** and a **condition factor** for aquatic communities in our "Vision Statement" for the STL classification (Hunt, 2000a) and expand on it here in an attempt to further clarify our approach. In the terrestrial classification for state heritage programs and ecoregional classifications, we generally seek to classify and track **climax or disclimax communities in good enough condition not to have been altered substantially from the type description** (e.g. the **"benchmark state"**, **"inherent state"**, or **"pre-settlement state"**). We took the same approach for aquatic communities, as summarized in our January 2000 Vision Statement:

> "in our aquatic community approach we seek to classify 'hydrological disclimax' communities and describe their biota and physical features by their reference/unaltered state (however difficult this may be given the long history of severe impacts to aquatic communities in many areas, often even more so than their associated surrounding terrestrial communities). "

Recognizing the potential for confusion in aquatic community classifications due to anthropogenic changes in hydrological features, especially water chemistry parameters, as cautioned by Higgins (2000a, 2000b) (e.g. conversion of an acidic lake to an alkaline lake upon the overwhelming of the natural water chemistry by agricultural fertilizer input), we avoided designating macrohabitat types based on disturbed examples and describing and classifying "successional" stages of aquatic communities. This approach is standard for terrestrial communities during TNC's ecoregional community classification process. There is much literature to suggest that biotic assemblages differ between disturbed, successional, and disclimax stages in aquatic communities. David strongly suggested that for the northern New York/Vermont region (especially NAP, but also including STL) enough examples of most river and lake types still exist close enough to their inherent physiochemical and biological state that we could infer and describe what they might have looked like in pre-settlement times and/or should or could look like in modern times given recent climatic trends and the potential for natural recovery. For example, in the 1996-1997 "Adirondack Exemplary Community Project" we sought out, surveyed and documented one **"best" example** of each river and lake community type in the Adirondack Region. From this project and review of additional literature, David is convinced that there is a broad natural/inherent range of variation of river and lake macrohabitat types in this region with different water chemistry, including acidic to alkaline examples, oligotrophic to eutrophic examples, and clear to turbid examples and that this range reflects different biologically based macrohabitat types. We tried to be careful to sort out patterns among unimpacted versus impacted rivers and lakes and generally focused neither the macrohabitat type nor regional macrohabitat classification on degraded examples with altered hydrology and biota. In fact, the NYHP classification (Reschke, 1990) addresses levels of historic impacts beyond which lakes are considered to be **cultural types**. We did not attempt to include any "cultural" aquatic macrohabitat types in our STL aquatic community classification.

E. Summary and Documentation of Basic Macrohabitat Types.

A comprehensive list of 9 river and 17 lake macrohabitat types for New York plus 5 provisional lake subtypes, as based on the results of our STL aquatic community classification efforts and team consensus, is shown in Table 2. This classification scheme is hypothesized to be comprehensive for New York, Vermont, STL and NAP and thought to be applicable to the entire NE U.S. region and perhaps far beyond. All 9 river types are known to occur in the New York-Vermont portion of STL; whereas only 13 of the 17 lake types are known to occur in this area, the other 4 types thought to be absent from this area: Salt Pond, Meromictic Lake, Acidic Pond, and Acidic Dimictic Lake. The latter three of 4 lake types are known from adjacent NAP, leaving only Salt Pond as absent from the New York-Vermont portions of STL and NAP combined. However, even that lake type is likely to be present in the Quebec portion of STL!

Macrohabitat types for our STL classification were derived in large part from the aquatic communities standardly used in the NYHP classification (see the river and lake sections below). Types are distinguished for easy reference in a diagnostic macrohabitat type key (Key 1). This key is graphically depicted in Figure 1 for rivers and Figure 2 for lakes. Common river types are schematically presented in Figure 3. Detailed characterization of river and lake macrohabitat types were applied at the regional macrohabitat level following a standard information template (see Classification Unit #2 below).

Ecological communities are typically presented in community classification documents as **"type descriptions**" (e.g., see NYHP's 1990 classification). Without documented **taxonomic bounds**, the range of community types is frequently and repeatedly misinterpreted by classification users (e.g., see criticisms of the NYHP classification above). In an effort to promote **conceptual clarity** of aquatic macrohabitat types, we documented quantitative thresholds between individual units, as well as between groups of similar units, via a taxonomic key, then we drafted detailed community characterizations of their component regional macrohabitats. Most of the quantitative and qualitative descriptions used in the river and lake macrohabitat type key and macrohabitat characterization documents were simply extracted from references standardly in use at NYHP such as the NYHP state community classification (Reschke, 1990) and the evolving NYHP community specifications (Hunt, 1999d; NYHP, 2002), but they also incorporated much other information such as descriptions present in the aquatic community classifications and frameworks of various state and regional heritage programs, the Great Lakes Basin, and Vermont's Aquatic Classification Work Group, as mentioned below.

1. Setting Community Thresholds.

General thresholds between aquatic macrohabitat types were used in the construction of a taxonomic key (Key 1). **Quantitative thresholds** were inferred from references, whenever available, or hypothesized based on the expertise and "best professional judgement" of our team members. The STL Aquatic Community Team realized that we probably did not know enough to precisely set the "absolute best" cut off value between community types, but we offered our best guess as a preliminary attempt. We deemed that it was better to propose preliminary quantitative thresholds between aquatic community types than to have no quantitative data at all to guide efforts of those trying to assign a classification unit label to individual aquatic community occurrences. We hoped that by hypothesizing and documenting these preliminary threshold values for review it would 1) provide a good starting point for further discussions on the conceptualization and refinement of aquatic macrohabitat types, and 2) be easier to refine documented values whenever more rigorously obtained data became available, rather than starting from scratch. During our team meetings, we evaluated some of the thresholds initially proposed by David and modified them whenever there was sufficient justification. We recommended a closer examination of these values during the second iteration of the plan and further attempts to determine whether more precise thresholds can or even should be set. Hauer and Lamberti's (1996) Stream Ecology contains some especially useful quantitative distinctions between various river types, as does Lampert and Sommer's (1997) Limnoecology for lake types. MEHP's 1991 classification document also provides an abbreviated key to the generalized aquatic macrohabitat types which was helpful to our efforts and reconciled with our taxonomic key.

Despite Higgins' (2000a) criticism of our team efforts that quantitative thresholds "should be verified" from all lakes of region to do an "adequate" job at classification, it is thought that our classification approach equaled or surpassed the efforts of classification formation for state heritage programs and TNC's terrestrial ecoregional teams of the NE U.S. in terms of "adequacy". Higgins' criticism that setting thresholds for some parameters "is not a good idea" because conditions in lakes may vary over time are also addressed here. Our criteria for taxonomically delineating aquatic communities followed standards long in place for all ecological communities at NYHP; thus, these criticisms are not specific to aquatic communities alone or to our STL team efforts alone. Ecological gradients are expected between all ecological communities in the NYHP classification and have been addressed for most via **"community specifications"** which denote the **typical state AND the range of variation of a community** (NYHP, 2002). While documented EOs typically may not span the full expected range of a community type and the characteristics of one example of an aquatic macrohabitat may vary over time within a given range, the specifications provide **guidelines for thresholds based on ecological intuition and extrapolations from "verified" knowledge that allow variation around a given "average condition"**. Surely, most of the communities of state heritage programs of the NE U.S. published between 1989 and 1992 have not been "adequately" documented by the full range of EOs and undoubtedly they present types that vary to differing degrees around an average state. At least for NYHP as of 1995, many communities in this applied classification had been taxonomically delineated and initially described by Reschke (1990) without a single EO documented (e.g., Tidal

River, Tidal Creek, Inland Non-Calcareous Lake Shore, Marine Eelgrass Meadow, Cobble Shore, Shoreline Outcrop). The process of community classification and threshold development at NYHP, thought to be fairly representative for heritage programs, has been a long, slow iterative process, which leaves room for improvement as more information becomes available. After 20 years of work devoted to the evaluation and refinement of the terrestrial community classification at NYHP, it would probably still not meet Higgins' criteria for "adequacy". Despite this issue, our STL team did our best to propose thresholds and adopt a useable classification, as discussed above.

2. Construction of a Key to Basic Aquatic Macrohabitat Types.

A dichotomous key (Key 1) was useful for explicitly documenting the **"taxonomic boundaries"** between basic river and lake macrohabitat types of the NE U.S., characterizing the range of morphological variation in addition to providing a **condensed "type description"** of each of these classification units. This key includes for each macrohabitat type: 1) quantitative thresholds between types, 2) typical characteristics, 3) dominant, characteristic or indicator biota, 4) a list of potential regional variants in the NE U.S., 5) an official name, and 6) recommended or widely-used synonyms.

To most easily visualize the **"biological breaks"** which form the basis for the biologically-anchored aquatic macrohabitat types in our classification, we tried to copiously add to the key any diagnostic biological features or generalizations which are hypothesized to hold up broadly across ecoregion and watershed lines throughout the NE U.S. Note that in many instances these correspond to coarse-level taxonomic groups (e.g., kingdom or phylum/division) or functional groups. Finer taxonomic groups are more applicable to the designation of specific (i.e., regional) macrohabitats (see Classification Unit #2 below) within each macrohabitat type. We attempted to design a key that is relatively "natural", with the coarsest biological breaks between macrohabitat types suspected to correspond to the earliest couplets and correlated with the coarsest physical breaks. We also attempted to generously quantify characteristics of macrohabitat types that would reflect our intended "seamless" classification.

We used the key as a focal point to allow our group to reach consensus on the names and concepts of both basic macrohabitat types and regional macrohabitats used in the STL aquatic community classification. The attached key (Key 1) represents an update to the "Dichotomous Key to Basic Aquatic Macrohabitat Types of February 8, 2001", which was presented as the initial summary of our team's classification decisions. The update reflects a few additions in 2002 to expand the key to all of New York and strengthen the biological and physical correlations. The key contains all 9 river and 17 lake macrohabitat types listed in Table 2, as well as the 5 additional provisional lake subtypes.

F. STL Riverine Macrohabitat Type Classification.

1. Classification Synthesis.

The macrohabitat types proposed for the STL river classification (with consideration also of NAP types and all of NY State) build upon several documented classifications. Lacking a river analog to Widoff's regional lake classification framework, the riverine community classifications of all 4 U.S. heritage programs in the STL and NAP Ecoregions proved to be the best substitute. Correlations with the Great Lakes Basin classification, which has apparently taken a somewhat different approach, were rather rough. Rosgen's (1994) river classification, representing an international effort, was of some help, but the types are based on river geomorphology and may only be weakly correlated with biological differences.

We assessed the various river community classifications for 1) the presence of each macrohabitat type in STL, 2) our conceptual understanding of each type, 3) the practicality of the number of classification units, and 4) apparent gaps in the classification needed to achieve the desired taxonomic comprehensiveness, at least for the NE U.S. area. We then critically evaluated these physiochemically-labelled types for correlations with biota using a combination of 1) the coarsest biological breaks in a top-down prioritization and 2) similarities in fine-scale biological associations in a bottom-up aggregation. Standard river texts such as Hauer and Lamberti (1996) suggest that the coarsest hydrological differences in rivers correspond to the coarsest biological differences. We thought that the "key" hydrological parameters that reflect these differences are similar to those used in classifications for all 4 state heritage programs in STL and NAP including New York and Vermont (see Attachments 2, 6, 7 and 8), as presented in detail below in our parameter hierarchy.

After evaluation of these various aquatic community classifications, it was deemed that heritage program classifications appear to be the most fully developed riverine macrohabitat type classifications for the region, spanning the broadest range of known types, and are relatively "grounded" with field data and/or actual descriptions of associated biota (i.e., biologically anchored). The 9 proposed river units for the NE U.S. region thus roughly represent 1) a bottom-up integration of classifications from all state heritage programs of STL and NAP from New York through Maine (NYHP, VTHP, NHHP, MEHP), 2) a subsequent reconciliation of all of these units with the classification approaches of the Great Lakes Basin and Vermont's Aquatic Classification Work Group, 3) attempts to reduce biological redundancy in types, and 4) supplementation with missing types that apparently have unique biological associations.

2. Classification Framework: Parameter Hierarchy.

Our team's discussions of river macrohabitat types addressed **correlations between various abiotic parameters and the geographic patterns of biotic composition and structure** in rivers of the region. These discussions led to a decision as to which abiotic parameters we thought were most important in (i.e., most correlated with) a biologically-anchored classification, as reflected by the hierarchy presented in the natural taxonomic key to river types (Key 1). The hierarchy of abiotic parameters we suggested for river macrohabitat types of STL, NAP and the general NE U.S. region, in order of importance, is: 1) salinity, 2) light regime, 3) water permanence, 4) stream order/position/size/discharge, 5) substrate texture/slope/confinement/sinuousity/turbulence, 6) river depth/stratification regime, and 7) alkalinity. Many of the parameters are partially correlated, and thus substantial biological differences are not expected between all combinations of variation in parameters, and not all combinations of variation in the 7 sets of parameters are known from the region or even suspected over larger geographic areas. Parameters 1 and 2 (salinity and light regime) reflect relatively uncommon river types in the region. The taxonomic delineation of common river types (Parameters 3-6) is relatively straight forward and reflects size differences along a river continuum. River macrohabitat types generally have little variation in the third dimension (depth), however very deep types known from the region are segregated by Parameter 6. Parameter 7 (alkalinity) was provisionally used only for very small stream types, as alkalinity variation in large river types was thought to be captured sufficiently by regional macrohabitats.

3. Summary of River Macrohabitat Type Choices.

After prioritization of parameters in the design of our river macrohabitat type classification, we sought to create a practical, comprehensive, and seamless classification. While a continuum of river types exists and each river could theoretically represent its own type, we evaluated the influence of each parameter on biota separately, on a case by case basis, and sought a **simplified division** of types, often resulting in only two categories per parameter, correlated with extremes in a continual gradient of biological composition and structure (see Figures 1 and 3). For the first iteration of the STL aquatic community classification, we reduced riverine macrohabitat type variation to only 9 types, all of which are represented in STL (see Table 2). The applied taxonomic discrimination of these types is detailed in Key 1 and graphically depicted in Figure 1.

Specialized River Types.

Both Spring and Deepwater River, proposed as river communities for the 2002 NYHP classification revision, were addressed during our STL team efforts and recognized as distinct macrohabitat types. Spring is designated as a small scale river community that has unique biota and is biologically uniform over a variety of aquatic landscape settings. Although small, we decided it was large enough to call a macrohabitat type. Subterranean Stream, another uncommon river type, is often overlooked in river classifications but is included here. We discussed the possible recognition of "lake outlet" (a specialized habitat of VT ACWG, 1998) as a separate macrohabitat type, but considered it to be an ecotonal feature with intermediate qualities of riverine and lacustrine macrohabitats that is best interpreted as a biologically unique variant of a microhabitat type (run) within Marsh Headwater Streams.

Lastly, several estuarine river macrohabitat types are suspected to be characteristic of the Quebec portion of STL. Although salinity is included in the parameter hierarchy for rivers, we did not develop the estuarine portion of our taxonomic key, these communities lacking from the New York-Vermont portion of STL. Estuarine river types suspected from STL were included in a list of targeted macrohabitats for the STL aquatic community portfolio (Table 3) as an afterthought. Descriptions of these types were not developed, pending 2nd iteration efforts and the involvement of Quebec ecology staff. Six estuarine river macrohabitat types were suggested from Quebec based on our classification hierarchy, stratified across a salinity and stream size gradient and corresponding to community entities tracked by NYHP. Thus we hypothesized marine, brackish and freshwater types for each of two stream size types: 1) "Tidal Creeks", small creeks of about 1st to 3rd order, and 2) "Tidal Rivers", large deep rivers. The latter category includes the lower St. Lawrence River, which may be of stream order 7 or more, and the associated mouths of large tributaries, expected to be of stream order 4 or more.

4. Residual Variation.

Much discussion from our STL Aquatic Community Team was held about where to cut off our macrohabitat type classification efforts for rivers and address the remaining or **residual variation** inherent within types via other mechanisms applicable to conservation: namely designation of regional macrohabitats or stratification of types in the STL portfolio selection scheme. The two largest known or suspected remaining variation in physiochemical features at the macrohabitat type scale that could be correlated with differences in biota but not rationalized simply by ecoregional variation were: 1) a slightly finer division of stream size classes, especially large streams, and 2) an overarching taxonomic split based on substrate type differences. Summaries of our team discussions on these two factors are presented below.

Stream Size. In our macrohabitat type classification, large river types were defined as spanning a rather broad range of stream size classes, typically ranging from 3rd to 6th order. We recognized two biologically-anchored macrohabitat types within this size range, differing in confinement and correlated sinuousity, microhabitat composition, flow rate, dissolved oxygen, and substrate texture: Confined River and Unconfined River. We discussed the taxonomic weight to place on **confinement versus stream order**. In NYHP's 1990 classification, the two largest riverine communities (Midreach Stream and Main Channel Stream) were described based on confinement characteristics, however their names suggest stream order as the defining feature over confinement: Midreach Stream usually referring to 3rd to 4th order streams, Main Channel Stream usually referring to 5th to 6th order streams. This dual system of two parameters that are seemingly only weakly correlated has resulted in much confusion over the concepts for these two river types throughout NYHP's history. When all combinations of the two factors are considered, four categories are possible: confined midreach stream, unconfined midreach stream, confined main channel stream, and unconfined main channel stream.

For the STL classification, we thought that biological differences were most pronounced among plants, fish and macroinvertebrates across a confinement gradient rather than a stream order gradient, thus we arrived at a Confined River/Unconfined River taxonomic split. However, Steve Fiske suggested that generally macroinvertebrate diversity in large rivers of an ecoregion may be split along an additional gradient of stream size/order, perhaps paralleling NYHP's original labels of "Midreach Stream" and "Main Channel Stream" and the Great Lakes Basin (2000) labels of "Midreaches" and "Mainstems". Biotic differences between such Midreach Stream and Main Channel Stream macrohabitat types were thought, at least in STL and NAP, to be possible for macroinvertebrates, but questionable or unknown for plants and fish. Because of the potential inconsistency between the three groups of species and the uncertainty of this pattern from ecoregion to ecoregion, we opted for a conservative classification and deferred further evaluation of a more refined STL river classification until the 2nd iteration.

Substrate Type. We also discussed further evaluation of potential finer scale taxonomic splits in large river types corresponding to reaches with different substrate types or crossing different surficial geology types, such as had been done in the Great Lakes Basin classification (Higgins et al., 1998; Great Lakes Basin, 2000). We suspected that 1) major differences in substrate type are already indirectly reflected in the river classification hierarchy via streams of different confinement, and 2) many of the changes in surficial and especially bedrock geology indicated on state geology maps may result in only fine-scale differences in species assemblages. We also suspected that fine scale substrate differences may often be highly variable even over short stream reaches, based partially on David's long reconnaissance transects along several streams in widely scattered sites throughout New York, suggesting the presence of much smaller occurrences if classifications were more finely split. If applied consistently across all macrohabitat types, further taxonomic separation based on substrate differences could potentially substantially expand the number of macrohabitat type units to a much less practical level. Because of all these reasons, we opted not to bring fine scale substrate differences explicitly into the classification. A more detailed discussion of the use of substrate characters as portfolio stratification factors and their relationship to surficial and bedrock geology is presented in Appendix 1 of the STL Aquatic Community Portfolio Development document (Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002b).

Many of the 9 basic river macrohabitat types differ in their average substrate composition, especially at the scale of coarse-textured vs. fine-textured substrates (e.g., Rocky Headwater Stream vs. Marsh Headwater Stream; Confined River vs. Unconfined River); however, fine-scale variability in calcareous vs. acidic substrates and coarse-textured vs. fine-textured substrate has been observed within each of these types over multiple river transects during field surveys. In addition to this spatial heterogeneity, coarse and fine-textured substrates may also be temporally variable at a local scale year to year and season to season, in response to flooding events, siltation, and the dynamic nature of riffles, runs and pools. Separate classification units based on fine scale differences in substrate seem warranted only if a predominantly different substrate type is uniformly present over long distances, and we seemingly treated this more on a case-by-case basis for regional macrohabitats within each ecoregion. Thus, taxonomic splits for river macrohabitats based on substrate differences were often a secondary consequence of designating ecoregional variants. For example, most NAP vs. STL variants of river macrohabitat types differ in acidic vs. calcareous bedrock, roughly correlated with a change in dominant bedrock types across the ecoregional boundary.

Rosgen River Types.

River types classified by Rosgen (1994) were created for purposes other than biological classification, such as stream restoration, and based primarily on factors such as sediment transport and river geomorphology. Seven basic river types were defined by combinations of gradient, entrenchment, width/depth ratio, and sinuousity, with about 6 subtypes designated for each of the 7 basic types based on bedrock or substrate type, totalling about 40 river types. The 7 basic river types of Rosgen resemble our STL classification in number of units and the use of gradient and sinuousity as classification parameters, although other features were not explicitly included as part of our STL classification (e.g., width/depth ratio). Subtypes suggest classification units finer in scale than our macrohabitat types and may be more applicable, in part, to distinctions between regional macrohabitats, as discussed above under Residual Variation for Substrate Type.

While biological differences are known between some of Rosgen's basic river types, Mark Bryer and David recommended using this classification only to further attribute our biologically-anchored macrohabitat types (Hunt, 2000d; Bryer, 2000). The finer scale physical differences of Rosgen's classification may be reflected by only subtle associated biological differences. We made recommendations for the 2nd iteration of the STL plan to more closely review Rosgen types to 1) examine correlations with our classification, 2) refine the geomorphological terminology in our macrohabitat type descriptions, and 3) provide guidance for stratification in site selection where there are more than one Rosgen type per regional macrohabitat. We thought that Mike Kline of VT DEC might be useful in helping with this effort.

G. STL Lacustrine Macrohabitat Type Classification.

1. Classification Synthesis

Like riverine macrohabitat types, the lake macrohabitat types proposed for the STL aquatic community classification (with consideration also of NAP types and all of New York State) build upon several documented classifications. Widoff's (1986) "theoretical" classification of 125 physically-defined and presumably biologically-correlated lake macrohabitat types for the New England region was a prime influence in our lake classification. We compared this regional classification with the classifications of the 4 state heritage programs of the region. Our resulting classification closely resembles that presented by Moyle and Ellison (1991) in their classification of California lakes. Correlations with the Great Lakes Basin classification, which has apparently taken a somewhat different approach, are rougher.

Like river macrohabitat types, we assessed these various aquatic community classifications for 1) the presence of macrohabitat types in STL, 2) our conceptual understanding of macrohabitat types, 3) the practicality of the number of classification units, and 4) apparent gaps in the classification needed to achieve the desired taxonomic comprehensiveness, at least for the NE U.S. area. We then critically evaluated these physiochemically-labelled types for correlations with biota using a combination of the coarsest biological breaks in a top-down prioritization with similarities in fine-scale biological associations in a bottom-up aggregation. Widoff (1986) and other lake ecology references suggest that the coarsest hydrological differences in lakes correspond to the coarsest biological differences. We thought that the "key" hydrological parameters that reflect these differences are similar to those used in classifications for all 4 state heritage programs in STL and NAP including New York and Vermont (see Attachments 2, 6, 7 and 8), as presented below in our parameter hierarchy.

After evaluation of these various aquatic community classifications, it was deemed that state heritage program classifications appear to be the most fully developed lake macrohabitat type classifications, spanning the broadest range of known types, and are relatively "grounded" with field data and/or actual descriptions of associated biota (i.e., "biologically anchored"). The 17 proposed lake units for the NE U.S. region thus roughly represent 1) a bottom-up integration of classifications from all state heritage programs of STL and NAP from New York through Maine (NYHP, VTHP, NHHP, MEHP) into the broader perspective of Widoff's regional classification framework, 2) a subsequent reconciliation of all of these units with the approach of the Great Lakes Basin classification, 3) attempts to reduce biological redundancy in types, and 4) supplementation with missing types that apparently have unique biological associations.

2. Classification Framework: Parameter Hierarchy.

Our team's discussions of lake macrohabitat types followed the same approach as river macrohabitat types. We addressed correlations between various abiotic parameters and the geographic patterns of biotic composition and structure in lakes of the region. These discussions led to a decision as to which abiotic parameters we thought were most important in (i.e., most correlated with) a biologically-anchored classification, as reflected by the hierarchy presented in the natural taxonomic key to lake types (Key 1). The hierarchy of abiotic parameters we suggested for lake macrohabitat types of STL, NAP and the general NE U.S. region is similar to the river macrohabitat type hierarchy. In order of importance these parameters are: 1) salinity, 2) light regime, 3) water permanence, 4) meromixis, 5) lake genesis and connectivity, 6) alkalinity, 7) lake depth/stratification regime, 8) trophic state, and 9) surface area. Our hierarchy closely resembles that presented by Moyle and Ellison (1991) in their classification of California lakes. Their first division is based on water permanence (which was third in our hierarchy after salinity and light regime) and like our classification they have units for ephemeral waters, saline lakes, dystrophic lakes, oxbow lakes, alpine ponds, and alkaline lakes.

The derivation of our lake parameter hierarchy was challenging and involved much team discussions and some apparent disagreement from Jonathan Higgins of TNC's Great Lakes Office. Many of the parameters are partially correlated, and thus substantial biological differences are not expected between all combinations of variation in parameters, and not all combinations of variation in the 9 sets of parameters are known from the region or even suspected over larger geographic areas. For example, Winter-Stratified Monomictic Lake and Summer-Stratified Monomictic Lake (very large lakes) are apparently restricted in New York to a low drainage network position in areas of calcareous bedrock and alkaline waters, thus no acidic counterparts of these lake types are suspected. Parameter 2 (light regime) and Parameter 4 (meromixis) reflect relatively uncommon lake types in the region. The taxonomic delineation of common lake types (Parameters 5-8) reflects differences along a continuum of lake depth, thermal patterns and water chemistry. Our decision to prioritize alkalinity over trophic state was rather involved and complex, and the details of our rationalization are presented below. Similarly, a discussion of the relative importance of lake depth and stratification regime versus surface area, especially in response to Higgins' (2000a) comment to our group that "to classify lakes using water chemistry and thermal patterns is often not necessary", is presented below. While the relative importance and even inclusion of lake depth and stratification regime parameters in our lake classification hierarchy may be debatable, as suggested by Higgins' (2000a, 2000b) lengthy critique of our choice of classification parameters in which he included concerns about 1) the application of the classification to lakes without field sampling, 2) the potential temporal variability of parameters in one lake, and 3) the potential changes in biota over time in response to disturbances in these parameters, we thought that the classification hierarchy we presented best reflects the greatest natural biological variation in lake types 1) through the use of parameters that most strongly influence resident biota, as discussed above under our general criteria for macrohabitat type units, and 2) through the creation of flexibly-defined physical units that, following standard heritage methodology interpretations which allow flexibility in community types, can have some biophysical variation within a given range due to disturbance and seasonal factors.

Taxonomic Importance of Alkalinity Versus Trophy.

We debated the relative importance of trophy (trophic state) versus alkalinity in influencing the biota of lakes so that we could position these factors in our classification hierarchy. David's initial analyses of lake data from the STL and NAP Ecoregions suggested that trophy and pH are both correlated roughly, but probably significantly, in this region with alkalinity and color. Thus, it seemed that trophy and pH should be used as a prime factors to segregate at least some lake types such as dystrophic lakes, which are not explicitly addressed in Widoff's (1986) lake classification. The STL Aquatic Community Team agreed that trophic state is roughly (but not 100%) correlated with alkalinity. Other parameters thought to be strongly correlated with trophy and alkalinity include color, productivity, nutrient levels, light penetration, buffering capacity, and pH. The lake classifications of NYHP and MEHP generally emphasize trophy over alkalinity, however alkalinity is used as a supplemental classification variable to distinguish extreme lake types such as Marl Pond (extremely alkaline) and Bog Lake (extremely acidic) in both classifications. NHHP lake names emphasize alkalinity and pH over trophy, apparently borrowing from the coarser hierarchical levels in Widoff, and VTHP seems to use a combination of both parameters, with names reflecting alkalinity but descriptions suggesting strong correlations between alkalinity and trophy.

Upon closer examination of alkalinity and trophy, there appears to be some variability in their relationship. Generally, oligotrophic lakes are less alkaline than eutrophic lakes. However, both alkaline and acidic oligotrophic lakes are known from NY NAP, and both oligotrophic and eutrophic alkaline lakes are known from NY STL. While David suspected from review of available data that the biota of an alkaline oligotrophic lake more closely resembles that of an acidic oligotrophic lake than an alkaline eutrophic lake, thus suggesting the greater importance of trophic state over alkalinity as a driving variable in the classification scheme, Susan Warren suggested otherwise for vascular plants of the region. Trophy is thought to be fairly uniform within single small to medium-sized lakes, but is known to vary widely in different parts of large to very large lakes of the region such as Lake Champlain and Lake George. Where such variation is known, biotic assemblage and association distributions are known to correlate with trophy. Because biotic assemblage and association distributions and related species diversity and density are also known to correlate with alkalinity, and that parameter was thought by Susan Warren to be more uniform throughout large lakes and a more limiting factor for the presence of biota, its priority over trophy and pH was suggested. Our team consensus was to adopt Susan's suggestion and prioritize alkalinity over trophy in the classification scheme, but allow for the possibility to apply variable combinations of the two factors whenever the biota suggests distinctly different lake types. David thought that a switch to alkalinity prioritization over trophy in the NYHP lake classification could improve that classification and reduce some of the past confusion of experts associated with applying the 1990 concepts based primarily on trophy and named accordingly.

Taxonomic Importance of Depth/Stratification Versus Surface Area.

Higgins (2000a) commented that "to classify lakes using water chemistry and thermal patterns is often not necessary" and suggested that we had overlooked lake size in our STL classification. Several macrohabitat types or groups of macrohabitat types in our classification were defined by a split based on lake depth and thermal features because the STL group consensus was that depth and thermal patterns have a much stronger influence on biota than size alone (Hunt, 2000b). Lakes with a hypolimnion and profundal zone support unique entire suites of biota lacking in shallower lakes. We thought that "lake size" alone, interpreted as "surface area", does not guarantee the presence of these deepwater features or unique biota, as some very large lakes are known to lack these zones and some very small lakes are known to have them.

We considered lake size to be mostly factored indirectly into our lake classification through its correlation with other parameters such as lake depth, however we did account for surface area as a direct factor lower in the classification hierarchy than depth/stratification regime to explain differences in biota unaccounted for by other parameters on a case by case basis for: 1) shallow, unstratified lakes and 2) deep, stratified lakes. For shallow, unstratified lakes, large examples are classified as Winter-Stratified Monomictic Lake while small examples are classified as various standard pond types. Similarly, for deep, stratified lakes large examples are classified as Summer-Stratified Monomictic Lake, moderate-sized examples are typically classified as standard dimictic lake types, and small examples may sometimes be classified as Meromictic Lake.

Thus, lake size seems of secondary importance to depth and stratification regime, resulting in perhaps only a few additional associations and only two additional lake types not resolved by other parameters (Winter-Stratified Monomictic Lake and Summer-Stratified Monomictic Lake). Higgins's strong emphasis on lake size in lake classifications also seems to be an extreme deviation from the classification approaches of Widoff and state heritage programs of the region.

3. Summary of Lake Macrohabitat Types Choices.

Like for the river macrohabitat type classification, after the prioritization of parameters in the design of our lake macrohabitat type classification, we sought to create a practical, comprehensive, and seamless classification. Widoff (1986) points out that like other types of communities, a continuum of lake types exists and each lake could theoretically represent its own lake type (i.e., in the "most finely split" classification). We evaluated the influence of each parameter on biota separately, on a case by case basis, and sought a **simplified division** of types, often resulting in only two categories per parameters, representing extremes in a continual gradient of biological composition and structure (see Figure 2). For the first iteration of the STL aquatic community classification, we reduced lacustrine macrohabitat type variation to only 17 types, 13 of which are represented in STL (see Table 2). The applied taxonomic discrimination of these types is detailed in Key 1 and graphically depicted in Figure 2. The logic in arriving at these specific units is detailed below, summarizing our team decisions.

Building Upon Widoff's Classification.

In fully developing the STL lake macrohabitat classification, Widoff's (1986) lake classification was taken three steps further: 1) the number of basic lake macrohabitat types (125) was reduced substantially based on a) correlations between the major hydrological parameters and b) knowledge of actual examples in the region rather than using all theoretical combinations, 2) supplemental lake macrohabitat types apparently outside the physiochemical spectrum of those included in her classification were added, and lastly 3) basic macrohabitat types were split into regional macrohabitats (see Classification Unit #2 below for more detail) where there are sufficient known regional differences in the biota.

Ecologically Holistic Units: When Widoff's (1986) classification is applied to New York, NAP, and STL, our analyses suggested that there are only 17 basic lake types (see Table 2 and Key 1) that have substantial differences in biological composition from other types. Lake types with all combinations of hydrological parameters presented in Widoff may not occur in the NE U.S. region and many with slightly different combinations of hydrological characteristics used as classification factors may have only subtle biological differences. We did not wish to elevate the latter lake types to the level of a separate classification unit, but rather we considered covering conservation of this variation via the site stratification process during the STL portfolio assembly.

Specialized Lake Types:

Three other lake types (which might be termed "specialized types") apparently not addressed in Widoff's (1986) classification were added to our STL aquatic macrohabitat type classification. Intermittent lakes such as Vernal Pool are the lacustrine equivalent of Intermittent Stream and have been recognized as aquatic features in the lake classification schemes of Northeastern U.S. heritage programs, Vermont's Aquatic Classification Work Group (1998), and Moyle and Ellison (1991), the latter for California. Subterranean Lake is the lacustrine equivalent of Subterranean Stream and is also recognized as an aquatic feature by Northeastern U.S. heritage programs and Vermont's Aquatic Classification Work Group (1998). The last of three additional lake macrohabitat types which may not have had a placeholder in Widoff's classification is a very deep lake with no winter stratification, namely Summer-Stratified Monomictic Lake, represented in STL by Lake Champlain and Lake Ontario (the latter peripheral to western STL).

We suspect several estuarine lacustrine macrohabitat types to be present in the Quebec portion of STL, but lacking from New York and Vermont STL. No information is yet available from leads and we did not focus any of our research efforts on Quebec, yet the landscape setting in Quebec is correct for these communities. We highly suspect lake types similar to those in NYHP's 1990 estuarine community classification and the draft 2002 revision to that classification. Estuarine lakes types of NYHP suspected from Quebec include 1) "Coastal Salt Pond" and 2) three types of "Tidal Bays": Marine Tidal Bay, Brackish Tidal Bay, and Freshwater Tidal Bay. Coastal Salt Pond is a regional variant of the Salt Pond macrohabitat type, perhaps equivalent to examples in the North Atlantic Coast (NAC) Ecoregion of New York well documented by NYHP. Tidal Bays are treated as a non-flowing, pool-dominated variant of Tidal River in NYHP's 2002 draft update to the classification. None of these lake types are listed as known from STL or described in the STL lake classification characterization, pending more definitive evidence of their existence in the ecoregion, although Salt Pond is addressed in the taxonomic key for the region.

Classification Divisions for Alkalinity and Trophy.

We sought to critically evaluate any taxonomic splits in lakes based on alkalinity or trophy by seeking correlations in biota differences (i.e., ecological associations) for both ponds and lakes. Two- to few-parted taxonomic splits are used for both alkalinity and trophy in various lake classifications. Continual gradients were suspected from acidic to alkaline lakes in NAP and from eutrophic to oligotrophic lakes in STL.

Alkalinity: While at least one lake classification (e.g., Widoff, 1986) has used up to 4 alkalinity categories, we decided as a general rule that a 2-parted split between acidic and alkaline lakes was most appropriate and simplest to apply. Biota in the region appear to be generally arrayed into characteristic acid-intolerant associations (dominating alkaline lakes) and acid-tolerant associations (dominating acidic lakes) (see Classification Unit #5 below).

Trophy: We explored the use of a 2- or 3-parted split for trophy. A 2-parted split between oligotrophic and eutrophic lakes is used frequently in standard limnology texts. The best presentation and description of this split may be in Lampert and Sommer (1997) (see Attachment 8). A 3-parted split of trophy into oligo-, meso-, and eutrophic lakes is also commonly applied to classifications (e.g., those of NYHP and MEHP). For trophic state, biota are apparently generally arrayed into characteristic oligotrophic associations (dominating oligotrophic lakes) and eutrophic associations (dominating eutrophic lakes) (see Classification Unit #5 below), with mesotrophic lakes supporting a mixed mosaic of the two association types. Documented lake community EOs and leads at NYHP suggest that plant assemblages are similar between mesotrophic and eutrophic variants. We proposed that the gradient and taxonomic split for lake macrohabitat types is analogous to the somewhat arbitrary conifer-mixed-deciduous split in the classification of matrix forest types. We thus opted for a 2-parted split in trophy, but recognized that whether we used a 2- or 3- unit classification, it was perhaps to some degree arbitrary.

4. Residual Variation.

Hunt (2000b) Our STL Aquatic Community Team decided that there was little or no residual variation in biota, other than regional variation addressed below under regional macrohabitats (Classification Unit #2), unaccounted for by our macrohabitat type classification. Although Jonathan Higgins (2000b) suggested during his review of our lake macrohabitat type classification that 1) we had overlooked drainage network position in our STL classification, 2) evaluating lake types without the drainage network position landscape context is "a big mistake", and 3) drainage network position is "critical" to a "robust lake classification" that addresses fish and snail assemblages, our team thought that this parameter was addressed indirectly via several aspects of our classification scheme and that in a holistic approach towards lake macrohabitat type classification that goes beyond the bias towards fishes and mollusks, drainage network position is not a strong factor in determining resident and potential biota. A summary of our team discussions on this factor is presented below.

Drainage Network Position.

The STL Aquatic Community Team considered drainage network position to be factored indirectly into our STL lake macrohabitat type classification via its correlation with several other parameters in our classification hierarchy. It shows a rough inverse correlation with lake depth and surface area, and it is apparently also indirectly correlated in the STL region with alkalinity and trophy (Hunt, 2000b).

We interpreted our lake genesis/connectivity parameter, which distinguishes lake types with typical lacustrine biota from those with typical riverine biota, to capture most drainage network position issues that result directly in substantial differences in resident biota other than those attributable to regional variation and captured by regional macrohabitats in our classification. The separation of ponds into isolated ponds and "fluvial lakes" for our STL macrohabitat type classification relates to drainage network position and although an apparent departure from the aquatic community classifications of NYHP, VTHP and NHHP, this separation was seen by David as an improvement to NYHP's fairly broad treatment of Oligotrophic Pond and Eutrophic Pond. MEHP's classification recognizes a "Deadwater Community", which we crosswalked to a fluvial lake type. The STL Aquatic Community Team agreed that we needed a category for fluvial lake types, that the biota of such lakes may resemble more those of riverine communities, and we even debated whether or not to call such lake types a microhabitat (i.e., a "large pool") of a river macrohabitat rather than a lake. We recognized that such connectivity issues alone (e.g., the connection of lakes to rivers) are not the overriding factors in determining biota: very large lakes in similar drainage network positions to fluvial lakes are known instead to have characteristic lacustrine biota because they have thermal patterns typical for lakes and lack the strong influence of flow found in fluvial lakes.

After fluvial types are separated from other lake types in the classification, and only lakes with characteristic lacustrine biota are examined, biota of lakes in the same drainage network position are known to vary substantially, attributable to differences in other parameters such as lake depth, alkalinity and trophy. Similarly, biota of lakes in different drainage network position but of similar water chemistry and thermal patterns are known to be fairly uniform. If elevation is interpreted as a component of drainage network position, much of STL has a uniform elevation (relatively low), but it still contains a mix of lake types with very small to very large surface area and very shallow to very deep depths that vary substantially in biota.

In analyzing regional differences in biota, species diversity appears to be greatest for alkaline aquatic communities, as it is for terrestrial communities, and although alkalinity is correlated with lower drainage network position in STL, the increased species diversity in this area is suspected to be mostly attributable to alkalinity, not to drainage network position, at least for resident macrophytes and macroinvertebrates. Fish and mollusks may be responding to different environmental features and thus, lower drainage network position may be more responsible for increased diversity in these species within STL as suggested by Higgins (2000b). We interpreted any residual variation in resident biota within our lake macrohabitat type classification due to other drainage network position factors such as elevation to be sufficiently captured at our regional macrohabitat scale for STL, distinguishing ecoregional variants of various lake macrohabitat types characteristic of STL versus NAP (e.g., NAP versus STL Alkaline Dimictic Lakes, the former being higher in the drainage network with lower species diversity, the latter lower in the drainage network with higher species diversity). We thought that the focus on regional macrohabitats in our STL classification addressed some of the criticisms of Higgins (2000b).

Drainage network position has not been an explicit factor in most state heritage program classifications of the region and we apparently did not treat it as such here, although it shows many variable correlations with other classification factors, as discussed above. A more detailed discussion of the use of drainage network position as a portfolio stratification factor and its relationship to elevation and aquatic connectivity is presented in Appendix 1 of the STL Aquatic Community Portfolio Development document (Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002b).

II. Classification Unit 2 (Abiotic): REGIONAL MACROHABITATS

A. Introduction.

The second hierarchical level in our abiotic aquatic community classification is the "**macrohabitat**" or "**regional macrohabitat**" or "**specific macrohabitat**", representing the application of repeating patterns of regional biophysical variation to basic macrohabitat types (Classification Unit #1). The regional aspect of this classification unit incorporates **"ecoregional units"** of the National Aquatic Classification (see Attachment 1 and Higgins et al., 1998). Instead of treating ecoregion units as the highest two levels of the abiotic portion of our STL classification, as suggested for the Great Lakes Basin (Higgins et al., 1998), we used them as the basis for constructing regional macrohabitats (the 4th hierarchical level of the National Aquatic Classification). We evaluated the use of two large-scale regional units to apply to macrohabitat types: 1) **TNC-designated ecoregions** and 2) major watersheds (i.e., **ecological drainage units** or "**EDUs**").

As a general rule, we decided upon ecoregion as the regional unit to be applied to macrohabitat types, hypothesizing the overall variation in aquatic biota of STL and NAP to be generally greater between ecoregions than between major watersheds. We made our decision based upon preference given to 1) **biotic data over abiotic data**, and 2) **expected potential species patterns over observed species patterns**. Our preference for ecoregion over major watershed might differ from that being used in macrohabitat classifications for other TNC ecoregions, however, we rationalized our choice with two justifications: 1) we attempted a holistic approach to classification (e.g., **not biased towards or restricted to migratory species**, which have geographic distributions that may correspond better with watershed boundaries), and 2) we attempted to **capture any variation attributable to watersheds** (the prime rational for using watershed units) **in the conservation portfolio via target stratification** rather than via the classification scheme. Assumptions and hypotheses which formed the basis for our general choice of ecoregion as the primary regional unit from which to construct regional macrohabitats are presented below.

Like macrohabitat types, we attempted to derive an aquatic macrohabitat classification for STL by building upon the foundation of existing macrohabitat classifications for the region. The historical status of such aquatic community classifications used during our efforts is also presented below. Our classification was based largely on the extrapolation of regional variants from macrohabitat types by analyzing individual species distributions and borrowing heavily from the limited regional physiochemical information associated with species assemblage descriptions for the STL region, most of which come from Vermont's Aquatic Classification Work Group (1998) efforts.

B. Hypotheses Supporting Use of Ecoregion as the Primary Regional Unit.

Four major assumptions and hypotheses are presented below which support our general choice of TNC-designated ecoregion as the primary regional unit in the STL classification (from which to formulate regional macrohabitats) over other regional units such as ecological drainage units and Omernik's aquatic ecoregions. Aquatic ecological alliances and associated macrohabitats of relatively consistent biotic composition and structure are expected to vary from ecoregion to ecoregion (as hypothesized in the National Vegetation Classification) and are hypothesized to be best identified and substantiated by discerning patterns in biota distribution.

1. Aquatic Succession, Potential Biota, and Historic Biota.

Hypothesis #1. Disclimax States of Aquatic Communities: Aquatic communities have long-term seral states paralleling those of terrestrial communities (e.g., various successional states prior to the formation of a climax forest type). After cessation of unnatural disturbances, aquatic communities can be thought of as eventually returning to their **"historic disclimax state"** where they attain a biological structure and species composition characteristic of and tolerant to the underlying natural hydrologic and substrate setting specific to that community (i.e., the conditions of the communities are within the environmental tolerance limits of its component species). Their **"potential disclimax state"** can be thought of as the **biological composition and structure possible IF all species of the region were able to freely disperse throughout the community**. Because of natural and unnatural barriers to the migration of some groups of obligate aquatic taxa that can travel only via water (e.g., fishes and mollusks), it may take longer for many aquatic communities to reach this state than their terrestrial counterparts. Plants and other macroinvertebrates (especially air-dispersed organisms) are thought to be able to achieve this state in shorter timespans and are thus better **indicators of "potential biota"**. Because of the isolated nature of many lakes, it probably takes much longer for aquatic obligate species to attain their potential state in lakes relative to rivers. For example, a river macrohabitat occurrence with a centrally located waterfall may have a characteristic fish and mollusk assemblage present only below the waterfall but characteristic plant and macroinvertebrate assemblages throughout (see Figure 4). It is hypothesized that the characteristic fish and mollusk assemblages would freely spread throughout the remainder of the occurrence above the waterfall (because of tolerance to the community conditions) if they could bypass the waterfall (e.g., via an artificial canal or a fish ladder, as exemplified by the Welland Canal in the Great Lakes system).

Hypothesis #2. Correlation of Migration Barriers with Macrohabitats: Barriers to the migration of fishes and mollusks which may have restricted their dispersal and thus limited their distribution relative to their full **"potential distribution"** are occasionally, but not always, associated with the upper limits of a specific macrohabitat. For example, the upstream boundary of an Unconfined River may correspond to a tall waterfall that represents the downstream boundary of a Confined River and is associated with a physiographic escarpment.

2. Geological Influences, Underlying Bedrock, and Regional Patterns.

Hypothesis #3. ELU Correlation with Ecoregions: Because underlying physical features are generally more consistent within an ecoregion than between ecoregions (e.g., see the Ecological Land Unit map for the New York-Vermont STL/NAP region produced by TNC ECS, 2002a), it is expected that the potential disclimax state of any given macrohabitat type and its associated microhabitat type composition will be much more comparable between sites throughout an ecoregion (thus normally cutting across major watershed lines) than throughout a major watershed (which often cuts across ecoregion lines). A recent conversation with NY Freshwater Institute staff supports this hypothesis, at least for aquatic macrophytes in lakes of northern New York, with macrophyte distribution and water chemistry both strongly correlated with underlying bedrock as well as with each other throughout NY NAP, regardless of which of the 4 EDUs of the Adirondacks portion of NAP these lakes are situated. Halliwell et al. (1999) suggests that fauna, like flora, are expected to be more similar among Omernik's ecoregions (which resemble STL and NAP within New York and Vermont) than between ecoregions, even for fish (which are the most mobile aquatic organisms and have the ability to most quickly travel across ecoregion boundaries).

Hypothesis #4. Bedrock Influence on Water Chemistry and Biota: Bedrock type is suspected to influence biota most strongly in waters that are most shallow. Thus, for riverine communities, this implies waters that are closest to the stream source. The water chemistry and biota in larger streams are expected to be less influenced by local underlying bedrock and more by the cumulative influence of bedrock in the watershed upstream. Thus, Intermittent Streams may be strongly influenced by bedrock type and consequently display different ecological alliances and thus macrohabitats in calcareous vs. acidic settings (e.g., waters over local areas of acidic bedrock in the otherwise calcareous STL Ecoregion) whereas this may not be true of the much larger Unconfined Rivers (e.g., which may have local areas flowing over acidic bedrock in the otherwise calcareous STL Ecoregion), and such rivers may need to flow over several miles of a different bedrock type to change to a different ecological alliance, and thus macrohabitat, with noticeable differences in biota and water chemistry. The same pattern is expected in lakes, with bedrock most influential in smaller, shallower lakes.

C. Justification for Choice of Ecoregional Units Applied to STL Aquatic Community Classification.

1. Potential Biota

The STL Aquatic Community Team agreed to base our choice of a **regional classification unit** (**ecoregions vs. watersheds**) to apply to macrohabitat types on **potential species patterns** (as inferred in part from the **combination of observed species patterns and underlying physical features**), rather than on observed patterns alone. Thus, our approach follows the suggestions of Halliwell et al. (1999) for "fish communities". Some migratory species, especially fish, may be naturally lacking from areas that they could potentially occupy due to migration barriers. Other species, especially fish, may have become unnaturally extirpated from such areas due to overharvest or displacement by invasive non-native species. Physical barriers exist within STL that are known to restrict the upstream movement of fishes and mollusks, especially in riverine communities and especially 1) at the Principal Fall Line of about 150-foot elevation and 2) at the STL/NAP Ecoregion interface, both often in the form of impassable waterfalls.

2. Regional Patterns: Ecoregions vs. Major Watersheds.

Each of the 3 Ecological Drainage Units (EDUs) in the New York-Vermont portion of STL (Lake Champlain EDU, St. Lawrence EDU, Northeast Lake Ontario EDU) span portions of both NAP and STL (e.g., see Attachment 12 from TNC-Great Lakes Regional Office, 2000a). An alternatively 4-parted EDU classification has apparently been used by TNC ECS (2002b), chopping the Northwest Adirondack EDU out of the St. Lawrence EDU. Under the latter scheme, the Northwest Adirondack EDU spans portions of both STL and NAP, while the St. Lawrence EDU is unique in being the only EDU entirely within STL.

Bedrock type is strongly correlated with ecoregion position. Thus, many aquatic systems in NAP are known or expected to be acidic, whereas many aquatic systems in STL are known or expected to be basic (see the ELU map for STL/NAP; TNC ECS, 2002a). Aquatic ecosystems and communities within a single EDU that span the NAP-STL ecoregion boundary (generally larger river types) are expected to change physiochemical characteristics roughly across this boundary. Analyses of fish species assemblages in Vermont support this taxonomic split for macrohabitats across the STL/NAP ecoregion boundary. This boundary is reportedly correlated well with both the division between warmwater and coldwater fish assemblages and the boundary between the North Atlantic Plateau and Uplands vs. the Northeast Highlands Aquatic Ecoregions of Omernik (1987) (see VT ACWG, 1998; Halliwell et al., 1999).

Thus, for the second taxonomic split in the abiotic classification of aquatic communities, we generally chose **TNC ecoregions** rather than EDUs to derive regional river and lake macrohabitats, evaluating differences between EOs characteristic of STL and NAP macrohabitats of the same macrohabitat type based on available information on biotic and physical features. If compelling biotic evidence was not available for a given macrohabitat, we did not opt, for instance, for a more complex taxonomic split in macrohabitat types based on unique combinations of and independent treatment of ecoregion and EDU, thus potentially doubling the number of macrohabitats for STL (e.g., a NAP-St. Lawrence Watershed, NAP-Lake Champlain Watershed, STL-St. Lawrence Watershed, STL-Lake Champlain Watershed split for each macrohabitat type).

Recognizing that for any given macrohabitat type biotic differences between EDUs apparently increase progressively lower in the drainage basin, especially for fish and mollusks, we kept the option open to use watershed splits in our macrohabitat classification for the largest stream units (e.g., Unconfined Rivers) which contain characteristic mollusks and larger, more mobile fishes. Using watershed as a classification unit for smaller stream types (e.g., Spring, Intermittent Stream, headwater streams) or small lake types (e.g., Vernal Pool, Sinkhole Pond, Marl Pond) which may not have a prominent fish or mollusk component hardly seem warranted. A classic example which demonstrates this point involves streams associated with Wallface and Street Mountains in the Adirondacks, situated near the juncture of 3 EDUs (see Figure 5). Intermittent Streams around the circumference of these summits are expected to be biologically uniform and not differ among the 3 different EDUs. While Higgins et al. (1998) noted that major watershed divisions often produce different "fish alliances", they suggest using watershed as an **attribute** of an EO, rather than as a separate regional unit. We followed this model in our classification, community characterization, and portfolio selection process.

At the lowest parts of drainage basins for the STL Ecoregion are the St. Lawrence River, as a Great Lakes Deepwater River, and Lake Champlain, as a STL Summer-Stratified Monomictic Lake. Each of these aquatic macrohabitats are in only one ecoregion (STL) and only one EDU, and they essentially represent the only EO of their macrohabitat type in the region. The ecoregion label for their macrohabitat type is based on similarities to other examples outside of STL. Thus, the "Great Lakes" label for Great Lakes Deepwater River reflects the expected similarity with large rivers upstream of the St. Lawrence River such as the Niagara River within the GL Ecoregion. In contrast, the Lake Champlain EO seems unique, however is closest to the five Great Lakes, tentatively classified as "Great Lakes Summer-Stratified Monomictic Lakes", thus perhaps the choice of a "STL" label over a "Lake Champlain (EDU)" label for the Lake Champlain EO as a "STL Summer-Stratified Monomictic Lake" may be arbitrary.

Because any regional label applied to regional macrohabitats should probably not be interpreted to be "just a label" and should definitely not imply that all EOs of that types have to be within that region, it was generally thought that macrohabitats with an **ecoregion label** would be more inclined by users of our classification to be flexibly interpreted than those designated by an **EDU label**. By designating ecoregion types, macrohabitats characteristic of other ecoregions (e.g., NAP) are allowed to be peripheral to STL, just as macrohabitats characteristic of the STL Ecoregion may be peripheral in nearby ecoregions (e.g., NAP), as has been well documented in the terrestrial community classification approach for NE U.S. ecoregions (TNC, 1998). For example, multiple Alkaline Dimictic Lakes known from the Hudson River Basin of the SE Adirondacks in NAP which have the three assemblages: 1) Isoetes lacustris meadows, 2) Lake Champlain type Potamogeton beds and 3) Lake Champlain type mollusk assemblages are suspected to resemble similar lakes in STL and within the Lake Champlain Basin (i.e., a different ecoregion and a different major watershed). Although we designated such lakes as "STL Alkaline Dimictic Lakes peripheral in NAP", it may be premature or even trivial to argue whether we should have alternately called these "Lake Champlain Watershed Alkaline Dimictic Lakes peripheral in the Hudson River Watershed". As long as the concept of such macrohabitats is clear (e.g., via descriptive summaries and characterizations of communities), we decided not to put too much emphasis on any "**ecoregional unit label**", especially if a given regional macrohabitat spans multiple ecoregions and watersheds, just as many terrestrial community types do.

While the default choice of ecoregions over EDUs as a label for Classification Unit #2 may sometimes be based on a hypothetical potential state, we suggested avoiding the difficult debate as to whether to tag a macrohabitat/alliance with an ecoregional or EDU label by simply "down-weighting" the importance of that part of the name in the overall STL classification and relying more heavily on the **conceptual clarity** of any macrohabitats via their biophysical characteristics. We acknowledged that as long as we focused foremost on the biota (ecological alliance), we could eventually theoretically map the full distribution of an alliance, then compare its range to ecoregion and EDU boundaries to see which of these two regional features, as a "label", provides a closer classification match. This approach may parallel the ecoregional approach to terrestrial community classification. For example, in the NAP Ecoregion terrestrial community classification, the NAP variant of NYHP's "Hemlock-Northern Hardwood Forest" is called "Hemlock-Pine-Spruce Forest", not a "NAP Hemlock-Northern Hardwood Forest". Thus, in theory, adding alliance name as a synonym to any "regionally-label" macrohabitat may be sufficient to avoid potential confusion and, in fact, desirable.

D. Current Status of Aquatic Macrohabitat Classifications.

Like for the macrohabitat type classification (Classification Unit #1 above), similar classifications relevant to STL (and adjacent parts of NAP) were examined to construct a regional macrohabitat classification for the STL Ecoregion. Much fewer classifications had information that could be applied directly to the ecoregion, compared to the more generalized and broad-ranging macrohabitat types. The most useful classifications, discussed below, include those of Vermont's Aquatic Classification Work Group and the Great Lakes Basin, with supplemental information from NYHP. There is much variation in the taxonomic and geographic scale of units that resemble regional macrohabitats in these existing classifications.

1. New York Natural Heritage Program.

Application of NYHP's 1990 aquatic macrohabitat type classification (Reschke, 1990) across New York has been suspected by Carol Reschke, David Hunt, and New York aquatic experts such as Bob Daniels (cf. Reschke, 1990) to reveal distinct species assemblages and ecological alliances which differ from ecoregion to ecoregion or perhaps, for some types, from major watershed to major watershed. NYHP appears unique among the four NE U.S. heritage programs considered during our efforts in having a classification that addresses any regional variation in basic aquatic macrohabitat types. In the description of some macrohabitat types of NYHP's 1990 classification is mention of potential **"regional variants"**, which have been interpreted by NYHP ecology staff to correspond to **regional macrohabitats** such as those addressed in our STL classification. For example, species of characteristic fish genera within NYHP's Main Channel Stream are reported to vary across the 5 major watersheds in New York. These regional variants were not elevated to the community level in the 1990 classification because correlations with plants and macroinvertebrates had not yet been analyzed (cf. Reschke, 1990).

While NYHP's aquatic community classification and approach seems to have been criticized and dismissed by some (e.g., see Vermont's Aquatic Classification Working Group (1998), in which it was claimed in 1998 that NYHP's 1990 classification had "not been tested", and recent correspondence of NYHP program managers (Edinger, 2002) with George Schuler of TNC's Freshwater Initiative, who claimed that NYHP's classification is "not broken down fine enough"), it is thought that the nuances of the classification, especially its evolution and testing subsequent to 1990, are poorly understood by these critics. The most frequent complaint probably has been that the classification units are too broad and do not separate regional variation, or else that regional variation is not recognized at all. These criticisms were deemed to stem from 1) misunderstanding of NYHP's multi-tiered classification hierarchy and framework used, 2) emphasis on the macrohabitat level as the most confident unit, and 3) the consideration of a variable range of biological composition across regions within each macrohabitat type (i.e., well beyond that of the "type description" in Reschke, 1990).

The units of NYHP's aquatic community classification, as named, are intended to represent aquatic macrohabitat types (Classification Unit #1), the 1st level of a multi-tiered physiochemical-based hierarchy, and be used in a top-down fashion which can be expanded by finer divisions of the classification, thus producing "regional variants" or "macrohabitats" (Classification Unit #2). For example, a Rocky Headwater Stream (a macrohabitat type concept) may be found anywhere on the globe, yet when further characterized (i.e., nomenclaturally prefixed) as a STL Rocky Headwater Stream, the unit becomes much more biotically refined (i.e., with biota of restricted geography). This two-tiered approach to community classification is no different from many other communities in the NYHP classification of other ecological systems such as "Cliff Community", "Sand Beach", "Calcareous Talus Slope Woodland", "Shrub Swamp", and "Floodplain Forest" (all global concepts with only a small subset of regional variants present in New York) and "Hemlock-Northern Hardwood Forest" and "Red Maple-Hardwood Swamp" (both broad-ranging North Temperate concepts, also with only a subset of regional variants present in New York). These broadly-defined terrestrial (non-aquatic) communities, which technically range from "alliances" to "formations" or even "groups" of the National Vegetation Classification, have been used in terrestrial ecoregion classifications, where they were made more explicit by crosswalking them with ecoregional variants (i.e., "associations") instead of being abandoned as "useless". The same process is advocated for the similarly broadly-defined aquatic communities of the NYHP classification.

While NYHP has historically continued to keep its state classification at a broadly-defined level, partially out of practicality and partially out of the desire to have the classification be comprehensive for whatever level it addresses, ecologists have continued to accumulate information that allows evaluation of potential finer-scale classifications (Hunt, 2000b). An update and second edition of NYHP's community classification has been underway for 2002 publication, and involved David's examination of much raw data for aquatic communities from which to evaluate the 1990 version of riverine and lake macrohabitat type descriptions. David suggested that there probably exists up to 7 regional variants of **most** NYHP-designated aquatic macrohabitat types (one for each of the 7 ecoregions in New York: STL, NAP, GL, LNE, HAL, WAP, NAC; i.e., 60 river types statewide and 70 lake types statewide) and proceeded to draft preliminary descriptions of biota for many, but not all, of these suspected variants. The proposed 2002 revisions present hypothesized descriptions of regional variants more detailed than those of the 1990 version; however, these variants were not yet suggested to be elevated to the level of separate **"community elements"** to be tracked. Thus, the taxonomic evolution of the NYHP aquatic community classification during the 1990s has apparently paralleled the development of TNC's National Aquatic Classification, the latter which came into being in the latter part of the 1990s. David proposed language for the 2002 version of NYHP's community classification as an update to Reschke's (1990) claims that the river and lake classifications were "tentative" and that there was a lack of field data to test the classification. He suggested a continuing effort to review the updated 2002 classification for more careful evaluation of any and all proposed regional variants, especially in conjunction with the evolution of any aquatic community classification revisions for adjacent states (especially those of heritage programs), the region, and the nation, and consideration of the potential, desirability and practicality of elevating these variants to separate community elements in the next iteration (3rd edition) of the classification expected to be published about 2010.

In support of the movement of NYHP's classification towards designation of more precise repeating and relatively consistent regional macrohabitats, NYHP field forms for aquatic communities (Attachments 4 and 5) have attempted to quantify the integrated composition and structure of plants and animals within a macrohabitat at the association level, allowing evaluation of aquatic communities beyond the simple confines of physiochemical-based macrohabitats types and into the realm of biological-based regional variants. Data on New York aquatic community EOs have been collected and methods for surveying and assessing aquatic community EOs as regional macrohabitats have been applied, documented and refined since 1996. Field and literature data have been used at NYHP to test the desirability of recognizing regional variants of macrohabitat types. To date about 100 plots and hundreds to thousands of reconnaissance observation points have been sampled across the state, from which to understand, assess, and hypothesize for classification any regional variants (see Hunt, 2000e which outlines biological and physical parameters used to describe aquatic community structure and composition).

2. Vermont's Aquatic Classification Work Group.

Vermont's Aquatic Classification Work Group (1998) made much progress on a macrohabitat classification for the STL-NAP region and apparently represented the most comprehensive attempt for this area, by far. Some regional macrohabitats in Vermont were suggested and others can be inferred from the documented physiochemical and biological descriptions associated with the numerous species assemblages presented (see Classification Unit #5 below) and the aggregation of these units into more structured and holistic ecological associations and alliances, the foundation for delineating regional macrohabitats from basic macrohabitat types.

<u>River Macrohabitats.</u> Specific riverine macrohabitat types and macrohabitats were suggested as correlated with different species assemblages for macroinvertebrates and fish, but not for plants (see Classification Unit #1 above). Some of the 7 fish assemblages and 10 macroinvertebrate assemblages in rivers were correlated with regional macrohabitats essentially of different ecoregions ("mountains" for NAP vs. "Champlain Valley" for STL), and many of these may in fact be best crosswalked with a regional macrohabitat rather than a more generalized macrohabitat type. The relationship between macroinvertebrate and fish assemblages was examined (see Table 7, p. 31-32 of VT ACWG, 1998), and while there were many correlations suggesting their aggregation into discrete regional macrohabitats, the two assemblage classifications were not correlated 1:1. Best correlated were assemblages of high gradient streams, whereas those of low gradient streams, which are somewhat poorly represented in the classification, showed poor correlations, attributed by VT ACWG to the limited sampling in these

types of streams relative to high gradient streams. One explanation offered for any general poor correlations between fish and macroinvertebrate assemblages at the macrohabitat level was that fish generally exhibit a relatively wide range of environmental tolerances, with only a few species occupying specialized habitats and thus having a limited distribution in Vermont (VT ACWG, 1998, p. 26).

Lake Macrohabitats. Little attempt seems to have been made to distinguish regional variants of the 4 to 5 lake types present in the VT ACWG (1998) document (see Classification Unit #1 above). At best, these different lake types, which generally range from oligotrophic through eutrophic, may partially reflect the regional variation in broader lake types (e.g., dimictic lakes), with oligotrophic lakes more characteristic of NAP and eutrophic lakes more characteristic of STL. However, this generalization does not conform well to our STL classification, which recognizes ecoregional variants of some of these lake macrohabitat types (e.g., NAP and STL variants of Alkaline Dimictic Lake).

3. Great Lakes Basin.

The Great Lakes Basin program presented a classification of macrohabitat types and/or macrohabitats for the Great Lakes Basin portion of New York including parts of STL and NAP. Macrohabitats (or possibly macrohabitat types) were designated for three regions in this area: the St. Lawrence/Champlain Valley (STL), the Adirondack Mountain Section (NAP), and the Tug Hill Plateau (NAP). There is probably much overlap in macrohabitat types (sensu our use of the term for the STL classification) among the regions, thus what is termed "macrohabitat type" for these three regions in Higgins et al. (1998) may, in many instances, be more comparable to the "regional macrohabitats" of our STL classification (i.e., macrohabitat types stratified by ecoregion sections). After documentation of an aquatic community classification framework, the Great Lakes Basin ecoregional planning team presented a more specific classification of aquatic community targets, apparently equivalent to macrohabitats, during the portfolio assembly process (Great Lakes Basin, 2000). The classification included macrohabitats for the St. Lawrence Drainage Unit of New York, entirely situated within STL and NAP, and for the Eastern Lake Ontario Drainage Unit of New York, which includes the Tug Hill and Black River Valley and only part of which occurs in STL and NAP, the remainder in the Great Lakes Ecoregion (Attachments 9 and 13). Detailed information on the delineation of these types, from which we could have made better assessments as to their status as macrohabitats rather than macrohabitat types, was not readily available.

River Macrohabitats.

Higgins et al. (1998, p. 45) suggested the derivation of a detailed riverine community classification of macrohabitats for the STL/NAP portion of the Great Lakes Basin (which excludes all of Vermont): 32 for the St. Lawrence/Champlain Valley (STL), 61 for the Adirondack Mountain Section (NAP), and 41 for the Tug Hill Plateau (NAP). Without information readily available for the description or nomenclature of these types, it is uncertain if these are macrohabitats or macrohabitat types. Our guess was that these may represent a range of 61 to 134 different macrohabitat type or regional macrohabitat units.

From the Great Lakes Basin portfolio assembly process (Great Lakes Basin, 2000), 8 river macrohabitats were superficially described for the St. Lawrence Drainage Unit of New York, all of which occur in STL and NAP, and 12 river macrohabitats were described for the Eastern Lake Ontario Drainage Unit of New York, 8 of which are thought to occur in STL and NAP (Attachments 9 and 13). These river types were apparently defined by, or at least characterized by, a mix of local physiography, geology, stream size, connectivity, and fish alliances, evidently with more emphasis placed on region than on geomorphological and physiochemical characteristics. Presumed regional macrohabitats of similar macrohabitat types in STL and NAP (e.g., 6 headwater streams, 5 midreaches, and 3 mainstems) seem to be differentiated by a combination of substrate types, surficial geology categories, ecoregion sections (St. Lawrence Valley, Adirondack Mountains, and Tug Hill), and ecoregions (STL and NAP). The classification apparently presents a mix of broadly to narrowly-defined river communities. For STL, this classification apparently presents macrohabitat-level classification units more numerous, numbering 12, and at a finer geographic scale than our river macrohabitats. River types characteristic of NAP are broadly defined and number about 3, only two of which (Black River Headwaters and Eastern Tributaries of Black River) appear to be divided finely enough to break apart units of substantially different stream sizes. Yet, these two types are much more geographically restrictive than our regional macrohabitats. Rivers of the Tug Hill are apparently defined at a moderate scale and number 3. Only Backwater Slough, designated in the Great Lakes Basin 2000 lake classification, may approximate the scale of the regional macrohabitats used in our STL classification.

Lake Macrohabitats.

Similar to river macrohabitats, Higgins et al. (1998) suggested a detailed macrohabitat classification of 36 to 54 different lacustrine units for the STL/NAP portion of the Great Lakes Basin: 9 for the St. Lawrence/Champlain Valley (STL), 36 for the Adirondack Mountain Section (NAP) and 19 for the Tug Hill Plateau (NAP). Without information readily available for the description or nomenclature of these types, it is uncertain if these are macrohabitats or macrohabitat types.

During the Great Lakes Basin (2000) portfolio assembly process, unlike the river community classification which presents macrohabitat-level classification units for STL more numerous and more specific than our regional macrohabitats, the classification of lakes in STL apparently presented units much broader than even the macrohabitat types of our classification, lumping several macrohabitat types into one (see Classification Unit #1 above). Lake types designated included 2 characteristic of STL, 2 characteristic of the Adirondack portion of NAP, and none characteristic of the Tug Hill. Thus, few regional macrohabitats could be deciphered from this broad classification, or else even after regional splits between STL and NAP were made, many macrohabitat types of our classification were still left lumped together and unresolved within a given ecoregion. For example, "Saint Lawrence Lake Plain Lakes" might include numerous macrohabitat types ranging from STL Vernal Pool to STL Alkaline Dimictic Lake in our STL classification; and "Adirondack Headwater Lakes and Lake Outlets" might include Meromictic Lake, Bog Lake, and many more in our classification. Perhaps the only lake type defined narrowly enough to parallel our STL classification of regional macrohabitats in scale is Oxbow Lake, corresponding closely to STL Oxbow Pond.

4. Other Heritage Programs.

The aquatic community classifications of heritage programs for the three states other than New York within STL and NAP {VTHP (1989, 1996), NHHP (1992, 1999), and MEHP (1991)} can be perceived as setting the physical framework for a finer scale biological classification. There is apparently no mention of regional variants or macrohabitats to be potentially taxonomically split from any of the basic river and lake macrohabitat types in these classifications. However, because each of these states span only about two ecoregions, the statewide concepts of macrohabitat types used may approach the regional macrohabitat concept used in our STL classification.

E. General Approach to Choosing Regional Macrohabitats.

Our STL Aquatic Community Team attempts to choose and characterize aquatic macrohabitats followed a similar approach to our efforts for macrohabitat types: 1) team agreement on which units we wanted in the STL aquatic community classification, then 2) documentation of regional variants of these types via a detailed classification characterization and crosswalk. Because 1) most of the models available for designating regional macrohabitats in STL were various macrohabitat type frameworks and 2) local attempts at a regional macrohabitat classification were relatively sparse, justification is provided below for our choices of regional river and lake macrohabitats. Despite the many field scientists knowledgeable about the STL region who contributed information to our classification effort (David, Liz McLean and several team cooperators from VT DEC), several STL types had apparently not been seen or well studied by our team, especially in New York where most of the aquatic information we reviewed from the northern New York region and most of the field studies conducted in this area were from NAP, not STL. Because we did not have a complete set of biological data from which to form a comprehensive classification of regional macrohabitats present in or even characteristic of STL, we sometimes had to resort to **hypothesizing suspected community types**. Although we could be fairly certain of the taxonomic comprehensiveness of the macrohabitat types present in the region, it was challenging to attempt a taxonomically comprehensive set of regional macrohabitats for STL, especially due to the **uncertainty of the presence of peripheral types** in the ecoregion characteristic of NAP and GL Ecoregions.

Our general approach involved starting with the macrohabitat type framework (Classification Unit #1) we developed, which was intended to be 1) taxonomically comprehensive for the New York-Vermont STL area, 2) ecologically holistic, 3) at a practical geographic scale for conservation, 4) practical in their total number of units, and 5) based on benchmark examples, then recognizing evidently biologically distinct variants of the same basic macrohabitat type characteristic of different ecoregional units (e.g., NAP vs. STL variants) which have these same 5 characteristics. Regional macrohabitats were assessed during the aggregation process used to derive macrohabitat types. Similarly, macrohabitats were partially derived and verified from aggregation of smaller classification units: species assemblages into ecological associations, then in turn into ecological alliances which were spatially correlated with regional macrohabitats. As a general rule, biota in the STL-NAP region appear to be generally arrayed into characteristic acid-intolerant associations (e.g., dominating alkaline lakes and rivers) and acid-tolerant associations (e.g., dominating acidic lakes and rivers) (see Classification Unit #5 below), and were thus helpful in distinguishing characteristic NAP and STL macrohabitats of the same basic macrohabitat type. When taxonomically split across ecoregional boundaries, the 9 basic river macrohabitat types for the STL/NAP region expand to 8 regional macrohabitats in STL and 9 in NAP, totalling 17 macrohabitats (see Table 1). Similarly, the 13 basic lake macrohabitat types for this region expand to 10 regional macrohabitats in STL and 9 in NAP, totalling 19 macrohabitats.

1. Unique Types.

Because we used regional macrohabitats as the prime surrogate unit to conserve aquatic associations and aquatic species, we especially sought to identify as a **unique community type** all regional macrohabitats that have **at least one unique association (or corresponding species assemblage).** Such regional macrohabitats are presented below in separate river and lake sections. The majority of the proposed river and lake macrohabitats may not contain a unique association, however they are all known or strongly suspected to differ in their combination of association types or, at a finer level, the relative abundance of different association types.

2. Residual Variation.

While the distillation of regional macrohabitats from macrohabitat types brought our STL aquatic community classification to a more finely resolved taxonomic scale for both biological and physiochemical features, it was suspected that some types of residual biological and especially physical variation were left unresolved for these macrohabitats, especially for rivers. We sought to address such finer scale variation inherent within types not captured by the STL macrohabitat classification or more relevant to the microhabitat scale (Classification Unit #3 below) via the stratification scheme for formulating a portfolio of important aquatic community sites (see Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002b). Like macrohabitat types, much discussion was held about where to taxonomically cut off our macrohabitat classification efforts (see Classification Unit #1 above). Any known or suspected remaining unresolved physical variation in macrohabitats that we thought could potentially be correlated with biological variation broad enough to warrant recognition of additional macrohabitats was essentially limited to two factors for regional river macrohabitats: 1) a slightly finer division of stream size classes, especially for large streams, and 2) an overarching taxonomic split based on substrate type differences. These issues were discussed in detail under Classification Unit #1 above and are not repeated here. No substantial residual biological variation in regional lake macrohabitats was suggested; however, the same issues raised by Higgins (2000b) discussed under Classification Unit #1 above (e.g., drainage network position) may apply to regional lake macrohabitats of STL. Perhaps the biggest issue we discussed regarding residual variation in regional macrohabitats was where to cut off **"regional variation"** within a single macrohabitat type in our classification efforts (see below).

<u>Intra-Ecoregion Variation Within Basic Macrohabitat Type.</u>

While patterns for terrestrial communities suggest some minor biotic differences among examples of one ecological association type across different ecoregion subsections, in the terrestrial community classifications for the NE U.S. region we commonly recognized types with a 1-to-1 range correlation with ecoregions (e.g., a STL association of a broad ranging terrestrial alliance). We generally followed this model for river and lake types of STL (i.e., at most one regional macrohabitat per ecoregion for each macrohabitat type) but applied it on a case-by-case basis upon careful consideration of biotic and/or physiochemical data, not blindly. For most regional macrohabitats characteristic of STL, biological variation across New York-Vermont STL is thought to be relatively minor, especially for resident biota, perhaps with a few exceptions noted in Appendices 1 and 2. However, the possibly more broad ranging NAP community types peripheral in STL (which may span Tug Hill to the Adirondack Mountains to the Green Mountains to the White Mountains to Maine) are suspected to be more biologically variable than STL types, potentially including typical NAP variants versus Boreal Lowland variants and variants of different major drainage units. Despite this variation, at most only one NAP variant of each macrohabitat type has been suggested in our regional macrohabitat classification for STL at this time following the terrestrial community model, pending more definitive evidence of substantial and consistent biological variation across this range.

Some patterns in intra-ecoregion variation in aquatic regional macrohabitats that emerged WITHIN the New York-Vermont area are potentially different biota between examples from Tug Hill and the rest of New York-Vermont NAP, as well as between examples from the upper Saint Lawrence Valley and the Champlain Valley (Hunt, 2000c, Bryer, 2000). These are tough comparisons and we did our best, with the help of some of our species experts, to reach a preliminary consensus. The assessment of NAP characteristic macrohabitats on the Tug Hill has generally been complicated. David suggested at terrestrial community crosswalk meetings for NAP that Tug Hill may be an "anomaly" within NAP, with many HAL-like community types (e.g., shale gorges) absent from the rest of NAP. David's suspicions are that the aquatic macrohabitats of the Tug Hill may resemble HAL communities, but our team's knowledge of HAL aquatic communities was somewhat limited at the time. A recommendation for the 2nd iteration of the STL plan was to explore any such potential **"intra-ecoregion differences"** in regional macrohabitats in more detail, especially for NAP characteristic types.

F. Summary and Documentation of Regional Macrohabitats.

A list of 18 river and 14 lake regional macrohabitats known or strongly suspected from the New York-Vermont portion of STL, as based on the results of our STL aquatic community classification efforts, is shown in Table 4. In an effort to promote conceptual clarity of regional aquatic macrohabitats, we provided a detailed characterization of each one including a "type description" (see below). Because 1) the biological and physical continuums between NAP and STL variants of one macrohabitat type are even more subtle than the gradients between different macrohabitat types, 2) even the distinctions between the "typical state" of these regional variants are not yet well established, and 3) much quantitative and even basic information of regional macrohabitats were lacking, we did not attempt to designate any thresholds between regional macrohabitats or construct a corresponding taxonomic key, as done for macrohabitat types. The most useful classifications for deriving regional macrohabitats of rivers and lakes in STL, as discussed below, include those of Vermont's Aquatic Classification Work Group and the Great Lakes Basin, with much supplemental information available from NYHP surveys and databases.

1. Community Characterization.

Detailed information on each river and lake macrohabitat in our STL aquatic community classification is presented in a 36-page document for rivers (Appendix 1) and a 27-page document for lakes (Appendix 2). These documents represent updates to two macrohabitat classification documents initially presented as summaries of our STL Aquatic Community Team decisions for macrohabitat units: one for rivers entitled "Saint Lawrence/Champlain Valley Ecoregion (STL). Known or Suspected, Extant or Extirpated Riverine Macrohabitats/Alliances; July 7, 2000" and one for lakes entitled "Saint Lawrence/Champlain Valley Ecoregion (STL). Known or Suspected, Extant or Extirpated Lacustrine Macrohabitats/ Alliances; February 23, 2001".

We attempted to generously describe regional macrohabitats and provide preliminary quantitative characteristics which would hopefully be diagnostic between related macrohabitats and groups of macrohabitats to reflect our intended "seamless" classification. The format and content we sought for creating regional river and lake macrohabitat descriptions are summarized in an **aquatic macrohabitat "template"** (Appendix 5). General information is presented for each regional macrohabitat on a fact sheet of one to few pages that includes a proposed macrohabitat name, synonymy and affinities with other macrohabitat and macrohabitat type classifications, synonymy with a proposed ecological alliance, a basic description broken down by various physiochemical features of the macrohabitat and biological features of the corresponding alliance, microhabitat composition, ecological association and species assemblage composition, potential prime sources of residual rangewide physical and biological variation, distribution by state and ecoregion, selected known New York and Vermont examples, and associated reference sources. Different sets of parameters are used to distinguish the basic hydrological descriptions of river and lake macrohabitats (see river and lake sections below for more detail). Other parameters shared in the descriptions of river and lake macrohabitats include community size/scale, watershed size, landscape setting, ELU signature, and general biota characteristics (such as dominant and characteristic species). For some macrohabitats, specific descriptions of microhabitats are provided.

G. STL River Macrohabitat Classification.

1. Classification Synthesis.

The regional macrohabitats proposed for the STL river classification build upon several documented classifications. We evaluated various classifications for the appropriate taxonomic and geographic scales of units: corresponding to various macrohabitat types, with geographic ranges appropriate to STL, and with biological correlations suggestive of a regional variant. The most useful classifications include those of Vermont's Aquatic Classification Work Group and the Great Lakes

Basin, with supplemental information from NYHP surveys and databases. The 25 regional river macrohabitats of the STL classification represent 1) the application of regional units to our macrohabitat type framework, then matched with evident biological differences to recognize distinct regional variants (e.g., NAP vs. STL variants), 2) a subsequent reconciliation of all of these units with the classification approaches of the Great Lakes Basin and Vermont's Aquatic Classification Work Group, and 3) attempts to reduce any biological redundancy in types.

In general, river types of the Great Lakes Basin (2000) classification represent units which 1) lump streams of multiple similar macrohabitat types, but 2) are much more geographically restrictive than our regional macrohabitats, thus apparently placing much more emphasis on region than on geomorphological and physiochemical characteristics. For example, the 12 river macrohabitats designated for STL in this classification represent only a fair approximation of the appropriate scale for regional macrohabitats sought by our team and appear somewhat too fine in scale (e.g., 2 types apparently restricted to part of one stream: the Black River). They were thought to come closest to the results of the stratification regime we used for our macrohabitat units in the STL portfolio, stratifying regional macrohabitats by ecoregion subsection. Reconciliation of all GL river types designated in the Great Lakes Basin (2000) classification with our STL classification is recommended for the second iteration of the STL plan.

2. Summary of River Macrohabitat Choices.

When the 9 basic riverine macrohabitat types of the NE U.S. are roughly divided across STL and the two adjacent ecoregions (NAP and GL) that are likely to have characteristic examples peripherally represented in STL, these macrohabitat types translate to about 16 regional river macrohabitats known or strongly suspected from the STL ecoregion, and 9 additional ones potentially peripheral within STL, totalling 25 regional macrohabitats, as listed in our proposed classification (Table 1). A total of 23 of these river macrohabitats were targeted for the STL portfolio (see Table 3) and descriptions were developed for 18 macrohabitats most certain from STL (Table 4; Appendix 1).

<u>Specialized River Types.</u> For most of the common river macrohabitat types, we generally recognized unique regional variants for each of STL, NAP and GL. We also suggested the presence in STL of some rather specialized river macrohabitats suspected to be of limited distribution, dependent upon the existence of localized features such as geology or water chemistry conditions. Examples of such macrohabitats potentially within STL include two Intermittent Stream types characteristic of NAP (acidic and calcareous variants). Intermittent Streams characteristic of STL are suspected to be mostly calcareous, and a unique acidic type was not known. However, we were not sure if examples in the few reported acidic pine barrens of STL may be best treated as a unique acidic STL type or peripheral examples of the more widespread acidic NAP or even LNE types. Such an acidic STL type was not designated, pending field verification of its existence. The Great Lakes Deepwater River represents a macrohabitat type present in STL that may be uniquely characteristic within the NE U.S. region to the GL Ecoregion, especially because of its low drainage network position, discharge, and depth.

<u>Unique River Features.</u> We attempted to identify species assemblages with a "*" in the riverine macrohabitat-alliance classification document (Appendix 1) that may occur in only one associated macrohabitat. From our preliminary estimates these correspond to 9 (i.e, about 35%) of the 25 specific riverine macrohabitats known, suspected or potential from STL and include types characteristic of the STL and GL Ecoregions (STL Rocky Headwater Stream, STL Marsh Headwater Stream, STL Unconfined River, GL Deepwater River) as well as NAP (two NAP Intermittent Stream types, NAP Rocky Headwater Stream, NAP Marsh Headwater Stream, NAP Backwater Slough, NAP Subterranean Stream).

3. Community Characterization.

Information on each regional river macrohabitat in our STL aquatic community classification is presented in Appendix 1. The format and content for information is explained in an attached **"aquatic macrohabitat template"** (Appendix 5). Hydrological information geared towards river macrohabitats, as outlined in the river section of the template, is presented for water permanence, stream position, discharge, temperature, substrate/water alkalinity, substrate texture, sediment transport regime, flow velocity, gradient, confinement, and nutrient source.

Detailed information was compiled for many of the proposed river macrohabitats in our classification, including all of those characteristic of STL. Once ELU maps and watershed characterizations were displayed for STL (TNC-ECS, 2002a) and the STL Aquatic Community Team had a chance to review them, peripheral community types characteristic of adjacent ecoregions were more strongly suspected to be present in STL. We had time early in our team efforts to develop detailed descriptions of all or most of the river macrohabitats characteristic of NAP. Detailed descriptions for most river macrohabitats characteristic of GL were not developed, other than GL Deepwater River for the St. Lawrence River, because a potential split between GL and STL types did not start to appear until 1) we reviewed maps produced by TNC ECS, 2) subsequent analyses suggested some characteristic physical differences (e.g. in ELUs) between these ecoregions and 3) a reexamination of the biological patterns, especially for fish, in these areas of different physical settings suggested that biological differences could potentially warrant recognition of separate river types. We struggled with how to address in our classification the general pattern of increased fish and mollusk diversity in rivers towards the western part of STL, following the historic zoogeography patterns mentioned by Rich Langdon. We considered two options: 1) one STL type with broad variation and 2) two different STL and GL types. Mention of most GL river macrohabitats in the characterization document is very preliminary, with just the name of a type or a skeletal description provided for now. Expansion of these types and complete reconciliation with the Great Lakes Basin classification is left until the next iteration of the STL plan and/or Great Lakes ecoregional planning efforts. Lastly, detailed development of Acadian estuarine river macrohabitats known or suspected from Quebec were not developed, as these types are absent from New York and Vermont. However, we did list them as provisional in the characterization document, to be expanded during the second iteration of the STL plan when Quebec ecologists will hopefully be involved in review of our classification.

H. STL Lake Macrohabitat Classification.

1. Classification Synthesis.

The regional macrohabitats proposed for the STL lake classification build upon several documented classifications. Like the river classification, we evaluated classifications for the appropriate taxonomic and geographic scales of units: corresponding to various macrohabitat types, with geographic ranges appropriate to STL, and with biological correlations suggestive of a regional variant. While the existing classifications of Vermont's Aquatic Classification Work Group and the Great Lakes Basin were useful at the macrohabitat level, our classification was formed primarily from application of regional units to our macrohabitat type framework, to distinguish biologically distinct variants of the same basic macrohabitat type characteristic of different ecoregional units (e.g., NAP vs. STL variants). Widoff's (1986) lake classification did not address the stratification of physical lake types across ecoregional units of any kind, although to some degree trophy and alkalinity differences reflect regional variation between STL and NAP, as previously discussed (see Classification Unit #1 above). Few or no suggestions of regional variation in lake types between STL and NAP were made in the classifications of the Great Lakes Basin and VT ACWG. Thus, we relied primarily on our initial analyses of raw field data, especially from NYHP, to seek out biologically distinct regional variants.

2. Summary of Lake Macrohabitat Choices.

When the 16 lacustrine macrohabitat types known from the New York-Vermont STL and NAP region are roughly divided across STL and the two adjacent ecoregions (NAP and GL) that are likely to have characteristic examples peripherally represented in STL, these macrohabitat types translate to about 14 regional lake macrohabitats known or strongly suspected from the STL ecoregion, and 11 additional ones potentially peripheral within STL, totalling 25 regional macrohabitats, as listed in our proposed classification (Table 1). A total of 18 of these lake macrohabitats were targeted for the STL portfolio (see Table 3), and descriptions were developed for the 14 macrohabitats most certain from STL (Table 4; Appendix 2).

<u>Specialized Lake Types.</u>

Like river macrohabitats, for most of the common lake macrohabitat types, we generally recognized unique regional variants for each of STL, NAP and GL. We also suggested the presence in STL of some rather specialized lake macrohabitat types suspected to be of limited distribution, dependent upon the existence of localized features such as surficial geology or water chemistry conditions. Unique lake types in STL are associated with marl, karst topography, acidic peatlands, and acidic pine barrens.

There may be more lake macrohabitat types present in STL uniquely characteristic of only one ecoregion than river types because of our methods for taxonomic delineation of lake macrohabitat types, which generally address more specific water chemistry parameters for lakes than for rivers. Alkalinity, used as a prime distinguishing factor in our lake macrohabitat type classification for STL, shows strong correlations with ecoregion among STL and NAP. Thus, the presence in STL of Sinkhole Pond and Marl Pond, not expected from NAP, can be attributed to calcareous and marl substrates characteristic of the STL ecoregion. Summer-Stratified Monomictic Lake, a rare lake type characterized by large depth, large surface area, and its unfrozen state throughout winter, appears unique to the NE U.S. region within the STL and GL Ecoregions. The STL variant is represented by Lake Champlain. Great Lakes Deepwater Community of NYHP's classification (Reschke, 1990) was considered in our STL classification as the GL variant of Summer-Stratified Monomictic Lake, and Lake Ontario has been mapped by NYHP as an example extending northeast into the western fringe of STL along the upper Saint Lawrence River to slightly downstream of the Chippewa Bay area.

Other unique types peripheral in STL and without a unique STL variant designated include Bog Lake, characteristic of NAP, and Pine Barrens Vernal Pond, characteristic perhaps of LNE. We did not know of any Meromictic Lakes in STL, although Susan Warren suspected that there may be one or more examples with a phosphorous gradient present in the Vermont part of STL. If this macrohabitat type is present in STL, it is uncertain if we would classify it as a peripheral example of the NAP variant, or designate a new variant for it.

Unique Lake Features. We attempted to identify species assemblages with a "*" in the lacustrine macrohabitat-alliance classification document (Appendix 2) that may occur in only one associated macrohabitat. From our preliminary estimates these correspond to 12 (i.e, about 50%) of the 25 specific lacustrine macrohabitats known, suspected or potential from STL. These include types present in STL that are characteristic of STL or GL Ecoregions (STL Subterranean Lake, STL Vernal Pool, GL Marl Pond, GL Salt Pond, STL Summer-Stratified Monomictic Lake, and GL Summer-Stratified Monomictic Lake).

3. Community Characterization.

Information on each regional lake macrohabitat in our STL aquatic community classification is presented in Appendix 2. The format and content for information is explained in an attached **"aquatic macrohabitat template"** (Appendix 5). Hydrological information geared towards lake macrohabitats, as outlined in the lake section of the template, is presented for water permanence, depth-surface area/morphometry, turnover/temperature regime, water/substrate acidity/alkalinity, trophy/productivity, and substrate texture.

Detailed information was compiled for many of the proposed lake macrohabitats in our classification, including all of those characteristic of STL. Like for river macrohabitats, once ELU maps and watershed characterizations were displayed for STL (TNC-ECS, 2002a) and the STL Aquatic Community Team had a chance to review them, peripheral community types characteristic of adjacent ecoregions were more strongly suspected to be present in STL. Some of these types are presented via only a condensed summary at the end of the community characterization document (Appendix 2). Many of the revisions to the community descriptions from earlier drafts of this document are for such peripheral community types. We did have time early in our efforts to develop preliminary descriptions of all or most lake types characteristic of NAP, but ran out of time for detailed descriptions of those types not known or suspected from STL such as Tarn Pond.

Like river macrohabitats, detailed descriptions for most lake macrohabitats characteristic of GL were not developed because a potential split between GL and STL types did not start to appear until 1) we reviewed maps produced by TNC ECS, 2) subsequent analyses suggested some characteristic physical differences (e.g. for ELUs) between these ecoregions and 3) a reexamination of the biological patterns, especially for fish, in these areas of different physical settings suggested that biological differences could potentially warrant recognition of separate lake types. Like river macrohabitats, we struggled with how to address in our classification the general pattern of increased fish and mollusk diversity in lakes towards the western part of STL and considered whether or not to lump or split potential STL and GL types. Mention of the only two GL variants of common lake macrohabitat types suspected from STL (Oxbow Pond, Vernal Pond) in the characterization document (Appendix 2) is very preliminary, with just the name of the type provided for now and the type targeted for the STL aquatic community portfolio. These two types were based on knowledge of the appropriate topographic setting for these aquatic features in a region with ELUs characteristic of the GL Ecoregion. The presence of GL lake types in STL was even more uncertain than for GL river types based on the limited biological information we had available for comparative analyses. For other common lake types such as Alkaline Pond and Alkaline Dimictic Lake, it remains uncertain whether both STL and GL variants or only a STL variant are present in STL, especially in the western part of STL with ELUs characteristic of GL in the Black River Valley and Lake Ontario Lake Plain. Expansion of the description of the two suspected common GL lake types in our classification, potential addition of other common GL types, and complete reconciliation with the Great Lakes Basin (2000) classification is left until the next iteration of the STL plan and/or Great Lakes ecoregional planning efforts.

Lastly, characterization of Acadian estuarine lake types (Tidal Bays and Salt Pond macrohabitats) suspected from Quebec were not developed, as these types are absent from the New York and Vermont portion of STL. We listed them as provisional in the characterization document, pending verification of their presence in STL during the second iteration of the STL plan when Quebec ecologists will hopefully be involved in the review of our classification.

III. Classification Unit 3 (Abiotic): MICROHABITAT TYPES

A. Introduction.

The third hierarchical level and finest scale unit in our abiotic aquatic community classification is the "**microhabitat type**", representing "discrete physical habitats within macrohabitats" (Higgins et al., 1998) with relatively uniform physical properties, especially for flow, light regime, water chemistry and thermal patterns. This unit is narrowly defined and geographically limited and represents the physical building blocks which are aggregated into macrohabitat types. The term "**microhabitat type**" is used synonymously with "**habitat unit type**" of Higgins et al. (1998). The STL macrohabitat type and macrohabitat classifications were intended to be comprehensive for STL across all microhabitats applicable to flowing and ponded waters in the ecoregion, including those for flow, depth/substrate, and light regime microhabitats. Microhabitat types provide a generalized framework of global applicability from which a theoretical classification of **"regional microhabitats"** specific to STL could be constructed.

Our objective for deriving a microhabitat type classification for STL was to hopefully borrow in entirety from existing microhabitat type classifications so we could instead focus our team efforts on higher taxonomic units, such as regional macrohabitats, as a more effective coarse filter for conservation. The historical status of aquatic microhabitat type classifications used during our efforts is presented below. We sought a **simplified classification**, and the New York Heritage Program classification met most of our criteria for **comprehensiveness** and **practicality** of a microhabitat type classification.

B. Current Status of Microhabitat Type Classifications.

While classifications of microhabitat types are commonly presented in the general aquatic literature, the application of this classification framework to the STL region appears limited, most classification efforts for this region having focused on larger geographic scales and higher taxonomic levels. NYHP applies standard microhabitat types designated for aquatic and subterranean communities to help classify, map, and describe aquatic macrohabitat EOs. More information can be found on NYHP field forms and instructions for aquatic communities (Hunt, 1999b; see also sample form in Attachment 5). These microhabitat types have been hypothesized to be and field tested as the primary split in the distribution of species **within** a given aquatic (or subterranean) community macrohabitat. Three general categories of microhabitat types designated and used by NYHP for rivers and lakes include: 1) **flow microhabitats**, 2) **depth/substrate microhabitats**, and 3) **light regime microhabitats**. NYHP has collected much field data on regional microhabitats, but not much classification efforts have been focused on that taxonomic level.

1. Flow Microhabitat Types.

Flow microhabitat types are based on flow speed and "turbulence" features (e.g., whitewater, "oxygenation", "aeration"). NYHP standardly uses three flow microhabitat types: **riffle**, **run** and **pool** (Reschke, 1990). Applied definitions can be found on NYHP aquatic community field form instructions (Hunt, 1999b), and these microhabitats within a typical river reach are graphically depicted in Figure 6. Other classification schemes range from as few as two (e.g., fast: riffle-run and slow: run-pool) to numerous categories. Hauer and Lamberti (1996) suggested a finer-scale classification of microhabitat types, for example, breaking pools up into 11 categories (see Attachment 14) and Higgins et al. (1998) cited a classification of pools into three types (scour, slackwater and obstruction). Flow microhabitats are best differentiated in riverine communities and poorly developed in lakes. Pool is the primary flow microhabitat in lakes, probably representing at least about 99% of the volume/area across all lake occurrences in STL.

2. Depth/Substrate Microhabitat Types.

Depth/substrate microhabitat types are related to thermal stratification, underwater light intensity (i.e., "light penetration" of Higgins et al., 1998), and the physical matrix from which organisms derive nutrients and energy (e.g., from the soil vs. dissolved in open water). Five such microhabitat types are standardly used at NYHP (Reschke, 1990): three benthic zone types (**littoral**, **sublittoral**, and **profundal**) and two pelagic zone types (**epilimnion** and **hypolimnion**). Applied definitions can be found on NYHP aquatic community field form instructions (Hunt, 1999b), and the microhabitats are graphically depicted for a typical lake cross section in Figure 7. One alternative finer-scale scheme for these microhabitats occasionally referenced in the general aquatic literature recognizes "metalimnion" as an additional, typically narrow, zone in the pelagic portion of water bodies transitional between the epilimnion and hypolimnion.

In the classification of species assemblages for Vermont, VT ACWG (1998) attempted to correlate assemblages with selected depth/substrate microhabitats and provided definitions of benthic concepts similar to those applied by NYHP. The profundal microhabitat was defined as areas below the thermocline, with deep bottom "gyttja" (i.e., organic-rich bottom) and strongly limited by dissolved oxygen. The sublittoral microhabitat was defined as areas above this depth but below the area of light penetration (similar to but not precisely matching NYHP criteria) and below the area of macrophyte growth with adequate oxygens levels except in extreme eutrophic conditions.

Depth/substrate microhabitats are generally much more pronounced and well-defined in lacustrine communities relative to riverine communities, thus have historically been used as a major factor in holistic lake classifications. In our river classification for STL, only Great Lakes Deepwater River is thought to have well developed variation across this microhabitat category (e.g., with sublittoral and profundal zones), the remaining river macrohabitat types being comprised primarily of benthic-littoral zone microhabitat.

3. Light Regime Microhabitat Types.

Light regime microhabitat types standardly used by NYHP for subterranean communities number five: four subterranean zones (**dark**, **inner twilight**, **outer twilight**, and **entrance** zones) and one above-ground zone (**light** zone). Applied definitions can be found on NYHP specifications for the Subterranean System (NYHP, 2002) and subterranean community field form instructions under development (Hunt, 2002b). In many speleological references outer and inner twilight zones are not distinguished from each other, as they have been during NYHP field surveys.

4. Other Features.

Lastly, the Great Lakes Basin aquatic community classification (Higgins et al., 1998) suggested the use of **"nearshore" lake areas** as important aquatic communities to target. Heritage programs may recognize a similar feature in their state lacustrine community classifications including: Great Lakes Aquatic Bed and Great Lakes Exposed Shoal (NYHP, 1990) and Lacustrine Shallow Bottom Community (MEHP, 1991). These areas evidently correspond most closely biologically to ecological associations, but may be physically at scales finer than the substrate microhabitats defined above (e.g., littoral zone) and perhaps might be better termed "submicrohabitats". They are similar to the **"embedded features"** which we targeted as specialized habitat types in our STL aquatic community portfolio and do not fit easily into the standard categories of our aquatic community classification (see Section X. "Other Classification Units Considered" below).

C. Application to STL Classification.

The STL Aquatic Community Team explored which microhabitat types to apply to the STL aquatic community classification. Our choices are presented in Table 5. Considering our focus on relatively large geographic scales and our desire to develop a simplified microhabitat type classification, we minimized the number of flow microhabitat types in the classification to the 3 basic types used by NYHP. Similarly, depth/substrate and light regime microhabitats used by NYHP were also adopted with only minor discussion and minor modifications. Only four light regime microhabitat types are recognized in the STL classification, instead of the five used by NYHP. We lumped outer and inner twilight zones into a single **"twilight zone"** for simplicity, as done in much of the generalized speleological literature. We also decided that nearshore areas in lakes occur at geographic scales too fine for our microhabitat classification; however, they seem most useful when correlated with ecological associations, many of which can co-occur within one lake microhabitat (see Classification Unit #5).

In the attached riverine and lacustrine classifications, microhabitat types associated with each regional macrohabitat (Appendices 1 and 2) and species assemblage (Appendices 3 and 4) are indicated under the descriptions of those entities. Many macrohabitats differ substantial in their microhabitat composition, and many species assemblages are restricted to only certain combinations of microhabitat types. A comprehensive classification of specific (i.e., regional) microhabitats of STL, corresponding spatially with a comprehensive classification of ecological associations, was deemed too fine in scale to be practical and too time consuming to attempt to compile for our first iteration classification. However, we acknowledged that this scale of precision may best approximate the **level of repeatability of biotic units** present in standard terrestrial community classifications (i.e., **units reflecting differences in dominant resident biota among all groups of taxa)**. We did make rough estimates of the number of specific microhabitats suspected in the 16 regional riverine macrohabitats and

14 regional lacustrine macrohabitats known or suspected from STL (see Table 1). With an average of about 2.5 microhabitats expected per riverine macrohabitat, about 40 riverine microhabitats are suggested, and with an average of about 3.5 microhabitats expected per lacustrine macrohabitat, about 50 lacustrine microhabitats are suggested. Because of the large number regional microhabitats estimated (about 100), we decided that this scale was too fine to be practical for the focus of our first iteration classification. Additionally, we recognized that at least for flow microhabitats in rivers, some microhabitats are temporally too unstable to be practical for mapping for the purposes of monitoring EO locations and long-term conservation.

IV. Classification Unit 4 (Biotic): ECOLOGICAL ALLIANCES

A. Introduction.

The first (i.e., highest) hierarchical level in our biotic aquatic community classification is the "**ecological alliance**", representing repeating aggregates of closely associated ecological associations and species assemblages (see Classification Unit #5 below). The difference between "ecological alliances" (Classification Unit #4) and "ecological associations" (Classification Unit #5) may be confusing to some (see Glossary). We followed the concepts presented in Higgins et al. (1998). Basically, "**ecological alliance**" is a biotic classification unit occurring at relatively large spatial scales, usually corresponding to regional macrohabitats (entire lakes or segments of stream systems specific to a given region), while "**ecological associations**" occur at relatively small spatial scales, usually corresponding to regional microhabitats (portions of lakes or portions of stream reaches specific to a given region). Ecological alliances are formulated by piecing together their component ecological associations of somewhat dissimilar taxa (e.g., fish, plants, and macroinvertebrates) which repeatedly occur together in close geographic proximity, clustered within a mosaic with each other more often than with other associations. Biotic community classification units can, in theory, be formed from combining "species assemblages" which repeatedly co-occur with one another across the landscape into units that occupy larger and larger geographic areas. Note that the concept of an aquatic alliance used here differs somewhat from that used in terrestrial community classifications: a group of taxonomically related associations which occur in different ecoregions, generally do not occur in close geographic proximity to each other, and share a few similar dominant species but differ by several regional indicator species.

Ecological alliances were an indirect focus of the first iteration of our STL river and lake classifications and their classification was intended to be comprehensive for the region primarily through their 1:1 correlation with regional macrohabitats. They were addressed to biologically anchor and describe regional macrohabitats rather than meant to be components of an independent classification. To derive an alliance classification, we built upon the foundation of any existing alliance classifications for the region. The historical status of such sparse community classifications at this level used during our efforts is presented below. Our classification of ecological alliances in STL, relied heavily on raw biological data, knowledge from state experts, and the few known documented attempts to synthesize biological information from this region into ecological units that repeat across the aquatic landscape. Our classification was based largely on the aggregation of species assemblage type information, especially from VT ACWG (1998).

B. Hypotheses Supporting an Alliance Classification.

Four assumptions and hypotheses are presented below which formed the basis for our choices for designating aquatic ecological alliances for STL. We focused on the correlation of alliances with other aquatic community classification units including species assemblages, ecological associations, microhabitats, and regional macrohabitats.

Hypothesis #1. Association of Species Assemblages into Alliances: "Species assemblages" from at least the 3 major groups of aquatic species (fishes, plants, and macroinvertebrates) and up to 7 different species groups used in the STL riverine and lacustrine community classifications (as detailed under Classification Unit #5 below) are expected to be generally spatially associated with each other to form "ecological associations" which, in turn, are aggregated into distinct "ecological alliances", especially those spatially situated within the same specific "substrate microhabitat" category. Pelagic associations and assemblages are thought to correlate well with each other; benthic associations and assemblages are thought to correlate well with each other. In rivers, for example, the Brook Trout fish assemblage (which may span multiple flow microhabitats) is expected to be spatially associated with the Plecoptera/Trichoptera macroinvertebrate assemblage and the Fontinalis plant assemblage (both of which may be limited to only one flow microhabitat). The basis for this correlation is that all of the three most charismatic species assemblage groups (fish, vascular plants, macroinvertebrates) are generally expected to show distribution patterns correlated with macrohabitat or finer scale units (e.g., one to few macrohabitats per assemblage). This correlation may be either direct (e.g., the Limnephildae-Tricladida macroinvertebrate assemblage found only in Spring macrohabitats, the Lake Sturgeon fish assemblage found only in Unconfined River macrohabitats) or indirect via direct correlation with microhabitats in combination with the characteristic microhabitat composition of macrohabitats (e.g., the Plecoptera/ Trichoptera macroinvertebrate assemblage correlated with riffle flow microhabitat which is abundant only in Rocky Headwater Streams and Confined Rivers). It is generally thought that numerous benthic and pelagic associations (each characterized by a unique combination of plant and macroinvertebrate assemblages) within a given lake form an ecological alliance at the macrohabitat level, with one fish assemblage spanning all associations in the lake. Similarly, it is generally thought that flow associations for riffle, run, and pool (each characterized by a unique combination of plant and macroinvertebrate assemblages) in rivers form an ecological alliance at the macrohabitat level, with one fish assemblage spanning all associations in the river macrohabitat.

Hypothesis #2. Correlation of Species Assemblages and Macrohabitats: Ecological alliances are expected to be generally spatially correlated with regional macrohabitats (see Higgins et al., 1998). Because of the suspected high correlation in geographic distribution between assemblages from several taxonomic groups, the 43 riverine species assemblages (including 15 plant, 16 macroinvertebrate and 9 fish assemblages) and 67 lacustrine species assemblages (including 26 plant, 24 macroinvertebrate and 8 fish assemblages) proposed to be characteristic of STL and NAP may translate to only about 25 riverine alliances (the number of riverine macrohabitats known, suspected or potentially from STL and NAP), and about 25 lacustrine alliances (the number of lacustrine macrohabitats known, suspected or potentially from STL and NAP), rather than the number of independent/unique combinations of assemblages expected under no correlations, which would total over 2000 (15 X 16 X 9) ecological alliances for rivers and over 6000 (26 X 24 X 8) ecological alliances for lakes.

Hypothesis #3. Correlations Between Pelagic and Benthic Associations: Because of the difference in scale of the local range of resident and migratory biota (see Classification Unit #5, Hypothesis #7 below), it is possible, perhaps even likely, that pelagic associations and assemblages may sometimes, or even often, be not well correlated with benthic associations and assemblages. One possibility is that pelagic associations and assemblages may generally correlate better with water flow patterns and connectivity issues (e.g., EDUs) while benthic assemblages may generally correlate better with underlying bedrock and substrate types (which generally follow ecoregion boundaries). If such a potential poor correlation of pelagic and benthic assemblages represents the actual situation in many river and lake types of STL or in general over a broad geographic range, it compounds the task of coming up with one practical classification at the macrohabitat-alliance level that addresses major patterns of biological variation in **all taxonomic species groups** as well as for both **resident AND migratory biota**. As an extreme exercise in taxonomy, one might consider developing separate pelagic versus benthic classifications, at least for communities where the two water depth zones are well differentiated (mostly larger river and lake types). More critical evaluation is needed of this potential phenomenon that presents large implications and taxonomic challenges for community classification.

<u>Hypothesis #4. Role of Fish Assemblages in Alliances:</u> It is generally perceived that individuals of many fish species are more mobile and wide ranging, within the aquatic environment, than individuals of other riverine and lake biota types (especially aquatic insects and plants) and have a wider range of environmental tolerance. Thus, fish may be most diagnostic of larger scale aquatic habitats at the ecological alliance/macrohabitat level, forming assemblages that overarch the finer scale variation in plant and macroinvertebrate assemblages. However, at the same time, their mobility and wide tolerance may allow fish to span multiple macrohabitats and thus, alliances. These more flexible associations of fish with physical habitat, especially substrate characters, presents challenges for classifications that seek to address the distribution patterns of resident biota. The potential analogy to species in terrestrial communities may be wide-ranging mammals and migratory birds, both of which are apparently not factored into terrestrial community classifications at all.

C. Current Status of Ecological Alliance Classifications.

There have apparently been few attempts at designating ecological alliances for STL, especially as biologically holistic units spanning multiple groups of taxa and formed from analyses of correlations between different species groups. However, good classifications of ecological associations and species assemblages of STL, which form the building blocks of ecological alliances, are described in detail under Classification Unit #5 below. The descriptions of aquatic communities in the NYHP classification (Reschke, 1990) perhaps come closest to representing ecological alliances, and the efforts of Vermont's Aquatic Classification Work Group (1998), which involved the delimitation of some ecological alliances which link species assemblages for fish, plants and macroinvertebrates of STL, also contributed much to the formation of our ecological alliances.

1. Vermont's Aquatic Classification Work Group (VT ACWG).

VT ACWG (1998) presents a classification of species assemblages (see

Classification Unit #5 below) and made attempts to address correlations between fish and macroinvertebrate assemblages within riverine macrohabitats (p. 31, Table 7) and correlations between plant and fish assemblages within lacustrine macrohabitats (p. 10-11, Table 1). These correlations were one of few such efforts for STL and NAP aimed at delimiting ecological alliances which link fish, plants and macroinvertebrates encountered during our literature review.

2. Great Lakes Basin.

Fish were used as the primary focus of the Great Lakes Basin alliance classification (Higgins et al., 1998), assumed to parallel the taxonomic scale of our STL ecological alliances, and a total of 5 "**fish alliances**" were designated. These alliances were mostly applicable to the western part of STL, and many are dominated by wide-ranging migratory species. At the New York portfolio meeting for the Great Lakes Basin (2000), a classification of 8 **"fish communities"** were presented: 3 for lakes, 5 for rivers. Higgins et al. (1998) claimed that alliances can cross aquatic macrohabitats (probably referring to fish alliances), thus suggesting stronger correlations of the Great Lake Basin-designated alliances with watersheds than with individual macrohabitats of our STL classification.

3. Heritage Programs.

Ecological alliances are not explicitly designated in any of the community classifications of the 4 state heritage programs within STL and NAP. However, **"associated species"** within the descriptions of aquatic communities (e.g. those of Reschke, 1990) can be perceived as describing ecological alliances. Although the aquatic communities of these classifications are not explicitly named with a "biological label" as done for some terrestrial communities (e.g., "Pitch Pine-Scrub Oak Barrens" of the NYHP classification), the macrohabitat type frameworks of heritage programs are intended to be biologically anchored and the biotic composition of each may approximate ecological alliances. The challenge in linking ecological alliances to heritage program classifications has been that most of their designated aquatic communities are slightly more general than regional macrohabitats (i.e., describing a whole state and spanning parts of two to several ecoregions) and thus may correlate best to biological groups somewhat more generalized than ecological alliances (e.g., perhaps most analogous to "ecological groups" of the NVC). Recent efforts to designate regional macrohabitats, such as NYHP's evolving classification of 2002, involve more explicitly identification of ecological alliances that occur at the taxonomic scale applied in our STL classification.

D. General Approach to Formation of Alliances.

Few or no general models were found which designate holistically named ecological alliances, and local attempts at ecological alliances within STL were apparently relatively sparse. Because the few existing alliance classifications relevant to STL apparently took disparate approaches, our synthesis of a comprehensive alliance classification for STL essentially involved designation of all new names. We did this by starting with the regional aquatic macrohabitat classification (Classification Unit #2 above), then designated a biological synonym to its taxonomy to reflect its biological anchor and provide an overview of its diagnostic biological characteristics. We assumed that there were enough correlations between ecological alliances and macrohabitats to formulate one linked classification for both, and thus submersed ecological alliances under the characterization of regional macrohabitats for both rivers (Appendix 1) and lakes (Appendix 2). Like macrohabitat types, we sought to describe ecological alliances from aquatic macrohabitats that represent the benchmark or least-altered condition for biological features. A discussion about biotic assemblages which differ between the successional and disclimax stages in aquatic communities and the effort we made to sort out patterns among unimpacted versus impacted or "cultural" river and lake assemblages was presented above (see Classification Unit #1).

Formation of an ecological alliance classification involved comparisons of top-down biological divisions with bottom-up aggregation of biotic features. We started our synthesis with regional macrohabitats then followed the guidelines for biologically anchoring these physical units. Using the top-down approach, apparent large-scale biotic divisions between broad groups of river and lake types were used, as noted on the key to river and lake macrohabitat types (Key 1). Although taxa in that key are resolved to the lowest common denominator in terms of taxonomic level, they are still at higher taxonomic levels (e.g., phyla, class, order) than the taxonomic levels of diagnostic features of ecological alliances characteristic of STL regional macrohabitats (e.g., genus and species) and we relied on the bottom up aggregation process to identify biota at the latter taxonomic levels. We did this by aggregating co-occurring species assemblages and identifying **"diagnostic species"** in each of the major taxonomic species groups, first into associations then in turn into alliances which were spatially correlated with regional macrohabitats.

We sought to designate ecologically holistic alliances based on the aggregation of similarly defined associations (see Classification Unit #5 below). Associations are generally based on **dominant and characteristic permanent (i.e., resident) plants and macroinvertebrates**, thought to be most diagnostic at that scale. Linkages of spatially-correlated species assemblages were crucial for establishing the **"biological anchoring"** of macrohabitats. Different associations in geographic proximity were linked if we thought they contain at least one shared fish assemblage, these assemblages generally occurring at larger spatial scales than those for associated plants and macroinvertebrates. However, we understood that any ecological alliance classification based on these migratory species presents the **complexity of correlating migratory fauna with geographically bounded areas**; such migratory fauna are typically never reconciled into terrestrial community classifications. While ideally, fish may be most diagnostic of and spatially correlated with larger scale aquatic communities, such as the ecological alliance/macrohabitat level, and generally form assemblages that overarch the finer scale variation in plant and macroinvertebrate assemblages, it is suspected that some fish assemblages are more wide ranging and may not provide fine enough distinctions at this scale. Thus, benthic fish species were sometimes used as supplementary taxa **"indicative"** of the ecological alliance/ regional macrohabitat scale we used for our STL classification. Much of the criticism of our classification came from zoologists who apparently suggest a bias in classification towards fish and mollusk assemblages, which seem to follow water flow patterns and aquatic connectivity more than the substrate and water chemistry patterns characteristic of plant and aquatic insect assemblages.

Confidence levels in the selection of the most diagnostic names for ecological alliances of STL was moderate and not as high as those for the physical features of macrohabitats present in the ecoregion. Thus, more review of these names is recommended for future iterations of the STL plan. While the STL Aquatic Community Team did not have comprehensive enough information on biotic distribution patterns throughout STL to allow as much confidence in the discernment of distinct aquatic ecological alliances as in the National Terrestrial Classification, we did follow the model of that classification based on the several working hypotheses presented above which constitute the basis for our conclusions presented below.

E. Summary and Documentation of Units.

A total of 16 tentative ecological alliances have been proposed in the STL riverine classification, corresponding to the 16 riverine macrohabitats, and 14 tentative ecological alliances have been proposed in the STL lacustrine classification, corresponding to the 14 lacustrine macrohabitats (see Table 4). Alliance names are listed in the macrohabitat characterization documents for rivers (Appendix 1) and lakes (Appendix 2) under each regional macrohabitat, with only one alliance per macrohabitat. The alliances are described basically by 1) the complete composition of ecological associations listed for their corresponding regional aquatic macrohabitat and 2) the biotic description of the macrohabitat.

<u>Nomenclatural Conventions.</u> Ecological alliances were designated by a scientific name. We used the following guidelines to derive such names:

1) Suggested Taxa:
   Select at least one taxon from each of the three major aquatic species assemblage groups (fishes, plants, macroinvertebrates). Consider including at least one taxon from each of the dominant microhabitat-species assemblage combinations in the name (e.g., one riffle macroinvertebrate and one pool macroinvertebrate). Give preference to **dominant species and species indicative** of the regional macrohabitat or the generalized macrohabitat type first, then to other characteristic species. For macroinvertebrates, give preference to **more charismatic species**, especially relatively large taxa such as mollusks and stoneflies. While some "species assemblages" or "fish alliances" of other classifications may correspond in geographic scale and taxonomic concept to the alliances we designated for the STL classification of "ecological alliances", representing interacting species and their physical environment, we sought to apply components of all 3 assemblage types to every alliance name. By doing this, we attempted to assign a name that 1) more **explicitly reflects the hypothesized interactions between the multiple species groups** and 2) assists experts who focus on only one taxonomic group with an understanding of the concept.

2) Suggested Order of Taxonomic Groups:
We consistently used: **Fishes-Plants-Macroinvertebrates** as a standard order for alliance names. List species from any other group of species (herptiles, zooplankton) at the end of the alliance name. The justification for this order is that fish species assemblages are thought to generally span the macrohabitat, and may be a better **"overarching set of taxa"** to use in comparison to plants and macroinvertebrates which are thought to generally occur at the microhabitat scale.

3) Alliances Lacking Species from the 3 Dominant Assemblage Groups:
All alliances are assumed to have a macroinvertebrate component. Alliances lacking fish are termed "**Fishless**". Alliances lacking vegetation are termed "**Non-Vegetated**" sensu (Anderson et al., 1998).

V. Classification Unit 5 (Biotic): ECOLOGICAL ASSOCIATIONS & SPECIES ASSEMBLAGES

A. Introduction.

The finest-scale units and lowest hierarchical levels in our biotic community classification are "**ecological associations**" and taxonomically more restrictive classification units that we called "**species assemblages**". Both units are narrowly defined and geographically limited and represent building blocks which are aggregated into ecological alliances.

Ecological Associations. The difference between "ecological alliances" (Classification Unit #4) and "ecological associations" (Classification Unit #5) may be confusing and was discussed under Classification Unit #4 above. Ecological associations generally correspond spatially with regional microhabitats (Classification Unit #3), examples of microhabitat types characteristic of specific regions, or even finer-scale physical divisions. The term "**plant association**", standardly used in TNC's ecoregional classifications for terrestrial communities, follows a concept similar to, but possibly taxonomically narrower in scope than our concept of ecologically holistic associations: "a plant community of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions" (Anderson et al., 2000). Ecological associations are formulated by piecing together their component species assemblages of somewhat dissimilar taxa (e.g., fish, plants, and macroinvertebrates) which repeatedly co-occur closely together within a relatively discrete physical habitat and interact with each other more often than with species of other assemblages.

Species Assemblages.

"**Species assemblages**", as defined and applied by Vermont's Aquatic Classification Work Group (1998), are interpreted in our STL classification efforts to mean "a distinct biological collection of (taxonomically similar) species which recur under similar habitat conditions and ecological processes." Species assemblages from up to 7 different taxonomic groups were used in the STL riverine and lacustrine community classifications: fishes, vascular plants, non-vascular macrophytes (including bryophytes and macroalgae), macroinvertebrates (including aquatic insects and mollusks), other vertebrates (including herptiles), phytoplankton, and zooplankton. Species assemblage features can vary from: wide-ranging anadromous or migratory fish, planktonic organisms, and assemblages lacking or depauperate in species of a given taxonomic group (e.g., "fishless assemblages"). **Fish, macroscopic plants, and macroinvertebrates** were considered the **three most charismatic dominant species groups** for use in our classification.

We interpreted and treated species assemblages not exactly as "associations" in the sense of the National Aquatic Classification and National Vegetation Classification; but rather as **"components of associations"**. For example, a typical riverine association might be composed of a unique combination of plant, macroinvertebrate, and fish assemblages, correlated with a unique hydrological and substrate setting. While associations can be interpreted as one level of "community classification", the holistic term "**ecological community**" being defined as "a variable assembly of interacting plant and animal populations that share a common environment" (Reschke, 1990), terms such as **"fish communities"** or **"plant communities"** often create or compound the confusion and detract from attempts at a holistic taxonomic classification that acknowledges 1) **correlations and interactions between flora and fauna**, and 2) **correlations and interactions between biota and the associated physical environment.** These terms may also compound difficulties in attempts to delineate the geographic boundaries of such holistic units, especially for "migratory fish communities". The holistic concept of a "vegetation-centric association" (in the sense of the NVC) was evaluated as to whether it corresponds most closely to fish and macroinvertebrate "assemblages" of Vermont's Aquatic Classification Work Group (1998) document or to "aquatic associations" or "aquatic alliances" which are more closely linked to abiotic features such as microhabitats and macrohabitats, respectively (see Figure 8). We sought to reach consensus between the NAC and NVC classifications on this matter.

Classification Objective: Ecological associations and species assemblages were not the primary focus of the first iteration of our STL river and lake classifications and their classifications were not intended to be comprehensive for the region, but they were used, whenever available, as invaluable tools and building blocks to support the formation of a classification of regional macrohabitats by aggregation into ecological alliances. We built upon the foundation of any existing association and assemblage classifications for the region. Like ecological alliance information, community classifications for STL at the association level are apparently sparse and only few such holistically described associations were found in readily available literature. Our classification of ecological associations in STL relied heavily on 1) aggregation of assemblage type information from VT ACWG (1998), 2) analyses of raw biological data, 3) knowledge from state experts, and 4) the few known documented attempts to synthesize biological information from STL into ecologically holistic units that repeat across the aquatic landscape. While we ideally sought readily available summarized/synthesized information on ecological associations and species assemblages in a concise format, we did consider other readily available documents on individual associations and assemblages for comparison. The current status of separate classifications for species assemblages of the region, the major components of ecological associations, are summarized below for each taxonomic group (see Classification Units #5A to #5D).

B. Hypotheses Supporting Association and Assemblage Classifications.

Eight assumptions and hypotheses are presented below which formed the basis of our choices for designating ecological associations and species assemblages. We focused on the correlation of these units with each other and with higher biological and physical classification units of various scales.

1. Correlations Between Various Classification Units.

Hypothesis #1. Correlations Between Assemblages of Different Taxonomic Groups: Assemblages from the three or more dominant and charismatic species groups used in the STL riverine and lacustrine classifications (Table 6) are expected to be generally spatially correlated with each other at the ecological association level. Their association with each other is expected not to be random.

Hypothesis #2. Independence of Rangewide Distribution for Assemblages of Different Taxonomic Groups: Species assemblages of different taxonomic groups show different rangewide geographic distribution patterns. Some are expected to be wide ranging, others of restricted distribution. Assemblages of different taxonomic groups that co-occur frequently throughout one region may occur with different assemblages in other regions.

Hypothesis #3. Correlations Between Assemblages and Microhabitats: Many species assemblages are expected to occur at the scale of microhabitats. However, such correlations between species and physical environment are expected to vary from one taxonomic group to the next. In rivers, many species assemblages apparently occur at the scale of flow microhabitats (run/riffle/pool). In lakes, many pelagic species assemblages apparently occur at the scale of depth/substrate microhabitats (epilimnion/hypolimnion). In contrast to this general rule, however, many benthic assemblages occur at finer scales, often correlated with specific substrate types (e.g., rock versus sand versus silt) within each benthic microhabitat type (e.g. benthic-littoral), especially in large lakes. Assemblages with migratory fishes may be one of the few exceptions to this rule and correlate better with larger scale physical habitats such as regional macrohabitats.

Hypothesis #4. Correlations Between Assemblages and Regions: The geographic range of many or most plant and macroinvertebrate assemblages that have species with stages that can undergo aerial transport (e.g., pollen, seed, winged adult stage) may best approximate ecoregion boundaries. In contrast, many assemblages dominated by fishes and mollusks (obligate aquatic species) may be correlated, at least in part, with watershed boundaries, thus complicating attempts to correlate different species assemblages and introducing the need to evaluate observed versus potential species composition in adjacent geographic areas.

Hypothesis #5. Correlations Between Assemblages and Macrohabitats: Different species assemblages are generally suspected across different ecoregional macrohabitats of the same macrohabitat type. For example, in rivers, plant assemblages in a NAP Marsh Headwater Stream are known to differ from plant assemblages in a STL Marsh Headwater Stream; in lakes, plant assemblages in a NAP Oxbow Pond are known to differ from plant assemblages in a STL Oxbow Pond.

Hypothesis #6. Correlations Between Assemblages and Macrohabitat Types: Different species assemblages are generally suspected across different macrohabitat types. Some species assemblages are found only in certain macrohabitat types and most, or perhaps all, macrohabitat types have a unique composition of species assemblages. For example, in rivers, plant assemblages in Rocky Headwater Streams are known to differ from plant assemblages in Marsh Headwater Streams; in lakes, macroinvertebrate assemblages in acidic ponds are known to differ from macroinvertebrate assemblages in alkaline ponds.

2. Taxonomic Prioritization of Different Groups of Biota.

Hypothesis #7. Prioritization of Resident Biota in Association Classifications: Assemblages of resident versus migratory species generally differ in the scale of their geographic range. Assemblages of resident species are suspected to correlate most closely with fine-scale community classification units (e.g., associations and microhabitats). Because fish are among the most mobile of aquatic biota, fish assemblages are generally more challenging to reconcile with an association classification than macroinvertebrate and plant assemblages, and thus need more critical evaluation at this scale than other species assemblages, especially for their usefulness in holistic river and lake classifications. Seasonal variation in migratory biota at the association level (i.e., spatially correlated with one microhabitat) is generally more pronounced in river communities than in lakes.

Hypothesis #8. Importance of Plants in Association Classifications: Plants, in the broad sense of the term, can and often do form a codominant component of aquatic associations (Figure 8), similar to terrestrial associations. Literature reports and NYHP field observations suggest that many above-ground ecological alliances and associations are dominated or codominated by plants in terms of percent cover or biomass. For rivers, dominant plants range from bryophytes in Rocky Headwater Streams, vascular plants in Marsh Headwater Streams, green algae in Confined Rivers, and phytoplankton in Unconfined Rivers. Similarly, the littoral zone of lakes often has abundant plants, and the epilimnion zone is cited as being dominated by phytoplankton (Widoff, 1986). This assumption was repeatedly challenged by at least one zoologist (Paul Novak); however, it is suspected that the basis of the criticism is a misunderstanding of the term **"plant"** (i.e., a focus only on vascular plants). Certainly, this assumption is well-supported by numerous plots and hundreds of observation points recorded by David during aquatic surveys for NYHP over a broad range of river and lake types and occurrences throughout New York. Granted however, there are apparently many portions of streams or even entire streams (especially degraded examples) that apparently lack vegetation, and the profundal zone of lakes is typically devoid of any vegetation.

C. Current Status of Association and Assemblage Classifications.

Few ecological associations relevant to STL were found in the literature. Most literature data focus on individual species assemblages rather than on more holistic descriptions of ecological associations linking multiple species groups. NYHP aquatic community inventory efforts since 1997 have been geared in part towards documenting ecologically holistic associations in both rivers and lakes. NYHP field forms for aquatic communities (Attachments 4 and 5) attempt to quantify the integrated composition and structure of plants and animals within a macrohabitat at the association level. Pilot ecological association classifications relevant to STL have been documented for Lake George (Hunt, 1999a; Attachment 15), presenting a holistic association classification for the littoral zone of the lake, with mention of all macroscopic species groups (see Classification Units #5A to 5C below). The NYHP classification (Reschke, 1990) also recognizes as distinct lacustrine communities 1) Great Lakes Aquatic Bed and 2) Great Lakes Exposed Shoal, two "anomalies" among the remainder of lake communities, which mostly represent basic macrohabitat types. These two lake types evidently correspond most closely to ecological associations in our STL classification.

The current status of species assemblage use in state and regional community classifications is discussed below for each of four taxonomic groups (see Classification Units #5A to 5D). The prime sources for species assemblages of STL and NAP are the classifications of VT ACWG and Great Lakes Basin. VT ACWG (1998) presents many assemblages of fishes, plants, and macroinvertebrates, with some attempts to integrate them into possible ecological associations. The Great Lakes Basin classification (Great Lakes Basin, 2000; Higgins et al., 1998) used fish assemblages as the primary and apparently sole focus of an "alliance classification", apparently this classification did not consider units at the association level.

D. Formation and Documentation of Associations and Assemblages.

Time was neither devoted nor available to fully and systematically develop background information on all ecological associations and species assemblages of STL during our team efforts, although we did opportunistically compile much information on river and lake species assemblages for the region into two characterization documents and we aggregated these into associations in the classification of regional macrohabitats, as discussed below.

1. Ecological Associations.

Like ecological alliances, we sought to designate associations that are ecologically holistic and based on least-altered benchmark examples. Their biological concept was based on dominant and characteristic permanent (i.e., resident) species and species assemblages, especially focusing on plants and macroinvertebrates, and we generally tried to avoid basing units on seasonal (i.e., migratory) species and species assemblages, especially fish and especially for the riverine classification. Because plants 1) dominate to codominate many portions of rivers and lakes, 2) are resident, non-mobile organisms, 3) are one of the least seasonally variable groups of organisms, and 4) form the food base which determines the presence of associated faunal organisms, we deemed that there is much usefulness to including plants in the concepts of ecological associations (Figure 8).

An estimate of 30 to 40 ecological associations for rivers and 100 to 200 for lakes have been proposed in the STL regional macrohabitat classification (see Table 1). Association names are listed in the macrohabitat characterization documents for rivers (Appendix 1) and lakes (Appendix 2) for each microhabitat within a regional macrohabitat, typically with many associations per macrohabitat and one to few associations per microhabitat. The associations are described basically by 1) the complete composition of species assemblages listed for their corresponding physical habitat and 2) the biotic description of these assemblages and associated habitats. Nomenclatural conventions for ecological associations are similar to those for ecological alliances presented above (see Classification Unit #4) and include: suggested taxa for the name, the order of taxonomic groups in the name, and guidelines for naming associations lacking certain groups of species.

2. Species Assemblages.

<u>Assemblage Characterization:</u> Detailed information on each of the proposed 41 riverine and 67 lake species assemblages of STL and NAP is

presented in a 13-page document for rivers (Appendix 3) and an 18-page document for lakes (Appendix 4). Assemblages are arrayed by species group, and the information is explained in an attached **species assemblage "template"** (Appendix 6). Species assemblage information includes a proposed common and scientific name, synonymy with other classifications, a basic biological description, corresponding macrohabitat and microhabitat settings, co-occurring species assemblages, distribution by state and ecoregion, known and suspected New York examples, and associated reference sources. The two species assemblage characterization documents represent updates to earlier versions which were presented for review by our team members during the classification formation process: "Riverine Species Assemblages": Part 1 of the March 22, 2000 draft of the STL river classification; "Lacustrine Species Assemblages": Part 1 of the April 27, 2000 draft of the STL lake classification. The characterization of each of three major taxonomic groups and other miscellaneous fauna is discussed below in more detail (see Classification Units #5A to 5D). Assemblages are also listed in the macrohabitat characterization documents for rivers (Appendix 1) and lakes (Appendix 2) for each microhabitat within a regional macrohabitat, typically with numerous assemblages per macrohabitat and multiple assemblages per microhabitat. The justification for the use of species assemblages of different taxonomic groups in the STL classification are also presented below in more detail.

Nomenclatural Guidelines: Species assemblages are designated in our STL classification by both common and scientific names. We chose common names that attempted to describe features of assemblages such as characteristic ecoregion, characteristic physical habitat, or diagnostic species (e.g., dominant species). Scientific names of assemblages may contain either common or scientific names of individual species or genera of component biota. Following the lead of other models, the conventions for **"assemblage scientific name"** are apparently to use scientific names for species or genera of macroinvertebrates (cf. VT ACWG, 1998), scientific names of species for plants (cf. NVC), but common names for fish (cf. Higgins et al., 1998; VT ACWG, 1998). Following the lead of Mark Anderson for macroinvertebrates, the Order associated with a specific genus or species was added to more easily identify the group of macroinvertebrates, an assumption being that many heritage community ecologists may not be able to easily infer the common name of macroinvertebrate orders from genus and species names without the use of this aid. Conventions for selecting component or diagnostic species to derive the assemblage name were intended to follow the standard guidelines for naming associations in the NVC, especially for plant assemblages, and are thought to have roughly followed the model for ecological alliances presented above (see Classification Unit #4).

VI. Classification Unit 5A (Biotic): VEGETATION ASSEMBLAGES

A. Introduction

We attempted to integrate vegetation (i.e., plant) assemblages into all ecological associations and alliances that form the biotic components of the 25 river macrohabitats/alliances proposed in our STL aquatic community classification, 8 of which are characteristic of STL, and 25 lake macrohabitats/alliances proposed in our STL aquatic community classification, 10 of which are characteristic of STL. These include assemblages of **vascular plants**, **bryophytes**, **macroscopic algae**, and **phytoplankton**, as well as one generic "**non-vegetated assemblage**". For simplicity sake, we treated phytoplankton as "plants" and proposed separate "vegetation assemblages" for them in the pelagic microhabitat, especially of lakes.

David Hunt and Susan Warren brought much expertise in aquatic plants to our team discussions to compile plant assemblages for STL. Steve Young (NYHP) was interviewed briefly and contributed to our knowledge of aquatic plants in lakes of New York. Although other ecologists on our team, Mark Anderson and Eric Sorenson, have their backgrounds in plant ecology, their expertise lies in terrestrial systems. Like for other species groups considered in the STL classification, our cumulative team knowledge base on aquatic plants increased during the ecoregion crosswalk meetings.

B. Current Status of Vegetation in Aquatic Classifications.

Regional and state community classification efforts have variably treated vegetation assemblages, as discussed below. As of 2000, the historic treatment of vegetation in the two national community classification initiatives has apparently been:

1) NVC: Includes some aquatic vascular plant assemblages, but is apparently far from being comprehensive. Excludes all or most aquatic non-vascular, aquatic sparsely vegetated, aquatic non-vegetated, and deepwater submergent vascular plant assemblages.
2) NAC: Essentially ignores the vegetation component of aquatic systems. In the pilot studies and classification for the Great Lakes Basin, there was apparently no mention of plants.

1. Terrestrial Ecoregion and Heritage Program Classifications.

Aquatic vegetation assemblages known from STL and NAP have been proposed for various terrestrial ecoregional classifications and crosswalks including NYHP's state association crosswalk (Hunt, 1995), NYHP's NAP crosswalk (Hunt, 1999c), ecoregional crosswalks for NAP (Anderson, 1998) and the Great Lakes (Faber-Langendoen, 1997), NE U.S. regional vegetation classification (Sneddon et al., 1998; see Attachment 16 for a sample), and the National Vegetation Classification (Anderson et al., 1998). Plants have received varying attention in the classifications of aquatic communities for heritage programs: NYHP (1990), VTHP (1989, 1996), NHHP (1992, 1999), and MEHP (1991). The classification of VTHP has little mention of vegetation species or assemblages in riverine communities except for Fontinalis (in Seasonal Stream) and Podostemum (in High Gradient Stream). The classification of MEHP mentions vegetation only generally, without reference to individual species, other than Fontinalis and Podostemum, which are listed in the key to river types under headwater to midreach streams. Characteristic plant species are described for 5 of the 6 Vermont lake types of VTHP (Thompson, 1989) and 6 of the 10 Maine lake types of MEHP, with a more general reference to plants made for 3 other Maine lake types. No references to plants are made in the NHHP classifications (Sperduto, 1992; NHHP, 1999). NYHP (Reschke, 1990) treats vegetation as an integral component of aquatic macrohabitats and many dominant and characteristic plants are listed in the description of 14 of the 16 lacustrine communities and all 7 riverine communities of this classification. David has drafted much language for the pending 2002 revision to the state classification which includes hypothesized dominant, characteristic, and indicator plant taxa for most river and lake macrohabitat types and many of their regional variants.

2. Vermont's Aquatic Classification Work Group (VT ACWG).

VT ACWG (1998) provides a classification of aquatic macrophyte assemblages in lakes but none for rivers. Four lake assemblages were designated for the entire state of Vermont, mostly from common deepwater lake types. This classification provided a good check to NVC associations and NYHP information. Only plant assemblages of specialized lake types such as Marl Pond and Meromictic Lake are suspected to be underrepresented.

3. Local Field Data.

NYHP field surveys of all aquatic macrohabitat types of the northern New York region were conducted by Elizabeth McLean and David Hunt. Elizabeth surveyed deeper water rivers and lakes and focused vegetation information on plankton assemblages, mostly from lakes. David surveyed shallower water rivers and lakes. Rivers surveyed by David within NAP were mostly headwater streams and Intermittent Streams, especially from the Tug Hill. David has also surveyed many headwater streams and Intermittent Streams and Confined Rivers in other parts of the state. David's surveys focused on compilation of macroscopic vegetation information including 1) bryophytes as dominants in communities such as Intermittent Stream and Vernal Pool, and 2) vascular plants, which were abundant in Marsh Headwater Streams. A pilot lake association classification project for Lake George conducted by David (Hunt, 1999a) provides very detailed information on plant assemblages and their corresponding physiochemical habitat throughout the littoral zone of the lake (Attachment 15). For Vermont, VT DEC has extensive macrophyte data from most lakes in the state (Susan Warren, pers. com.), and as of 2001 Susan and Neil Kamman had plans to compile that information into detailed assemblage descriptions for each lake type.

C. Justification for Treatment of Vegetation Assemblages in Proposed STL Aquatic Community Classification.

Vegetation assemblages are useful for classifying various aquatic communities because they occur at a fine scale, display a wide variety of types which differ in their local to rangewide distribution, and different plant species can be dominant in, characteristic of, or indicative of microhabitats, regional macrohabitats, or macrohabitat types. Vegetation assemblages in aquatic communities (at least those of the STL-NAP) are essentially restricted to the benthic depth/substrate microhabitat, with the exception of some phytoplankton assemblages, which are especially common in lakes. They apparently occur at the scale of flow microhabitats (run/riffle/pool) in rivers and generally at or finer than the scale of depth/substrate microhabitats in lakes. In lakes, many pelagic plant assemblages (primarily phytoplankton) apparently occur at the scale of depth/substrate microhabitats (e.g., epilimnion), while many benthic plant assemblages occur at finer scales, often correlated with specific substrate types (e.g., rock versus sand versus silt) within each benthic microhabitat type, primarily the benthic-littoral zone.

Vegetation assemblages generally differ across riverine macrohabitat types (e.g., headwater streams vs. Confined River vs. Unconfined River) and lacustrine macrohabitat types (e.g., acidic lakes vs. alkaline lakes; intermittent lakes vs. permanent lakes). Additionally, different vegetation assemblages are generally suspected in different ecoregional variants of the same macrohabitat type (e.g., NAP Unconfined River vs. STL Unconfined River). The literature suggests that some plant assemblages, including those dominated by vascular plants or phytoplankton, are unique to certain basic macrohabitat types or regional macrohabitats. Inland Salt Pond has a unique array of vascular plants (see Appendices 2 and 4). Additionally, certain phytoplankton species are known to form distinctive assemblages in the pelagic zone of lakes in the STL ecoregion, especially for Lake Champlain (Lake Champlain Basin Study, 1979; Darrin Freshwater Institute staff, pers. com.). Phytoplankton may also form distinctive assemblages in the pelagic zone of larger, more slowly flowing rivers in STL, especially the Saint Lawrence River as a Great Lakes Deepwater River, as suggested by standard aquatic ecology references.

D. STL/NAP Vegetation Assemblage Classification.

Vegetation assemblages proposed for STL were not intended to be comprehensive, but rather were compiled mostly to provide support to our regional macrohabitat classification. Vegetation assemblages in the STL aquatic macrohabitat/alliance classification are based primarily upon the model and products of the National Vegetation Classification (NVC) (Anderson et al., 1998). Assemblages in rivers built upon those in the NVC, supplemented by those suggested from 1) NYHP's riverine classification (Reschke, 1990), 2) David's preliminary review of numerous data from NYHP field surveys documented for the Adirondack Exemplary Community Project, and 3) river occurrence leads throughout the Adirondack Chapter of TNC (Hunt, 2002a). The latter sources include field forms which presented some of the few information on potential bryophyte assemblages. Assemblages in lakes also built upon those in the NVC, with supplementation from those suggested from 1) lacustrine classifications of heritage programs, primarily NYHP (Reschke, 1990), 2) the lake assemblages in Vermont's Aquatic Classification Work Group document (1998), 3) David's preliminary review of numerous data from NYHP field surveys documented for the Adirondack Exemplary Community Project, and 4) lake occurrence leads throughout the Adirondack Chapter of TNC (Hunt, 2002a). The latter sources included 1) a pilot lake association project on Lake George (Hunt, 1999a), which presented the only information on sparsely vegetated and deep littoral associations (Attachment 15), and 2) field forms with potential phytoplankton assemblages. Historic reports for Lake Champlain and Lake George were especially helpful for phytoplankton assemblages. Less information was available for review for phytoplankton assemblages than for assemblages of macroscopic plants, and thus the confidence level for these types is lower.

Tallies of plant assemblages known from rivers and lakes of STL and NAP are presented in Table 1. A total of 15 river assemblages are characterized (see Appendix 3), 10 of which are characteristic of STL and 14 of which are suspected to occur in STL. These include 6 vascular plant-dominated assemblages, 6 bryophyte-dominated assemblages, 1 macroalgae-dominated assemblage, and 1 phytoplankton-dominated assemblage. A total of 26 lake assemblages are characterized (see Appendix 4), 18 of which are characteristic of STL and 23 of which are suspected to occur in STL. These include 11 vascular plant-dominated assemblages, 7 macroscopic non vascular plant-dominated assemblages, and 8 phytoplankton-dominated assemblages.

Vascular plant assemblages are variable, ranging from those dominated by floating-leaved plants to those dominated by rosette-leaved submergents, shallow water assemblages to the deeper water quillwort meadow, densely vegetated to sparsely vegetated assemblages, and those characteristic of rocky, sandy or silty substrates. "Milfoil bed" designated from Lake George (Hunt, 1999a) was not included in our classification as it is treated as a cultural association type. Non-vascular plant-dominated assemblages include those with abundant cover (e.g., deepwater beds of Nitella, a macroalgae, in lakes) to "sparsely vegetated" algae-dominated assemblages (e.g., aquatic cliffs), to various shallow stream assemblages dominated by bryophytes.

VII. Classification Unit 5B (Biotic): MACROINVERTEBRATE ASSEMBLAGES

A. Introduction

We attempted to integrate macroinvertebrate assemblages into all ecological associations and alliances that form the biotic components of the 25 river macrohabitats/alliances proposed in our STL aquatic community classification, 8 of which are characteristic of STL, and 25 lake macrohabitats/alliances proposed in our STL aquatic community classification, 10 of which are characteristic of STL. These include assemblages of **aquatic insect larvae**, **adult aquatic insects**, and **mollusks** (bivalves and snails).

NYHP staff did not have enough familiarity with several of Vermont's Aquatic Classification Work Group (VT ACWG) macroinvertebrate assemblages to easily crosswalk state assemblages and attribute these assemblages to New York EOs. Kathy Schneider (NYHP), the program's expert on mollusks, had good knowledge of mollusk assemblages in riverine macrohabitats of the region and fair knowledge of them in lacustrine macrohabitats of the region. Assistance was also solicited from Paul Novak (NYHP), the program's expert on odonates, who had time to help only with our river assemblage classification efforts. Our cumulative team knowledge base on macroinvertebrates increased during the ecoregion crosswalk meetings, with Vermont macroinvertebrate ecology expert Steve Fiske present to help guide our decisions. An initial crosswalk between macroinvertebrate assemblages and associated microhabitats and macrohabitats (and/or macrohabitat types) was attempted for many assemblages.

B. Current Status of Macroinvertebrates in Aquatic Classifications:

Regional and state community classification efforts have variably treated macroinvertebrate assemblages, as discussed below. As of 2000, the historic treatment of macroinvertebrates in the two national community classification initiatives has apparently been:

1) NVC: Treats macroinvertebrates as an integral component of vegetation associations, but they have not been an explicit focus of the association description and name, and apparently little or no macroinvertebrate assemblages, and perhaps few macroinvertebrate species, have been addressed in this classification.

2) NAC: Presents a classification framework as a model for including macroinvertebrate assemblages. Apparently a national classification of assemblages has not yet been attempted, however assemblages in part of the Great Lakes Basin were examined as part of a pilot study.

1. Great Lakes Basin.

A pilot study for macroinvertebrate assemblages of the Great Lakes Basin (Higgins et al., 1998) was conducted in Lower Michigan and only for rivers. From 8 to 16 species groups were able to be distinguished, suspected perhaps to correspond to aquatic macrohabitats. Species identification efforts of the survey teams were apparently focused at the family level, and thus Higgins et al. (1998) claimed that it was difficult to characterize macroinvertebrate assemblages, recommending finer resolution of taxa to the genus or species level. This study apparently did not document any specific assemblages for STL. Similarly, no macroinvertebrate assemblages were presented at the Great Lakes Basin portfolio meeting for New York (Great Lakes Basin, 2000).

2. Vermont's Aquatic Classification Work Group (VT ACWG).

VT ACWG (1998) presented a classification of 10 riverine macroinvertebrate assemblages from a wide range of perennially flowing river macrohabitats of STL and NAP across Vermont, about 4 characteristic of STL and 4 characteristic of NAP. This classification appears to be biased towards the riffle flow microhabitat (see VT ACWG, 1998, p. 5). Macroinvertebrate assemblages of other microhabitats (especially pools) may be underrepresented or undercharacterized. The data also appears to be biased towards wadeable streams (see VT ACWG, 1998, p. 5). Thus, macroinvertebrate assemblages of other macrohabitats (e.g., deep streams, shallow streams, and subterranean streams) may be underrepresented. Despite its gaps, the VT ACWG classification provided the best starting point for a comprehensive set of macroinvertebrate assemblages for rivers of STL and a very good model to follow. It appears comprehensive for a subset of STL streams but neither for all macrohabitat types, all regional macrohabitats, all microhabitat types, nor all specific microhabitats in Vermont or in STL.

VT ACWG (1998) presented a classification of 28 potential lacustrine macroinvertebrate assemblages from a moderately wide range of lake macrohabitats across Vermont. This classification appears comprehensive across the full array of light regime and depth/substrate microhabitat types, even covering subterranean and profundal areas, unlike VT ACWG's river assemblage classification. Assemblages covering most of the common lake macrohabitat types for STL, from deepwater to intermittent lakes, were presented. Only macroinvertebrate assemblages of specialized lake types such as Marl Pond are suspected to be underrepresented. The classification was presented as "preliminary" and mostly arrayed into a 5 by 5 matrix of lake types (corresponding to lake macrohabitat types) and habitat types (corresponding to microhabitat types) within those lakes, listing up to 3 dominant and characteristic species for each of the 25 combinations. There was apparently no attempt made to further consolidate these combinations into biologically unique units and to describe associated taxa. Three additional types were proposed, including Vernal Pool and Subterranean Lake, but the remaining one is deemed to be a palustrine type and wasn't added to our STL aquatic community classification. Despite its gaps, the VT ACWG classification also provided the best starting point for a comprehensive set of macroinvertebrate assemblages for lakes of STL.

3. Terrestrial Ecoregion and Heritage Program Classifications.

Aquatic macroinvertebrate assemblages have evidently not been addressed in aquatic associations of any terrestrial ecoregional classifications and crosswalks for the NE U.S. Also, macroinvertebrates have received at most only few references in the classifications of aquatic communities for state heritage programs of this region: NYHP (1990), VTHP (1989, 1996), NHHP (1992, 1999), and MEHP (1991). The only mention of macroinvertebrates in riverine community classifications of these four states has been that of VTHP (1989), with a casual reference to mayflies and stoneflies (i.e., at the taxonomic level of Order) and mussels in one stream type (Medium Gradient Stream). Similarly, mention in lacustrine communities is sparse, with only NYHP (1990) presenting information on a few macroinvertebrate genera in 4 of its 16 lake types. In practice, NYHP has treated macroinvertebrates as an integral component of aquatic macrohabitats, but the historically published classification (Reschke, 1990) does not provide much detailed information on specific macroinvertebrate assemblages at any scale. David has drafted much language for the pending 2002 revision to the state classification which includes hypothesized dominant, characteristic, and indicator macroinvertebrate taxa (mostly at the family to genus level) for most river and lake macrohabitat types and many of their regional variants.

C. Justification for Treatment of Macroinvertebrate Assemblages in Proposed STL/NAP Classification.

Like vegetation assemblages, macroinvertebrate assemblages are useful for classifying aquatic communities because they occur at a fine scale, display a wide variety of types which differ in their local to rangewide distribution, and different macroinvertebrate species can be dominant in, characteristic of, or indicative of microhabitats, regional macrohabitats, or macrohabitat types. Macroinvertebrate assemblages in aquatic communities of STL may be concentrated in the benthic depth/substrate microhabitat (e.g., benthic epifauna in riffles of rivers; fauna of the firm substrate and vegetation of the benthic zone in lakes), although assemblages from the pelagic microhabitat (e.g., neuston fauna in pool microhabitats of rivers; neuston fauna of lakes) are known and have been proposed. Few or no pelagic assemblages are suspected from the open water column of lakes, other than perhaps freshwater jellyfish which David has observed in LNE lakes, this part of the lake typically being dominated by fish and plankton assemblages. Macroinvertebrate assemblages apparently occur at the scale of flow microhabitats (run/riffle/pool) in rivers of STL and depth/substrate microhabitats or even finer scale in lakes of STL. In lakes, pelagic macroinvertebrate assemblages are suspected to occur at the scale of depth/substrate microhabitats (epilimnion/hypolimnion), while many benthic macroinvertebrate assemblages occur at finer scales, often correlated with specific substrate types (rock versus sand versus silt) within each benthic microhabitat type (e.g. benthic-littoral).

Macroinvertebrate assemblages generally differ across riverine macrohabitat types (e.g., headwater streams vs. Confined River vs. Unconfined River) and lacustrine macrohabitat types (e.g., acidic lakes vs. alkaline lakes; intermittent lakes vs. permanent lakes) (cf. VT ACWG, 1998). Additionally, different macroinvertebrate assemblages are generally suspected in different ecoregional variants of the same macrohabitat type (e.g., NAP Unconfined River vs. STL Unconfined River) (cf. VT ACWG, 1998). Donnelly (1999) suggests that odonates in the Adirondacks portion of NAP represent one of the most complete "boreal assemblages" in the E U.S., although specific corresponding macrohabitats are not indicated, and these "assemblages" may be geographically much broader in concept than those used in our classification. The literature suggests that some macroinvertebrate assemblages are unique to certain basic macrohabitat types or regional macrohabitats. Physical habitats known to have a unique array of macroinvertebrates (see Appendices 2 and 4) include: 1) subterranean areas, with species adapted to darkness and known from both rivers and lakes, 2) deep profundal areas, with many infauna adapted to anaerobic conditions and known especially from lakes, 3) species of dystrophic waters, 4) species of meromictic waters, 5) species of vernally aquatic habitats, and 6) several assemblages apparently unique to Lake Champlain.

D. STL/NAP Macroinvertebrate Assemblage Classification.

Macroinvertebrate assemblages proposed for STL were not intended to be comprehensive, but rather were compiled mostly to provide support to our regional macrohabitat classification. Macroinvertebrate assemblages in the STL aquatic macrohabitat/alliance classification are based primarily on assemblages documented by Vermont's Aquatic Classification Work Group (1998). Other information comes from 1) David's casual preliminary review of rivers and lakes documented for the Adirondack Exemplary Community Project, 2) a pilot lake association project on Lake George (Hunt, 1999a), 3) river and lake occurrence leads throughout the Adirondack Chapter of TNC (Hunt, 2002a), and 4) a few other references including two which focus on Lake Champlain assemblages (Fiske & Levey 1996; Levey & Fiske 1996) and two which focus on mollusk assemblages of New York (Ericson, 1995; Strayer, 1995). NYHP EOs and leads include field forms which presented some of the few information on potential "neuston assemblages". The pilot lake association project on Lake George (Hunt, 1999a) presented good quantitative information on shallow to deep littoral associations.

While we had a good model to follow for macroinvertebrates of rivers (VT ACWG, 1998) to distinguish regional variants across STL and NAP, a similar model for lakes was lacking. Regional differences between STL and NAP variants of lake types were inferred in our efforts: 1) as a secondary consequence of differences in pH, trophy and alkalinity correlated with the physical settings of STL and NAP, with STL types generally being more alkaline and eutrophic than NAP types, and 2) from scattered data synthesized by NYHP with less precise descriptions. A total of 13 lake macroinvertebrate assemblages thought to be characteristic of either STL or NAP were proposed by David, as reflected by "STL" or "NAP" in the name of many of these assemblages (see Appendix 4). Further review of these assemblages is recommended for the second iteration of the plan, especially for the New York part of STL and especially by NYS DEC macroinvertebrate expert Bob Bode.

Tallies of macroinvertebrate assemblages known from rivers and lakes of STL and NAP are presented in Table 1. A total of 16 river assemblages are characterized (see Appendix 3), 11 of which are characteristic of STL and all 16 of which are suspected to occur in STL. These include 10 assemblages derived directly from VT ACWG (1998) and 6 additional types derived from NYHP data corresponding to gaps in the VT ACWG classification at the microhabitat level (subterranean areas, profundal areas, and especially pool areas) or for "uncommon" river types (e.g., very shallow streams).

A total of 24 lake assemblages are characterized (see Appendix 4), 11 of which are characteristic of STL and 21 of which are suspected to occur in STL. These include 12 assemblages directly consolidated from VT ACWG (1998) and 12 additional types derived from NYHP data corresponding primarily to gaps in the VT ACWG classification which cover a combination of specialized lake macrohabitat types, regional variants across STL and NAP, and 3 odonate assemblages which were not easily crosswalked with VT ACWG types. Upon casual analysis of the 28 potential assemblage types in VT ACWG (1998), which include species under 25 different combinations of lake type and habitat type, David suggested that these could be consolidated into the aforementioned 12 relatively biologically unique assemblage types. Assemblages for Pine Barrens Vernal Pond, Meromictic Lake, Winter-Stratified Monomictic Lake and Summer-Stratified Monomictic Lake, all apparently lacking in the VT ACWG classification, were proposed. Five assemblages, thought to be somewhat unique, were proposed from Lake Champlain (a Summer-Stratified Monomictic Lake) and thought to differ in dominant species from similar assemblages proposed in VT ACWG (1998). Confidence in macroinvertebrate assemblage types varies, with high confidence in VT ACWG riverine assemblages, good confidence in VT ACWG lacustrine assemblages, and lower confidence in the NY-proposed assemblages.

VIII. Classification Unit 5C (Biotic): FISH ASSEMBLAGES

A. Introduction.

We attempted to integrate fish assemblages into all ecological associations and alliances that form the biotic components of the 25 river macrohabitats/alliances proposed in our STL aquatic community classification, 8 of which are characteristic of STL, and 25 lake macrohabitats/alliances proposed in our STL aquatic community classification, 10 of which are characteristic of STL. These include various assemblages dominated by coldwater to warmwater fishes as well as one generic "**fishless assemblage**".

NYHP staff did not have enough familiarity with several of the Vermont fish assemblages to easily crosswalk state assemblages and attribute assemblages to New York EOs. Assistance was solicited from Paul Novak, (NYHP), the program's expert on fish, but he had little time to help with our efforts. Our cumulative team knowledge base on fishes increased during the ecoregion crosswalk meetings, with Vermont fish ecology experts Rich Langdon and Mark Ferguson present to help guide our decisions. An initial crosswalk between fish assemblages and associated macrohabitats (and/or macrohabitat types) was attempted for several assemblages.

B. Current Status of Fish in Aquatic Classifications.

Regional and state community classification efforts have variably treated fish assemblages, as discussed below. As of 2000, the historic treatment of fishes in the two national community classification initiatives has apparently been:

1) NVC: The NVC apparently treats fishes as an integral component of vegetation associations, but they have not been an explicit focus of the association description, and apparently little or no fish assemblages, and perhaps few fish species, have been addressed in this classification.

2) NAC: Presents a classification framework as a model for including fish assemblages. Apparently a national classification of assemblages has not yet been attempted, however assemblages throughout the Great Lakes Basin were proposed as part of a pilot study.

1. Great Lakes Basin.

A pilot study for fish assemblages in the Great Lakes Basin (Higgins et al., 1998) was conducted in Lower Michigan and only for rivers. Five "fish alliances" (interpreted in our classification to mean "species assemblages") were able to be distinguished that were "biologically and statistically meaningful" and suspected to correspond roughly in geographic scale to aquatic macrohabitats (see Attachment 17). No examination of fish assemblages in lakes were apparently conducted for this pilot study. More recently, during efforts of the Great Lakes Basin (2000) ecoregion team to assemble a portfolio of aquatic sites for the New York portion of the basin, 8 "fish communities" (interpreted in our classification to mean "species assemblages") were proposed: 5 riverine assemblages and 3 lacustrine assemblages (see

Attachment 18).

2. Vermont's Aquatic Classification Work Group (VT ACWG).

VT ACWG (1998) presents a classification of 6 fish assemblages in rivers of STL and NAP, 3 characteristic of STL, 3 characteristic of NAP. This classification appears to lump together information from all microhabitats within a macrohabitat, and is apparently not refined enough to classify fish assemblages that occur at the microhabitat scale (e.g., assemblages of more sedentary species, more specific to the benthic zone). While it was thought that some fish assemblages were spatially correlated 1:1 with regional macrohabitats, others may span associated pairs of macrohabitats such as Rocky Headwater Stream-Marsh Headwater Stream or Confined River-Unconfined River. The classification, based on fish sampling data, appears to be biased towards wadeable streams, like the macroinvertebrate assemblage classification. Fish assemblages of other river macrohabitats (e.g., deep streams, shallow streams, and subterranean streams) may be underrepresented. Despite its gaps, the VT ACWG classification provided the best starting point for a comprehensive set of fish assemblages in rivers of STL, more comprehensive than that of the Great Lakes Basin (2000) and a good model to follow. It appears fairly comprehensive for common stream types throughout Vermont and applicable to much of STL in general.

VT ACWG (1998) presented a classification of 4 lacustrine fish assemblages, essentially unresolved between STL and NAP types and borrowing from the macrophyte assemblage classification which designated species assemblages apparently mostly for common deepwater lake types. Because of the large historic impact on fish composition in lakes of Vermont from disturbances such as stocking and the scarcity of "reference-level lakes" with their presettlement fish composition still intact, the classification was presented as "suspect", but the result of best professional judgement as to the original historic assemblage types. Despite its gaps, the VT ACWG classification also provided the best starting point for a comprehensive set of fish assemblages for lakes of STL, more comprehensive than that for the Great Lakes Basin (2000) in the ecoregion.

3. Terrestrial Ecoregion and Heritage Program Classifications.

Fish assemblages have evidently not been addressed in aquatic associations of any terrestrial ecoregional classifications and crosswalks for the NE U.S. Also, fish are not well-addressed in aquatic community classifications of three of the four state heritage programs of the region: VTHP (1989, 1996), NHHP (1992), and MEHP (1991). For rivers, there is only casual mention of 1) anadromous fish for one river type each in the classifications of VTHP (Major River) and MEHP (Main Channel River Community), and 2) brook trout for VTHP's High Gradient Stream. The only mention of fish in lake communities classified by these three programs is lake trout for MEHP's Tarn Community.

New York Heritage Program treats fishes as an integral component of aquatic macrohabitats, and the historically published classification (Reschke, 1990) provides much preliminary detail on specific fish assemblages, derived primarily from state fish expert Bob Daniels. Fish assemblage information is presented at the species level for all 6 perennial stream macrohabitats in the classification. Additionally, for one stream type, Midreach Stream, fish of different microhabitat types (i.e., riffle/run/pool) are mentioned. Fish assemblage information is also presented at the species level for 11 of the 16 lake types and there is a more general reference to fish in an additional 3 of the 5 remaining types. Despite the abundance of fish information in this classification, the descriptions of macrohabitats may represent an averaging of streams of aquatic macrohabitats across New York which may lump fish of different regions and thus present groups of fish that differ somewhat in concept from those of the apparently more geographically restrictive "fish assemblages" used in our STL classification. Regional variation in fish composition, suggestive of the fish assemblages used in our STL classification, are presented for one lake type (North Atlantic Coast variant of Eutrophic Dimictic Lake) and one river type (Main Channel Stream, with several regional variants) in the NYHP classification. David has drafted much language for the pending 2002 revision to the state classification which includes hypothesized dominant, characteristic, and indicator fish taxa for most river and lake macrohabitat types and many of their regional variants.

C. Justification for Treatment of Fish Assemblages in Proposed STL Classification.

The role of fish in delineating ecological alliances was discussed above under Classification Unit #4. Basically, it is generally perceived that individuals of many fish species are more mobile and wide ranging and have a wider range of environmental tolerance than plant and macroinvertebrate species, similar to species in terrestrial communities such as wide-ranging mammals and migratory birds, and thus may be more helpful in distinguishing ecological alliances than finer scale ecological associations. Fish assemblages appear most useful for classifying and designation of larger-scale aquatic communities and different fish species may be dominant in, characteristic of, or indicative of regional macrohabitats, or macrohabitat types. Unlike plant and macroinvertebrate assemblages, all or most STL fish assemblages apparently occur at or beyond the scale of macrohabitats, both in river and lakes. They usually span more than one of the run/riffle/pool flow microhabitat types in rivers, often span more than one depth/substrate macrohabitat in lakes (e.g., epilimnion and hypolimnion), and they are even suspected to cross light regime microhabitats from subterranean to above-ground areas. Many assemblages are suspected even to span pairs of associated macrohabitats of similar stream order (e.g., the Rocky Headwater Stream-Marsh Headwater Stream pair or Confined River-Unconfined River pair). At the extreme may be assemblages based on anadromous fish that represent the most widely ranging aquatic species in the region. Anadromous fish from the STL and NAP regions include 1) American shad from the Saint Lawrence River, 2) Atlantic salmon from the northwest Adirondack area and Lake Champlain, and 3) smelt and sea lamprey from Lake Champlain (TNC-ECS, 2002c).

Most fish assemblages of rivers and lakes in STL are apparently centered in the pelagic depth/substrate microhabitat, although some fish species are suspected to be more closely tied to the benthic microhabitat (e.g., darters and suckers), and some of these species may be restricted to even finer scale habitats, often correlated with specific substrate types (rock versus sand versus silt) within each benthic microhabitat type (e.g. benthic-littoral), as observed during NYHP surveys in the STL-NAP area by David (e.g., for Tug Hill streams, Lake George). As a general rule, resident fish, which provide a stronger basis for association-level community classification, are hypothesized to be primarily benthic species, and we tried to weight these species more heavily than migratory and pelagic fish species in our classification for STL aquatic communities, at least for our regional macrohabitat classification. The complexities of heavily weighting migratory fish species in a community classification have been discussed many times in this report, and led to much debate during our efforts between our team of community ecologists and peripherally involved cooperating zoologists.

Fish assemblages in STL and throughout the NE U.S. region are hypothesized to differ across macrohabitat types, or at least across different groups of macrohabitat types. For example, in rivers, different assemblages are expected between headwater streams vs. larger rivers. Similarly, in lakes, different assemblages are expected between acidic lakes vs. alkaline lakes, isolated ponds vs. oxbow ponds, and intermittent lakes vs. permanent lakes. Part of these differences are attributable to the correlation between temperature-dependent fish assemblages and temperature-related parameters (temperature, stream position and elevation). Like plant and macroinvertebrate assemblages, different fish assemblages are generally suspected in different ecoregional variants of the same macrohabitat type (e.g., NAP Unconfined River vs. STL Unconfined River) (cf. VT ACWG, 1998). Again, these differences are expected to be correlated with the difference in coldwater vs. warmwater fishes across ecoregion lines and historic zoogeography patterns.

Only a few fish species occupy specialized habitats and thus have limited distribution in STL (VT ACWG, 1998). The most unique fish assemblage may be that for Bog Lake, with fish diversity essentially reduced to a single species, and the very diverse assemblages of Lake Champlain, as a Summer-Stratified Monomictic, and St. Lawrence River, as a Deepwater River. Shallow lakes and rivers with only a limited number of species may also represent relatively unique types, with more consistency in species composition than deepwater aquatic communities.

D. STL/NAP Fish Assemblage Classification.

Fish assemblages proposed for STL were not intended to be comprehensive, but rather were compiled mostly to provide support to our regional macrohabitat classification. Fish assemblage components used in the STL macrohabitat/alliance classification come primarily from Vermont's Aquatic Classification Work Group document (1998) and 3 assemblages applied to the NW part of the New York/Vermont STL study area presented in the Great Lakes Basin (2000) aquatic site selection portfolio (see Attachments 17 and 18). Other information comes from 1) David's casual preliminary review of rivers and lakes documented for the Adirondack Exemplary Community Project, 2) a pilot lake association project on Lake George (Hunt, 1999a), 3) surveys of several Tug Hill streams, 4) river and lake occurrence leads throughout the Adirondack Chapter of TNC (Hunt, 2002a), and 5) a few other reports.

Because of their usually wide environmental tolerance range, fish assemblages, perhaps more so than assemblages of plants and macroinvertebrates, apparently represent a continuum paralleling the similar continual gradient between riverine and lake macrohabitat types (e.g., see Figure 3) and comparable to the typical continuum observed between matrix forest types within an ecoregion in the corresponding terrestrial community classification system. Thus, somewhat arbitrary thresholds between fish assemblage types are suspected. Sparse New York data for fish reviewed by NYHP suggests that there are unclear breaks in VT ACWG's fish assemblages among New York EOs, possibly partially an artifact of such potentially arbitrary divisions. Correlations with fish assemblages from several stream systems on the Tug Hill (NAP) spanning four macrohabitat types surveyed by David Hunt were rather rough (see NYHP field forms). In addition to the taxonomic challenge of a continuum of fish assemblages, the "inherent" expression of many fish assemblages has reportedly been altered by major hydrological disturbances and introduction and spread of exotic fish species (e.g., from stocking and escape of bait fish), thus further confounding any classification attempts using fish, especially relative to plant and macroinvertebrate assemblages (cf. VT ACWG, 1998). Review of fish assemblages for the New York portion of STL is recommended for the second iteration of the STL plan, especially evaluation of assemblages potentially characteristic of the western part of STL and especially by NYS DEC fish experts Doug Carlson and Bill Schoch.

Tallies of fish assemblages known from rivers and lakes of STL and NAP are presented in Table 1. A total of 9 river assemblages are characterized (see Appendix 3), 7 of which are suspected to occur in STL, all characteristic of the ecoregion. The 9 river assemblages include 6 types derived directly from VT ACWG (1998) and 3 additional types derived from NYHP analysis including one generic "fishless assemblage" and 2 assemblages thought to be restricted to the western part of STL in New York and more similar to the assemblages of the Great Lakes Basin (2000). A total of 8 lake assemblages are characterized (see Appendix 4), again with 7 suspected to occur in STL and all 7 characteristic of the ecoregion. The 8 lake assemblages include 4 types derived directly from VT ACWG (1998) and 4 additional types derived from NYHP analysis including one generic "fishless assemblage", 2 pond (shallow water) assemblages thought to be distinct from or subsets of their corresponding lake (deepwater) assemblages in their lower species diversity, and one unique assemblage for Lake Champlain with especially high species diversity mentioned as a "particularly unique" example of Mesotrophic-Eutrophic Lake in VT ACWG (1998). Confidence in these fish assemblages are moderately high but variable, with VT ACWG types thought to be more substantiated than those proposed by NYHP.

IX. Classification Unit 5D (Biotic): OTHER FAUNAL ASSEMBLAGES
(Herptiles, Mammals, and Zooplankton)

A. Introduction.

No concerted effort was made to systematically organize information for faunal assemblages of STL and NAP other than those for fish and macroinvertebrates; however, where we had ready access to information on other faunal types, we reviewed the information and opportunistically used it to propose species assemblages, especially those thought to be characteristic or indicative of taxonomically higher physical and biological classification units such as regional macrohabitats. The literature suggests that 1) the presence and abundance of herptiles are related to the presence and abundance of predatory fish, and 2) some zooplankton assemblages are unique to certain basic macrohabitat types, thus justifying the use of herptile and zooplankton assemblages in our proposed STL classification.

B. Current Status of Other Faunal Groups in Aquatic Classifications.

Few attempts were made to identify herptile and zooplankton assemblages for aquatic communities of STL from the literature, especially for rivers. The best source of herptile assemblages for use in the aquatic macrohabitats of STL and NAP may be that presented in Vermont's Aquatic Classification Work Group document (1998). Other information comes from David's casual preliminary review of lakes documented for the Adirondack Exemplary Community Project, river and lake occurrence leads for the Adirondack Chapter of TNC (Hunt, 2002a), and a few other literature reports.

C. STL/NAP Herptile and Zooplankton Assemblage Classifications.

Herptile and zooplankton assemblages proposed for STL were not intended to be comprehensive, but rather were compiled opportunistically to provide support to our regional macrohabitat classification. Several herptile and zooplankton assemblages were proposed as provisional types which need further correlation with other assemblages in our classification. Herptile assemblages were proposed from a preliminary review of VT ACWG (1998) and NYHP field survey data. Several zooplankton assemblages in lakes were proposed, primarily based on casual preliminary review of lakes documented for the Adirondack Exemplary Community Project such as Lake Champlain. In general, less information on zooplankton was available for review, and the confidence in these types are lower than for assemblages of macroscopic biota. A future recommendation is to conduct additional research for both herptile assemblages, including more review of the VT ACWG (1998) document, and zooplankton assemblages, especially to determine if a classification of lake zooplankton of the region is discernible from the results of Stemberger and Miller (1999) who studied several lakes in the STL and NAP region of New York and Vermont, and synthesize the information into refined assemblage descriptions.

Tallies of river and lake assemblages for herptiles and zooplankton of STL and NAP are presented in Table 1. For rivers, 2 herptile assemblages are presented (Appendix 3), both of which are suspected to occur in STL, all characteristic of the ecoregion. No zooplankton assemblages were proposed for rivers. For lakes, 2 herptile assemblages are presented (Appendix 4), both of which are suspected to occur in STL, and 1 of which is characteristic of the ecoregion. Also for lakes, 7 zooplankton assemblages are presented (Appendix 4), 6 of which are suspected to occur in STL, all of these characteristic of the ecoregion.

X. Other Classification Units Considered.

The STL Aquatic Community Team decided to address relatively small aquatic features of various structure embedded within the two largest aquatic macrohabitats of the region, namely Lake Champlain as a STL Summer-Stratified Monomictic Lake and the upper St. Lawrence River as a Great Lakes Deepwater River, as primary conservation targets in the STL aquatic community portfolio, but did not explicitly design a classification of them. We termed these features **"embedded features"** and addressed them in more detail in the STL Aquatic Community Viability and Portfolio Documents (Saint Lawrence/Champlain Valley Aquatic Community Working Group, 2002a, 2002b). Two types of embedded features were designated: **"nearshore features"** (or **"shoreline habitats"**) and **"faunal concentration areas"** (or **"significant habitat types"**). Together, these features relate to aquatic species assemblages or levels of diversity intermediate between associations and alliances (i.e., aggregations of associations) and generally occur at physical scales smaller than microhabitats.

Nearshore features addressed in our STL aquatic community portfolio include: bays, deltas, and rocky nearshore areas. Great Lakes Aquatic Bed of the NYHP classification represents an aggregation of one or more ecological associations typically found in bays, with several EOs documented by NYHP in the upper St. Lawrence River and also Lake Champlain (the latter EOs provisionally classified as "Mesotrophic Dimictic Lake"). Great Lakes Exposed Shoal of the NYHP classification also represents an aggregation of one or more ecological associations and is typically found in rocky nearshore areas, with one EO documented by NYHP in the upper St. Lawrence River. "Delta" was not recognized as a distinct community type in the 1990 NYHP classification but is known to be an embedded feature in many lake types of this classification. Several nearshore lake areas were suggested as conservation targets during the portfolio selection meetings for the New York portion of the Great Lakes Basin (2000) which included part of STL. Five specific nearshore types were presented for the STL portion of the basin roughly analogous to rocky nearshore areas, bays and deltas and ranging in substrate type from various bedrock types to clay (see Attachment 9). The specific nearshore areas listed for the Great Lakes Basin portfolio were applied only to Lake Ontario and the adjacent Saint Lawrence River, but undoubtedly crosswalk to similar littoral associations within large lakes in STL, especially Lake Champlain.

Faunal concentration areas tracked by NYHP include warmwater fish concentration areas, waterfowl concentration areas, and raptor concentration areas. These features are thought to represent areas where migratory species concentrate during a particular stage of behavior, generally correlated with certain seasons of the year.

FUTURE RECOMMENDATIONS.

The following recommendations are suggested as selective ways to explore improvements to the STL aquatic community classification, ideally during the second iteration of the STL Ecoregion plan.

A. Review of Additional Classification Schemes.

1. Conduct a more extensive review of approaches to aquatic community classification among the many references in the general aquatic ecology and limnology literature, especially "The Development of an Aquatic Habitat Classification System for Lakes" available at ECS and Rosgen's "A Classification of Natural Rivers"; Focus on any references that cover all or part of STL. Review references suggested by Jonathan Higgins (Lewis and Magnuson, 1998; Lewis et al., 1999; Schupp, 1992; Tonn et al., 1990; Tonn and Magnuson, 1982) relating to the use of fish and snails in lake classifications that he claimed were "critical to the development of a robust lake classification".
2. Review other products of TNC's regional Aquatics Working Group to assess and improve our classification units, especially for thresholds used to distinguish similar macrohabitat types and macrohabitats.
3. Continue to compare methods used to derive our STL classification to general classification methods used in TNC ecoregional plans nationwide.
4. Reconcile any aquatic community classifications that are created for adjacent ecoregions, including Northern Appalachians, Great Lakes, and Lower New England. Note that the NAP classification has been started by the STL Aquatic Community Team of David Hunt, Eric Sorenson, Mark Anderson with the help of Vermont aquatic experts.
5. Obtain information on how river and lake types in STL were designated during the Great Lakes Basin ecoregional planning efforts. Compare these types to units designated during our STL ecoregion planning efforts. Refine the reconciliation of Great Lakes Basin (2000) classification units with those of our STL classification, especially for rivers and especially for types characteristic of STL.
6. Collaboratively review the similarities and discrepancies between the Heritage Approach and TNC's Aquatic System Approach to classification for both physical and, if available from the latter, biological features. Compare 1) the number of classification units, 2) parameters used to derive classification units, and 3) thresholds between classification units. Evaluate the integration of the two approaches to classification as a way to have one procedure for identifying occurrences at the aquatic macrohabitat level, thus deciding whether to rely most heavily on heritage or GIS-derived data for any given occurrence.
7. Conduct an initial comparison between our STL lake classification and any GIS classification of lakes eventually derived from TNC ECS.

B. Re-evaluate the First Iteration Classification Units.

8. More rigorously evaluate whether our first iteration classification units, especially regional macrohabitats, are comprehensive and appropriately delimited and denote accurate and precise threshold values. Include further comparisons to all classification schemes referenced above.

9. Lump together equivalent species assemblages, especially of the same taxonomic group, and better link assemblages into associations and alliances.
10. Explore the desirability and feasibility of identifying and documenting thresholds between regional macrohabitats (e.g., NAP vs. STL variants of each macrohabitat type), as was done for macrohabitat types.
11. More critically assess the relationship between alkalinity/pH and trophic status to biota distribution in lakes, then reevaluate the associated prioritization of these factors in our classification hierarchy.
12. Further evaluate a potential refinement of the classification of large rivers, especially differences between midreach stream (3rd to 4th order) and main channel stream (5th to 6th order) and especially by evaluating correlations between the suspected macroinvertebrates differences among these types with any potential differences in plants and fish assemblages.
13. Evaluate the potential split of NAP community types, especially regional macrohabitats, between those characteristic of 1) the Tug Hill (and possibly HAL), 2) the central, typical portion of NAP from the Adirondacks to western Maine, and 3) the Boreal Lowlands, and between the drainage of 1) the Atlantic Coast versus 2) the Great Lakes and Saint Lawrence River.
14. Conduct more literature review and research for herptile and plankton assemblages, especially for rivers, and synthesize the information into appropriate assemblage descriptions. Review especially any results from Stemberger and Miller (1999) for zooplankton assemblages from 26 lakes in the Adirondacks and Champlain Valley of New York and 4 lakes in the Champlain Valley of Vermont.
15. More carefully evaluate the desirability and feasibility of generating a comprehensive classification of all regional microhabitats and ecological associations applicable to water bodies throughout STL.
16. More critically evaluate the relationship between potential pelagic versus benthic assemblage classifications, especially in regards to resident plants and macroinvertebrates versus migratory fish, and the possibility and desirability of maintaining separate classifications.
17. Consult academic and field experts and specialists to review our classification units. Conduct expert interviews (e.g., "experts meetings") to refine and strengthen the classification, especially in New York beyond the efforts of Carol Reschke (1985-1990) and D. Hunt (1995-1997). David's suggestions for additional experts include member of NYS DEC Division of Water, Cornell University, and David Strayer. Experts that have previously been interviewed might be revisited, especially Bob Daniels and staff of the Adirondack Lake Survey, Darrin Freshwater Institute, NYS DEC Fisheries, SUNY Plattsburgh, and Paul Smiths College.
18. Track down additional GIS data layers, especially those that include lake depth, alkalinity and other water chemistry parameters to advance GIS analyses of lake macrohabitats.
19. Consult information from aquatic databases, especially those of state agencies, to further review our classification units.

C. Revise Community Descriptions.

20. More rigorously evaluate whether our classification units are accurately and precisely described. Include further comparisons to classification schemes referenced above. Continue to solicit review of our characterization documents from STL Aquatic Community Team members: these documents are large and team members may not have had enough time for a thorough review. A recommended focus for edits is to the revise the microhabitat and assemblage composition of all macrohabitats.
21. Further review ecological alliance names to best represent diagnostic species.
22. Reconcile descriptive information for macrohabitat types between heritage-documented EOs and other EOs crosswalked to our classification during the 1st iteration with any TNC GIS analyses.
23. Reconcile any occurrence specifications of heritage programs other than NYHP with specifications of NYHP for macrohabitat types and the general classification methods used to guide our approach here.
24. Supplement and/or refine the community descriptions and general parameters used to distinguish and describe community types.
25. Refine the geomorphological terminology in our macrohabitat type descriptions with the help of Mike Kline of VT DEC and more careful review of the river types in Rosgen's classification.
26. Finish revisions of the descriptions of community types peripheral within STL (mostly NAP types but especially GL types) to further distinguish them.
27. Develop descriptions of estuarine river and lake types suspected from the Quebec portion of STL with the help of Quebec ecology staff.
28. Compile extensive VT DEC macrophyte data information available from most Vermont lakes into detailed assemblage descriptions for each regional lake macrohabitat in our STL classification (already planned by Susan Warren and Neil Kamman).
29. Refine community descriptions using any newly surveyed EOs (heritage documented or in other databases), especially to help refine the taxonomic bounds of classification units.
30. Encourage additional surveys, especially using heritage methodology, to seek information to fill gaps in community descriptions, especially regional macrohabitats with skeletal descriptions.
31. Better quantify aspects of communities including abundances of plants and animals, flow parameters in rivers, and water chemistry parameters in lakes.
32. Continue to derive from GIS quantitative features of community types from documented EOs to add to the description.
33. More fully develop descriptive information on associations and assemblages, especially consolidating information from several known scattered sources.

D. Apply the Classification to EOs and Test the Fit.

34. Apply descriptions of aquatic macrohabitat types and regional macrohabitats to known occurrences (heritage-documented EOs or EOs in other state databases) to help refine their identity.
35. Increase NYHP staff familiarity with VT macroinvertebrate and fish assemblages to more easily crosswalk VT ACWG-based assemblages to NY EOs of STL-designated regional macrohabitats.
36. More critically compare VT river macroinvertebrate sampling sites to our STL river macrohabitat classification with the help of Steve

Fiske (VT DEC) to explore crosswalking to our classification.

37. More critically compare VT fish data to our river macrohabitat classification with the help of Rich Langdon (VT DEC) to explore crosswalking to our classification.
38. Conduct additional expert interviews (e.g., experts meetings) to identify and crosswalk the best examples of each community type especially for New York beyond the efforts of D. Hunt (1995-1997). David's suggestions for additional experts are listed in Recommendation #17 above.
39. Assess, compile, and crosswalk to community types extensive New York sampling data from agencies such as NYS DEC Fisheries and NYS DEC Water. Use sampling data from Adirondack Lake Survey, Darrin Freshwater Institute, Paul Smiths Aquatic Institute and others to refine NAP lake types.
40. Confirm the presence of EOs of any peripheral communities questionably present in STL, especially Great Lakes types and especially in the Black River Valley and Jefferson County. Seek out literature information or obtain field data anew for occurrences in these areas.
41. Apply our classification to all heritage-documented EOs or EOs in other databases from the Quebec portion of STL.

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DICHOTOMOUS KEY TO BASIC FRESHWATER AQUATIC MACROHABITAT TYPES OF NEW YORK

Used for STL Ecoregion
Draft 2: January 10, 2003
Consolidated Riverine/Lacustrine Version
David M. Hunt, Ecological Intuition & Medicine

Need Eventual Expansion of Key for Estuarine and Marine Aquatic Types.
(e.g., especially for estuarine types in Quebec STL).

(Reschke, 1990) Aquatic communities of a flowing, non-tidal stream, in portions of the stream that lack persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation.
Riverine System (1)

(Reschke, 1990) Aquatic communities of a lake or pond in a topographic depression or dammed river channel, in portions of the lake or pond that lack persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation. **Lacustrine System** (2)

1A. (Reschke, 1990 supplemented) Underground communities that are never exposed to sunlight (or at a minimum containing an outer twilight zone, ideally containing a small portion of dark zone). BIOTA: dark zone tolerant and possibly obligate species present.......................................**Riverine Cave Community**
=Subterranean Stream
Biotic/Ecoregional Variants: STL, NAP, LNE, HAL, GL?.

1A. (Reschke, 1990 supplemented) Above-ground communities that are usually exposed to some sunlight. BIOTA: light tolerant and obligate species. (ABOVE GROUND STREAMS)

1B. Stream flow intermittent or ephemeral (during an average year number of zero-flow days at least ten days and flow detectable for at least one week); uppermost part of river system (including "zero order" stream segments); watershed small (typically much less than 2 mi^2). BIOTA: bryophytes abundant, often greater than 50% cover, obligate aquatic plants (algae, plankton, hydrophytic vascular plants) absent or very scarce, fish absent or very scarce, amphibians may be present..............**Intermittent Stream**
Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC.

1B. Stream flow perennial (during an average year number of zero-flow days at most ten days); 1st or higher order stream segments. BIOTA: bryophytes at most only moderately abundant and concentrated on banks and periodically exposed substrate, obligate aquatic plants (algae, plankton, hydrophytic vascular plants) typically present and often abundant, fish typically present, amphibian abundance relatively low. (PERENNIAL STREAMS)

1C. Surface connectivity to adjacent stream communities only at downstream end; watershed very small (typically much less than 2 mi^2).

1D. Flow trickling vertically from deep groundwater. BIOTA: generally coldwater plant and animal species, typically abundant hydrophytic vascular plants and bryophytes, fish may be absent..**Spring**
Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC?

1D. Flow stagnant emanating laterally through subsurface of upstream end of levee associated with adjacent river

(hyporheic?); BIOTA: generally warmwater plant and animal species including abundant aquatic macrophytes and algae, fish typically present..............................**Backwater Slough**
Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC.

1C. Surface connectivity to adjacent aquatic communities both upstream and downstream; watershed moderate-sized to large (typically much greater than 2 mi^2).
(STANDARD STREAM SEGMENTS)

1E. Relatively shallow (usually less than 4 m deep) and narrow (usually averaging less than 2 m wide) streams of stream order 1 to 2 (3 to 4) near the source of a river system (usually within 5 miles); usually with low discharge, high adjacent canopy cover in forested regions, principal nutrient source allochthonous (originating outside the stream system), limited coarse woody debris, non-braided channels, headward erosion, minimal deposition, and temperature often relatively cool to cold; watershed moderate-sized (typically 2 to 30 mi^2). BIOTA: bryophytes typically in moderate amounts, typically with coldwater animal species, plankton assemblages poorly developed, fish diversity typically low to moderate. (HEADWATER STREAMS)

1F. Confined streams with predominance (greater than 30% area) of riffle microhabitat and paucity of run microhabitats; with high to low gradient (slope typically at least 2 degrees, as low as 1 degree), coarse rocky substrate (typically bedrock and cobble), good aeration (typically with abundant whitewater), relatively high velocity; usually surrounded by upland (terrestrial) communities, typically forested uplands. BIOTA: bryophytes typically in moderate amounts, epilithic algae moderately abundant, vascular plants depauperate, riffle specialist fauna abundant, fauna characteristic of pools and soft bottoms at low abundance....................**Rocky Headwater Stream**
= Confined Headwater Stream
=High Gradient Headwater Stream

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC?

1F. Meandering streams with predominance of run microhabitat and paucity of riffle microhabitat; with very low gradient (slope usually much less than 1 degree), fine mucky substrate, poor aeration (typically with little or no whitewater), low velocity; usually surrounded by wetland (palustrine) communities, typically shrub swamp, emergent marsh or fen, for greater than 50% of length. BIOTA: vascular plants typically abundant, bryophytes typically at low amounts, epilithic algae typically at low amounts, riffle specialist fauna at low abundance, fauna characteristic of pools and soft bottoms abundant ....**Marsh Headwater Stream**
= Unconfined Headwater Stream
= Meandering Headwater Stream
= Low Gradient Headwater Stream

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC?
Coastal Plain Stream of Reschke (1990) may include NAC Variant.

1E. Relatively deep (often with portions greater than 4 m deep) and wide (usually averaging more than 2 m wide) streams of stream order (3 to 4) 5 or higher, well downstream from the source of a river system (usually greater than 5 miles); usually with high discharge, low adjacent canopy cover, principal nutrient source autochthonous (originating within the stream system), abundant coarse woody debris, temperature often relatively warm; often with lateral erosion, braided channels and substantial deposition; watershed large (typically greater than 30 mi^2). BIOTA: bryophytes absent or confined to banks and exposed surfaces, typically with warmwater animal species, plankton assemblages may be well developed, fish diversity typically high to moderate. (HIGH ORDER STREAMS, "RIVERS")
(= MAJOR RIVERS)

1G. Shallower rivers, without a profundal (dark) zone and a hypolimnion), usually of small to moderately large stream orders (5 to 6); watershed very large (typically 30 to 4000 mi^2). BIOTA: profundal obligates in low abundance or absent, fish diversity typically moderate to high.
(STANDARD "RIVER" TYPES)

1H. Confined stream with a well-defined pattern of riffle, run and pool microhabitats and abundance of riffle microhabitat; with moderate to low gradient (typically with slope at least 2 degrees, as low as 1 degree), coarse rocky substrate (typically cobble or sand), good aeration (typically with moderate amount of whitewater), relatively high velocity, prominent erosion and minimal deposition; usually surrounded by upland communities, typically cobble shore or riverside sand-gravel bar. BIOTA: epilithic algae moderately abundant, vascular plants absent to sparse, plankton assemblages relatively sparse, riffle specialist fauna abundant, fauna characteristic of pools and soft bottoms at low abundance................................**Confined River**
= Confined Moderate to Large Stream
Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP.

1H. Meandering stream with predominance of run microhabitat and paucity of riffle microhabitat; with very low gradient (slope usually much less than 1 degree), fine substrate (typically silt), poor aeration (typically with little or no whitewater), relatively low velocity, prominent deposition and minimal erosion; usually surrounded by wetland communities, typically floodplain forest, often with levees. BIOTA: epilithic algae relatively sparse, plankton assemblages relatively abundant, vascular plants may be common in shallow areas and areas of slow flow, riffle specialist fauna relatively sparse, fauna characteristic of pools and soft bottom at high abundance...........**Unconfined River**
= Meandering River
= Unconfined Moderate to Large Stream
= Meandering Moderate to Large Stream
Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC.
NAC Variant included under Coastal Plain Stream of Reschke (1990).

1G. Deepwater river, theoretically with a profundal (dark) zone (and possibly a hypolimnion zone?), usually of very large stream order (8 or higher?); watershed very large (typically much greater than 4000 mi^2). BIOTA: profundal obligates present in profundal zone, fish diversity typically very high........................**Deepwater River**

Biotic/Ecoregional Variants: GL.

2A. Salinity at least 0.5 ppt; BIOTA: saline-tolerant species. (SALINE LAKES)

Includes...**Salt Pond**

Biotic/Ecoregional Variants: GL.

Expansion of Key for Saline Lakes Outside of New York Would Go Here.

2A. Salinity less than 0.5 ppt; BIOTA: saline-intolerant species. (FRESHWATER LAKES)

2B. (Reschke, 1990 supplemented) Underground communities that are never exposed to sunlight (or at a minimum containing an outer twilight zone, ideally containing a small portion of dark zone); BIOTA: dark zone tolerant and possibly obligate species present. ....**Lacustrine Cave Community** (=Subterranean Lakes)

Biotic/Ecoregional Variants: STL, GL?, NAP?, LNE?, HAL?, WAP?

2B. (Reschke, 1990 supplemented) Above-ground communities that are usually exposed to some sunlight; BIOTA: light tolerant and obligate species. (ABOVE GROUND LAKES)

2C. Surface water intermittent (during an average year water level drops below substrate surface for at least ten days, water level remains above substrate surface for at least one week), often inundated in the spring and dry by late summer; heavily influenced by groundwater levels; BIOTA: amphibians relatively abundant, fish usually absent or at most relatively scarce. (INTERMITTENT PONDS)

2D. Situated in deep, acidic (pH less than 7), sandy soils; usually in a barrens, especially pine-dominated terrestrial barrens; usually containing several closely associated emergent aquatic vegetation zones; BIOTA: suspected to be acid tolerant species............. **Pine Barrens Vernal Pond**

Biotic/Ecoregional Variants: LNE-GL-NAP, NAC.

2D. Often situated in loamy soils of variable pH; (water chemistry differences are known between this and sinkhole pond); usually in a forested setting, especially deciduous forests, and typically with overhanging forest canopy; BIOTA: usually with depauperate emergent aquatic vegetation zones and leaving an exposed mudflat when drying; BIOTA: variable....................................... **Vernal Pool**

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC.

2D. Situated in calcareous soils (pH at least 7), often clay; (water chemistry differences are known between this and vernal pool); often in limestone woodland settings, usually underlain by karst topography. BIOTA: suspected to be calciphiles/acid intolerant species........... **Sinkhole Pond**

Biotic/Ecoregional Variants: STL-GL, LNE, NAP?, HAL?, WAP?.

2C. Surface water perennial (during an average year water level generally remains above the substrate or drops below substrate surface for only less than ten days); not heavily influenced by groundwater levels; BIOTA: fish typically present, amphibian abundance relatively low. (PERENNIAL LAKES)

2E. Closely associated with riverine communities (of fluvial lake genesis) usually surrounded by a marsh or floodplain, and with hydrology strongly influenced by the associated river (frequency of levee overflow less than 5 years); thermal stratification of water column disrupted during summer of an average year, permanent stratification only during winter ("inverse stratification" with ice at the surface); water continually circulating throughout summer and thus monomictic, shallow to moderately shallow lakes (typically to maximum of ca. 20 feet deep); BIOTA: may contain riverine species assemblages; profundal obligates in low abundance or absent, profundal intolerant species relatively abundant; pelagic component suspected to be poorly developed. (FLUVIAL LAKES)

2F. Situated adjacent to but separated from the main channel of a riverine community most of the year, typically formed from old meanders of the river cut off on both ends from the channel or from periodic overflow of the river levee; water relatively stagnant with relatively low flushing rate; generally associated with streams of orders 3 and higher; BIOTA: varying from riverine to mixed riverine-lacustrine species assemblages based on frequency of levee overwash events.........**Oxbow Pond** = Levee Lake

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC?.

2F. Situated along the main channel of a riverine community, usually formed from a relatively large natural impoundment (e.g., beaver dams) or deepening of the river; water not stagnant and with relatively high flushing rate; generally associated with streams of orders 3 and lower; BIOTA: riverine species assemblages.........................**Flow Through Pond** (= In-Line Lake)

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL, WAP, NAC?.

2E. Not associated with and strongly influenced by adjacent riverine communities, usually not surrounded by a marsh or floodplain; water strongly influenced vertically from deep groundwater (EVALUATE TERMINOLOGY); thermal stratification variable; BIOTA: primarily lacustrine species assemblages, typically with riverine species assemblages lacking or at low abundance. (STANDARD LAKE TYPES)

2G. Water column with permanent or prolonged periods of chemical stratification (forming a chemocline); Water column never completely mixes at any time of the year or with only very brief periods of complete mixing: ideally with only partial mixing in the mixolimnion above the chemocline but no mixing in the monimolimnion below the chemocline, where conditions are anoxic and there are high concentrations of dissolved salts; typically within a small, deep sheltered kettle; BIOTA: generally biotically depauperate, "chemically tolerant" species in the monimolimnion zone.............**Meromictic Lake**

Biotic/Ecoregional Variants: STL, GL, NAP, LNE?, HAL?, WAP?.

2G. Water column completely mixes at least once per year; Water column generally not permanently chemically stratified; BIOTA: "chemically tolerant" species absent. (HOLOMICTIC LAKES)

2H. Alkalinity low (generally less than 12.5 mg/l calcium carbonate); ANC low; trophic state typically oligotrophic;

BIOTA: vascular plants with low species diversity; "acid tolerant" species dominant. (ACIDIC LAKES)

2I. Trophic state dystrophic (with low conductivity, stained dark brown/tannic colored); typically unstratified, (may be dicothermic??: EVALUATE THIS FURTHER); lake usually with a closely associated peatland; substrate of thick peat to muck; BIOTA: "dystrophic tolerant" species present.. **Bog Lake**

Biotic/Ecoregional Variants: NAP, LNE, HAL, GL?, WAP?, NAC?.

2I. Trophic state oligotrophic; water clear; stratification variable; lake usually without a closely associated peatland; substrate typically of coarse sediments; BIOTA: dominated by oxygen-requiring species; vascular plants usually at relatively low abundance and dominated by rosette-leaved species, green algae at low abundance, cyanobacteria generally absent, cold-water fish present and typically dominant, chironomids typically in Tanytarsus group (apply to NAP & STL?: check Steve F.), low-oxygen tolerant species including warm-water fish typically in low abundance, lacking or confined to the littoral and epilimnion zones (especially in sheltered shallow bays); "dystrophic tolerant" species in low abundance. (CLEAR ACIDIC LAKES)

2J. Thermal stratification of water column disrupted during summer of an average year, permanent stratification only during winter ("inverse stratification" with ice at the surface); water continually circulating throughout summer and thus monomictic (FURTHER EVALUATE THIS: NOT POLYMICTIC?); shallow to moderately shallow lakes (typically to maximum of ca. 20 feet/7 m deep); usually with low habitat diversity; BIOTA: profundal obligates in low abundance or absent, profundal intolerant species relatively abundant; pelagic component, including fish predators, poorly developed................ **Acidic Pond**

Biotic/Ecoregional Variants: NAP, LNE, HAL, WAP, GL?, NAC?.

2K. Note: in some ecoregions in NY (NAC, possibly GL), "coastal ponds" might key here (SEPARATE DESCRIPTION NOT PROVIDED IN STL TEXT: seasonal water level fluctuations usually dramatic, temperature warm, coarse underlying sediments, need comparison with intermittent ponds), BIOTA:.............. **Coastal Pond**

Biotic/Ecoregional Variants: NAC, GL, LNE?.

2K. Note: (A POTENTIAL HIGHLY ACIDIC/ACIDIC SPLIT MAY BE WARRANTED AND SHOULD BE DISCUSSED FOR NAP LAKE TYPES). Highly acidic, high elevation ponds in NAP have been called "tarn ponds", distinguished from the more typical acidic ponds: pH acidic; temperature relatively cold; BIOTA: vegetation sparse.... **Tarn Pond**

Biotic/Ecoregional Variants: NAP, LNE?, HAL?.

2J. Thermal stratification of water column persistent throughout summer of an average year (maintaining a distinct thermocline separating the epilimnion and hypolimnion), water not continually circulating throughout summer; moderately to very deep lakes (typically at least 20 feet/7 m deep, ideally at least 30ft/10m deep); usually with high habitat diversity; BIOTA: profundal tolerant/ obligate species in abundance (especially in the profundal zone); pelagic component well developed with cold-water fish typically abundant and typically including deepwater salmonids and coregonids (ACIDIC DIMICTIC LAKES)

Biotic/Ecoregional Variants: NAP, LNE, HAL, WAP?, GL?, NAC?.

2L. May Include........... **Oligotrophic Acidic Dimictic Lake**
2L. May Include.............. **Eutrophic Acidic Dimictic Lake**

2H. Alkalinity high (generally greater than 12.5 mg/l calcium carbonate); ANC high; trophic state typically eutrophic to mesotrophic; secchi depth typically < 4 m; substrate organic; BIOTA: vascular plants with high species diversity; floating-leaved aquatic plants common;"acid tolerant" species in low abundance. (ALKALINE LAKES)

2M. Thermal stratification of water column disrupted during summer of an average year, permanent stratification only during winter ("inverse stratification" with ice at the surface); water continually circulating throughout summer and thus monomictic (FURTHER EVALUATE THIS: NOT POLYMICTIC?); shallow to moderately shallow lakes (typically to maximum of ca. 20 feet deep); BIOTA: profundal obligates in low abundance or absent, profundal intolerant species relatively abundant; pelagic component generally poorly developed. (SHALLOW ALKALINE LAKE TYPES) (=WINTER-STRATIFIED MONOMICTIC)

2N. Large, open lakes, usually at least about 100 acres and with sufficient width and surface area/depth ratio to have thermal stratification strongly influenced by wind so that the water column is well mixed in summer creating fairly uniform temperature and oxygen levels from top to bottom; may have moderately depth (to at most about 30 or 40 feet), can occur at deeper depths than sheltered ponds without summer stratification; usually with high habitat diversity; BIOTA: pelagic component, including fish predators, moderately well developed........... **Winter-Stratified (Monomictic) Lake**

Biotic/Ecoregional Variants: STL-GL, NAP, LNE?, HAL?, WAP?. Suspect all New York examples of this type are alkaline.

2N. Small, sheltered lakes, usually less than about 100 acres ("ponds") and with insufficient width and surface area/depth ratio to have thermal stratification strongly influenced by wind, thus the summer water column is fairly uniform in temperature and oxygen levels from top to bottom as a result of shallow depth; usually very shallow, up to at most about 20 feet/7 m deep; usually with low habitat diversity; BIOTA: pelagic component, including fish predators, poorly developed. (ALKALINE PONDS)

2O. Alkalinity moderately high (with calcium carbonate concentrations 12.5 to 70 mg/l // 50 ppm) .... **Alkaline Pond**

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL?, WAP?.

2O. Alkalinity very high (with calcium carbonate concentrations exceeding 70 mg/l // 50 ppm); with calcium rich marl deposits on substrate and plants; BIOTA: calciphiles predominate including Chara spp., Potamogeton filiformis, P. vaginatus, vascular plant diversity low............................ **Marl Pond**

Biotic/Ecoregional Variants: GL, LNE?, HAL?, WAP?.

2M. Thermal stratification of water column persistent throughout summer of an average year (maintaining a distinct thermocline separating the epilimnion and hypolimnion), water not continually circulating throughout summer; moderately to very deep lakes (typically at least ca. 20 feet deep); usually with high habitat diversity; BIOTA: profundal tolerant/obligate species in abundance (especially in the profundal zone); pelagic component well developed. (DEEP ALKALINE LAKES)

2P. (Inverse) Thermal stratification of water column not developed or only weakly developed during winter of an average year (not forming ice at surface) or disrupted throughout much of winter and thus permanently stratified only during summer, and water continually circulating and isothermal throughout winter and thus with only one period of mixing and turnover (in the fall) and therefore monomictic; lakes usually very large and open (well over 5,000 acres) and usually very deep (well over 200 feet), and with sufficient width and surface area to have thermal stratification strongly influenced by wind and wave action during the winter so that the ice cover is broken up during times that similar lake types are frozen over, thus creating fairly uniform temperature and oxygen levels from top to bottom; BIOTA: deep profundal species and winter epilimnion plankton species abundant. ....**Summer-Stratified (Monomictic) Lake** (=? Warm-Monomictic Lake)

Biotic/Ecoregional Variants: STL, GL-HAL, LNE?, WAP?.

Suspect all New York examples of this type are alkaline.

2Q. (NEED EXPANSION AND COMPILATION FOR GL; IS THIS JUST THE GL VARIANT OF THE FORMER?) May Include: Size >500,000 acres; BIOTA: with estuarine species ....**Deepwater Lake**

Biotic/Ecoregional Variants: only GL.

Known in Reschke (1990) as Great Lakes Deepwater Community.

2P. Water column inversely thermally stratified during winter (forming ice at surface) in addition to summer stratification and with two turnovers/periods of mixing per year (in the spring and fall) and thus dimictic; BIOTA: deep profundal species and winter epilimnion plankton species suspected to be at relatively low abundance (ALKALINE DIMICTIC LAKES)

2R. Trophic state typically oligotrophic (nutrient poor, with chlorophyll a levels 0.3-3 ug/l, with total phosphorous 0 to 10 ug/L after complete circulation, with low primary productivity reflected by low DIC/dissolved inorganic carbon at less than 75 g/m2/year, with relatively low nitrogen concentrations, with relatively low epilimnion volume/hypolimnion volume ratio (usually <1), with high transparencies reflected by secchi depths greater than 4 m, well oxygenated in the profundal zone) to dystrophic; substrate typically of shallow, coarse mineral soil; BIOTA: dominated by oxygen-requiring species; vascular plants usually at relatively low abundance and rosette-leaved species may dominate, cyanobacteria generally absent, cold-water fish present and typically dominant, chironomids typically in Tanytarsus group (apply to NAP & STL?: check Steve F.), low-oxygen tolerant species including warm-water fish typically in low abundance, lacking or confined to the littoral and epilimnion zones (especially in shallow sheltered bays)............. **Oligotrophic Alkaline Dimictic Lake**

Biotic/Ecoregional Variants: STL, GL?, NAP?, LNE?, HAL?, WAP?.

2R. Trophic state typically eutrophic to mesotrophic (relatively nutrient rich, with chlorophyll a levels greater than 3 ug/l, with total phosphorous greater than 10 ug/L after complete circulation, with high primary productivity reflected by high DIC/dissolved inorganic carbon at 75-200 g/m2/year, with relatively low nitrogen concentrations, with relatively high epilimnion volume/hypolimnion volume ratio (usually >1), with relatively low transparencies reflected by secchi depths less than 4 m, with oxygen depletion in the profundal zone); substrate typically of deep fine organic sediments; BIOTA: vascular plants usually at relatively high abundance, usually dominated by low-oxygen tolerant species, cyanobacteria and green algae generally abundant, warm-water fish abundant and typically dominated by cyprinids and centrachids (sunfishes), chironomids typically in Chironomus group (apply to NAP & STL?: check with Steve F.), oxygen-requiring species including cold-water fish typically in low abundance, lacking or confined to the profundal and hypolimnion zones................ **Eutrophic Alkaline Dimictic Lake**

Biotic/Ecoregional Variants: STL, GL, NAP, LNE, HAL?, WAP?.

Biotic/Ecoregional Variants:
STL = Saint Lawrence-Lake Champlain Ecoregion
GL = Great Lakes Ecoregion
NAP = Northern Appalachians Ecoregion
LNE = Lower New England Ecoregion
HAL = High Allegheny Plateau Ecoregion
WAP = Western Allegheny Plateau Ecoregion
NAC = North Atlantic Coast Ecoregion

APPENDIX 1.

SAINT LAWRENCE/CHAMPLAIN VALLEY ECOREGION (STL)
RIVERINE MACROHABITAT/ALLIANCE CLASSIFICATION
First Iteration

Known and Suspected, Extant and Extirpated Community Elements
Crosswalked to Current and Potential State and National Classifications

Including all Known Northern Appalachian (NAP) Types in New York and Vermont

Original: July 7, 2000; David Hunt, New York Natural Heritage Program
Update: January 10, 2003; David Hunt, Ecological Intuition & Medicine

LIST OF RIVERINE MACROHABITATS FOR STL (**R**iver **M**acrohabitats)

A. Characteristic STL and NAP Macrohabitats. (with fully developed descriptions)

RM3 STL Intermittent Stream
RM1 NAP Acidic Intermittent Stream
RM2 NAP Calcareous Intermittent Stream
RM18 STL Spring
RM4 NAP Spring
RM6 STL Rocky Headwater Stream
RM5 NAP Rocky Headwater Stream
RM8 STL Marsh Headwater Stream
RM7 NAP Marsh Headwater Stream
RM10 STL Confined River
RM9 NAP Confined River
RM12 STL Unconfined River
RM11 NAP Unconfined River
RM15 STL Backwater Slough
RM14 NAP Backwater Slough
RM17 STL Subterranean Stream
RM16 NAP Subterranean Stream
RM13 GL Deepwater River

B. Estuarine Macrohabitats Likely from Quebec STL/Absent from NY & VT STL. (without descriptions developed)

RM. Acadian Freshwater Tidal River
RM. Acadian Brackish Tidal River
RM. Acadian Marine Tidal River
RM. Acadian Freshwater Tidal Creek
RM. Acadian Brackish Tidal Creek
RM. Acadian Marine Tidal Creek

C. GL Macrohabitats Peripheral in STL. (without fully developed descriptions)

RM. GL Intermittent Stream
RM. GL Spring
RM. GL Rocky Headwater Stream
RM. GL Marsh Headwater Stream
RM. GL Confined River
RM. GL Unconfined River
RM. GL Backwater Slough

COMMONLY USED ACRONYMS & SOURCES:

Ecoregions
- NAP Northern Appalachians
- STL St. Lawrence/Lake Champlain
- GLB Great Lakes
- LNE Lower New England
- HAL High Allegheny Plateau

Assemblages
- RAP River Assemblages, Plants
- RAM River Assemblages, Macroinvertebrates
- RAF River Assemblages, Fish
- RAH River Assemblages, Herptiles

NAC National Aquatic Community Classification
BCD Biological and Conservation Databases (of the Heritage Network and The Nature Conservancy)
EOR Element Occurrence Records (on BCD)
ELU Ecological Land Unit
EOSPECS Element Occurrence Specifications (field on BCD)
ELDESCRIP Element Description (field on BCD)

NYHP (New York Natural Heritage Program). 1990: Reschke (1990)
VTHP (Vermont Natural Heritage Program). 1989: Thompson (1989); 1996: Vermont Nongame and Natural Heritage Program (1996)
NHHP (New Hampshire Natural Heritage Program). 1992: Sperduto (1992)
MEHP (Maine Natural Heritage Program). 1991: Maine Natural Areas Program (1991)
VT ACWG (1998): Vermont's Aquatic Classification Work Group (1998)

GLB (Great Lakes Basin). 1998: Higgins et al. (1998). 2000: Great Lakes Expert Meeting, NY State, Handouts (2000)
ANC (Adirondack Nature Conservancy)
VTDEC (Vermont Dept. of Environmental Conservation)

NY Counties

NWWASH = Washington, NYESSE = Essex, NYCLIN = Clinton, NYFRAN = Franklin, NYSTLA = Saint Lawrence, NYJEFF = Jefferson, NYLEWI = Lewis, NYONEI = Oneida, NYOSWE = Oswego.

* = Assemblage thought to be essentially restricted to the described macrohabitat.

Basic Macrohabitat Type #1: **INTERMITTENT STREAM** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley Intermittent Stream (RM3)**
Synonymy/Affinities:
= NYHP (1990): INTERMITTENT STREAM (in part)
= VTHP (1989): Seasonal Stream (in part)
= VT ACWG (1998): apparently no equivalent?
= GLB (2000): apparently no equivalent
Suggested Alliance Name: **[unknown calcareous bryophytes]-[unknown macroinvertebrates] Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: small.
Watershed Size: << 2 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground (small subterranean reaches may be common). Flow microhabitats: variable, generally alternating riffles and pools. The pelagic zone becomes so small it merges with benthic zone.
Water Permanence: intermittent to ephemeral and "extremely flashy" (R. Langdon).
Stream Position: source, usually 0 to 1st order.
Discharge: very low.
Temperature: cool to cold.
Substrate/Water Alkalinity: primarily circumneutral (acidic variants reported in sandplains).
Substrate Texture: variable; limestone bedrock in one known EO.
Sediment Transport Regime: headward erosion with minimal deposition.
Flow velocity: variable.
Gradient: variable? (most probably lower than NAP equivalent). Low gradient streams may be most common.
Confinement: unconfined, low sinuosity.
Nutrient Source: leaf litter (allochthonous/heterotrophic).
Landscape Setting:
full canopy (with many EOs likely altered from cultural factors); large runoff area; known EO from flat watershed with mix of agriculture and forest.
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:
Fairly poor biotic data available. Calcareous bryophytes suspected to predominate. Macroinvertebrates possibly include acid-intolerant leaf shredders. R. Langdon reports an amphipod (a permanent resident) in one NY EO (St. Lawrence Co.). Obligate aquatic plants and fish probably scarce. Amphibians may be present. Presence of Fontinalis from VTHP (1989) is uncertain in STL, as is "roach-like stonefly".
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)**
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle: **[Calcareous bryophytes]-[unknown macroinvertebrate] Fishless Association**

Potential Plant Assemblage: **Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (RAP8)**
Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Potential Plant Assemblage: **Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (RAP9)** (?)
Rhytidium sp. Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Potential Plant Assemblage: **Intermittent Calcareous Stream Bryophyte Vegetation (RAP10)** (?)
Cryptogramma stelleri Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown. consult Steve Fiske, VTDEC.

2) Pool: **[unknown macroinvertebrate] Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)1

Macroinvertebrate Assemblage: unknown. consult Steve Fiske, VTDEC.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Substrate Alkalinity Variants.
   Notes: most suspected to have circumneutral to basic water and underlying bedrock. Examples on coarse acidic sands (e.g., from sandplains near Lake Champlain) are suspected, but differences in biota are unknown. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
2) Regional/Watershed Variants.
   Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available).
3) Stream Order/Discharge Variants.
   Notes: May vary between different stream order and across a discharge range.
4) Substrate Texture and Slope Variants.
   Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, sand, soil. Examples with sand may correlate with acidic substrate (see above)
5) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAP?, STLy; VT: NAP?, STLy

NY Examples:
NYFRAN?: Pollys Creek; NYJEFF: N of Watertown; hundreds of occurrences suspected, a few known, but little biotic data available.
VT Examples:

Sources: Reschke (1990); VTHP (1989), R. Langdon, VTDEC expert; much based on speculation by D. Hunt, NYHP.

Basic Macrohabitat Type #1: **INTERMITTENT STREAM** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian Acidic Intermittent Stream (RM1)**

Synonymy/Affinities:

= NYHP (1990): INTERMITTENT STREAM (in part)
= VTHP (1989): Seasonal Stream (in part)
= MEHP (1991): Intermittent Stream Community (ME River Type R1) (in part)
= NHHP (1992): Intermittent Stream (in part)
= VT ACWG (1998): apparently no equivalent (closet to Herptile classes?)
= GLB (2000): apparently no equivalent

Suggested Alliance Name: **Scapania-Arctocorixa-Trichoptera-Amphibia Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: << 2 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground (small subterranean reaches may be common). Flow microhabitats: variable, generally alternating riffles and pools. The pelagic zone becomes so small it merges with benthic zone.
Water Permanence:
intermittent to ephemeral; typically with flowing water only after heavy rains or during the spring; typically drying in summer.
Stream Position: source, usually 0 to 1st order.
Discharge: very low.
Temperature: cool to cold.
Substrate/Water Alkalinity: acidic
Substrate Texture: variable.
Sediment Transport Regime: headward erosion with minimal deposition.
Flow velocity: variable.
Gradient: variable; typically moderate to steep. Most probably higher than STL equivalent. High gradient streams common.
Confinement: unconfined, low sinuosity.
Nutrient Source: leaf litter (allochthonous/heterotrophic).
Landscape Setting: full canopy.
Other Features:
ELU Signature: Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota:
Acidic bryophytes suspected to predominate. Macroinvertebrates possibly include acid-intolerant leaf shredders. Obligate aquatic plants and fish probably scarce. Amphibians may be present. Presence of Fontinalis from VTHP (1989) is uncertain in STL, as is "roach-like stonefly".
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)**
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Herptile Assemblage: **Spring Salamander-Northern Two-lined Salamander-Green Frog Intermittent Stream Fauna (RAH1)**
Gyrinophilus porphyriticus-Eurycea bislineata-Rana clamitans Assemblage
Assemblage Description: (See Herptile Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle: **Scapania nemorosa-Chiloscyphus polyanthos-[unknown macroinvertebrate] Fishless Association**

* Plant Assemblage: **Subalpine Intermittent Stream Scapania Bryophyte Vegetation (RAP11)**
Scapania nemorosa-Bryum pseudotriquetrum-Hygrohypnum ochraceum-Chiloscyphus polyanthos-Isopterigyium muelleriana Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Potential Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)** (?)
Fontinalis sp.-epilithic green algae Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Potential Plant Assemblage: **Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (RAP8)**?
Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown. consult Steve Fiske, VTDEC.

2) Pool: **Arctocorixa-Northern Two-Lined Salamander Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Water Boatman-Dominated Pool Fauna (RAM11)**
Hemiptera (Arctocorixa, Gerridae)-Trichoptera Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Stream Order/Discharge Variants.
   Notes: May vary between different stream order and across a discharge range.
2) Substrate Texture and Slope Variants.
   Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, sand, soil.
3) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.
4) Watershed Variants.
   Notes: Major watershed variants not suspected, but possible; need more assessment.

Distribution: NY: NAPy, STL?; VT: NAPy?, STL?

NY Examples: NYESSE Chicken Coop Brook, NYESSE Chapel Pond, NYESSE Porter Mountain, NYESSE Cascade Mountain, NYESSE Johns Brook Tributary, NYESSE Schroon Lake Tributary, NYWARR Breisch Property; hundreds of occurrences suspected.
VT Examples:

Sources: Reschke (1990), VTHP (1989), NYHP BCD Community EORs (2002), NYHP Community Leads (2002), Slack (1985).

Basic Macrohabitat Type #1: **INTERMITTENT STREAM** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian Calcareous Intermittent Stream (RM2)**

Synonymy/Affinities:

= NYHP (1990): INTERMITTENT STREAM (in part)
= VTHP (1989): Seasonal Stream (in part)
= NHHP (1992): Intermittent Stream (in part)
= MEHP (1991): Intermittent Stream Community (ME River Type R1) (in part)
= VT ACWG (1998): apparently no equivalent
= GLB (2000): apparently no equivalent

Suggested Alliance Name: **Rhytidium-Amphibia Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: << 2 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground (small subterranean reaches may be common). Flow microhabitats: variable, generally alternating riffles and pools. The pelagic zone becomes so small it merges with benthic zone.
Water Permanence: intermittent to ephemeral.
Stream Position: source, usually 0 to 1st order.
Discharge: very low.
Temperature: cool to cold.
Substrate/Water Alkalinity: circumneutral to alkaline.
Substrate Texture: calcareous bedrock.
Sediment Transport Regime: headward erosion with minimal deposition.
Flow velocity: variable.
Gradient: variable. Most probably higher than STL equivalent.
Confinement: unconfined, low sinuosity.
Nutrient Source: leaf litter (allochthonous/heterotrophic).
Landscape Setting: full canopy.
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota: calciphilic bryophytes suspected to predominate. vertebrates dominated by salamanders.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)**
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Herptile Assemblage: **Spring Salamander-Northern Two-lined Salamander-Green Frog Intermittent Stream Fauna (RAH1)**
Gyrinophilus porphyriticus-Eurycea bislineata-Rana clamitans Assemblage
Assemblage Description: (See Herptile Assemblage Descriptions)
Possibly additional salamander species characteristic of calcareous sites.

Suggested Microhabitat-Association Composition:

1) Riffle: **Rhytidium sp.-[unknown macroinvertebrate] Fishless Association**

Plant Assemblage: **Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (RAP9)**
Rhytidium sp. Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

* Plant Assemblage: **Intermittent Calcareous Stream Bryophyte Vegetation (RAP10)**
Cryptogramma stelleri Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Potential Plant Assemblage: **Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (RAP8)**?
Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown. consult Steve Fiske, VTDEC.

2) Pool: **Arctocorixa-Northern Two-Lined Salamander Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown. consult Steve Fiske, VTDEC.
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Probably/reportedly also includes Crustacea (Cambaridae), other characteristic invertebrates.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Stream Order/Discharge Variants.
    Notes: May vary between different stream order and across a discharge range.
2) Substrate Texture and Slope Variants.
    Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, sand, soil.
3) Connectivity Variants.
    NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAPy, STL?; VT: NAPy, STL?

NY Examples: NYESSE Cascade Lakes.
VT Examples:

Sources: Reschke (1990), NYHP Community Leads (Hunt, 2002), VTHP (1989), MEHP (1991).

Basic Macrohabitat Type #2: **SPRING** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley (Circumneutral) Spring (RM18)**

Synonymy/Affinities:

= VTHP (1989): Spring Run Community (in part)
= VTHP (1996): Woodland Seep/Spring Run (in part)
= VT ACWG (1998): Spring seeps (RAM10)
= NYHP (1990): ROCKY HEADWATER STREAM (in part)
= NYHP (1990): MARSH HEADWATER STREAM (in part)
= NYHP (1990): MIDREACH STREAM (in part)
= NYHP (1990): MAIN CHANNEL STREAM (in part)
= GLB (2000): apparently no equivalent

Suggested Alliance Name: **Tricladida Non-Vegetated Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: very small (reportedly a few meters to about 15 meters long); VTHP (1989): spring and area just downstream.
Watershed Size: << 2 mi^2
Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground (distinguished from adjacent subterranean areas). Flow microhabitats: suspected to be primarily pool, but may also be small runs. The pelagic zone becomes so small it merges with benthic zone.

Water Permanence:

permanent. VTHP (1989): downstream end at point where "surface water is encountered"; D. Hunt interpretation: at point where water exceeds 50% of surface composition during average flow conditions.

Stream Position: source, usually 0 to 1st order.
Discharge: very low.
Temperature: cool to cold. constant (VT ACWG, 1998).
Substrate/Water Alkalinity: primarily circumneutral to calcareous.
Substrate Texture: variable including sandy (VT ACWG, 1998).
Sediment Transport Regime: headward erosion with no deposition.
Flow velocity: slow.
Gradient: low.
Confinement: unconfined, low sinuosity.
Nutrient Source: groundwater minerals? leaf litter? (allochthonous/heterotrophic).
Landscape Setting: full canopy (with many EOs likely altered from cultural factors).
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:

Fairly poor biotic data available. Potential indicator vascular plants and bryophytes. Characteristic and unique indicator coldwater "medicolous" macroinvertebrates including one reported dragonfly. STL Aquatic Community Team thought that springs warrant separation as a distinct macrohabitat and that NAP and STL examples have different biota. Biota are reportedly repeatable across Springs of a given region, regardless of the associated adjoining stream macrohabitat type. More biotic data are needed to confirm these hypotheses. Low productivity. vertebrates dominated by salamanders. Fish are typically absent.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)** (?)
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Herptile Assemblage: **Spring Salamander-Northern Two-lined Salamander-Green Frog Intermittent Stream Fauna (RAH1)**
Gyrinophilus porphyriticus-Eurycea bislineata-Rana clamitans Assemblage
Assemblage Description: (See Herptile Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Pool: **Tricladida Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Golden Saxifrage Spring (RAP1)** (?)
Chrysosplenium americanum Herbaceous Vegetation (CEGL006193)
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Cold Sandy Spring Fauna (RAM10)** (???)
Trichoptera (Limnephilidae)-unknown group (Tricladida) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Uncertain if associated with this basic macrohabitat type or regional macrohabitat.

2) Run: No biotic information yet available.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.
   Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available).
2) Substrate Alkalinity Variants.
   Notes: most suspected to have circumneutral to basic water and underlying bedrock. Examples on coarse acidic sands (e.g., from sandplains near Lake Champlain) are suspected, but differences in biota are unknown.
3) Substrate Texture and Slope Variants.
   Notes: Subtypes may include bedrock, boulder/cobble, sand, soil.
4) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

NY Examples: many occurrences suspected, at least one lead, but no biotic data analyzed.
VT Examples: reportedly very common.

Distribution: NY: NAP?, STLy?; VT: NAP?, STLy?

Sources: Reschke (1990), VT ACWG (1998), VTHP (1989, 1996), NYHP Community Leads (2002).

Basic Macrohabitat Type #2: **SPRING** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian (Acidic) Spring (RM4)**

Synonymy/Affinities:

= VTHP (1989): Spring Run Community (in part)
= VTHP (1996): Woodland Seep/Spring Run (in part)
= VT ACWG (1998): Spring seeps (RAM10)
= VT ACWG (1998): Woodland Seep (VT Amphibian Type)
= NYHP (1990): ROCKY HEADWATER STREAM (in part)
= NYHP (1990): MARSH HEADWATER STREAM (in part)
= NYHP (1990): MIDREACH STREAM (in part)
= NYHP (1990): MAIN CHANNEL STREAM (in part)
= NHHP (1992): apparently no equivalent (closest to High Gradient Stream?)
= MEHP (1991): apparently no equivalent (part of Midreach Stream Community, possibly others)
= GLB (2000): apparently no equivalent

Suggested Alliance Name: **Tricladida-Amphibia Non-Vegetated Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: very small (reportedly a few meters to about 15 meters long); VTHP (1989): spring and area just downstream.

Watershed Size: << 2 mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground (distinguished from adjacent subterranean areas). Flow microhabitats: suspected to be primarily pool, but may also be small runs. The pelagic zone becomes so small it merges with benthic zone.

Water Permanence:

permanent. VTHP (1989): downstream end at point where "surface water is encountered"; D. Hunt interpretation: at point where water exceeds 50% of surface composition during average flow conditions.

Stream Position: source, usually 0 to 1st order.

Discharge: very low.

Temperature: cool to cold. constant VT (1998).

Substrate/Water Alkalinity: primarily acidic to circumneutral.

Substrate Texture: variable.

Sediment Transport Regime: headward erosion with no deposition.

Flow velocity: slow.

Gradient: low.

Confinement: unconfined, low sinuosity.

Nutrient Source: groundwater minerals? leaf litter? (allochthonous/heterotrophic).

Landscape Setting: full canopy.

Other Features: reported to form along fracture lines.

ELU Signature: Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.

Biota:

Fairly poor biotic data available. Potential indicator vascular plants and bryophytes. Characteristic and unique indicator coldwater "medicolous" macroinvertebrates including one reported dragonfly (per Steve Fiske). STL Aquatic Community Team thought that springs warrant separation as a distinct macrohabitat and that NAP and STL examples have different biota. Biota are reportedly repeatable across springs of a given region, regardless of the associated stream macrohabitat type. More biotic data are needed to confirm these hypotheses. Low productivity. Vertebrates dominated by salamanders. Fish are typically absent.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)** (?)

Fishless aquatic areas

Assemblage Description: (See Fish Assemblage Descriptions)

Herptile Assemblage: **Spring Salamander-Northern Two-lined Salamander-Green Frog Intermittent Stream Fauna (RAH1)**

Gyrinophilus porphyriticus-Eurycea bislineata-Rana clamitans Assemblage

Assemblage Description: (See Herptile Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Pool: **Tricladida-Amphibia Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**

Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Cold Sandy Spring Fauna (RAM10)** (???)

Trichoptera (Limnephilidae)-unknown group (Tricladida) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Uncertain if associated with this basic macrohabitat type or regional macrohabitat.

2) Run: No biotic information yet available.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Substrate Alkalinity Variants.
   Notes: most suspected to have acidic to circumneutral water and underlying bedrock. Examples on calcareous bedrock are possible, but differences in biota are unknown.
2) Substrate Texture and Slope Variants.
   Notes: Subtypes may include bedrock, boulder/cobble, sand, soil.
3) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

NY Examples: many occurrences suspected, but no biotic data analyzed.
VT Examples: reportedly very common.

Distribution: NY: NAPy?, STLn?; VT: NAPy?, STL?

Sources: Reschke (1990), VT ACWG (1998), VTHP (1989, 1996), NYHP Community Leads (2002).

Basic Macrohabitat Type #3: **ROCKY HEADWATER STREAM** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley (Circumneutral) Rocky Headwater Stream (RM6)**

Synonymy/Affinities:

= NYHP (1990): ROCKY HEADWATER STREAM (in part)
= VTHP (1989): High-Gradient Stream? (in part)
= VT ACWG (1998): Moderate-sized mountain streams (RAM3)
= VT ACWG (1998): Lower reaches of small rivers (RAM4)
= VT ACWG (1998): Cold, headwater mountain streams (RAM2)?
= VT ACWG (1998): Moderately-sized streams and small rivers, mid elevation mixed cold-warmwater (RAF4) (in part)
= VT ACWG (1998): Moderately-sized streams to small rivers, low elevation, warmwater (RAF5) (in part)
= VT ACWG (1998): Moderate to large, warmwater rivers, entering directly into Lake Champlain (RAF6) (in part)
= GLB (2000): Northern Jefferson County Coastal Streams (GLB Stream Type 32) (in part)
=? GLB (2000): Glacial Marine Plain Tributaries (GLB Stream Type 40) (in part)
=? GLB (2000): Till Plain Tributaries (GLB Stream Type 41) (in part)
=? GLB (2000): Small Marine Plain Coastal Streams (GLB Stream Type 43) (in part)
=? GLB (2000): St. Lawrence Lake Plain Tributaries (GLB Stream Type 44) (in part)

Suggested Alliance Name: **Bluntnose Minnow-[calcareous bryophytes]-Promeresia-Chloroperlidae Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small to large.
Watershed Size: moderate, 2-30 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: riffles abundant, runs sparse. The pelagic zone becomes so small it may merge with benthic zone.
Water Permanence: permanent.
Stream Position: headwater, usually 1st to 3rd order.
Discharge: low.
Temperature: warm to cool to cold (probably warmer than NAP equivalent).
Substrate/Water Alkalinity: primarily circumneutral.
Substrate Texture: coarse; many examples with limestone bedrock in St. Lawrence River Valley.
Sediment Transport Regime: headward erosion with minimal deposition.
Flow velocity: fast to moderate.
Gradient:
Medium to slight (to high?) (most probably lower than average example of NAP equivalent). Slope at least 1 degree, usually at least 2 degrees. Low gradient streams may be most common.
Confinement: strongly to moderately confined, low sinuosity.
Nutrient Source: leaf litter (allochthonous/heterotrophic).
Landscape Setting: full canopy uplands (with many EOs likely altered from cultural factors).
Other Features:
depth usually < 4m, width usually < 2m; coarse woody debris in low abundance; channels without braids; whitewater areas common.
ELU Signature:
Stream Size Class 1?. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:
Calcareous bryophytes and possibly epilithic green algae suspected to predominate. Vascular plants are depauperate. Macroinvertebrates may include those characteristic of adjoining larger rivers in STL and possibly acid-intolerant leaf shredders, (and possibly also riffle specialists, algae shredders, and neuston fauna). Fish assemblages are warmwater to transitional species and likely to span all microhabitats.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblages:
Warmwater assemblages including RAF4, RAF5 and RAF 6 (Mark Ferguson, VTHP). Apparently correspond to GLB Stream Type 32 (Northern NYJEFF coastal streams). See Richard Langdon, VTDEC, for more suggestions.

Fish Assemblage: **Blacknose Dace-Common Shiner (RAF4)**
Blacknose Dace-Common Shiner Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)**
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Some species of GLB (2000) Cool Headwaters (GLB Fish Community H1) suggest RAF3 or possibly this assemblage is in NAP Rocky Headwater Stream. GLB (2000) Warm Headwaters (GLB Fish Community H2) might crosswalk to "transition" water rocky headwater streams of the Tug Hill (as well as to NAP Marsh Headwater Stream in this area).

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle: **Bluntnose Minnow-[calcareous bryophytes]-Promeresia-Chloroperlidae Association**

Potential Plant Assemblage: **Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (RAP9)** (?)
Rhytidium sp. Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Coleoptera-Dominated Warm, Basic Stream Fauna (RAM4)**
Coleoptera (Promeresia, Stenelmis)-Plecoptera (Neoperla)-Trichoptera (Chimara) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in STL Rocky Headwater Stream confirmed by Steve Fiske, VTDEC.

Macroinvertebrate Assemblage: **Algae Shredder/Scraper-Dominated Fauna (RAM3)**
Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in STL Rocky Headwater Stream confirmed by Steve Fiske, VTDEC. Margaritifera may be absent in examples of this macrohabitat (too calcaerous?).

* Macroinvertebrate Assemblage: **Acid-Intolerant Leaf Shredder Insects (RAM2)** (?)
Ephemeroptera (Rithrogenia)-Trichoptera (Symphitopsyche?, Glossosoma)-Diptera (Simulium, Antocha) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

2) Pool: **Bluntnose Minnow-[algae?]-[unknown macroinvertebrate] Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown, possibly same as riffle. Consult Steve Fiske, VTDEC.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.
Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available), especially in fish and mollusk diversity, but these may represent the same assemblage, simply different levels of "expression" based on historical migration routes. GLB (2000): Drainage unit split used is Eastern Lake Ontario vs. Saint Lawrence vs. Lake Champlain. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
2) Substrate Alkalinity Variants.
Notes: All or most suspected to have circumneutral to basic water and not be substantially affected by local changes in underlying bedrock.
3) Stream Order/Discharge Variants.
Notes: May vary between different stream order and across a discharge range.
4) Substrate Texture and Slope Variants.
Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats. Examples flowing from "cobbly knobs" are known from the Champlain Valley. Examples with sand are possible, but these usually develop meanders and might be classified under Marsh headwater stream.
5) Temperature Variants.
Notes: warmwater examples are known and coldwater examples may exist. These two variants are reportedly likely to have different fish and macroinvertebrate assemblages.
6) Connectivity Variants.
NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAPy?, STLy; VT: NAPy?, STLy?

NY Examples:
Few known. Potential sites of GLB (2000) Stream Type 32 that may include STL Rocky Headwater Stream include: NYJEFF Chaumont River?, NYJEFF Perch River?, NYJEFF Kents Creek?
VT Examples:
STL Portfolio: Trout Brook Milton, Thorp Brook Charlotte. Others Suspected from VT ACWG (1998): Castleton River?, Hubbardton River?, Lewis Creek?, Missiquoi River?

Sources:
STL Aquatic Community Team; VT ACWG (1998); Reschke (1990); VTHP (1989). Bruce Gilman is a reported expert on northern NYJEFF examples.

Basic Macrohabitat Type #3: **ROCKY HEADWATER STREAM** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian (Acidic) Rocky Headwater Stream (RM5)**
Synonymy/Affinities:
= NYHP (1990): ROCKY HEADWATER STREAM (in part)
= MEHP (1991): Rocky Headwater Stream Community (ME River Type R3) (in part)
= VTHP (1989): High Gradient Stream (in part)
= NHHP (1992): High Gradient Stream (in part)
= VT ACWG (1998): Cold, headwater acidic mountain streams (RAM1)
= VT ACWG (1998): Small, high elevation, cold, headwater streams (RAF1, RAF2) (in part)
= GLB (2000): Adirondack Highland Streams (GLB Stream Type 38) (in part)
= GLB (2000): Black River Headwaters (GLB Stream Type 34) (in part)
= GLB (2000): Tug Hill Headwater Streams (GLB Stream Type 28) (in part)
Suggested Alliance Name: **Brook Trout-Fontinalis-Eurynchium-Green Algae-Parapsyche-Chloroperlidae-Gerridae Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: small to large.
Watershed Size: moderate, 2-30 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: riffles abundant, runs sparse. The pelagic zone becomes so small it may merge with benthic zone.
Water Permanence: permanent.
Stream Position: headwater, usually 1st to 3rd order.
Discharge: low.
Temperature: cold to cool.
Substrate/Water Alkalinity: primarily acidic; pH and ANC critically low.
Substrate Texture: coarse (bedrock to cobble).
Sediment Transport Regime: headward erosion with minimal deposition.
Flow velocity: fast to moderate.
Gradient: high to medium.
Confinement: strongly to moderately confined, low sinuosity.
Nutrient Source: leaf litter (allochthonous/heterotrophic).
Landscape Setting: full canopy forested uplands.
Other Features:
Depth usually < 4m, width usually < 2m; coarse woody debris in low abundance; channels without braids; whitewater areas common; with waterfalls and gorges. GLB (2000): some fed by headwater lakes; Tug Hill examples with radial drainage.
ELU Signature: Stream Size Class 1?. Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota: Bryophytes and epilithic green algae predominate. Vascular plants are depauperate, although Podostemum may be reported to occur in this macrohabitat (VTHP, 1989; MEHP, 1991). Macroinvertebrates include riffle specialists, acid-tolerant leaf shredders, algae shredders and neuston fauna. Fish assemblages are coldwater and low diversity; they span all microhabitats as addressed below.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

* Fish Assemblage: **Brook Trout (RAF1)**
Brook Trout Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
No NY data are readily available/analyzed.

*? Fish Assemblage: **Brook Trout-Slimy Sculpin (RAF2)**
Brook Trout-Slimy Sculpin Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)** (?)
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle: **Brook Trout-Fontinalis-Eurynchium-Green Algae-Parapsyche-Chloroperlidae Association**
Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)**
Fontinalis sp.-epilithic green algae Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (RAP8)**
Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)**
Assemblage Description: (See Plant Assemblage Descriptions)
Algal assemblages may differ across microhabitats, but data have not been analyzed.

* Macroinvertebrate Assemblage: **Acid-Tolerant Leaf Shredder Insects (RAM1)**

Trichoptera (Parapsyche, Palegapetus)-Plecoptera (Capniidae)-Chironomidae (Eukiefferella) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Macroinvertebrate Assemblage: **Algae Shredders/Scrapers (RAM3)**

Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

K. Schneider interview: Margaritifera characteristic of "acidic" (DH: circumneutral?) Rocky Headwater Streams in NAP, especially Adirondack foothills; rare in VT, S2 in NY. DH: Margaritifera is dominant mollusk and at high density in Tug Hill RM5 (NAP Rocky Headwater Streams) grading to RM9 (NAP Confined River).

2) Pool: **Brook Trout-[Green Algae]-Gerridae Association**

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)** SEE RIFFLE

Plant Assemblage: **Non-Vegetated Stream (RAP14)**

Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Cold Sandy Spring Fauna (RAM10)**???

Trichoptera (Limnephilidae)-unknown group (Tricladida) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Uncertain if associated with this basic macrohabitat type or regional macrohabitat.

Macroinvertebrate Assemblage: **Water Strider-Dominated Pool Fauna (RAM13)**

Hemiptera (Gerridae, Vellidae, Mesovellidae) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Calcareous/Circumneutral Substrate Variants.

Potential Plant Assemblage: **Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (RAP9)**

Rhytidium sp. Bryophyte Vegetation.

Notes: May include other calcareous bryophytes. NYHP has poor information on this assemblage. Need to evaluate potential equivalency with Intermittent Calcareous Stream Bryophyte Vegetation (RAP10). Uncertain if intermittent or perennial. Lead from published report with uncertainty about presence of Rhytidium in aquatic or terrestrial setting.

2) Stream Order/Discharge Variants.

Notes: Need to evaluate Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation (RAP 8) for equivalency to/distinction from other vegetation assemblages: Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7) and Subalpine Intermittent Stream Scapania Bryophyte Vegetation (RAP11). Need to evaluate slight differences across macrohabitats in Slack analysis (no obvious species differences noted): Uncertain if only perennial or also intermittent.

3) Substrate Texture and Slope Variants.

Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats.

4) Regional Variants.

Notes: Adirondack and Green Mountain EOs may differ substantially from Tug Hill EOs especially in gradient, temperature, and fish assemblages (Adirondack/Green Mts: RAF1, RAF2, cold, steep, high to mid elevation; Tug Hill: RAF5(?), cool, low gradient, only mid elevation. Is the driving parameter elevation within NAP? (Are there high-elevation vs. mid-elevation variants?) or is it a geographic (E to W) or watershed gradient?

5) Watershed Variants.

Notes: Major watershed variants not suspected, but possible, need more assessment.

Distribution: NY: NAPy, STLy; VT: NAPy, STLy

NY Examples:

NYLEWI E Branch Fish Creek, NYLEWI E Fork Salmon River, NYLEWI W Fork Salmon River, NYLEWI Black Creek New Bremen (STL), NYESSE Opalescent River Headwaters, NYESSE Gay Brook? (circumneutral), NYESSE Allen Brook, NYESSE Coot Hill (NAP/STL), NYWARR Northwest Bay Brook, NYESSE Johns Brook, NYESSE W Branch Ausable River Tributaries, many leads surrounding High Peaks. See GLB (2000) for more examples.

VT Examples:

STL Portfolio: Lewis Creek, Browns River. Others suspected from VT ACWG (1998): Bickford Hollow Brook, Bourn Brook, Braser Brook, Cold Brook, Stevensville Brook.

Sources:

Reschke (1990), MEHP (1991), VTHP (1989), VT ACWG (1998); NYHP BCD Community EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Slack (1985), Hunt (1999c), NYHP BCD Animal EORs (2002), K. Schneider/NYHP mollusk expert, Higgins et al. (1998), Carlson (1993), Smith (1985).

Basic Macrohabitat Type #4: **MARSH HEADWATER STREAM** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley (Circumneutral) Marsh Headwater Stream (RM8)**

Synonymy/Affinities:

= NYHP (1990): MARSH HEADWATER STREAM (in part)
= VTHP (1989): Low-Gradient Stream (in part)
= VT ACWG (1998): Small streams in lower Champlain Valley (RAM7)
= VT ACWG (1998): Lake marsh outlet stream (RAM9) (in part?)
= VT ACWG (1998): Moderate to large, warmwater rivers, entering directly into Lake Champlain (RAF6) (in part)
= VT ACWG (1998): Moderately-sized streams to small rivers, low elevation, warmwater (RAF5)? (in part)
= VT (Richard Langdon): "Slow winders"
= GLB (2000): Glacial Marine Plain Tributaries (GLB Stream Type 40)
= GLB (2000): Till Plain Tributaries (GLB Stream Type 41)
= GLB (2000): Small Marine Plain Coastal Streams (GLB Stream Type 43)
= GLB (2000): St. Lawrence Lake Plain Tributaries (GLB Stream Type 44)
= GLB (2000): Northern Jefferson County Coastal Streams (GLB Stream Type 32) (in part)

Suggested Alliance Name: **Pumpkinseed-Potamogeton-Elodea-Nymphaea-Stenonema-Beaver Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small to large.

Watershed Size: moderate, 2-30 mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: run-pool abundant; riffles, if present, are very small; beaver dams (associated with pool microhabitats) are common. Streams may vary from shallow to moderately deep with a well-defined pelagic zone nearest their mouths (especially ones that join directly to Lake Champlain and the Saint Lawrence River). Lake outlets are special "submicrohabitats" of some runs.

Water Permanence: permanent.

Stream Position: headwater, usually 1st to 3rd order.

Discharge: low.

Temperature: suspected to be warm.

Substrate/Water Alkalinity: primarily calcareous or circumneutral; VT ACWG 1998: high pH and ANC.

Substrate Texture: fine (e.g., sand, silt, and clay); some peat deposits, some over limestone bedrock (GLB, 2000).

Sediment Transport Regime: headward erosion with minimal deposition.

Flow velocity: slow to very slow.

Gradient: low, with slope less than 1 degree.

Confinement: poorly confined, high sinuosity.

Nutrient Source: leaf litter (?) (allochthonous/heterotrophic).

Landscape Setting:

full canopy. Wetlands: usually shrub swamps lined with alder and willow. GLB (2000): other communities cited include deep emergent marsh (in areas of stabilized water levels) and peatlands.

Other Features: Examples with high water quality typically have low IBI; whitewater is sparse to absent.

ELU Signature:

Stream Size Class 1?. Wet-Moist Flats. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.

Biota:

Submergent vascular plants predominate, but substantial phytoplankton populations are suspected for examples with connectivity to large water bodies. Macroinvertebrates include characteristic soft-bottomed, marsh and pool species possibly including neuston and lake outlet fauna. Large mussels are typically absent. Beaver are common. Warmwater fish assemblages likely to span all microhabitats are addressed below. GLB (2000) crosswalks types to 3 fish assemblages (GLB Fish Communities H2, M1, M2). RAF4 or RAF3 were suggested from several GLB Stream Types which crosswalk to H2 (Warm Headwaters) and Till Plain Tributaries which crosswalk to M1 (Cool Mainstem). Some examples of GLB Stream Type 43, crosswalked to Warm Headwater Fish Community (H2), have coldwater fish and brook trout (resembling RAF2?). The apparent confusion in fish assemblages was addressed by Mark Ferguson (VTHP) below.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence confirmed in STL Marsh Headwater Stream by Mark Ferguson, VTHP.

Fish Assemblage: **Iowa Darter-Pugnose Shiner (RAF7)**
Iowa Darter-Pugnose Shiner Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence confirmed in STL Marsh Headwater Stream by Mark Ferguson, VTHP.

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)** (?)
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence suspected in STL Marsh Headwater Stream by Mark Ferguson, VTHP.

* Herptile Assemblage: **STL Marsh Headwater Stream Fauna (RAH2)**
Blanding's Turtle-Beaver Assemblage
Assemblage Description: (See Herptile Assemblage Descriptions)

Blanding's turtle is a rare indicator species. Presence in STL Marsh Headwater Stream confirmed by Mark Ferguson, VTHP & D. Hunt, NYHP.

Suggested Microhabitat-Association Composition:

1) Run: **Pumpkinseed-Potamogeton-Elodea-Beaver Association**

Plant Assemblage: **American Eelgrass STL Herbaceous Vegetation (RAP3)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in STL Marsh Headwater Stream confirmed by D. Hunt, NYHP and Susan Warren, VTDEC.

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

2) Run/Lake Outlet: **Pumpkinseed-[unknown plants]-Simulidae? Association**

Macroinvertebrate Assemblage: **Filter Collectors (RAM9)**
Diptera (Simulidae)-Trichoptera (Hydropsyche, Cheumatopsyche, Symphytopsyche?)-Chironomidae (Tanytarsini) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence of typical assemblage in low discharge examples in STL Marsh Headwater Stream confirmed by Steve Fiske, VTDEC. High discharge examples may support a different assemblage.

3) Pool: **Pumpkinseed-Nymphaea-Stenonema-Beaver Association**

* Plant Assemblage: **Broadleaf Pondlily STL Herbaceous Vegetation (RAP6)**
Nuphar lutea ssp. advena Herbaceous Vegetation (CEGL004324) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in STL Marsh Headwater Stream confirmed by D. Hunt, NYHP & Susan Warren, VTDEC.

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Golden Saxifrage Spring (RAP1)** (?)
Chrysosplenium americanum Herbaceous Vegetation (CEGL006193)
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Diptera-Dominated Basic Stream Fauna (RAM7)**
Diptera (Tipula, Atherix, Simulum)-Chironomidae (Apsectrotnypus, Rheocricotopus)-Crustacae (Hyallela)-Mollusca (Pisidium)-Ephemeroptera (Stenonema) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in STL Marsh Headwater Stream confirmed by Steve Fiske, VTDEC.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.
Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available), especially in fish and mollusk diversity, but these may represent the same assemblage, simply different levels of "expression" based on historical migration routes. GLB (2000): "coastal" and "lake plain" types are split. GLB (2000): Drainage unit split used is Eastern Lake Ontario vs. Saint Lawrence vs. Lake Champlain. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
2) Substrate Texture and Slope Variants.
Notes: Subtypes may include flat bedrock, boulder/cobble, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic pavement, aquatic boulder field and aquatic unconsolidated flats. GLB (2000): target types were split among several surficial geology classes including: a) marine/lacustrine sand, silt and clay, b) lacustrine calcareous silt, clay, c) fine-textured till and d) limestone bedrock. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
3) Substrate Alkalinity Variants.
Notes: All or most suspected to have circumneutral to basic water and not be substantially affected by local changes in underlying bedrock.
4) Stream Order/Discharge Variants.
Notes: May vary between different stream order and across a discharge range.
5) Connectivity Variants.
NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAPy?p?, STLy; VT: NAP?, STLy

NY Examples:
NYSTLA Brandy Brook, NYSTLA Sucker Brook, NYSTLA Coles Creek, NYSTLA Tibbetts Creek, NYSTLA S Beaver Creek, NYSTLA Crooked Creek, NYSTLA Black Creek, NYJEFF Black River-Jewett Creek, NYJEFF Cranberry Creek, NYJEFF French Creek, NYJEFF Perch River, NYJEFF Mud Creek Cape Vincent, NYCLIN Riley Brook, NYCLIN Little Salmon River, NYLEWI Black River Tributary, NYWARR Dunham Bay Marsh (NAP). GLB (2000) additions: NYSTLA Chippewa Creek, NYJEFF Perch River, NYSTLA? Plum Brook, NYSTLA? Squeak Brook, NYSTLA? Trout Brook?, NYSTLA? Lawrence Brook, NYSTLA Little River?, NYSTLA? Fish Creek?, NYSTLA? Otter Creek?, NYSTLA? Tanner Creek?, NYJEFF Chaumont Creek?, NYJEFF Kents Creek, NYFRAN? Deer River.
VT Examples: STL Portfolio: Lewis Creek. Others Suspected from VT ACWG (1998): Trout Brook, Thorp Brook.

Sources:

STL Aquatic Community Team; VT ACWG (1998); NYHP BCD Plant EORs (2002); NYHP BCD Animal EORs (2002); NYHP BCD Significant Habitat EORs (2002); NYHP Community Leads; Reschke (1990); (Smith, 1985); Higgins et al. (1998); Faber-Langendoen (1997); Sneddon et. al (1998); Anderson et al. (1998); Hunt (1999c); Sneddon et al. (1994); VTHP (1989); GLB (2000).

Basic Macrohabitat Type #4: **MARSH HEADWATER STREAM** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian (Acidic) Marsh Headwater Stream (RM7)**

Synonymy/Affinities:

= NYHP (1990): MARSH HEADWATER STREAM (in part)
= MEHP (1991): Marsh Headwater Stream Community (ME River Type R5) (in part)
= MEHP (1991): Peatland Outlet Stream Community (ME River Type R2) (in part?)
= VTHP (1989): Low Gradient Stream (in part)
= NHHP (1992): Low Gradient Stream (in part)
= VT ACWG (1998): Small headwater marsh streams (RAM5)
= VT ACWG (1998): Lake marsh outlet stream (RAM9)? (in part)
= VT ACWG (1998): Small, high elevation, cold, headwater streams (RAF2) (in part)
= VT ACWG (1998): Moderately-sized, high elevation coldwater stream (RAF3) (in part)
= GLB (2000): Adirondack Highland Streams (GLB Stream Type 38) (in part)
= GLB (2000): Tug Hill Headwater Streams (GLB Stream Type 28) (in part)
=? GLB (2000): Black River Headwaters (GLB Stream Type 34) (in part)

Suggested Alliance Name: **Brook Trout?-Potamogeton epihydrus-Brasenia schreberi-Litobrancha-Nepidae Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small to large.

Watershed Size: moderate, 2-30 mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: run-pool abundant; riffles, if present, are very small; beaver dams (associated with pool microhabitats) are common. A small pelagic zone may be present. Lake outlets are special "submicrohabitats" of some runs.

Water Permanence: permanent.

Stream Position: headwater, usually 1st to 3rd (4th) order.

Discharge: low.

Temperature: cold to cool.

Substrate/Water Alkalinity: primarily acidic.

Substrate Texture: fine (e.g., sand, silt, muck, some gravel), some peat deposits.

Sediment Transport Regime:

Flow velocity: slow.

Gradient: low.

Confinement: poorly confined, high sinuosity.

Nutrient Source: leaf litter (?) (allochthonous/heterotrophic).

Landscape Setting:

full canopy. Wetlands: usually shrub swamps densely lined with alder, willow, dogwood or cedar, often associated with springs.

Other Features:

Depth usually < 4m, width usually < 2m; coarse woody debris in low abundance; channels without braids; whitewater is sparse to absent. Examples with high water quality typically have low IBI; whitewater is sparse to absent. outlets (especially associated with peatlands) often strongly dark colered with high levels of tannic and humic acids. GLB (2000): some fed by headwater lakes, with deranged drainages in the Adirondacks and radial drainage in the Tug Hill.

ELU Signature: Stream Size Class 1?. Wet-Moist Flats. Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.

Biota:

Submergent vascular plants predominate. Macroinvertebrates include characteristic marsh and pool species including neuston and possibly lake outlet fauna. Beaver are common. Possible coldwater to transitional fish assemblages, spanning all microhabitats, are addressed below. Reaches at peatland outlets are depauperate in biota (MEHP, 1991).

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS

Fish Assemblage: **Brook Trout-Slimy Sculpin (RAF2)** (?)

Brook Trout-Slimy Sculpin Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Need expert review: in this macrohabitat?

Fish Assemblage: **Brook Trout-Blacknose Dace (RAF3)** (?)

Brook Trout-Blacknose Dace Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Need expert review: in this macrohabitat?

Suggested Microhabitat-Association Composition:

1) Run: **Brook Trout?-Potamogeton epihydrus-Litobrancha-Nepidae Association**

Plant Assemblage: **American Eelgrass NAP Herbaceous Vegetation (RAP2)**

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)

Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**

Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Cold Sandy Marsh Fauna (RAM5)**
Mollusca (Pisidium)-Trichoptera (Polycentropus)-Ephemeroptera (Litobrancha)-Odonata (Cordulegaster) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

* Macroinvertebrate Assemblage: **NAP Marsh Headwater Stream Run Fauna (RAM15)**
Hemiptera (Nepidae)-Mollusca (Sphaerium)-Chironomidae Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Macroinvertebrate Assemblage: **Filter Collectors (RAM9)** (?)
Diptera (Simulidae)-Trichoptera (Hydropsyche, Cheumatopsyche, Symphytopsyche?)-Chironomidae (Tanytarsini) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

2) Pool: **Brook Trout?-Brasenia schreberi-Gerridae? Association**

Plant Assemblage: **Broadleaf Pondlily NAP Herbaceous Vegetation (RAP5)**
Nuphar lutea ssp. advena Herbaceous Vegetation (CEGL004324) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Water Strider-Dominated Pool Fauna (RAM13)** (?)
Hemiptera (Gerridae, Vellidae, Mesovellidae) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

3) Lake Outlet: **Brook Trout?-[unknown plants]-Simulidae? Association**

Plant Assemblage: Uncertain, probably same as run association.

Macroinvertebrate Assemblage: **Filter Collectors (RAM9)** (?)
Diptera (Simulidae)-Trichoptera (Hydropsyche, Cheumatopsyche, Symphytopsyche?)-Chironomidae (Tanytarsini) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions/ SEE RUN MICROHABITAT ABOVE)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Substrate Alkalinity Variants.
Notes: All or most suspected to have acidic water and not be substantially affected by local changes in underlying bedrock. MEHP (1991): a highly acidic variant with darkly colored (tannic/dystrophic) water which is split as a separate type (Peatland Outlet Stream Community) was deemed to be an ecotonal feature by the STL Aquatic Community Team; upon further evaluation it might be separated out as a separate entity and given a name such as "Bog Stream" (see lacustrine equivalent Bog Lake).
2) Stream Order/Discharge Variants.
Notes: May vary between different stream order and across a discharge range.
3) Substrate Texture and Slope Variants.
Notes: Subtypes may include flat bedrock, boulder/cobble, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic pavement, aquatic boulder field and aquatic unconsolidated flats.
4) Regional Variants.
Notes: Adirondack and Green Mountain EOs may differ from Tug Hill EOs especially in temperature, elevation and fish assemblages (Adirondack/Green Mts: cold, high to mid elevation; Tug Hill: cool, only mid elevation). Is the driving parameter elevation within NAP? (Are there high elevation vs. mid elevation variants?) or is it a geographic (E to W) or watershed gradient?
5) Watershed Variants.
Notes: Major watershed variants not suspected, but possible; need more assessment.

Distribution: NY: NAPy, STLy; VT: NAPy, STLy.

NY Examples:
NYSTLA Main Branch Oswegatchie River, NYSTLA S Branch Grass River, NYSTLA Sawyer Creek (STL), NYSTLA Tanner Creek (STL), NYSTLA Otter Creek (STL), NYSTLA Little River (STL), NYSTLA Trout Brook Stockholm (STL), NYSTLA Parkhurst Brook (STL), NYSTLA Allen Brook Lawrence (STL), NYSTLA Farrington Brook (STL), NYHAMI Shingle Shanty Brook, NYHAMI Bog Stream, NYHAMI Red River Inlet, NYLEWI Whetstone Creek, NYLEWI E Branch Fish Creek, NYLEWI South Branch Mad River, NYHAMI W Branch Sacandaga River, NYCLIN North Branch Great Chazy River (STL), NYCLIN Corbeau Creek (STL), NYHAMI? Sacandaga Lake Outlet, GLB (2000) examples: NYSTLA? Elm Creek?, NYSTLA? Allen Brook Burke?, NYSTLA? Hawkins Creek?. See also GLB (2000) for more potential examples.
VT Examples: STL Portfolio: Trout Brook Milton, Thorp Brook Charlotte.

Sources:
VT ACWG (1998); NYHP BCD Community EORs (2002), NYHP BCD Plant EORs (2002), NYHP GMF Community Field Forms (2000), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), Higgins et al. (1998), Hunt (1999c); Sneddon et. al (1998), Anderson et al. (1998), Anderson (1998), VTHP (1989), MEHP (1991).

Basic Macrohabitat Type #5: **CONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley Confined River (RM10)**

Synonymy/Affinities:
= NYHP (1990): MIDREACH STREAM (in part)
= VTHP (1989): Mid-Gradient Stream (in part)
= VT ACWG (1998): Lower reaches of small rivers (RAM4)
= VT ACWG (1998): Moderate-sized mountain streams (RAM3)
= VT ACWG (1998): Moderately-sized streams and small rivers, mid elevation mixed cold-warmwater (RAF4) (in part)
= VT ACWG (1998): Moderately-sized streams to small rivers, low elevation, warmwater (RAF5) (in part)
= GLB (2000): Large St. Lawrence Tributaries (GLB Stream Type 39) (in part)
= GLB (2000): Midreaches of St. Lawrence Tributaries (GLB Stream Type 42) (in part)
=? GLB (2000): Glacial Marine Plain Tributaries (GLB Stream Type 40)
=? GLB (2000): Till Plain Tributaries (GLB Stream Type 41)
=? GLB (2000): St. Lawrence Lake Plain Mainstems (GLB Stream Type 45)
=? GLB (2000): Black River Mainstem (GLB Stream Type 35) (in part) (GL variant may be better)
=? GLB (2000): Lower Black River (GLB Stream Type 36) (in part) (GL variant may be better)
Suggested Alliance Name: **Blacknose Dace-Common Shiner-Green Algae-Neoperla Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: large.
Watershed Size: moderate to large; 30-4,000 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: Diverse (riffle, run and pool in a well-defined pattern), riffles moderately abundant. The pelagic zone may be substantially differentiated from benthic zone.
Water Permanence: permanent.
Stream Position: midreach (usually 3rd to 4th order) to main stem/main channel (usually 5th to 6th order).
Discharge: moderate to high.
Temperature: warm; VT ACWG (1998): high summer temperature.
Substrate/Water Alkalinity: circumneutral to basic (high pH).
Substrate Texture: coarse substrate (rock, gravel, sand).
Sediment Transport Regime: lateral erosion with deposition.
Flow velocity: fast to moderate.
Gradient: medium to slight (i.e., slope at least 1 degree, usually at least 2 degrees).
Confinement: strongly to moderately confined, low sinuosity.
Nutrient Source: autotrophic food base (autochthonous).
Landscape Setting:
Upland, typically of riverside sand/gravel bar or cobble shore, some exposed bedrock outcrops; lower valleys of major watersheds, < 35% canopy cover typical.
Other Features:
Some rapid reaches, whitewater areas common, with waterfalls; relatively deep (with areas > 4m deep), relatively wide (averaging > 2m wide), with abundant coarse woody debris and braided channels with instream islands.
ELU Signature:
Stream Size Class 2-4. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota: Epilithic green algae predominate. Vascular plants depauperate. Macroinvertebrates include riffle specialists, algae shredders, warmwater, basic stream fauna dominated by beetles and a diverse mussel component characteristic of the Upper Great Lakes, the latter represented by frequent mussel beds. Coldwater to transitional fish assemblages are of high diversity, spanning all microhabitats, and are addressed below. Variation in fish and mollusk assemblages seem well correlated with position relative to the Principal Fall Line, which in turn may correlate well with stream size within this category.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Blacknose Dace-Common Shiner (RAF4)**
Blacknose Dace-Common Shiner Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence in STL Confined River confirmed by Mark Ferguson, VTHP.

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)**
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence in STL Confined River confirmed by Mark Ferguson, VTHP.

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)** (?)
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence in STL Confined River at low abundance confirmed by Mark Ferguson, VTHP.

Suggested Microhabitat-Association Composition:

1) Riffle-Run: **Blacknose Dace-Common Shiner-[Green Algae]-Neoperla Association**

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)**
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in STL Confined River suspected by D. Hunt, NYHP.

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Algae Shredder/Scraper-Dominated Fauna (RAM3)**

Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Presence in moderate-sized examples of STL Confined River confirmed by Steve Fiske, VTDEC.

Macroinvertebrate Assemblage: **Coleoptera-Dominated Warm, Basic Stream Fauna (RAM4)**

Coleoptera (Promeresia, Stenelmis)-Plecoptera (Neoperla)-Trichoptera (Chimara) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Presence in large examples of STL Confined River confirmed by Steve Fiske, VTDEC.

Macroinvertebrate Assemblage: **Upper Great Lakes Glacial Refugia Mollusks (RAM8)**

Mollusca (Potamilus, Lampsilis, Leptodea, Pyganodon, Sphaerium, Pisidium)-Ephemeroptera (Hexagenia)-Coleoptera (Dubiraphia)-Trichoptera (Phylocentropus)-Crustacea (Gammarus)-Chironomidae (Polypedilum)-Diptera (Spheromias, Culicoides) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Presence in large river examples of STL Confined River (below the fall line) confirmed by Steve Fiske, VTDEC.

2) Pool: **Blacknose Dace-Common Shiner-[green algae]-[macroinvertebrate] Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**

Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown, poor data available.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.

Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ based on available data, especially in fish and mollusk diversity, but these may represent the same assemblage, simply different levels of "expression" based on historical post-glacial migration routes. There is evidence that besides biological differences, the Lake Champlain Valley examples represent occurrences with stream bottoms of deep sands with mollusks burrowing deep into the sand; while the more diverse St. Lawrence River Valley examples represent occurrences with rocky stream bottoms supporting mollusks in shallow sands in bedrock cracks. GLB (2000): Drainage unit split used is Eastern Lake Ontario vs. Saint Lawrence vs. Lake Champlain. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.

2) Elevation Variants (in relation to "Principal Fall Line").

Notes From March 14, 2000 meeting: Most examples are found above the "Principal Fall Line" in VT STL, the Poultney River being an exception and supporting a unique assemblage of species (especially fishes and mollusks), but located only within a small area (ca. 0.25 miles long). From May 10, 2000 meeting: We decided not to treat examples of this type below the fall line as a separate and rare river type, since fish and mollusk distributions are apparently determined primarily by the vertical barrier presented by the fall line, not necessarily the characteristics of the river above the fall line. We also thought that biota in examples above the fall line in STL differed from the biota in NAP confined rivers, including examples farther upstream on the same river system. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION (may correspond closer with next factor, stream size).

3) Stream Order/Discharge Variants.

Notes: Reportedly varies between different stream order and across a discharge range. Macroinvertebrates assemblages differ between moderate-sized rivers and large rivers such as the lower Winooski River of VT (S. Fiske, VTDEC), with leaf shredders and algae scrapers dominant in the former and warmwater assemblages in the latter. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.

4) Substrate Texture and Slope Variants.

Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats.

5) Connectivity Variants.

NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAP?, STLy; VT: NAP?, STLy?

NY Examples: NYFRAN? Chateaugay River, NYWASH Poultney River (LNE).

VT Examples:

Lower Winooski River. STL Portfolio: Lamoille River, Lewis Creek, Missiquoi River. Others suspected from VT ACWG (1998): Castleton River?, Hubbardton River?

Sources:

VT ACWG (1998); NYHP BCD Animal EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Erickson (1995), K. Schneider/NYHP mollusk expert, VTHP (1989), P. Novak/NYHP odonate expert.

Basic Macrohabitat #5: **CONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian Confined River (RM9)**

Synonymy/Affinities:

= NYHP (1990): MIDREACH STREAM (in part)
= VTHP (1989): Medium Gradient Stream? (in part)
= NHHP (1992): Medium Gradient Stream? (in part)
= MEHP (1991): Midreach Stream Community (ME River Type R4) (in part)
= VT ACWG (1998): Moderately-sized mountain stream (RAM3)
= VT ACWG (1998): Moderately-sized, high elevation coldwater stream (RAF3) (in part)
= VT ACWG (1998): Moderately-sized streams and small rivers, mid elevation mixed cold-warmwater (RAF4) (in part)
= GLB (2000): Adirondack Highland Streams (GLB Stream Type 38) (in part)
= GLB (2000): Eastern Tributaries to Black River (GLB Stream Type 33) (in part)
= GLB (2000): Southern Tug Hill Transition Streams (GLB Stream Type 27) (in part)
=? GLB (2000): Western Tug Hill Transition Streams (GLB Stream Type 29) (in part)
=? GLB (2000): Midreaches of St. Lawrence Tributaries (GLB Stream Type 42) (in part)

Suggested Alliance Name: **Brook Trout-Blacknose Dace-Fontinalis-Green Algae-Chloroperlidae-Gerridae Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: large.
Watershed Size: moderate to large; 30-4,000 mi^2
Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: Diverse (riffle, run and pool in a well-defined pattern), riffles moderately abundant. The pelagic zone may be substantially differentiated from benthic zone.

Water Permanence: permanent.
Stream Position: midreach (usually 3rd to 4th order) to main stem/main channel (usually 5th to 6th order).
Discharge: moderate to high.
Temperature: cool? to cold.
Substrate/Water Alkalinity: circumneutral (moderate pH); VT ACWG (1998): often over 7.0 pH and with ANC not limiting.
Substrate Texture: coarse substrate (rock, gravel, sand), including those derived from till.
Sediment Transport Regime: depositional with lateral erosion.
Flow velocity: fast.
Gradient: high to medium (to slight).
Confinement: moderately to highly confined.
Nutrient Source: autotrophic food base (autochthonous).
Landscape Setting:

Upland, typically with cobble shore, also with riverside sand/gravel bar and shoreline outcrop; 45% canopy cover typical.

Other Features:

Some rapid reaches, whitewater areas common, with waterfalls; relatively deep (with areas > 4m deep), relatively wide (averaging > 2m wide), with abundant coarse woody debris and braided channels with instream islands, especially in lower reaches. GLB (2000): fed by headwater lakes and connected to large drainage lakes; within highly deranged drainage networks; some groundwater fed reaches.

ELU Signature: Stream Size Class 2-4. Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota:

Epilithic green algae predominate. Vascular plants depauperate. Macroinvertebrates include riffle specialists, algae shredders and scrapers (both "well represented"), and, in pools, neuston fauna. Mussel diversity is generally poor and occasional scattered large mussel beds are suspected. Fish assemblages are relatively diverse for the ecoregion, of coldwater to transitional species, and span all microhabitats, as addressed below.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Brook Trout-Blacknose Dace (RAF3)**
Brook Trout-Blacknose Dace Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Blacknose Dace-Common Shiner (RAF4)**
Blacknose Dace-Common Shiner Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Brook Trout-Slimy Sculpin (RAF2)** (?)
Brook Trout-Slimy Sculpin Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)** (?)
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)** (?)
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle-Run: **Brook Trout-Blacknose Dace-Fontinalis-Green Algae-Chloroperlidae Association**

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Algae Shredders/Scrapers (RAM3)**
Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
K. Schneider interview: Margaritifera characteristic of "acidic" (DH: circumneutral?) Rocky Headwater Streams in NAP, especially Adirondack foothills; rare in VT, S2 in NY. DH: Margaritifera is dominant mollusk and at high density in Tug Hill RM9 (NAP Confined River) grading to RM5 (NAP Rocky Headwater Streams).

Macroinvertebrate Assemblage: **Cold Sandy Marsh Fauna (RAM5)** (?)
Mollusca (Pisidium)-Trichoptera (Polycentropus)-Ephemeroptera (Litobrancha)-Odonata (Cordulegaster) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

2) Pool: **Brook Trout-Blacknose Dace-[green algae]-Potamogeton sp.-Gerridae Association**

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)** SEE RIFFLE

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **American Eelgrass NAP Herbaceous Vegetation (RAP2)** (?)
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Water Strider-Dominated Pool Fauna (RAM13)**
Hemiptera (Gerridae, Vellidae, Mesovellidae) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Stream Order/Discharge Variants.
Notes: May vary between different stream order and across a discharge range.
2) Substrate Texture and Slope Variants.
Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats.
3) Regional Variants.
Notes: Adirondack and Green Mountain EOs may differ from Tug Hill EOs, especially in temperature, elevation and fish assemblages (Adirondack/Green Mts: cold, mid elevation; Tug Hill: cool, only mid to low elevation). Is the driving parameter elevation within NAP? (Are there mid elevation vs. low elevation variants?) or is it a geographic (E to W) or watershed gradient?
4) Watershed Variants.
Notes: Major watershed variants (e.g., St. Lawrence/Lake Champlain watershed, E Lake Ontario watershed, Hudson River watershed, Connecticut River watershed?) possible but not strongly suspected, need more assessment. Need to evaluate potential split between Hudson drainage and STL drainage (potential anadromous fish differences reported).

Distribution: NY: NAPy, STLy; VT: NAPy, STLy

NY Examples:
NYESSE W Branch Ausable River, NYESSE E Branch Ausable River, NYESSE Boquet River, NYESSE Upper Hudson River, NYFRAN Saranac River, NYFRAN N Branch Saranac River, NYFRAN? Salmon River (STL), NYFRAN? Middle Branch Saint Regis River, NYFRAN? West Branch Saint Regis River (STL), NYSTLA Main Branch Oswegatchie River, NYSTLA Oswegatchie River, NYSTLA Grass River (STL), NYSTLA? Deer River (STL), NYHAMI W Branch Sacandaga River, NYHAMI Moose River, NYHERK Middle Branch Oswegatchie River, NYLEWI E Branch Fish Creek Midreach, NYLEWI Independence River, NYCLIN Great Chazy River, NYSTLA Raquette River, NYSTLA Elm Creek, NYFRAN? Chateaugay River, NYFRAN? Trout River, NYFRAN? Little Salmon River. See GLB (2000) for more examples, especially from the western Tug Hill.
VT Examples:
STL Portfolio: Lamoille River, Browns River, Missiquoi River, Winooski River, Fairfield-Black Creek. Others suspected from VT ACWG (1998): Bourn Brook, Cold River, Dog River, East Branch North River, East Branch Passumpsuc River, East Branch Nulhegan River, East Putney Brook, Flower Brook, Green River, Moose River, Ottauquechee, Saxtons River, South Stream, Third Branch White, White River, Winhall River.
Sources:
VT ACWG (1998); NYHP BCD Animal EORs (2002), NYHP BCD Significant Habitat EORs (2002), NYHP BCD Community EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), Higgins et al. (1998), MEHP (1991).

Basic Macrohabitat Type #6: **UNCONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley Unconfined River (RM12)**

Synonymy/Affinities:
= NYHP (1990): MAIN CHANNEL STREAM (in part)
= VTHP (1989): Low-Gradient Stream? (in part)
= VTHP (1989): Major River? (in part)
= VT ACWG (1998): Moderate to large rivers directly entering Lake Champlain (RAM8)
= VT ACWG (1998): Medium-sized mid-reach meandering streams (RAM6)
= VT ACWG (1998): Small streams in lower Champlain Valley (RAM7)
= VT ACWG (1998): Moderately-sized streams to small rivers, low elevation, warmwater (RAF5) (in part)
= VT ACWG (1998): Moderate to large, warmwater rivers, entering directly into Lake Champlain (RAF6) (in part)
= VT (Richard Langdon): "Slow winders"
= GLB (2000): Large St. Lawrence Tributaries (GLB Stream Type 39)
= GLB (2000): Midreaches of St. Lawrence Tributaries (GLB Stream Type 42)
= GLB (2000): St. Lawrence Lake Plain Mainstems (GLB Stream Type 45)
=? GLB (2000): Glacial Marine Plain Tributaries (GLB Stream Type 40)
=? GLB (2000): Till Plain Tributaries (GLB Stream Type 41)
=? GLB (2000): Black River Mainstem (GLB Stream Type 35) (probably better for GL macrohabitat)
=? GLB (2000): Lower Black River (GLB Stream Type 36) (probably better for GL macrohabitat)

Suggested Alliance Name: **Pumpkinseed-Bluntnose Minnow-Potamogeton-Podostemum-Green Algae-Potamilus-Lampsilis Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: large.
Watershed Size: moderate to large; 30-4,000 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: littoral, possibly with small to moderate amounts of sublittoral area. Light regime microhabitat: all above-ground. Flow microhabitats: predominantly run with abundant pools; riffles, if present, are very small. The pelagic zone is substantially differentiated from the benthic zone.
Water Permanence: permanent.
Stream Position: midreach (usually 3rd to 4th order) to main stem/main channel (usually 5th to 6th order).
Discharge: moderate to high.
Temperature: warm.
Substrate/Water Alkalinity: calcareous, basic (high pH); with high ANC (VT ACWG, 1998).
Substrate Texture: fine substrate (sand to silt); typically sand/gravel stream bed with clay/silt banks.
Sediment Transport Regime: depositional with lateral erosion.
Flow velocity: slow to moderate.
Gradient: low to very low, with slope less than 1 degree.
Confinement: poorly confined with meanders, high sinuosity.
Nutrient Source: autotrophic food base (autochthonous).
Landscape Setting:
Unconfined, wide rivers in broad valleys, including outwash plains. With meanders, sand bars, eroded sand banks and silt/clay banks. Associated with marshes, floodplain forests of alder, willow and poplar, and some peatlands. Canopy cover typically low.
Other Features:
relatively deep (with areas > 4m deep), relatively wide (averaging > 2m wide), with abundant coarse woody debris and braided channels with instream islands. whitewater is sparse to absent. typically below the principal fall line (150 foot elevation).
ELU Signature:
Stream Size Class 2-4. Wet-Moist Flats. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota: Vascular plants may be abundant in shallow and slower sections; epilithic green algae and phytoplankton may be abundant. Macroinvertebrates are predominated by pool and soft-bottomed species. Characteristic macroinvertebrates include odonates typical of floodplains. These rivers are known as good warmwater fish concentration areas. Fish assemblages are warmwater, diverse and span all microhabitats, as addressed below. GLB (2000): crosswalked to fish assemblages M2, LR and possibly M1. Anadromous fish are possible (VTHP, 1989) including rainbow smelt, American shad, and sea lamprey. Contains regionally restricted fish and mollusk species aggregates from Great Lakes refugia.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)**
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Reportedly only above the principal fall line (Richard Langdon, VTDEC). Presence in moderate-sized examples of STL Unconfined River confirmed by Mark Ferguson, VTHP.

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Presence in large examples of STL Unconfined River confirmed by Mark Ferguson, VTHP.

Fish Assemblage: **Iowa Darter-Pugnose Shiner (RAF7)**
Iowa Darter-Pugnose Shiner Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Fish Assemblage: **Lake Sturgeon Riverine Assemblage (RAF8)**

Lake Sturgeon-Greater Redhorse-Channel Darter Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Assemblage is likely to span littoral and sublittoral areas.

Suggested Microhabitat-Association Composition:

1) Riffle-Run: **Pumpkinseed-Bluntnose Minnow-Potamogeton-Podostemum-Potamilus-Lampsilis Association**

Plant Assemblage: **American Eelgrass STL Herbaceous Vegetation (RAP3)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in STL Unconfined River confirmed by Susan Warren, VTDEC & D. Hunt, NYHP.

* Plant Assemblage: **Riverweed Herbaceous Vegetation (RAP4)**
Podostemum ceratophyllum Herbaceous Vegetation (CEGL004331)
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)** (?)
Fontinalis sp.-epilithic green algae Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Main Channel Stream Fontinalis Bryophyte Vegetation (RAP12)** (?)
Fontinalis sp. Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Phytoplankton Vegetation (RAP15)**
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in this specific macrohabitat and microhabitat type from D. Hunt speculation based on standard aquatic ecology references.

Macroinvertebrate Assemblage: **Odonata-Dominated Floodplain Fauna (RAM6)**
Coleoptera (Dubiraphia)-Chironomidae (Polypedilum)-Ephemeroptera (Leptophelbidae)-Mollusca (Pisidium)-Odonota (Aeshnidae, Calopterygidae, Coenargionidae, Gomphidae)-Trichoptera (Hydaphylax) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in moderate-sized examples of STL Unconfined River confirmed by Steve Fiske, VTDEC.

Macroinvertebrate Assemblage: **Diptera-Dominated Basic Stream Fauna (RAM7)**
Diptera (Tipula, Atherix, Simulum)-Chironomidae (Apsectrotnypus, Rheocricotopus)-Crustacae (Hyallela)-Mollusca (Pisidium)-Ephemeroptera (Stenonema) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in large examples of STL Unconfined River confirmed by Steve Fiske, VTDEC.

Macroinvertebrate Assemblage: **Upper Great Lakes Glacial Refugia Mollusks (RAM8)**
Mollusca (Potamilus, Lampsilis, Leptodea, Pyganodon, Sphaerium, Pisidium)-Ephemeroptera (Hexagenia)-Coleoptera (Dubiraphia)-Trichoptera (Phylocentropus)-Crustacea (Gammarus)-Chironomidae (Polypedilum)-Diptera (Spheromias, Culicoides) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)
Presence in large examples of STL Unconfined River confirmed by Steve Fiske, VTDEC.

2) Pool: **Pumpkinseed-Bluntnose Minnow-[unknown phytoplankton]-[unknown macroinvertebrate] Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Phytoplankton Vegetation (RAP15)** (?)
Assemblage Description: (See Plant Assemblage Descriptions)
Presence in this specific macrohabitat and microhabitat type from D. Hunt speculation based on standard aquatic ecology references.

Macroinvertebrate Assemblage: unknown, poor data available.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.
   Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ based on available data, especially in fish and mollusk diversity, but these may represent the same assemblage, simply different levels of "expression" based on historical post-glacial migration routes. There is evidence that besides biological differences, the Lake Champlain Valley examples represent occurrences with stream bottoms of deep sands with mollusks burrowing deep into the sand; while the more diverse St. Lawrence River Valley examples represent occurrences with rocky stream bottoms supporting mollusks in shallow sands in bedrock cracks. GLB (2000): Drainage unit split used is Eastern Lake Ontario vs. Saint Lawrence vs. Lake Champlain. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
2) Elevation Variants (in relation to "Principal Fall Line").
   Notes From March 14, 2000 meeting: Rich Langdon, VTDEC: fish and mollusk assemblages differ above and below the "Principal Fall Line" at 150 foot elevation in VT STL. Smith reference suggests a fall line in Adirondacks at 200 feet, thus approximating the NAP/STL ecoregion boundary. From May 10, 2000 meeting: We decided not to treat examples of this type above and below the fall line as separate river types, since fish and mollusk distributions are apparently determined primarily by the vertical barrier presented by the fall line, not necessarily the characteristics of the river above the fall line. We also thought that biota in examples above the fall line in STL differed from the biota in NAP unconfined rivers, including examples farther upstream on the same river system. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION (may correspond closer with next factor, stream size).
3) Stream Order/Discharge Variants.
   Notes: Reportedly varies between different stream order and across a discharge range, at least for macroinvertebrates assemblages, between moderate-size rivers and large rivers (S. Fiske, VTDEC). STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
4) Substrate Texture and Slope Variants.
   Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats. GLB (2000): target types were designated based on various surficial geological classes: a) marine/lacustrine sandy, silt, clay, b) fine-textured till and outwash channels, c) lacustrine calcareous silt and clay. STL AQUATIC COMMUNITY TEAM STRONGLY RECOMMENDED USING THIS FACTOR TO STRATIFY SITE SELECTION.
5) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification.

Distribution: NY: NAPy?, STLy; VT: NAP?, STLy

NY Examples:
NYCLIN Salmon River, NYSTLA Grass River, NYSTLA Oswegatchie River, NYSTLA Raquette River, NYSTLA St. Regis River, NYSTLA Chippewa Creek, NYFRAN Salmon River, NYSTLA Beaver Creek?, NYWASH Poultney River (LNE), NYWASH Mettawee River (LNE), NYESSE Boquet River, NYCLIN Saranac River, NYJEFF Indian River, NYESSE LaChute River, NYCLIN Little Ausable River. GLB (2000) additions: NYSTLA? Black Creek, NYLEWI? West Branch Oswegatchie River (NAP).

VT Examples:
STL Portfolio: Lamoille River, Missiquoi River, Lewis Creek, Winooski River, Otter River & tributaries, Poultney River (NY/VT LNE).

Sources:
VT ACWG (1998); NYHP BCD Animal EORs (2002), NYHP BCD Plant EORs (2002), NYHP BCD Significant Habitat EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), Higgins et al. (1998), Hunt (1999c); Sneddon et. al (1998), Anderson et al. (1998), VTHP (1989).

Basic Macrohabitat Type #6: **UNCONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian Unconfined River (RM11)**

Synonymy/Affinities:

= NYHP (1990): MAIN CHANNEL STREAM (in part)
= VTHP (1989): Low-Gradient Stream? (in part)
= VTHP (1989): Major River? (in part)
= NHHP (1992): Major River? (in part)
= MEHP (1991): Main Channel River Community (ME River Type 7) (in part)
= VT ACWG (1998): Medium-sized mid-reach meandering streams (RAM6)
= VT ACWG (1998): Moderately-sized streams and small rivers, mid elevation mixed cold-warmwater (RAF4) (in part)
= GLB (2000): Adirondack Highland Streams (GLB Stream Type 38) (in part)
=? GLB (2000): Midreaches of St. Lawrence Tributaries (GLB Stream Type 42) (in part)
=? GLB (2000): Southern Tug Hill Transition Streams (GLB Stream Type 27) (in part)
=? GLB (2000): Eastern Tributaries to Black River (GLB Stream Type 33) (in part)

Suggested Alliance Name: **Blacknose Dace-Common Shiner-Potamogeton-Green Algae-Aeshnidae Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: moderate to large.

Watershed Size: moderate to large; 30-4,000 mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: littoral, possibly with small amounts of sublittoral area. Light regime microhabitat: all above-ground. Flow microhabitats: predominantly run with abundant pools; riffles, if present, are very small. The pelagic zone is substantially differentiated from the benthic zone.

Water Permanence: permanent.

Stream Position: midreach (usually 3rd to 4th order) to main stem/main channel (usually 5th to 6th order).

Discharge: moderate.

Temperature: cool?

Substrate/Water Alkalinity: circumneutral (moderate pH) (?).

Substrate Texture: fine substrate (sand and gravel to silt), some peat deposits.

Sediment Transport Regime: depositional with lateral erosion.

Flow velocity: slow.

Gradient: low to very low.

Confinement: poorly confined with meanders, high sinuosity.

Nutrient Source: autotrophic food base (autochthonous).

Landscape Setting:

Unconfined with meanders, sand bars in broad valleys. Associated with floodplain marshes, lined with alder, willow (and possibly poplar [per VT ACWG (1998)]). Canopy cover typically low. NY: presence of poplar questioned in NAP.

Other Features:

Relatively deep (with areas > 4m deep), relatively wide (averaging > 2m wide), with abundant coarse woody debris. variable channel morphometry (MEHP, 1991), typically with braided channels and alternating sections of erosional and depositional features (MEHP, 1991). whitewater sparse to absent. GLB (2000): fed by headwater lakes, connecting to large drainage lakes.

ELU Signature: Stream Size Class 2-4. Wet-Moist Flats. Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.

Biota: Vascular plants may be abundant in shallow and slower sections; epilithic green algae and phytoplankton may be abundant. Macroinvertebrates are predominated by pool and soft-bottomed species. Characteristic macroinvertebrates include odonates typical of floodplains. Fish assemblages are relatively diverse for the ecoregion, with transitional species, and span all microhabitats, as addressed below. Anadromous fish, reported by VTHP (1989) and MEHP (1991), are not expected to be widespread in this type, possibly only Atlantic salmon and possibly only in a restricted part of the community range (e.g., at the lowest elevations/along the lowest reaches).

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Blacknose Dace-Common Shiner (RAF4)**
Blacknose Dace-Common Shiner Assemblage
Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)** (?)
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Individual Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Riffle-Run: **Blacknose Dace-Common Shiner-Potamogeton-Green Algae-Aeshnidae Association**

Plant Assemblage: **American Eelgrass NAP Herbaceous Vegetation (RAP2)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)** (?)
Fontinalis sp.-epilithic green algae Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)
Apparently reported from this specific macrohabitat, but may be confined to shallow shoals or banks or a represented by a different assemblage (see RAP12).

Plant Assemblage: **Main Channel Stream Fontinalis Bryophyte Vegetation (RAP12)** (?)

Fontinalis sp. Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Phytoplankton Vegetation (RAP15)** (?) SEE POOL MICROHABITAT BELOW

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Odonata-Dominated Floodplain Fauna (RAM6)**

Coleoptera (Dubiraphia)-Chironomidae (Polypedilum)-Ephemeroptera (Leptophelbidae)-Mollusca (Pisidium)-Odonota (Aeshnidae, Calopterygidae, Coenargionidae, Gomphidae)-Trichoptera (Hydaphylax) Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

2) Pool: **Blacknose Dace-Common Shiner-Nymphaea-[unknown macroinvertebrate] Association**

Plant Assemblage: **Broadleaf Pondlily NAP Herbaceous Vegetation (RAP5)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Phytoplankton Vegetation (RAP15)** (?)

Assemblage Description: (See Plant Assemblage Descriptions)

Concentrated in the pelagic-epilimnion microhabitat. Presence in this specific macrohabitat and microhabitat type from D. Hunt speculation based on standard aquatic ecology references.

Macroinvertebrate Assemblage: unknown, poor data available.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Stream Order/Discharge Variants.
Notes: May vary between different stream order and across a discharge range.

2) Substrate Texture and Slope Variants.
Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, gravel, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats.

3) Regional/Watershed Variants.
Notes: Possible regional variants typical for other NAP macrohabitat not suspected, as no examples suspected from the outlying Tug Hill area. Major watershed variants (e.g., St. Lawrence/Lake Champlain watershed, E Lake Ontario watershed, Hudson River watershed, Connecticut River watershed?) possible but not strongly suspected; need more assessment. Need to evaluate potential split between Hudson drainage and STL drainage (potential anadromous fish differences, only difference may be Atlantic salmon).

Distribution: NY: NAPy, STLy; VT: NAPy?, STLy.

NY Examples:
NYSTLA Lower Raquette River (STL), NYFRAN Raquette River Harrietstown, NYFRAN? Saint Regis River (STL), NYESSE Schroon River (NAP), NYSTLA Indian River (STL), NYSTLA Oswegatchie River (STL), NYSTLA Little River (STL), NYCLIN Boquet River, NYCLIN Great Chazy River (STL), NYCLIN Ausable River (STL), NYLEWI Beaver River (STL), NYFRAN? Lawrence Creek.
VT Examples: STL Portfolio: Missiquoi River, Winooski River.

Sources: VT ACWG (1998); NYHP BCD Community EORs (2002), NYHP BCD Animal EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), MEHP (1991), VTHP (1989).

Basic Macrohabitat Type #7: **BACKWATER SLOUGH** Last Update: December 12, 2002

Macrohabitat Name: **St. Lawrence-Champlain Valley (Circumneutral) Backwater Slough (RM15)**

Synonymy/Affinities:

= NYHP (1990): BACKWATER SLOUGH (in part)
= VT ACWG (1998): apparently no equivalent
= VTHP (1989): apparently no equivalent (closest to Low Gradient Stream?)
= GLB (2000): Till Plain Tributaries (GLB Stream Type 41) (in part)

Suggested Alliance Name: **Pumpkinseed-Bluntnose Minnow-Potamogeton-Elodea-Stenonema Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: very small; << $2mi^2$
Microhabitat Composition:

Depth/Substrate microhabitat: littoral, possibly with small to moderate amounts of sublittoral area. Light regime microhabitat: all above-ground. Flow microhabitats: predominantly pools. The pelagic zone may be substantially differentiated from the benthic zone.

Water Permanence: permanent.
Stream Position: headwater, usually only 1st order.
Discharge: very low.
Temperature: warm.
Substrate/Water Alkalinity: calcareous, basic (high pH).
Substrate Texture: fine substrate (silt?); examples on bedrock also known.
Sediment Transport Regime: depositional during flood stage.
Flow velocity: very slow, stagnant most of year.
Gradient: very low, with slope much less than 1 degree.
Confinement: poorly confined.
Nutrient Source: autotrophic food base? (autochthonous).
Landscape Setting:

Usually associated with and connected to unconfined streams in broad valleys with meanders and Oxbow Lakes. Associated with floodplain forests or shrub swamps. Canopy cover typically low.

Other Features: connectivity restricted to downstream end, either to Marsh Headwater Stream or Unconfined River.
ELU Signature:

Wet-Moist Flats. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.

Biota:

Fairly poor biotic data available. Warmwater plants and animals with pool species abundant. Vascular plants may be abundant, phytoplankton may be abundant. Fish assemblages likely characteristic of connected river type. Prone to invasion by Eurasian watermilfoil.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
GLB (2000) crosswalks to GLB Fish Community Types M1 and M2 (spanning STL Types RAF4, RAF5, RAF6, RAF7).

Fish Assemblage: **Bluntnose Minnow-Creek Chub (RAF5)** (?)
Bluntnose Minnow-Creek Chub Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Pool: **Pumpkinseed-Bluntnose Minnow-Potamogeton-Elodea-Stenonema Association**

Plant Assemblage: **American Eelgrass STL Herbaceous Vegetation (RAP3)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Diptera-Dominated Basic Stream Fauna (RAM7)**
Diptera (Tipula, Atherix, Simulum)-Chironomidae (Apsectrotnypus, Rheocricotopus)-Crustacae (Hyallela)-Mollusca (Pisidium)-Ephemeroptera (Stenonema) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Macroinvertebrate Assemblage: **Algae Shredder/Scraper-Dominated Fauna (RAM3)** (?)
Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional/Watershed Variants.
   Notes: Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available), especially in fish and mollusk diversity, but these may represent the same assemblage, simply different levels of "expression" based on historical migration routes. GLB (2000): Drainage unit split used is Eastern Lake Ontario vs. Saint Lawrence vs. Lake Champlain.
2) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification. Differences in fishes are reported between examples connected to Marsh Headwater Stream versus Unconfined Rivers (R. Langdon, VTDEC).
3) Elevation Variants (in relation to "Principal Fall Line").
   Notes From March 14, 2000 meeting: Rich Langdon, VTDEC: fish and mollusk assemblages differ above and below the "Principal Fall Line" at 150 foot elevation in VT STL. Smith reference suggests a fall line in Adirondacks at 200 feet, thus approximating the NAP/STL ecoregion boundary.
4) Substrate Texture and Slope Variants.
   Notes: Subtypes may include bedrock, boulder/cobble, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic pavement, aquatic boulder field and aquatic unconsolidated flats. Examples are known on silt and bedrock.
5) Substrate Alkalinity Variants.
   Notes: All or most suspected to have circumneutral to basic water and not be substantially affected by local changes in underlying bedrock.

Distribution: NY: NAP?, STLy; VT: NAP?, STLy

NY Examples:
NYSTLA Little River Canton, NYSTLA Whitehouse Bay, NYCLIN Ausable Delta, NYESSE Boquet River. GLB (2000): also associated with lower reaches of Grass River, Raquette River, St. Regis River.

VT Examples:

Sources: NYHP BCD Plant EORs (2002), NYHP Community Leads (2002), Reschke (1990).

Basic Macrohabitat Type #7: **BACKWATER SLOUGH** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian (Acidic) Backwater Slough (RM14)**
Synonymy/Affinities:
= NYHP (1990): BACKWATER SLOUGH (in part)
= MEHP (1991): Backwater Slough Community (ME River Type R8) (in part)
= VTHP (1989): apparently no equivalent (closest to Low Gradient Stream?)
= NHHP (1992): apparently no equivalent (closest to Low Gradient Stream?)
= VT ACWG (1998): apparently no equivalent
=? GLB (2000): Adirondack Highlands Stream (GLB Stream Type 38) (in part)
Suggested Alliance Name: **Creek Chub-Common Shiner-Potamogeton epihydrus-Dytiscus Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: small.
Watershed Size: very small; << $2mi^2$
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitats: predominantly pools with some runs expected. The pelagic zone may be substantially differentiated from the benthic zone.
Water Permanence: permanent.
Stream Position: headwater, usually only 1st order.
Discharge: very low.
Temperature: cold to warm.
Substrate/Water Alkalinity: acidic (low pH).
Substrate Texture: fine substrate (silt?).
Sediment Transport Regime: depositional during flood stage.
Flow velocity: very slow, stagnant most of year.
Gradient: very low with slope much less than 1 degree.
Confinement: poorly confined.
Nutrient Source: autotrophic food base? (autochthonous).
Landscape Setting:
Usually associated with and connected to unconfined streams in broad valleys with meanders. Associated with floodplain forests or shrub swamps. Full canopy cover typical. MEHP (1991): in a "slough" or "bogan" (embayments and old meanders cut off from the main channel of the associated adjacent river).
Other Features:
Connectivity restricted to downstream end, either to Marsh Headwater Stream or Unconfined River; bedrock type differs from STL variant.
ELU Signature: Wet-Moist Flats. Acidic-Mafic Bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota:
Fair biotic data available. Pool species abundant. Vascular plants abundant; phytoplankton may be abundant. Characteristic suite of associated birds reportedly use habitat. Fish assemblages characteristic of connected river type. Fish species differ from STL variant, with abundance of riffle specialists.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Brook Trout-Blacknose Dace (RAF3)** (?)
Brook Trout-Blacknose Dace Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
In this macrohabitat, contains only a subset of creek chub, common shiner, and sculpin per Rich Langdon (VTDEC).

Suggested Microhabitat-Association Composition:

1) Pool: **Creek Chub-Common Shiner-Potamogeton epihydrus-Dytiscus Association**

Plant Assemblage: **American Eelgrass NAP Herbaceous Vegetation (RAP2)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)
Need comparison to similar association for lakes.

Potential Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)** (?)
Fontinalis sp.-epilithic green algae Bryophyte Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Diving Beetle-Dominated Pool Fauna (RAM12)**
Coleoptera (Dytiscus) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Macroinvertebrate Assemblage: **Algae Shredder/Scraper-Dominated Fauna (RAM3)** (?)
Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Connectivity Variants.
   NAC/GL Basin uses local connectivity patterns (e.g., connection to lakes) to further stratify classification. Differences in fishes are reported between examples connected to Marsh Headwater Stream versus Unconfined Rivers (R. Langdon, VTDEC).
2) Substrate Texture and Slope Variants.
   Notes: Subtypes may include bedrock, boulder/cobble, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic pavement, aquatic boulder field and aquatic unconsolidated flats. Examples are known on silt.
3) Substrate Alkalinity Variants.
   Notes: most suspected to have acidic to circumneutral water and not be substantially affected by local changes in underlying bedrock. However, examples over calcareous bedrock are reported from VT; uncertain if these have biota characteristic of NAP or STL macrohabitat.
4) Watershed Variants.
   Notes: Major watershed variants not suspected, but possible; need more assessment.

Distribution: NY: NAPy, STL?; VT: NAPy?, STL?

NY Examples: NYFRAN Raquette River Harrietstown, NYESSE Upper Chubb River.
VT Examples:

Sources: Reschke (1990), MEHP (1991), NYHP BCD Community EORs (2002), NYHP Community Leads

Basic Macrohabitat Type #8: **RIVERINE CAVE COMMUNITY** Last Update: July 7, 2000

Macrohabitat Name: **St. Lawrence-Champlain Valley Subterranean Stream (RM17)**
Synonymy/Affinities:
= NYHP (1990): AQUATIC CAVE COMMUNITY (in part)
= VTHP (1989): Subterranean Stream/Pool (stream part) (in part?)
= VT ACWG (1998): apparently no equivalent
= GLB (2000): apparently no equivalent
Suggested Alliance Name: **(unknown characteristic invertebrates) Non-Vegetated Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: small.
Watershed Size:
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all subterranean (dark, twilight, entrance). Flow microhabitats: suspected to be a mix of riffle, pool and possibly run. The pelagic zone probably becomes so small it merges with benthic zone.
Water Permanence: permanent suspected.
Stream Position: headwater, low order.
Discharge: very low.
Temperature: cool to cold suspected.
Substrate/Water Alkalinity: primarily circumneutral to calcareous.
Substrate Texture: bedrock.
Sediment Transport Regime: headward erosion with no deposition.
Flow velocity:
Gradient:
Confinement: confined, low sinuosity.
Nutrient Source: groundwater minerals?
Landscape Setting: terrestrial cave community, possibly in karst topography.
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota: Fairly poor biotic data available. Potential indicator macroinvertebrates.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)** (?)
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition: (poor information)

1) Dark-Twilight Zone: **[unknown macroinvertebrate] Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown.

2) Entrance Zone: **[unknown macroinvertebrate] Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection): Not enough information available; potential sources of variation include:

1) Regional/Watershed Variants.
2) Substrate Alkalinity Variants.
3) Stream Order/Discharge Variants.
4) Connectivity Variants.

Distribution: NY: NAP?, STLy?; VT: NAP?, STL?

NY Examples: NYJEFF Black River Bay; some others suspected.
VT Examples:

Sources: Reschke (1990), VTHP (1989), R. Langdon, VTDEC.

Basic Macrohabitat Type #8: **RIVERINE CAVE COMMUNITY** Last Update: December 12, 2002

Macrohabitat Name: **Northern Appalachian Subterranean Stream (RM16)**
Synonymy/Affinities:
= NYHP (1990): AQUATIC CAVE COMMUNITY (in part)
= VTHP (1989): Subterranean Stream/Pool (stream part) (in part?)
= NHHP (1992): apparently no equivalent (closest to High Gradient Stream?)
= MEHP (1991): apparently no equivalent (closest to Rocky Headwater Stream or Cave Community)
= VT ACWG (1998): apparently no equivalent
= GLB (2000): apparently no equivalent
Suggested Alliance Name: **Cambaridae-Carabidae-Gerridae Non-Vegetated Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):
Scale: small.
Watershed Size:
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all subterranean (dark, twilight, entrance). Flow microhabitats: variable mix of riffle, pool and run. The pelagic zone probably becomes so small it merges with benthic zone.
Water Permanence: permanent.
Stream Position: headwater, low order.
Discharge: very low.
Temperature: variable; cold to moderately warm.
Substrate/Water Alkalinity: primarily acidic to circumneutral.
Substrate Texture: bedrock.
Sediment Transport Regime: headward erosion with no deposition.
Flow velocity: moderately slow.
Gradient: moderately low.
Confinement: very strongly confined, very low sinuosity.
Nutrient Source: upstream above-ground ponds and streams.
Landscape Setting: terrestrial cave community (solution cave variant), talus cave community.
Other Features:
ELU Signature: variable bedrock; Gently Sloping, Side Slopes, and Slope Bottoms.
Biota: Fair biotic data available. Potential indicator macroinvertebrates, including possible obligate dark zone species.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless aquatic areas (RAF9)**
Fishless aquatic areas
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Dark-Twilight Zone: **Cambaridae-Carabidae Non-Vegetated Fishless Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Subterranean Stream Fauna (RAM17)**
Crustacea (Cambaridae)-Coleoptera (Carabidae)-Trichoptera Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

2) Entrance Zone: **Gerridae Non-Vegetated Fishless Pool Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: **Water Strider-Dominated Pool Fauna (RAM13)**
Hemiptera (Gerridae, Vellidae, Mesovellidae) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection): Not enough information available; potential sources of variation include:

1) Substrate Alkalinity Variants.
2) Stream Order/Discharge Variants.
3) Connectivity Variants.
4) Watershed Variants.
Notes: Major watershed variants not suspected, but possible; need more assessment.

Distribution: NY: NAPy, STL?; VT: NAP?, STL?

NY Examples: NYESSE Burroughs Cave, NYESSE Big Luke, NYESSE Neverellen Cave, NYESSE Allen Brook, NYESSE Indian Pass, NYWARR Crane Mountain, NYWARR Stone Bridge and Caves.

VT Examples:

Sources: Reschke (1990), VTHP (1989), NYHP BCD Community EORs (2002), NYHP Community Leads (2002).

Basic Macrohabitat Type #9: **DEEPWATER RIVER** Last Update: December 12, 2002

Macrohabitat Name: **Great Lakes Deepwater River (RM13)**

Synonymy/Affinities:

= NYHP (1990): MAIN CHANNEL STREAM (in part)
= VTHP (1989): Major River?
= VT ACWG (1998): apparently no equivalent
= GLB (2000): Large St. Lawrence Tributaries (GLB Stream Type 39) (in part)
includes as part of littoral zone:
GLB (2000): Limestone shoreline with limestone nearshore (GLB Nearshore Type N10)
GLB (2000): Bedrock (sandstone) shoreline with sandy nearshore (GLB Nearshore Type N11)
GLB (2000): Shoreline wetland with bedrock nearshore (GLB Nearshore Type N12)
GLB (2000): Shoreline wetland with clay nearshore (GLB Nearshore Type N13)
GLB (2000): Clay banks and low plain with clay nearshore (GLB Nearshore Type N14)

Suggested Alliance Name: **Lake Sturgeon-Potamogeton-Elodea-(unknown invertebrates) Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: very large.
Watershed Size: very large; >> 4,000 mi^2
Microhabitat Composition:
Depth/Substrate microhabitat: very deep with littoral, sublittoral and profundal zones. Large pelagic zone, possibly with a hypolimnion. Light regime microhabitat: all above-ground. Flow microhabitats: predominantly run, small riffles reported (at least historically before dam).
Water Permanence: permanent.
Stream Position: very large main stem, very large order (8 or above?).
Discharge: very high.
Temperature: warm.
Substrate/Water Alkalinity: calcareous.
Substrate Texture: fine to rocky.
Sediment Transport Regime: depositional with lateral erosion.
Flow velocity: moderate to slow.
Gradient: low.
Confinement: moderately confined, moderately low sinuosity.
Nutrient Source: autotrophic food base (autochthonous).
Landscape Setting: open canopy.
Other Features:
ELU Signature:
Stream Size Class 4 (or higher?). Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:
Warmwater species are dominant. Plankton expected to be abundant. Macroinvertebrates with probable profundal indicator species. Fish diversity reportedly very high, with regular runs of anadromous fish (at least historically and probably primarily American shad). Need more information on vertical stratification of biota; oligochaetes probably an important component of the community. Oligochaete assemblages are tentatively designated as RAM18. Per K. Schneider (NYHP): historically there were mussel populations in the St. Lawrence River, but they have apparently been severely altered or eliminated by the dams.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

* Fish Assemblage: **Lake Sturgeon Riverine Assemblage (RAF8)**
Lake Sturgeon-Greater Redhorse-Channel Darter Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Littoral Zone: **Lake Sturgeon-Vallisneria-[unknown macroinvertebrate] Association**

Plant Assemblage: **American Eelgrass STL Herbaceous Vegetation (RAP3)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown.

2) Profundal Zone: **Lake Sturgeon-[unknown macroinvertebrate] Non-Vegetated Association**

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown.

3) Pelagic Zone: **Lake Sturgeon-[unknown phytoplankton]-[unknown macroinvertebrate] Association**

Plant Assemblage: **Phytoplankton Vegetation (RAP15)**
Assemblage Description: (See Plant Assemblage Descriptions)

Plant Assemblage: **Non-Vegetated Stream (RAP14)**
Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Oligochaete Deep Benthic Fauna (RAM18)** (?)
Oligochaeta (unknown families/genera) Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Substrate Texture Variants.

Notes: Subtypes may include flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil. Such non-vegetated associations used in lake classifications have included aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats. GLB (2000): targeted limestone, sandstone, sand and clay nearshore areas. WE CAN EVALUATE WHETHER TO STRATIFY THIS MACROHABITAT/EO DURING THE DISCUSSIONS ON SITE SELECTION CRITERIA FOR COMMUNITIES.

Distribution: NY: NAPn, STLy; VT: NAPn, STLn?

NY Examples:

NYSTLA Saint Lawrence River (only occurrence in STL). Niagara River (GL) is suspected to be relatively similar and tentatively suggested to be this same type.

VT Examples: probably none.

Sources:

NYHP BCD Animal EORs (2002), NYHP BCD Plant EORs (2002), NYHP ANC Community Leads (Hunt, 2002), K. Schneider/NYHP mollusk expert, several local experts on St. Lawrence River including Tom Brown, Lee Harper, Steve LaPan.

OTHER TYPES NOT YET FULLY DEVELOPED.

B. ESTUARINE MACROHABITATS LIKELY FROM QUEBEC STL/ABSENT FROM NY & VT STL.
(Descriptions not yet developed)
(All included as targets in STL portfolio)

Macrohabitat Name: **Acadian Freshwater Tidal River**
Macrohabitat Name: **Acadian Brackish Tidal River**
Macrohabitat Name: **Acadian Marine Tidal River**
Macrohabitat Name: **Acadian Freshwater Tidal Creek**
Macrohabitat Name: **Acadian Brackish Tidal Creek**
Macrohabitat Name: **Acadian Marine Tidal Creek**

C. GL MACROHABITATS PERIPHERAL IN STL
(Full descriptions to be developed elsewhere)
(All included as targets in STL portfolio)

Macrohabitat Name: **Great Lakes Intermittent Stream** (not yet developed)
Macrohabitat Name: **Great Lakes Spring** (not yet developed)
Macrohabitat Name: **Great Lakes Rocky Headwater Stream** (partially developed; see below)
Macrohabitat Name: **Great Lakes Marsh Headwater Stream** (not yet developed)
Macrohabitat Name: **Great Lakes Confined River** (partially developed; see below)
Macrohabitat Name: **Great Lakes Unconfined River** (partially developed; see below)
Macrohabitat Name: **Great Lakes Backwater Slough** (not yet developed)

Basic Macrohabitat Type #3: **ROCKY HEADWATER STREAM** Last Update: December 12, 2002

Macrohabitat Name: **Great Lakes (Circumneutral) Rocky Headwater Stream (RM.)**
Synonymy/Affinities:
= NYHP (1990): ROCKY HEADWATER STREAM (in part)
=? GLB (2000): Northern Jefferson County Coastal Streams (GLB Stream Type 32) (in part)

ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPn, STLy, GLy?; VT: NAPn, STLn?

NY STL Examples: Few known. NYLEWI Whetstone Creek?, NYLEWI Roaring Brook Martinsburg, NYJEFF? Gulf Stream (and associated tributaries); Potential sites of GLB (2000) Stream Type 32 that may include GL Rocky Headwater Stream include: NYJEFF Chaumont River?, NYJEFF Perch River?, NYJEFF Kents Creek?

Sources: Bruce Gilman is a reported expert on northern NYJEFF examples.

Basic Macrohabitat Type #5: **CONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **Great Lakes Confined River (RM.)**

Synonymy/Affinities:
= NYHP (1990): MIDREACH STREAM (in part)
= GLB (2000): Black River Mainstem (GLB Stream Type 35) (in part)
= GLB (2000): Lower Black River (GLB Stream Type 36) (in part)
= GLB (2000): Large St. Lawrence Tributaries (GLB Stream Type 39) (in part)
=? GLB (2000): Till Plain Tributaries (GLB Stream Type 41) (in part)

ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPn?, STLy, GLy?; VT: NAPn, STLn?

NY STL Examples: NYLEWI Deer River, NYONEI Sugar River.

Basic Macrohabitat Type #6: **UNCONFINED RIVER** Last Update: December 12, 2002

Macrohabitat Name: **Great Lakes Unconfined River (RM.)**

Synonymy/Affinities:

= NYHP (1990): MAIN CHANNEL STREAM (in part)
= GLB (2000): Black River Mainstem (GLB Stream Type 35) (in part)
= GLB (2000): Lower Black River (GLB Stream Type 36) (in part)
=? GLB (2000): Glacial Marine Plain Tributaries (GLB Stream Type 40) (in part)

ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy? (peripheral), STLy, GLy?; VT: NAPn, STLn?

NY STL Examples: GLB (2000): NYLEWI Black River, NYLEWI? Deer River. NYLEWI? West Branch Oswegatchie River (NAP).

APPENDIX 2.

SAINT LAWRENCE/CHAMPLAIN VALLEY ECOREGION (STL)
LACUSTRINE MACROHABITAT/ALLIANCE CLASSIFICATION

First Iteration

Known and Suspected, Extant and Extirpated Elements
Crosswalked to Current and Potential State and National Classifications

With Many Known Northern Appalachian (NAP) Types in New York and Vermont

Original: February 23, 2001; David Hunt, NY Natural Heritage Program
Update: January 10, 2003; David Hunt, Ecological Intuition & Medicine

1. TAXONOMIC HIERARCHY: MACROHABITAT TYPES AND MACROHABITATS CHARACTERISTIC OF STL AND ADJACENT ECOREGIONS

Basic Macrohabitat Type #1: **LACUSTRINE CAVE COMMUNITY**
Macrohabitat Name: **St. Lawrence-Champlain Valley Subterranean Lake (LM1)**
Macrohabitat Name: **Northern Appalachian Subterranean Lake (LM.)**

Basic Macrohabitat Type #2: **INTERMITTENT POND**

Basic Macrohabitat Type #2A: **VERNAL POOL**
Macrohabitat Name: **St. Lawrence-Champlain Valley Vernal Pool (LM3)**
Macrohabitat Name: **Northern Appalachian Vernal Pool (LM2)**
Macrohabitat Name: **Great Lakes Vernal Pool (LM.)**

Basic Macrohabitat Type #2B: **SINKHOLE POND**
Macrohabitat Name: **St. Lawrence-Champlain Valley Sinkhole Pond (LM5)**
Macrohabitat Name: **Northern Appalachian Sinkhole Pond** (LM.) (not yet designated)

Basic Macrohabitat Type #2C: **PINE BARRENS VERNAL POND**
Macrohabitat Name: **Northern Appalachian (GL/STL/LNE) Pine Barrens Vernal Pond (LM4)**

Basic Macrohabitat Type #3: **OXBOW (MONOMICTIC) POND**
Macrohabitat Name: **St. Lawrence-Champlain Valley Oxbow Pond (LM16)**
Macrohabitat Name: **Northern Appalachian Oxbow Pond (LM15)**
Macrohabitat Name: **Great Lakes Oxbow Pond (LM.)** (not yet designated)

Basic Macrohabitat Type #4: **FLOW-THROUGH (MONOMICTIC) POND**
Macrohabitat Name: **St. Lawrence-Champlain Valley Flow-Through Pond (LM18)**
Macrohabitat Name: **Northern Appalachian Flow-Through Pond (LM17)**
Macrohabitat Name: **Great Lakes Flow-Through Pond (LM.)**

Basic Macrohabitat Type #5: **MEROMICTIC LAKE**
Macrohabitat Name: **Northern Appalachian Meromictic Lake (LM8)**

Basic Macrohabitat Type #6: **DYSTROPHIC LAKE**
Macrohabitat Name: **Northern Appalachian Bog Lake (LM6)**

Basic Macrohabitat Type #7: **ACIDIC (MONOMICTIC) POND**
Macrohabitat Name: **Northern Appalachian Acidic Pond (LM9)**
Macrohabitat Name: **Northern Appalachian Tarn Pond (LM.)**

Basic Macrohabitat Type #8: **ACIDIC DIMICTIC LAKE**
Macrohabitat Name: **Northern Appalachian Acidic Dimictic Lake (LM21)**

Basic Macrohabitat Type #9: **WINTER-STRATIFIED MONOMICTIC LAKE**
Macrohabitat Name: **St. Lawrence-Champlain Valley Winter-Stratified Monomictic Lake (LM20)**
Macrohabitat Name: **Northern Appalachian Winter-Stratified Monomictic Lake (LM19)**

Basic Macrohabitat Type #10: **ALKALINE (MONOMICTIC) POND**

Basic Macrohabitat Type #10A: **ALKALINE (MONOMICTIC) POND**
Macrohabitat Name: **St. Lawrence-Champlain Valley Alkaline Pond (LM12)**
Macrohabitat Name: **Northern Appalachian Alkaline Pond (LM11)**

Basic Macrohabitat Type #10B: **MARL POND**
Macrohabitat Name: **Great Lakes Marl Pond (LM13)**

Basic Macrohabitat Type #10C: **SALT POND**
Macrohabitat Name: **Great Lakes Salt Pond (LM14)**

Basic Macrohabitat Type #11: **SUMMER-STRATIFIED MONOMICTIC LAKE**
Macrohabitat Name: **St. Lawrence-Champlain Valley Summer-Stratified Monomictic Lake (LM25)**
Macrohabitat Name: **Great Lakes Summer-Stratified Monomictic Lake (LM26)**

Basic Macrohabitat Type #12: **ALKALINE DIMICTIC LAKE**

Basic Macrohabitat Type #12A: **EUTROPHIC ALKALINE DIMICTIC LAKE**
Macrohabitat Name: **St. Lawrence-Champlain Valley Eutrophic Alkaline Dimictic Lake (LM24)**
Macrohabitat Name: **Northern Appalachian Eutrophic Alkaline Dimictic Lake (LM23)**

2. LIST OF LACUSTRINE MACROHABITATS FOR STL (**L**ake **M**acrohabitats)

I) Macrohabitats Addressed in STL Portfolio.

- A. Fully Developed Descriptions Attached (Mostly STL Characteristic Macrohabitats).
  - **LM1 STL Subterranean Lake**
  - **LM3 STL Vernal Pool**
  - **LM4 NAP (GL/STL/LNE) Pine Barrens Vernal Pond**
  - **LM5 STL Sinkhole Pond**
  - **LM6 NAP Bog Lake**
  - **LM12 STL Alkaline Pond**
  - **LM13 GL Marl Pond**
  - **LM16 STL Oxbow Pond**
  - **LM18 STL Flow-Through Pond**
  - **LM20 STL Winter-Stratified Monomictic Lake**
  - **LM27 STL Oligotrophic Alkaline Dimictic Lake**
  - **LM24 STL Eutrophic Alkaline Dimictic Lake**
  - **LM25 STL Summer-Stratified Monomictic Lake**
  - **LM26 GL Summer-Stratified Monomictic Lake**
- B. Partially Developed Descriptions Documented Elsewhere (NAP Macrohabitats Peripheral in STL).
  - **LM2 NAP Vernal Pool**
  - **LM15 NAP Oxbow Pond**
  - **LM17 NAP Flow-Through Pond**
- C. Developed Descriptions Pending (GL Macrohabitats Peripheral in STL).
  - **LM. GL Vernal Pool**
  - **LM. GL Oxbow Pond**

II) Macrohabitats Not Addressed in STL Portfolio, But Potentially Peripheral in STL.

- A. Partially Developed Descriptions Documented Elsewhere (Mostly NAP Macrohabitats Peripheral in STL).
  - **LM. NAP Subterranean Lake**
  - **LM. NAP Sinkhole Pond**
  - **LM8 NAP Meromictic Lake**
  - **LM9 NAP Acidic Pond**
  - **LM. NAP Tarn Pond**
  - **LM21 NAP Acidic Dimictic Lake**
  - **LM19 NAP Winter-Stratified Monomictic Lake**
  - **LM11 NAP Alkaline Pond**
  - **LM23 NAP Alkaline Dimictic Lake**
  - **LM14 GL Salt Pond**
- B. Developed Descriptions Pending (GL Macrohabitats Peripheral in STL).
  - **LM. GL Flow-Through Pond**
- C. Developed Descriptions Pending (Estuarine Macrohabitats Possible From Quebec STL/Absent from NY & VT STL).
  - **LM. Coastal (NAC) Salt Pond**
  - **LM. Acadian Freshwater Tidal Bay**
  - **LM. Acadian Brackish Tidal Bay**
  - **LM. Acadian Marine Tidal Bay**

COMMONLY USED ACRONYMS & SOURCES:

Ecoregions
- NAP Northern Appalachians
- STL St. Lawrence/Lake Champlain
- GLB Great Lakes
- LNE Lower New England
- HAL High Allegheny Plateau

Assemblages
- LAP Lake Assemblages, Plants
- LAM Lake Assemblages, Macroinvertebrates
- LAF Lake Assemblages, Fish
- LAH Lake Assemblages, Herptiles
- LAZ Lake Assemblages, Zooplankton

NAC National Aquatic Community Classification
BCD Biological and Conservation Databases (of the Heritage Network and The Nature Conservancy)
EOR Element Occurrence Records (on BCD)
ELU Ecological Land Unit
EOSPECS Element Occurrence Specifications (field on BCD)
ELDESCRIP Element Description (field on BCD)

NYHP (New York Natural Heritage Program). 1990: Reschke (1990)
VTHP (Vermont Natural Heritage Program). 1989: Thompson (1989); 1996: Vermont Nongame and Natural Heritage Program (1996)
NHHP (New Hampshire Natural Heritage Program). 1992: Sperduto (1992)

MEHP (Maine Natural Heritage Program). 1991: Maine Natural Areas Program (1991)
VT ACWG (1998): Vermont's Aquatic Classification Work Group (1998)
GLB (Great Lakes Basin). 1998: Higgins et al. (1998). 2000: Great Lakes Expert Meeting, NY State, Handouts (2000)
ANC (Adirondack Nature Conservancy)
VTDEC (Vermont Dept. of Environmental Conservation)

NY Counties

NWWASH = Washington, NYESSE = Essex, NYCLIN = Clinton, NYFRAN = Franklin, NYSTLA = Saint Lawrence, NYJEFF = Jefferson, NYLEWI = Lewis, NYONEI = Oneida, NYOSWE = Oswego.

* = Assemblage thought to be essentially restricted to the described macrohabitat.

Basic Macrohabitat Type #1: **LACUSTRINE CAVE COMMUNITY**

Macrohabitat Name: **St. Lawrence-Champlain Valley Subterranean Lake (LM1)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990): AQUATIC CAVE COMMUNITY
= VTHP (1989): Subterranean Stream/Pool (in part: pool part)
= VT ACWG (1998): Subterranean areas (VT Lake Macroinvertebrates Type 28) (in part)
Widoff (1986): apparently no equivalent/not addressed.
GLB (2000): apparently no equivalent/not addressed.

Suggested Alliance Name: **[unknown fish]-[unknown characteristic invertebrates] Non-Vegetated Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: variable.
Microhabitat Composition:

Depth/Substrate microhabitat: littoral-epilimnion, may extend to sublittoral-hypolimnion. Light regime microhabitats: all subterranean (dark, twilight, entrance). Flow microhabitat: all pool.

Water Permanence: permanent (known example).
Depth/Surface Area/Morphometry: small, shallow.
Turnover/Temperature Regime: variable (constant if EOs restricted to Lake Champlain shoreline).
Water/Substrate Acidity/Alkalinity: neutral-basic/hardwater (known example).
Trophy/Productivity: mesotrophic-eutrophic (known example).
Substrate Texture: limestone bedrock (known example).
Landscape Setting: with overlying upland areas; typical setting under limestone bluffs on shore or islands of Lake Champlain. Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota: fish reported; cave amphipods suspected (Steve Fiske); very limited species level information available.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Lake Champlain Fish (LAF6)**? (only known example)

Yellow Perch-Sauger-Burbot-Slimy Sculpin Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:

1) Dark-Twilight Zone.
2) Entrance Zone.

If large examples exist, there may be different pelagic or benthic associations as well as different depth associations within both pelagic and benthic zones.

Plant Assemblage: **Non-Vegetated Lake (LAP1)**

Assemblage Description: (See Plant Assemblage Descriptions)

* Macroinvertebrate Assemblage: **Subterranean Macroinvertebrates (LAM10)**

[unknown characteristic macroinvertebrates] Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions) unknown species assemblage.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

Uncertain, potential splits could include the following, but only limited examples are known or reported and these may all represent one of the full component of theoretical variants.

1) Trophy variants.
2) Regional variants.
3) Connectivity. Migratory biota expected to differ between known examples along the shoreline of Lake Champlain and other suspected isolated "inland" examples.

Distribution: NY: NAPn, STLy; VT: NAPn?, STL?

NY Examples: Leads: NYCLIN Valcour Island
VT Examples: reported only from LNE.

Sources: Reschke (1990), NYHP ANC Community Leads (Hunt, 2002), VT ACWG (1998), VTHP (1989).

Basic Macrohabitat Type #2: **INTERMITTENT POND**

Macrohabitat Name: **St. Lawrence-Champlain Valley (calcareous) Vernal Pool (LM3)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990): VERNAL POOL (in part)

NOTES: NYHP currently classifies this "aquatic community" type under the Palustrine System, Forested Subsystem; this placement has been reevaluated as a lacustrine community since about 1995 and continued to be evaluated and debated at NYHP as of 2002.

= VTHP (1989): Temporary Pool (in part)

= VTHP (1996): Vernal Woodland Pool (in part: STL part)

= VT ACWG (1998): Temporary Palustrine Systems (VT Lake Macroinvertebrates Type 27)

= VT ACWG (1998): Under 1200 feet Vernal Pool (VT Herptile Lake Type 1)

Widoff (1986): apparently no equivalent/not addressed.

GLB (2000): apparently no equivalent/not addressed.

Suggested Alliance Name:

(unknown characteristic plants)-(unknown characteristic invertebrates)-Ambystoma jeffersonianum Fishless Alliance

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.

Watershed Size: very small, << 2mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool. The pelagic zone is so small it usually merges with benthic zone.

Water Permanence:

Intermittent (semipermanent); typically vernally, sometimes autumnally, aquatic. VT ACWG (1998): water above substrate at least 2 months during springs of average rainfall dry during portions of late summer or fall.

Depth/Surface Area/Morphometry: small, shallow "ponds".

Turnover/Temperature Regime: unstratified.

Water/Substrate Acidity/Alkalinity: pH >4. neutral to basic/hardwater.

Trophy/Productivity: eutrophic?

Substrate Texture: loamy (to sandy) to bedrock (e.g., granite; conglomerates such as Potsdam sandstone).

Landscape Setting:

Settings variable, terrestrial forest typical, can be palustrine, can be somewhat open. Includes intermittent oxbows, intermittent swamps, intermittent pools on sandstone pavement. Typically with no surface inflow or outflow. Seasonal outlets may be present.

Other Features:

ELU Signature: Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.

Biota:

With diverse invertebrates and amphibians, hydrophytic plants tolerant of intermittent flooding, but no fish. Breeding habitat for amphibians and aquatic invertebrates. Some species characteristic of drawdown may be useful indicators. VTHP (1996): typically with few vascular plants.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless Lakes (LAF7)**

Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition: All uniform, littoral microhabitat.

Plant Assemblage: uncertain; possibly: **STL Vernal Pool Plants (LAP3)**

Eleocharis acicularis-Sium suave Assemblage?

Assemblage Description: (See Plant Assemblage Descriptions) Very poor data.

Unusual bryophytes reported from one potential example. Assemblage suspected similar to STL Sinkhole Pond.

Macroinvertebrate Assemblage: **STL Temporary Palustrine Macroinvertebrates (LAM12)**

[unknown characteristic macroinvertebrates] Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

*? Herpetofauna Assemblage: **STL Vernal Pool Herpetofauna (LAH1)**

Ambystoma (maculatum, jeffersonianum, A. laterale)-Rana sylvatica-Hemidactylium scutatum Assemblage

Assemblage Description: (See Herptile Assemblage Descriptions)

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

Only limited examples are known or reported and these may all represent one of the full component of theoretical variants; uncertain, potential splits could include:

1) Trophy/Alkalinity Variants.
2) Substrate Variants. Varying from clay to bedrock.
3) Regional Variants.

Distribution: NY: NAPn?, STLy?; VT: NAP., STLy

NY Examples: few known, many suspected. Leads: NYSTLA Fullerville Sands? (STL), NYCLIN Altona Flat Rock? (STL/NAP).
VT Examples:

Sources:
Reschke (1990), NYHP ANC Community Leads (Hunt, 2002), VTHP (1989, 1996), VT ACWG (1998). VT has a large collection of data from July 2000 study.

Basic Macrohabitat Type #2: **INTERMITTENT POND**

Macrohabitat Name: **Northern Appalachian (GL/STL/LNE) Pine Barrens Vernal Pond (LM4)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) PINE BARRENS VERNAL POND (aquatic part)

NOTES: NYHP has both aquatic and non-aquatic (emergent) portions lumped into a "landscape complex" community type and classifies them under the Palustrine System.

= VTHP (1996): affinities with Outwash Plain Pondshore ("Outwash Plain Pond")

= VTHP (1989): Temporary Pool (in part)

=? NHHP (1992): Vernal Woodland Pool? (if in this landscape setting)

=? MEHP (1991): Vernal Pool Community? (in part: if in this landscape setting)

= VT ACWG (1998): Temporary Palustrine Systems (VT Lake Macroinvertebrates Type 27)

Widoff (1986): apparently no equivalent/not addressed.

GLB (2000): apparently no equivalent/not addressed.

Suggested Alliance Name: **Potamogeton sp.-Rana clamitans-(Bufo woodhousii)-Water Beetle Sparsely-Vegetated Fishless Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.

Watershed Size: very small, << 2mi^2

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool. The pelagic zone becomes so small it may merge with benthic zone.

Water Permanence:

Seasonally fluctuating water levels. Intermittent (semipermanent), typically vernally aquatic. NYHP EOR: apparently dry during portions of late summer or fall. VTHP (1996): water levels can drop significantly in dry years.

Depth/Surface Area/Morphometry: shallow "ponds".

Turnover/Temperature Regime: unstratified.

Water/Substrate Acidity/Alkalinity: circumneutral, probably low alkalinity.

Trophy/Productivity: probably oligo-mesotrophic.

Substrate Texture: coarse, sandy.

Other Features: possibly groundwater fed (Reschke, 1990), warm.

Landscape Setting:

Large glacial outwash sandplains, pine forests typical, glacial kettlehole depressions, open canopy.

Other Features:

ELU Signature: Acidic Bedrock; Coarse-Grained Dry Flats.

Biota:

Excludes emergent zones (usually characterized by Dulichium arundinaceum), assumed to be covered in terrestrial community crosswalks. Probably characteristic herpetofauna, need to evaluate comparison with more typical vernal pools. No fish known or suspected.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless Lakes (LAF7)**

Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition: All uniform littoral microhabitat.

Plant Assemblage: **NAP Tapegrass-Pondweed Bed (LAP6A)**

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (6196)

Plant Assemblage: **STL Eutrophic Water Lily Shallows (LAP5B)**? (large enough?)

Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation (2386)

Assemblage Description: (See Individual Plant Assemblage Descriptions)

NYHP EOR for this type: sparsely vegetated with Nuphar variegatum (1%), Potamogeton spp. (10%), with submergent Sphagnum cuspidatum.

Macroinvertebrate Assemblage: **NAP Outwash Plain Temporary Palustrine Macroinvertebrates (LAM13)**

[unknown characteristic macroinvertebrates] Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions) type description.

Herpetofauna Assemblage: **STL Vernal Pool Herpetofauna (LAH1)**

Ambystoma (maculatum, jeffersonianum, A. laterale)-Rana sylvatica-Hemidactylium scutatum Assemblage

Assemblage Description: (See Herptile Assemblage Descriptions)

Need to develop new assemblage if different from LAH1. NYHP EOR: Dominated by spring peeper (Pseudoacris cruciata), with associated green frog (Rana clamitans), exotic bullfrog (R. catesbyiana). Could Bufo woodhousii (listed in Reschke, 1990 for this community type and in VT ACWG (1998) in this assemblage type) be in NAP/STL examples of this lake type?

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

Only limited examples are known or reported and these may all represent one of the full component of theoretical variants; uncertain, potential splits could include:

1) Regional Variants.

2) Color Variants. Clear and dark variants are known.

Distribution: NY: NAPy (peripheral?), STL?; VT: NAP?, STLy (peripheral?) (GL, LNE type peripheral in NAP?); ME: NAP?; NH: NAP?

NY Examples: none known from STL, few suspected; EOR: NYLEWI Chase Lake Sandplain (NAP).
VT Examples: VTHP (1996) suggests rare in VT.

Sources: NYHP BCD Community EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), VTHP (1996).

Basic Macrohabitat Type #2: **INTERMITTENT POND**

Macrohabitat Name: **St. Lawrence-Champlain Valley Sinkhole Pond (LM5)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) SINKHOLE WETLAND (aquatic part)

NOTES: NYHP has both aquatic and non-aquatic (emergent) portions lumped into a "landscape complex" community type and classifies them under the Palustrine System.

= VTHP (1996): Vernal Woodland Pool? (in part: if in STL and corresponding to this state type)

= VT ACWG (1998): Temporary Palustrine Systems (VT Lake Macroinvertebrates Type 27)?

Widoff (1986): apparently no equivalent/not addressed.

GLB (2000): apparently no equivalent/not addressed.

Suggested Alliance Name:

Eleocharis acicularis-Sium suave-(unknown characteristic invertebrates)-(unknown characteristic herptile) Fishless Alliance

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.

Watershed Size: very small, << $2mi^2$

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool. The pelagic zone becomes so small it may merge with benthic zone.

Water Permanence:

Possibly intermittent (semipermanent), possibly vernally aquatic. Water levels thought to fluctuate dramatically with rainfall. Poorly drained (Reschke, 1990). Heavy groundwater influence.

Depth/Surface Area/Morphometry: small, very shallow (EOR: to 15 cm deep), "ponds".

Turnover/Temperature Regime: unstratified.

Water/Substrate Acidity/Alkalinity: basic. high alkalinity?/hardwater, high pH.

Trophy/Productivity: eutrophic.

Substrate Texture: deep gleyed clay (EOR); dark muck (Reschke, 1990).

Landscape Setting:

Ideally karst topography. Bedrock types in NY include marble, leucogranitic gneiss, Theresa dolostone, Potsdam sandstone.

Other Features:

ELU Signature: Calcareous Bedrock; Wet Moist Flats to Fine-Grained Dry Flats.

Biota:

Excludes emergent zones, assumed to be covered in terrestrial community crosswalks. There are probably characteristic herpetofauna; need to evaluate comparison with more typical vernal pools. Characteristic beetles in dark-colored variant. NYHP EOR: breeding frogs.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Fishless Lakes (LAF7)**

Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition: All uniform littoral microhabitat.

Plant Assemblage: **STL Vernal Pool Plants (LAP3)**

Eleocharis acicularis-Sium suave Assemblage

Assemblage Description: (See Plant Assemblage Descriptions) NYHP: type description.

Macroinvertebrate Assemblage: **STL Temporary Palustrine Macroinvertebrates (LAM12)**

[unknown characteristic macroinvertebrates] Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

NYHP: poor data; suspected to differ from (loamy) Vernal Pool and Pine Barrens Vernal Pond assemblages, need more data and evaluation. NYHP EOR: diverse assemblage of breeding (adult) damselflies, but in pond shore zone.

Herpetofauna Assemblage: **STL Vernal Pool Herpetofauna (LAH1)** ?

Ambystoma (maculatum, jeffersonianum, A. laterale)-Rana sylvatica-Hemidactylium scutatum Assemblage

Assemblage Description: (See Herptile Assemblage Descriptions)

Need to develop new assemblage if different in this macrohabitat. NYHP EOR: Green frog, leopard frog.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

Only limited examples are known or reported and these may all represent one of the full component of theoretical variants; uncertain, potential splits could include:

1) Regional Variants. Need to evaluate Saint Lawrence River Valley vs. Champlain Valley examples.

Distribution: NY: NAPn?, STLy; VT: NAPn?, STLn?

NY Examples:

EOR: NYSTLA Spile Bridge Road Wetlands, NYJEFF Johnny Cake Road Sinkhole Wetlands?; Leads: NYSTLA Chippewa Creek Plains, NYSTLA Beaver Creek Macomb,

NYSTLA Beaver Creek Dekalb, NYSTLA Bostwick Creek, NYSTLA Indian Creek, NYCLIN Chazy Barrens?
VT Examples:

Sources: NYHP BCD Community EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990).

Basic Macrohabitat Type #4: **DYSTROPHIC LAKE**

Macrohabitat Name: **Northern Appalachian Bog Lake (LM6)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) BOG LAKE (in part)
= VTHP (1989): Tannic Water Lake/Pond
= MEHP (1991): Bog Pond Community (ME Lake Type L3)
= NHHP (1992): Acidic Brownwater Lake/Pond
= VT ACWG (1998): Dystrophic Lake (VT Lake Macrophyte Type 1)
= VT ACWG (1998): Dystrophic Lake (VT Lake Macroinvertebrate Types 1-5)
= VT ACWG (1998): Dystrophic/High Elevation Acidic Lake (VT Lake Fish Types 1 & 2)
= NY FWI: "Clearwater Acid Lakes"
= Widoff (1986): Softwater, Strongly Colored, variously stratified (Unstratified and ?Stratified) Lakes/Ponds
=? GLB (2000): Adirondack Headwater Lakes and Lake Outlets (GLB Lake Type L6)

Suggested Alliance Name: **Brown Bullhead-Nymphaea odorata-Zalutschia-Hyallela azteca Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: typically small.
Microhabitat Composition:
Depth/Substrate microhabitat: littoral, may extend into sublittoral (and reportedly profundal zone in some occurrences). Light regime microhabitat: all above-ground. Flow microhabitat: all pool.
Water Permanence: permanent.
Depth/Surface Area/Morphometry: relatively shallow (typically less than 30 feet deep), relatively small.
Turnover/Temperature Regime:
Winter stratified monomictic to dimictic. "unstratified monomictic" per MEHP (1991), but probably implying unstratified in summer, not in winter.
Water/Substrate Acidity/Alkalinity: acidic/softwater (e.g., EOR: pH 4.3), low alkalinity, ANC 2.0-7.0.
Trophy/Productivity:
Dystrophic (dark brown to tan color ("stained") >30 pt-co from tannic and humic acids (VT ACWG, 1998)); low productivity, low light penetration.
Substrate Texture:
substrate thick organic muck with abundant peaty detritus, undefined bottom. One NYHP lead in STL, Mud Lake, is described as having peaty bottom and flooded boggy shore.
Other Features: clear. warm. low conductivity.
Landscape Setting:
Typically associated with kettlehole and domed peatlands (e.g., "bogs"), typically acidic and typically on glacial outwash.
Other Features:
ELU Signature: Acidic to Moderately Calcareous Bedrock; Wet-Moist Flats and Fine- to Coarse-Grained Dry Flats.
Biota:
Low species richness (MEHP, 1991). NYHP EORs: fish absent or low diversity; hooded mergansers, ring-neck duck, beaver reported in pelagic zone. Many examples are fishless.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

*? Fish Assemblage: **Dystrophic/High Elevation Acidic Lake Fish (LAF1)**
Brown Bullhead-Golden Shiner Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition:
Assemblage Descriptions: (See Individual Macroinvertebrate Assemblage Descriptions)

1) Benthic Littoral Mud/Sand: **Brown Bullhead-Nymphaea odorata-Hyallela azteca Association**
Plant Assemblage: **NAP Dystrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5A)**
Nymphaea odorata-Brasenia schreberi Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)
One NYHP STL lead, Mud Lake, NY, is described as having the following plant species: Ceratophyllum, Scirpus subterminalis, Najas, Nuphar, Nymphaea, Hippuris vulgaris, Vallisneria, Eleocharis robbinsii. Hippuris and Ceratophyllum would not be good indicator species from VT perspective.

* Macroinvertebrate Assemblage: **Dystrophic Benthic Littoral Mud/Sand Macroinvertebrates (LAM8)**
Hyallela azteca-Musculium Assemblage

2) Benthic Littoral Rock: **Brown Bullhead-[algae?]-Ferresia californica Association**
Macroinvertebrate Assemblage:
Dystrophic/Acidic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM6)
Ferresia californica-Trebelos-Phaenopsectra Assemblage
Plant Assemblage: uncertain
Unknown, no data yet, green algae likely. 1 or more of the 4 basic sparsely vegetated rocky associations (LAP 12-15) are possible, especially **Aquatic Pavement (LAP13)**.

3) Benthic Profundal-Sublittoral: **Brown Bullhead-Zalutschia Non-Vegetated Association**
* Macroinvertebrate Assemblage: **Dystrophic Benthic Profundal-Sublittoral Macroinvertebrates (LAM1)**

Zalutschia-Chironomus-Musculium Assemblage

4) Pelagic: **Brown Bullhead-Synura-Chaoborus Non-Vegetated Association**

Plant Assemblage: **Meromictic? Phytoplankton (LAP17)**

*? Synura-Asterionella Phytoplankton Assemblage

Assemblage Descriptions: (See Plant Assemblage Descriptions)

NYHP EOR: Phytoplankton at very low concentrations {Asterionella, Ceratium hirundinella}.

* Zooplankton Assemblage: **NAP Dystrophic Zooplankton Assemblage (LAZ1)**

Keratella-Chaoborus Assemblage

Assemblage Description: (See Zooplankton Assemblage Description). NYHP EOR: type description.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

Uncertain, potential splits could include:

1) Temperature Regime/Stratification Variants. Dimictic vs. monomictic.
2) Substrate Variants. Rock versus mud.
3) Regional Variants.

Once Quebec lakes are considered, it is suspected that Bog Lakes characteristic of STL might be separated out as a unique type. No unique STL type (formerly tracked as "St. Lawrence-Champlain Valley Bog Lake (LM7)") is known or suspected from the NY/VT part of STL. Examples of this lake type in STL are considered to be simply peripheral EOs of this macrohabitat characteristic of NAP.

Distribution: NY: NAPy, STLy (peripheral); VT: NAPy, STLy (peripheral); ME: NAPy?, NH: NAPy?

NY NAP Examples:

EORs: NYHAMI Helldiver Pond (NAP), NYFRAN Spring Pond Bog (NAP). Leads: very numerous including the following A-ranked examples: NYFRAN Pink Pond, NYFRAN Rolley Pond, NYFRAN Rat Pond, NYFRAN Blue Pond, NYFRAN Little Echo Pond, NYFRAN Rock Pond, NYFRAN Bog Pond, NYHERK Squash Pond, NYHERK Wheeler Pond, NYHAMI Ferd Bog, NYHAMI Long Pond, NYCLIN Mud Pond Black Brook.

NY STL Examples:

Leads: NYJEFF Mud Lake Diana (Fort Drum Training Area 19); No expert leads available from ANC; Strongly suspected at sites such as Lisbon Swamp, Rogers Pond.

VT Examples: VT ACWG (1998): Branch Pond, Bourn Pond, Grout Pond, Wheeler Pond, Wolcott Pond.

Sources:

NYHP BCD Community EORs (2002), VT ACWG (1998), Hunt (1999c), NYHP ANC Community Leads (Hunt, 2002), NYHP BCD Plant EORs (2002), Reschke (1990), Sperduto (1992), MEHP (1991), Widoff (1986), VTHP (1989).

Basic Macrohabitat Type #10A: **ALKALINE (MONOMICTIC) POND**

Macrohabitat Name: **St. Lawrence-Champlain Valley Alkaline Pond (LM12)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

GENERAL TYPE:

= NYHP (1990) EUTROPHIC POND (in part)
= VTHP (1989): Very Rich Lake/Pond (pond part; assume in STL)
= VTHP (1989): Moderately Rich Lake/Pond (pond part; assume in STL)
= Widoff (1986): Alkaline and Moderately Alkaline, Variously Colored, Unstratified Lakes/Ponds
= VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4)
=? GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several)

EUTROPHIC VARIANT:

=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 23-25) (if includes ponds)

MESOTROPHIC VARIANT:

=? VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 18-20) (if includes ponds)

Suggested Alliance Name: **(unknown characteristic fish-plant-macroinvertebrates) Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.

Watershed Size: small.

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral, at most only small sublittoral areas; all epilimnion, at most only small hypolimnion areas. The pelagic zone may become so small it merges with the benthic zone. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.

Water Permanence: permanent.

Depth/Surface Area/Morphometry: shallow, small surface area.

Turnover/Temperature Regime: winter-stratified monomictic.

Water/Substrate Acidity/Alkalinity: alkaline/hardwater, typically high to moderately high alkaline.

Trophy/Productivity:

Eutrophic (to mesotrophic). Does not include "hypereutrophic ponds", which are cultural lake types modified by severe anthropogenic disturbance (i.e., eutrophication).

Substrate Texture: typically with deep organic sediments/muck.

Other Features:

Landscape Setting:

Typically isolated from other aquatic communities; variable surrounding communities, typically upland. Typically associated with deep emergent marsh along shoreline. Ponds with beaver lodges in basins with flooded dead trees may be included here or even typical for this ecoregion.

Other Features:

ELU Signature: Lake. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.

Biota:

Poor data readily available for NY STL. Expected general characteristics based on similar NAP type: High biotic diversity with abundant and diverse algae, plankton and vascular plants. Submergent and floating-leaved vascular plants may be common in moderate numbers. Alkaline/eutrophic fish and macroinvertebrates are suspected.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Eutrophic-Mesotrophic Epilimnion/Pond Fish (LAF5)**? NEED COMPARISON TO NAP EUTROPHIC POND
(unknown characteristic fish) Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)

Suggested Microhabitat-Association Composition: NEED COMPARISON TO NAP EUTROPHIC POND
Assemblage Description: (See Plant Assemblage Descriptions)

1) Benthic Littoral Mud/Sand: **[unknown fish]-Potamogeton spp.-Nuphar-[unknown macroinvertebrate] Association**

probable Plant Assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**
Potamogeton spp.-Ceratophyllum sp.Midwest Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions)

probable Plant Assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**
Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions).

Macroinvertebrate Assemblage: unknown.

2) Benthic Littoral Rock: **[unknown fish]-[algae]-Physidae Association**

possible Plant Assemblages:
Possibly 1 or more of 4 basic algae-dominated sparsely vegetated rocky assemblages (LAP 12-15), especially **Aquatic Pavement (LAP13)** and **Aquatic Boulder Field (LAP15)**.

possibly Macroinvertebrate Assemblage: **Oligotrophic/Mesotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM7)**?
Amnicola-Physidae-Stenonoma Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions) NEED COMPARISON TO NAP EUTROPHIC POND

3) Pelagic Epilimnion: [unknown fish]-[unknown macroinvertebrate] Non-Vegetated Association

Plant Assemblage: **Eutrophic Pond? Phytoplankton (LAP16)**? NEED COMPARISON TO NAP EUTROPHIC POND
Chrysosphaerella longispina-Ceratium Phytoplankton Assemblage
Assemblage Description: (See Plant Assemblage Descriptions).

Zooplankton Assemblage: **Oligotrophic-Mesotrophic Lake? Zooplankton (LAZ6)**? NEED COMPARISON TO NAP EUTROPHIC POND
Keratella-Polyarthra-Bosmina-Daphnia Assemblage
Assemblage Descriptions: (See Zooplankton Assemblage Descriptions).

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Trophy/Productivity +/- Acidity/Alkalinity Variants.
VT ACWG (1998) apparently distinguishes mesotrophic versus eutrophic ponds, here tentatively lumped together based on apparently similar biota. NY does not currently recognize this split for ponds, but does for lakes. In general, the Oligo-Meso-Eu trophic split needs to be more critically evaluated with correlations in biota (association) differences for both ponds and lakes. Possibilities include a 2 or 3 parted split. Continual gradients from oligotrophic to eutrophic and acidic to alkaline lakes are suspected. There appears to be characteristic oligotrophic associations and eutrophic associations, with mesotrophic lakes supporting a mixed mosaic of the two types. Could this be analogous to the conifer-mixed-deciduous split in matrix forest classification? Could the 2 or 3 unit classification be considered arbitrary?

Other uncertain, potential splits could include:
2) Color Variants. Widoff (1986) stratified this lake type in classification into 5 color variants.
3) Substrate Variants. Bedrock geology ranges from "calcareous shales" to limestone.
4) Regional Variants.

Distribution: NY: NAPn?, STLy; VT: NAP., STLy

NY Examples: Leads: NYESSE Rogers Pond, NYESSE Webb Royce Swamp, NYSTLA Yellow Lake Beaver Flow (riverine?).
VT Examples: STL Portfolio: Round Pond, Coggman Pond, Winona Lake, Metcalf Lake, Cedar Lake, Hoffman Pond.

Sources: NYHP ANC Community Leads (Hunt, 2002), Widoff (1986), Reschke (1990), VTHP (1989), VT ACWG (1998).

Basic Macrohabitat Type #10C: **ALKALINE (MONOMICTIC) POND/SALT POND**

Macrohabitat Name: **Great Lakes Marl Pond (LM13)** Last Update: December 10, 2002

POTENTIAL ECOREGIONAL SPLIT NEEDS TO BE EVALUATED BY GREAT LAKES OR NAP ECOREGION PLANNING EFFORTS? (NAP vs. GL EOs)

Synonymy/Affinities/Crosswalk:

= NYHP (1990) MARL POND (in part)

Does not include Alkaline Ponds and lakes with localized areas of marl deposition (e.g., See Oligotrophic Dimictic Lake, Eutrophic Dimictic Lake).

= VTHP (1989): Hard Water Lake/Pond (="Marl Pond")

= MEHP (1991): Alkaline Pond Community (ME Lake Type L4) (in part?: "Marl Pond" variant)

=? NHHP (1992): Highly Alkaline Lake/Pond (if with marl)

=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 23-25) (unsure if includes this lake type)

= Widoff (1986): Highly Alkaline Lakes/Ponds

=? GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several)

Suggested Alliance Name:

(unknown characteristic fish)-Potamogeton filiformis-Chara sp.-(unknown characteristic macroinvertebrates) Alliance

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.

Watershed Size: Size: very small, << $2mi^2$

Microhabitat Composition:

Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.

Water Permanence: permanent.

Depth/Surface Area/Morphometry: small, shallow.

Turnover/Temperature Regime: probably winter-stratified monomictic. "unstratified" per MEHP (1991).

Water/Substrate Acidity/Alkalinity: very alkaline/hardwater, CaCO3 >50 ppm.

Trophy/Productivity:

Suspected to be eutrophic. Cole (1979): marl lakes in Laurentian Great Lakes are oligotrophic with low productivity.

Substrate Texture: calcium rich marl deposits typical.

Other Features:

Landscape Setting:

Some occurrences possibly with associated Marl Fen, others with associated Marl Pond Shore, both NY Palustrine community types (Reschke, 1990).

Other Features:

ELU Signature: Calcareous Bedrock; Wet Moist Flats to Fine-Grained Dry Flats.

Biota:

Low vegetative diversity; plants thickly encrusted with calcium carbonate rich deposits. Cole (1979) cites marl lakes in Laurentian Great Lakes as having scattered littoral periphyton and indicator diatoms and zooplankton including species of calciphilic desmids, Holopedium (cladoceran), and calciphilic species of Brachionus (rotifer).

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: unknown

Assemblage Description: Need data from ME for potential NAP variant and GL Ecoregion for potential GL variant. Need review of 1 VT occurrence in STL. Fish may be lacking (Fish Assemblage: **Fishless Lakes-LAF7**)

Suggested Microhabitat-Association Composition:

1) Benthic Littoral Mud/Sand:

(unknown characteristic fish)-Chara sp.-(unknown characteristic macroinvertebrates) Association

Plant Assemblage: **Marl Pond Plants (LAP4)**

Potamogeton filiformis-P. strictifolius-Chara sp. Assemblage

Assemblage Description: (See Plant Assemblage Descriptions)

Macroinvertebrate Assemblage: unknown

Assemblage Description: need data from ME for potential NAP variant and GL Ecoregion for potential GL variant.

2) Pelagic Epilimnion: (unknown characteristic fish)-(unknown characteristic plankton) Non-Vegetated Association

Most EOs suspected to be too shallow for well-developed pelagic zone?

Plant Assemblage: unknown; characteristic phytoplankton suspected, unique to lake type (cf. Cole, 1979).

Macroinvertebrate Assemblage: unknown; characteristic zooplankton suspected, unique to lake type (cf. Cole, 1979).

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

1) Regional Variants.

Undoubtedly different ecoregional variants between NAP and GL. NYHP EORs only from GL Ecoregion. If STL EOs are present, need careful comparison to known NAP and GL EOs.

Distribution: NY: NAPn, STL?; VT: NAPn?, STLy; ME: NAPy?; NH: NAPn?

ME EO reported from limestone belt of Aroostook Co. (NAP)

NY Examples:

Leads: NYHERK Deer Pond North Lake? (NAP), NYHERK Moose River Recreation Area? (NAP), NYSTLA Lisbon Swamp? (STL).

Conversations with Adirondack experts revealed no solid leads. Best candidates were Deer Pond North Lake (described in 1905 literature as having marl margins, but with marl suspected to have misidentified) and Moose River Recreation Area (which contains several lakes of high alkalinity; Walter Kretser suggested looking at geology maps for calcium carbonate deposits=Hbg? of NY bedrock geology map). Slight possibility that there may be very small occurrences in NY STL (dense Chara beds noted in small ponds near Lisbon Swamp).

VT Examples: Root Pond.

Sources: Reschke (1990), MEHP (1991), Widoff (1986), Sperduto (1992), VTHP (1989), Cole (1979).

Basic Macrohabitat Type #3: **OXBOW (MONOMICTIC) POND**

Macrohabitat Name: **St. Lawrence-Champlain Valley (neutral) Oxbow Pond (LM16)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) OXBOW LAKE (in part)
=? VTHP (1989): Very Rich Lake/Pond? (in part: pond part; assuming present in VT, in STL and this type)
= VTHP (1989): Moderately Rich Lake/Pond? (in part: pond part; assuming present in VT, in STL and this type)
=? VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4) (if includes ponds and this type)
=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 23-25) (if includes ponds and this type)
=? VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 18-20) (if includes ponds and this type)
= Widoff (1986): Unstratified, (variously alkaline), (variously 3 to 5 colored) Lakes/Ponds
=? GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part, 1 of several)
=? GLB (2000): Backwater Sloughs (GLB Lake Type L9) (in part)
=? GLB (2000): Oxbow Lakes (GLB Lake Type L1) (in part)
=? GLB (2000): Till Plain Tributaries (GLB River Type R41) (in part)

Suggested Alliance Name: **(unknown characteristic fish)-Nuphar-(unknown characteristic macroinvertebrates) Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: small.
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.
Water Permanence: permanent.
Depth/Surface Area/Morphometry: shallow.
Turnover/Temperature Regime: winter-stratified monomictic.
Water/Substrate Acidity/Alkalinity: alkaline/hardwater.
Trophy/Productivity: eutrophic.
Substrate Texture: fine texture?
Other Features: warm water.
Landscape Setting: Oxbows associated with cut off meanders of unconfined river macrohabitats.
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Wet-Moist Flats, Fine- to Coarse-Grained Dry Flats.
Biota: Suspected to have species characteristic of more nutrient rich and alkaline waters relative to NAP examples of this basic macrohabitat type. Limited species information readily available from this habitat, but some from adjacent sloughs. Suspect that biota are similar between associated STL Backwater Sloughs and STL Oxbow Ponds, perhaps the latter weighted more towards typically lacustrine species.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Eutrophic-Mesotrophic Epilimnion/Pond Fish (LAF5)**?
(unknown characteristic fish) Assemblage
Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**?
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Descriptions: (See Individual Fish Assemblage Descriptions)
Limited fish suspected due to warm waters (R. Langdon, VT DEC); no data from NYHP BCD EORs or field forms.

Suggested Microhabitat-Association Composition: SEE NAP Oxbow Pond (little or no readily available information)

1) Benthic Littoral Mud/Sand:
(unknown characteristic fish)-Ceratophyllum-Nuphar-(unknown characteristic macroinvertebrate) Association

probable Plant Assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**
Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation
probable Plant Assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**
Potamogeton spp.-Ceratophyllum sp.Midwest Herbaceous Vegetation
Assemblage Description: (See Individual Plant Assemblage Descriptions)
Adjacent STL Backwater Sloughs have Nuphar variegata and rare indicator species Armoracia lacustris, both possible from STL Oxbow Pond.

Macroinvertebrate Assemblages: NEED COMPARISON TO NAP EUTROPHIC POND
Assemblage Description: S. Fiske: High abundance of gastropods.

2) Pelagic Epilimnion: (unknown characteristic fish)-(unknown characteristic plankton) Non-Vegetated Association
Plant Assemblage: unknown; prominent and potentially characteristic phytoplankton assemblage suspected.
Macroinvertebrate Assemblage: unknown; prominent and potentially characteristic zooplankton assemblage suspected.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Geomorphological Variants:

Need to further evaluate "Levee Pond" vs. typical "Oxbow Pond" split. Also need to evaluate split between examples associated with Marsh Headwater Streams (in marshes) vs. Unconfined Rivers (in floodplain forests). Levee Ponds tentatively crosswalked to this macrohabitat; typical Oxbow Ponds tentatively split between this macrohabitat and Alkaline Pond, based on frequency of overflow from adjacent river.

Uncertain, potential splits could include:

2) Acidicity/Alkalinity Variants.

3) Color Variants.

Widoff (1986) stratified this lake type in classification by 5 colors. Most lakes are suspected to fall in the hardly colored to mildly colored range. Color is thought to strongly correlate with alkalinity.

4) Trophy Variants. Possibly other examples that are not eutrophic.

5) Substrate Variants.

Rock versus mud substrate probable, but intraEO variation suspected to be much greater than interEO variation. Most EOs suspected to have organic substrates; if rocky substrate is substantial, rocky plant (sparsely vegetated algae-dominated) and macroinvertebrate assemblages should be crosswalked to this type.

6) Regional Variants.

Distribution: NY: NAPn?, STLy; VT: NAP., STLy

NY Examples:

Leads: NYSTLA Little River Canton, NYCLIN Ausable Delta. GLB (2000): suspected to be common along the lower reaches of Oswegatchie, Raquette, St. Regis, and Grass Rivers.

VT Examples: Swanton Oxbow.

Sources: NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), Widoff (1986), VT DEC: Steve Fiske, R. Langdon.

Basic Macrohabitat Type #4: **FLOW-THROUGH (MONOMICTIC) POND**

Macrohabitat Name: **St. Lawrence-Champlain Valley (neutral) Flow-Through Pond (LM18)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) OLIGOTROPHIC POND (in part)
= NYHP (1990) EUTROPHIC POND (in part)
In older iteration of state classification, some examples of "Beaver Pond" would crosswalk here.
= VT ACWG (1998): Small streams in lower Champlain Valley (RAM7)
=? VTHP (1989): Very Rich Lake/Pond? (in part: pond part; assuming present in VT, in STL and this type)
=? VTHP (1989): Moderately Rich Lake/Pond? (in part: pond part; assuming present in VT, in STL and this type)
=? VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4) (but poor crosswalk)
=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 23-25) (but poor crosswalk)
=? VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 18-20) (but poor crosswalk)
= Widoff (1986): (variously alkaline), Unstratified, (variously 3 to 5 colored) Lakes/Ponds
=? GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several)

Suggested Alliance Name: **(unknown characteristic fish-plant-macroinvertebrates) Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: small.
Watershed Size: variable.
Microhabitat Composition:
Depth/Substrate microhabitat: all littoral. Light regime microhabitat: all above-ground. Flow microhabitat: all pool, ecotones with riverine communities (e.g., "lake outlets") may grade into runs.
Water Permanence:
Permanent. Beaver dam variants are prone to conversion (back) to riverine communities upon disappearance of dam.
Depth/Surface Area/Morphometry: small, shallow.
Turnover/Temperature Regime:
Concept is winter-stratified monomictic (need data to confirm). Stratification is hypothesized to be affected strongly enough by flow from adjacent river segments so that community may attain deeper depths than other (monomictic) ponds and still remain monomictic while retaining enough lacustrine properties and attaining large enough size not to be deemed simply a pool microhabitat of a river community.
Water/Substrate Acidity/Alkalinity: probably neutral to basic/hardwater, moderately alkaline.
Trophy/Productivity: probably eutrophic.
Substrate Texture: fine textured silt and muck.
Other Features:
Of fluvial lake genesis. Hydrology should be so strongly influenced by the associated river as to be of a different character than larger lakes with river inlets and outlets that have only localized hydrologic influence from those rivers (e.g., usually only at the inlets and outlets). Water not stagnant. NYHP Leads: high flushing rate.
Landscape Setting:
Situated along the main channel of a riverine community ("in line lakes") with both connected upstream and downstream river segments. Can be caused either by large beaver impoundments, or natural widenings/deepening in the river. With closely associated riverine communities usually in a marsh or floodplain along a 1st to 2nd order, at most 3rd order Marsh Headwater Stream. In a depositional setting.
Other Features:
ELU Signature: Calcareous to Moderately Calcareous Bedrock; Wet-Moist Flats, Fine- to Coarse-Grained Dry Flats.
Biota:
Need to elaborate on distinction between this pond type, Oxbow Ponds and similar non-fluvial ponds. Are there biota differences other than those expected because of connectivity issues? Riverine species assemblages suggested from general literature.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Eutrophic-Mesotrophic Epilimnion/Pond Fish (LAF5)**?
(unknown characteristic fish) Assemblage
Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (RAF6)**?
Pumpkinseed-Bluntnose Minnow Assemblage
Assemblage Descriptions: (See Individual Fish Assemblage Descriptions). no data available on NYHP BCD.

Suggested Microhabitat-Association Composition:

Plant Assemblages: unknown.
Macroinvertebrate Assemblages: unknown.
1) Benthic Littoral: (unknown characteristic fish-plant-macroinvertebrates) Association
2) Pelagic Epilimnion: (unknown characteristic fish-macroinvertebrates) Non-vegetated Association

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

Uncertain, potential splits could include:
1) Trophy Variants.
2) Substrate Variants.
3) Regional Variants.
Lake Champlain versus Saint Lawrence Valley/Eastern Lake Ontario drainages may differ (but discerning data are not available), especially in fish and mollusk diversity, but these may represent the same assemblages, simply with different levels of "expression" based on historical migration routes. GLB (2000): "coastal" and "lake plain" types are split. GLB (2000): Drainage unit split used in Eastern Lake Onatario vs. Saint Lawrence vs. Lake Champlain.

Distribution: NY: NAPn?, STLy?; VT: NAP., STLy

NY Examples: Leads: NYSTLA Twin Pond West.
VT Examples:

Sources: NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), VTHP (1989).

Basic Macrohabitat Type #9: **WINTER-STRATIFIED MONOMICTIC LAKE**

Macrohabitat Name: **St. Lawrence-Champlain Valley Winter-Stratified Monomictic Lake (LM20)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) WINTER-STRATIFIED MONOMICTIC LAKE (in part)
= VTHP (1989): Very Rich Lake/Pond? (in part?; lake part: if in STL and same state type)
= VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4)
= VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Fish Type 4)
= VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 18-20)
=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 23-25) (?: if includes this type)
= Widoff (1986): (Alkaline to Moderately Alkaline), Cold? Monomictic, (Slightly to Mildy Colored?) Lake/Pond
= GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several, typical?)

Suggested Alliance Name: **Walleye-Ceratophyllum-Hexagenia Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: large.
Watershed Size: large to very large.
Microhabitat Composition:

Depth/Substrate microhabitat: mostly littoral, may have limited sublittoral areas. Pelagic zone typically well developed. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.

Water Permanence: permanent.
Depth/Surface Area/Morphometry: relatively shallow (NYHP EOR: <15 ft deep), large surface area/depth ratio.
Turnover/Temperature Regime:

Typically stratified (inversely) only in winter (freezing early); turnover once per year with mixing due to complete exposure to winds throughout summer, typically deep enough to stratify in summer without wind influence, thus distinguishing this from eutrophic pond.

Water/Substrate Acidity/Alkalinity: probably alkaline/hardwater.
Trophy/Productivity: NYHP EOR: eutrophic. (Reschke, 1990 allows mesotrophic)
Substrate Texture: variable, reportedly ranging from mud to bedrock.
Landscape Setting: variable. GLB (2000): drainage lakes with multiple stream connections.
Other Features: GLB (2000): high shoreline development.
ELU Signature: Lake. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **(STL?) Eutrophic/Warmwater? Lake Fish (LAF3A)**

Yellow Perch-Walleye-Northern Pike Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

NY references: type description. GL Basin (2000) crosswalked this lake type to GL Basin Fish Type IL1, a good match with LAF3A. R. Langdon: northern pike is a better indicator than muskellunge.

Suggested Microhabitat-Association Composition: (COMPARE TO NAP Winter-Stratified Monomictic Lake for equivalency)

Benthic: Armoracia reported, probably rare but good STL indicator.

1) Benthic Littoral Mud/Sand: **Walleye-Ceratophyllum-Nuphar-Hexagenia Association**

Microhabitat Description: deep mud reported.

Plant Assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**

Potamogeton spp.-Ceratophyllum sp.Midwest Herbaceous Vegetation (2282)

Assemblage Description: (See Plant Assemblage Descriptions)

Described as "weed filled areas". NYHP EOR & Schiavone (1984): typical with abundant species: Ceratophyllum, Elodea canadensis, Heteranthera dubia, Najas flexilis, Potamogeton pectinatus, P. perfoliatus, P. pusillus, P. richardsonii, P. zosteriformis, P. nodosus, Vallisneria. Less common species include Potamogeton obtusifolius, P. praelongus, Myriophyllum heterophyllum. Ceratophyllum and Heteranthera dubia and NY state-rare Callitriche hermaphroditica and Armoracia aquatica may be good diagnostic species separating the variant from NAP equivalent. Other NYHP lead is similar.

Plant Assemblage: **STL Eutrophic Water Lily Shallows (LAP5B)**

Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation (2386)

Assemblage Description: (See Plant Assemblage Descriptions)

NYHP EOR: abundant species: Nuphar variegata, Nymphaea tuberosa, Spirodella polyrhiza. Less common species: Lemna minor, Lemna trisulca, Utricularia vulgaris.

Macroinvertebrate Assemblage: **Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM4)**

Hexagenia-Pisidium Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions)

Poor NY data readily available. NEED VT EXPERTS TO CORRELATE VT ACWG (1998) ASSEMBLAGE TYPE TO THIS LAKE TYPE.

2) Benthic Littoral Rock: **Walleye-[algae?]-(unknown characteristic macroinvertebrate) Association**

Microhabitat Description: large areas of bedrock and boulders reported from Black Lake in areas of steep rocky shore.
Plant Assemblages: sparsely vegetated algae-dominated rocky associations

No biotic data yet, green algae likely. All 4 basic sparsely vegetated rocky associations (LAP 12-15) are reported or likely, including **Aquatic Cliff Community (LAP12), Aquatic Pavement (LAP13), Aquatic Talus (LAP14)** and **Aquatic Boulder Field (LAP15).** Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

3) Pelagic Epilimnion: **Walleye-(unknown characteristic plankton) Association**

Plant Assemblage: unknown phytoplankton assemblage

Assemblage Description:

Algae blooms common in summer. prominent and potentially characteristic phytoplankton assemblage suspected.

Zooplankton Assemblage: unknown zooplankton assemblage

Assemblage Description: prominent and potentially characteristic zooplankton assemblage suspected.

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

Uncertain, potential splits could include:

1) Regional Variants.

Distribution: NY: NAPn, STLy; VT: NAPn?, STLy

NY Examples: EOR: NYJEFF: Perch Lake. Leads: NYSTLA Black Lake. Other possible sites in the Indian Lake Complex (NYJEFF).
VT Examples: Lake Carmine (other outside possibilities: Lake Fairfield, Lake Shelburne).

Sources:

NYHP BCD Community EORs (2002), NYHP BCD Plant EORs (2002), NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), Widoff (1986), Schiavone (1984), GLB (2000).

Basic Macrohabitat Type #12B: **OLIGOTROPHIC ALKALINE DIMICTIC LAKE**

Macrohabitat Name: **St. Lawrence-Champlain Valley Oligotrophic Alkaline Dimictic Lake (LM22)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) OLIGOTROPHIC DIMICTIC LAKE (in part)
= VTHP (1989): Moderately Rich Lake/Pond (lake part)
=? VTHP (1989): Clear Softwater Lake/Pond (lake part)
= VT ACWG (1998): Oligotrophic Moderately Alkaline Lake (VT Macroinvertebrate Types 11-15)
= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3)
= VT ACWG (1998): Oligotrophic Lake (VT Fish Lake Type 2)
= Widoff (1986): Softwater (to moderately alkaline?), variously colored, Dimictic Lake/Pond
=? GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several?)

Suggested Alliance Name: **Lake Trout?-Eriocaulon aquaticum-Isoetes lacustris-Nitella flexilis-Sialis Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: large?

Watershed Size: moderate to large.

Microhabitat Composition:

Depth/Substrate microhabitat: all depth and substrate zones; well-developed profundal zone. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.

Water Permanence: permanent.

Depth/Surface Area/Morphometry: deep (to greater than 100 feet); NYHP Leads: 30-150+ ft deep.

Turnover/Temperature Regime:

Dimictic (2 turnovers/year), thermally stratified in both summer and winter (inversely), low water temperature (coldwater), epilimnion volume small relative to hypolimnion volume.

Water/Substrate Acidity/Alkalinity: alkaline, neutral: pH 7.8 to about 6.6 (NYHP leads and EORs).

Trophy/Productivity:

Oligotrophic, nutrient poor, P <11 ug/l, VT ACWG (1998), low productivity (typical) to unproductive, low Ca, DIC 7-25 g/m2/year, mean summer secchi depth >6.5 m (>4 m in Reschke, 1990; 21.5 ft secchi depth in NYHP lead), high transparency. Some examples, especially larger lakes, have oligotrophic open water/pelagic and profundal zones with mesotrophic bays/littoral zone.

Substrate Texture:

Typically with diverse substrate characteristics, bottom with exposed bedrock, cobble, and sand, generally low in accumulated organic matter. Silty substrate is common in portions of larger lakes and in bays/littoral zone.

Other Features:

GLB (2000): high shoreline development. water very clear to bluish-green, high D.O. levels year round throughout water column (VT ACWG, 1998).

Landscape Setting:

Variable, includes examples on marble bedrock. typically with steep banks. microhabitats can include inlet streams (see sandy delta for corresponding association). R. Langdon: elevations correspond to those of historic Lake Vermont, at the 600 feet contour.

Other Features:

ELU Signature: Lake. Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.

Biota:

Vegetation at moderate abundance. Littoral zone ranging from "unvegetated" (i.e., without vascular plants) (VT ACWG 98) or with sparse aquatic "plants" and algae, to moderately densely vegetated with characteristically oligotrophic plants (NYHP EOR). Good faunal diversity including good fish diversity and productivity. Some examples noted as coldwater fish spawning areas (apparently with lake trout targeted) (NYHP BCD). Loons are reported on water surface from multiple examples. Characteristic midges include Tanytarsus rather than Chaoborus, the latter a dystrophic indicator (Reschke, 1990). Zooplankton and plankton are diverse but at low abundance (Reschke, 1990). NYHP leads suggest zooplankton and phytoplankton component can be abundant, rich, and diverse. Characteristic littoral algae may include Batrachospermum and Nostoc.

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Oligotrophic Lake Fish (LAF2)**?

Lake Trout-Round Whitefish Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

NYHP EORs & Leads from NAP Oligotrophic Dimictic Lakes: Typical, including lake trout (Salvelinus namaycush), round whitefish (Prosopium cylindraceum), rainbow smelt, Atlantic salmon and, possibly only in Lake George, cisco.

Suggested Microhabitat-Association Composition:

(little summary data readily available other than Lake George, which is assumed to be this type, compare to NAP Oligotrophic Dimictic Lake)

1) Benthic Littoral Mud/Sand:

Largemouth Bass-Eriocaulon aquaticum-Isoetes lacustris-Myriophyllum tenellum-Notonectidae Association

Fish Assemblage: **Mesotrophic-Eutrophic Lake Fish (LAF3)**

Chain Pickerel-Golden Shiner-Pumpkinseed-Largemouth Bass Assemblage

Assemblage Description: (See Fish Assemblage Descriptions)

Abundant in Lake George (assume associated with bays) with typical species. Rock bass and fantail darter common especially in sparsely vegetated rocky associations (LAP12-15) and with johnny darter common on sand.

Plant Assemblages: Little summary data readily available from STL examples, information from peripheral NAP examples.

Plant Assemblage: **Benthic Littoral Pipewort-Water Lobelia Shoal (LAP7)**

Eriocaulon aquaticum-Lobelia dortmanna Herbaceous Vegetation

Assemblage Description: (See Plant Assemblage Description: including parts extracted from Lake George Report).

NYHP EORs: typical and representing large portion of vascular plant-dominated littoral zone. Some examples in SE Adirondacks may have more vascular plant diversity including potential STL indicator species.

Plant Assemblage: **STL Benthic Littoral Tapegrass-Pondweed Bed (LAP6B)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Description: including parts extracted from Lake George Report).
Limited in area in this macrohabitat, mostly restricted to inlet mouths and nutrient rich portions (e.g., sheltered bays) and more common in moderately alkaline variant. See Lake George Report for detailed description. VT examples: abundant plants include Potamogeton gramineus, P. amplifolius, P. praelongus, P. robbinsii, and P. illinoensis.

Plant Assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**
Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Description)
Very limited in area in this macrohabitat, mostly restricted to inlet mouths and nutrient rich portions (e.g., sheltered bays) and more common in moderately alkaline variant.

Plant Assemblage: **Sand Flats (LAP8)**
Myriophyllum tenellum-Potamogeton gramineus Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Description: including parts extracted from Lake George Report). Typical

*? Plant Assemblage: **Quillwort Meadow (LAP9)**
Isoetes lacustris-Potamogeton robbinsii Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Description: including parts extracted from Lake George Report).
Typical. NYHP EOR: type description. Isoetes lacustris potentially rare but very characteristic of lake type.

Macroinvertebrate Assemblages: Little summary data readily available from STL examples, information from NAP examples.

Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Mud Macroinvertebrates (LAM21)**
Elliptio complanata-Lampsilis radiata Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Abundant in Lake George on silty to sandy bottom.

Macroinvertebrate Assemblage: **Clear Acidic/Oligotrophic Benthic Littoral Mud-Sand Macroinvertebrates (LAM9)**
Dytiscidae-Corixidae-Notonectidae Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Lake George EOR: dominants include Crustaceans, Diptera, Trichoptera, Gastropoda, Ephemeroptera: where does this crosswalk with VT ACWG (1998) types? Not as acidic as typical NAP oligotrophic lakes. Species data may be available on NYHP EOR or secondary source reports.

2) Benthic Littoral Rock: **Lake Trout-Myriophyllum alterniflorum-[green algae]-Physidae Association**

Plant Assemblages: sparsely vegetated algae-dominated rocky associations
All 4 basic sparsely vegetated rocky associations (LAP 12-15) are documented. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients. See Lake George Report for detailed description. No biotic data yet from STL examples.

Plant Assemblage: **Aquatic Cliff Community (LAP12)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Cliff Vegetation
Plant Assemblage: **Aquatic Pavement (LAP13)**
Myriophyllum alterniflorum-Nostoc sp. Sparsely Vegetated Permanently Flooded Pavement Vegetation
Plant Assemblage: **Aquatic Talus Slope (LAP14)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Talus Slope Vegetation
Plant Assemblage: **Aquatic Boulder Field (LAP15)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Boulder Field Vegetation

Macroinvertebrate Assemblage: **Oligotrophic/Mesotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM7)**
Amnicola-Physidae-Stenonoma Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
VT ACWG (1998) Microhabitat Description: wave swept shallow shoreline and shoals. Presence in type strongly suspected. Lake George EOR: Physa heterostropha dominant, especially on Aquatic Cliff Community (LAP12); Amnicola also present. Freshwater sponges common on Aquatic Pavement (LAP13) and Aquatic Boulder Field (LAP15). Hydroids common on Aquatic Cliff Community (LAP12).

3) Benthic Profundal-Sublittoral: **Lake Trout-Nitella flexilis-Sialis Association**
Microhabitat Description:
Below the thermocline. with deep bottom gyttja (organic-rich bottom). strongly limited by dissolved oxygen.

Plant Assemblages: information from peripheral NAP example, none available from STL examples.

Plant Assemblage: **Sublittoral Nitella Bed (LAP10)**
Nitella flexilis Non-Vascular Vegetation
Assemblage Description: (See Plant Assemblage Description: including parts extracted from Lake George Report). Typical.

Plant Assemblage: **Deep Sublittoral Dichotomosiphon tuberosus beds (LAP22)**
Dichotomosiphon tuberosus Non-Vascular Vegetation

Assemblage Description: (See Plant Assemblage Descriptions). type description.

Macroinvertebrate Assemblage:

Clear, Acidic, Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM2)?
Sialis-Procladious-Heterotrissocladious Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Presence in this lake type strongly suspected, but little summary data readily available. Consult VT EXPERTS FOR VT TYPE; suggested from VT ACWG (1998) reference. Only in the acidic variant?

Macroinvertebrate Assemblage:

Moderately Alkaline Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM3)
Pisidium-Amphipoda Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Presence in this lake type strongly suspected, but little summary data readily available. Consult VT EXPERTS FOR VT TYPE; suggested from VT ACWG (1998) reference. Only in the acidic variant?

Macroinvertebrate Assemblage: **Eutrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM5)**?
Chaoborus-Oligochaeta-Chironomus Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Apparently present in Lake George, where it may be limited in size? Chironomids are dominant, may not have genus information yet (RECHECK NYHP field forms, etc.).

4) Pelagic Epilimnion: **Lake Trout-[Cyclotella?]-[zooplankton] Non-vegetated Association**

Plant Assemblage: **Oligotrophic Lake? Phytoplankton (LAP23)**?
Asterionella-Cyclotella Assemblage
Assemblage Description: (See Plant Assemblage Descriptions). type description.

Zooplankton Assemblage: **Oligotrophic Lake? Zooplankton (LAZ6)**
Keratella-Polyarthra-Bosmina-Daphnia Assemblage
Assemblage Description: (See Zooplankton Assemblage Descriptions). type description.

5) Pelagic Hypolimnion: **Lake Trout-[unknown characteristic zooplanton] Non-vegetated Association**
Zooplankton Assemblage: unknown?

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Trophy/Productivity =/- Alkalinity Variants.
Widoff's (1986) classification stratified dimictic lakes into 5 alkalinity types, two of these may cover most "oligotrophic" lakes. Need careful review of differences in biota and hydrology. Lakes in STL may be oligo-mesotrophic (and all moderately alkaline, not acidic), and moderately vegetated (e.g. Lake George, classified by NYHP as Oligotrophic Dimictic Lake): Lake George and nearby lakes in SE Adirondacks of NAP are tentatively treated as STL Oligotrophic Alkaline Dimictic Lake, a peripheral type within NAP.

Other uncertain, potential splits could include:
2) Color Variants. Widoff (1986) stratified this lake type in classification by 5 colors.
3) Substrate Variants.
4) Regional Variants.

Distribution: NY: NAPy, STLy; VT: NAP., STLy
We tentatively decided to treat Oligotrophic Alkaline Dimictic Lakes in STL as a unique lake type based on unique biota (distinguished especially from Oligotrophic Alkaline Dimictic Lakes characteristic of NAP, rather than as peripheral examples of a NAP type. Acidic (oligotrophic) Dimictic Lakes are not known from STL and may not be suspected.

NY STL Examples: (O = Oligotrophic, M = Mesotrophic)
Leads: NYSTLA Cedar Lake (O-M?), NYSTLA Chubb Lake, NYJEFF Millsite Lake?. SEE NAP oligotrophic dimictic lake, moderately alkaline variant, for other possible examples of this type in NAP.
NY NAP Examples: (O = Oligotrophic, M = Mesotrophic)
EORs (Oligotrophic Dimictic Lake): NYWARR Lake George (O-M); Leads (Oligotrophic Dimictic Lake): NYWARR Loon Lake (O), NYWARR Schroon Lake (O).
VT Examples: Sunset Lake?, Lake Dunmore.

Sources:
NYHP ANC Community Leads (Hunt, 2002), Reschke (1990), VTHP (1989), NYHP BCD Community EORs (2002), NYHP BCD Significant Habitat EORs (2002), NYHP BCD Plant EORs (2002), NYHP BCD Animal EORs (2002), VT ACWG (1998), Widoff (1986).

Basic Macrohabitat Type #12A: **EUTROPHIC ALKALINE DIMICTIC LAKE**

Macrohabitat Name: **St. Lawrence-Champlain Valley Eutrophic Alkaline Dimictic Lake (LM24)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

GENERAL TYPE:

= VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4)
= VT ACWG (1998): Mesotrophic-Eutrophic Lake (VT Fish Lake Type 3)
= Widoff (1986): Alkaline to moderately alkaline, variously colored, Dimictic Lake/Pond
= GLB (2000): St. Lawrence Lake Plain Lakes (GLB Lake Type L8) (in part: 1 of several, typical?)

EUTROPHIC VARIANT:

= NYHP (1990) EUTROPHIC DIMICTIC LAKE (in part)
= VTHP (1989): Very Rich Lake/Pond (lake part)
= VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 21-25)

MESOTROPHIC VARIANT:

= NYHP (1990) MESOTROPHIC DIMICTIC LAKE (in part)
= VTHP (1989): Moderately Rich Lake/Pond (lake part)
= VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 16-20)

Suggested Alliance Name: **Largemouth Bass-Nuphar-Ceratophyllum-Oligochaeta Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: large?
Watershed Size: moderate to large.
Microhabitat Composition:
Depth/Substrate microhabitat: all depth and substrate zones; well-developed profundal zone. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.
Water Permanence: permanent.
Depth/Surface Area/Morphometry:
Moderate depth (40 to 100 feet). Relatively shallow for lake (depth and trophy are reportedly roughly correlated).
Turnover/Temperature Regime:
Dimictic (2 turnovers/year), thermally stratified in both summer and winter (inversely), low water temperature, high epilimnion/hypolimnion volume ratio.
Water/Substrate Acidity/Alkalinity:
GENERAL TYPE: Alkaline. Neutral to basic. ANC moderate to high. pH 6.2 (NYHP lead).
MESOTROPHIC VARIANT: VT ACWG (1998) & NYHP Leads: pH >6. hardwater. moderate ANC (>50 mg/l).
Trophy/Productivity:
Eutrophic to mesotrophic, P 11-25 ug/l, moderately nutrient rich, VT ACWG (1998). VT ACWG (1998): productive.
Substrate Texture: bottom may include rocky to sandy areas.
Landscape Setting:
Variable, many examples apparently with underlying marble bedrock. GLB (2000): drainage lakes with multiple stream connections.
Other Features:
GENERAL TYPE: GLB (2000): high shoreline development. moderate water clarity (13-26 ft Secchi depth), VT ACWG (1998).
EUTROPHIC VARIANT: oxygen limited.
ELU Signature: Lake. Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota:
GENERAL TYPE:
Abundant aquatic macrophytes in shallow littoral areas. reportedly poor diversity in profundal zone, limited to species tolerant of low oxygen (Reschke, 1990). Rosette-leaved plants in low abundance or lacking (VTHP 1989). May include warmwater fish concentration areas. VT ACWG (1998): (vascular) plants occur as deep as 20 to 25 feet deep, extensive vascular plant coverage in littoral zone, diverse and abundant; Shallow coves and wetland edges with mixed floating and submergent aquatics; exposed shorelines with submersed species.
MESOTROPHIC VARIANT:
High diversity (including some typically oligotrophic assemblages).
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

Fish Assemblage: **Mesotrophic-Eutrophic Lake Fish (LAF3)**
Chain Pickerel-Golden Shiner-Pumpkinseed-Largemouth Bass Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
Typical. GLB (2000) crosswalked this lake type to GL Basin Fish Community IL1 (thought to be synonymous with STL Fish Assemblage LAF3A); D. Hunt: probably a better crosswalk is GL Basin Fish Community IL2 (thought to be synonymous with this assemblage); needs more critically evaluation. R. Langdon: warmwater to coolwater fish.

Suggested Microhabitat-Association Composition:

1) Benthic Littoral Mud/Sand: **Pumpkinseed-Nuphar-Ceratophyllum-[Hexagenia?] Association**
Plant Assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**
Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions). Typical with STL indicators.

Plant Assemblage: **STL Benthic Littoral Tapegrass-Pondweed Bed (LAP6B)**
Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions). Typical with STL indicators.

Macroinvertebrate Assemblage: **Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM4)?**

Hexagenia-Pisidium Assemblage

Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).

Suspected but little summary data readily available. Consult VT EXPERTS FOR VT TYPE; suggested from VT ACWG 98 reference.

2) Benthic Littoral Rock: **Pumpkinseed-Rock Bass-[algae?]-[Physidae?] Association**

Plant Assemblages: sparsely vegetated algae-dominated rocky associations possible to probable.
Green algae likely. All 4 basic sparsely vegetated rocky associations (LAP 12-15) are reported or likely. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.
Plant Assemblage: **Aquatic Cliff Community (LAP12)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Cliff Vegetation
Plant Assemblage: **Aquatic Pavement (LAP13)**
Myriophyllum alterniflorum-Nostoc sp. Sparsely Vegetated Permanently Flooded Pavement Vegetation
Plant Assemblage: **Aquatic Talus Slope (LAP14)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Talus Slope Vegetation
Plant Assemblage: **Aquatic Boulder Field (LAP15)**
Filamentous Green Algae Sparsely Vegetated Permanently Flooded Boulder Field Vegetation

Macroinvertebrate Assemblage: **Oligotrophic/Mesotrophic Rocky Littoral/Shoal Macroinvertebrates (LAM7)**
Amnicola-Physidae-Stenonoma Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Suspected but little summary data readily available. Consult VT EXPERTS FOR VT TYPE; suggested from VT 98 reference. In both NAP and STL ecoregions? Only in mesotrophic part of range?

3) Benthic Profundal-Sublittoral: **Pumpkinseed-Nitella-Hexagenia-Oligochaeta Association**
Microhabitat Description:
VT ACWG (1998): Below the thermocline. With deep bottom gyttja (organic-rich bottom). Strongly limited by dissolved oxygen.

Plant Assemblage: **Sublittoral Nitella Bed (LAP10)**?
Nitella flexilis Non-Vascular Vegetation
Assemblage Description: (See Plant Assemblage Descriptions). VT ACWG (1998) examples cited are in this lake type.

Macroinvertebrate Assemblage: **Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM4)?**
Hexagenia-Pisidium Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Possibly in this lake type, but no direct summary data from NY.

Macroinvertebrate Assemblage: **Eutrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM5)**
Chaoborus-Oligochaeta-Chironomus Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).
Possibly in this lake type, but no direct summary data from NY.

4) Pelagic Epilimnion: **Largemouth Bass-[cyanobacteria?]-[unknown zooplankton] Association**

Phytoplankton Assemblage: cyanobacteria Assemblage?
Assemblage Description:
Reschke (1990) (Eutrophic Dimictic Lake): phytoplankton (cyanobacteria characteristic) abundant, but with low species diversity. Possibly **Eutrophic Lake? Phytoplankton (LAP24)**.

Zooplankton Assemblage: unknown?
Assemblage Description:
Zooplankton abundant, but with low species diversity per Reschke (1990). Possibly **Eutrophic Lake? Zooplankton (LAZ7)**.

5) Pelagic Hypolimnion: **Lake Trout-[unknown characteristic zooplankton] Non-Vegetated Association**
Fish Assemblage: **Oligotrophic Lake Fish (LAF2)**?
Lake Trout-Round Whitefish Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
One NYHP lead with lake trout. Restricted to this microhabitat in this type of lake. May fit better in STL Oligotrophic Alkaline Dimictic Lake (EVALUATE FURTHER).

Zooplankton Assemblage: unknown?

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences;
Prime factors to use in stratification during portfolio selection):

1) Trophy/Productivity +/- Alkalinity Variants.

Both NYHP and VT ACWG distinguish mesotrophic and eutrophic dimictic lakes, which are here tentatively lumped together. Need careful review of differences in hydrologic parameters (especially water chemistry) and biota. In general, the Oligo-Meso-Eu trophic split needs to be more critically evaluated with correlations in biota (association) differences for both ponds and lakes. Possibilities include a 2 or 3 parted split. Continual gradients from oligotrophic to eutrophic and acidic to alkaline lakes are suspected. The general pattern of associations is apparently characteristic oligotrophic associations and eutrophic associations, with mesotrophic lakes supporting a mixed mosaic of the two types. Could this be analogous to the conifer-mixed-deciduous split in matrix forest classification? Could the 2 or 3 unit classification be considered arbitrary?

Other uncertain, potential splits could include:
2) Substrate Variants.
3) Regional Variants.

Distribution: NY: NAPn?, STLy; VT: NAP?, STLy

NY Examples:
GENERAL TYPE:
Leads: NYJEFF Grass Lake?
EUTROPHIC TYPE (E):
Eutrophic Dimictic Lake Leads: STLA Mud Lake (E).
MESOTROPHIC TYPE (EM, M):
Eutrophic Dimictic Lake Leads: STLA Trout Lake (E-M?), STLA Hickory Lake (E-M?), STLA Yellow Lake (E-M?).
Mesotrophic Dimictic Lake Leads: none.
VT Examples: STL Portfolio: Long Pond, Fern Lake, Colchester Pond, Lake Iroquois, Fairfield Pond, Lake Carmi.

Sources:
VT ACWG (1998), Reschke (1990), NYHP ANC Community Leads (Hunt, 2002), Widoff (1986), VTHP (1989), GLB (2000).

Basic Macrohabitat Type #11: **SUMMER-STRATIFIED MONOMICTIC LAKE**

Macrohabitat Name: **St. Lawrence-Champlain Valley Summer-Stratified Monomictic Lake (LM25)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

= NYHP (1990) SUMMER-STRATIFIED MONOMICTIC LAKE (in part)
=? VTHP (1989): Moderately Rich Lake/Pond (in part; lake part: if same state type)
=? VTHP (1989): Clear Soft Water Lake/Pond (in part; lake part: if same state type)
= VT ACWG (1998): Lake Champlain (part of VT Lake Fish Type 3)
=? VT ACWG (1998): Mesotrophic-Eutrophic Lakes (VT Lake Macrophyte Type 4) (if includes this type)
=? VT ACWG (1998): Eutrophic Lakes (VT Lake Macroinvertebrate Types 21-25) (if includes this type)
=? VT ACWG (1998): Mesotrophic Lakes (VT Lake Macroinvertebrate Types 16-20) (if includes this type)
=? VT ACWG (1998): Oligotrophic Lakes (VT Lake Macroinvertebrate Types 11-15) (if includes this type)
= Widoff (1986): Moderately alkaline (to alkaline), Warm Monomictic?, (slightly color to mildly colored) Lake/Pond
GLB (2000): apparently not addressed, not in study area.

Suggested Alliance Name: **Yellow Perch-Sauger-Burbot-Heteranthera dubia-Lampsilis ovata Alliance**

Macrohabitat Description (including parameters for use in ELU analysis):

Scale: very large.
Watershed Size: very large, > 4,000 mi^2
Microhabitat Composition:

Depth/Substrate microhabitat: all depth and substrate zones; very well-developed profundal zone. Light regime microhabitat: all above-ground. Flow microhabitat: all pool. A diverse set of microhabitats are known from the one example, Lake Champlain.

Water Permanence: permanent.
Depth/Surface Area/Morphometry: relatively large surface area.

CENTER: very deep center (400 feet).
BAYS: broad shallow bays.

Turnover/Temperature Regime:

CENTER:

Stratified only in summer; if stratified in winter, then weak (i.e., with at most only a brief period of temporary or intermittent thin ice cover, with ice break up soon following; or sporadic prolonged freezing once every several years). Thick epilimnion (60% volume, 60 feet deep in middle of lake).

BAYS: Shallow bays are mostly unstratified and warmwater.

Water/Substrate Acidity/Alkalinity: (neutral) to basic/hardwater. Alkaline, with calcium levels at 11 (mg/l?), throughout
(CHECK PARAMETER VALUE WITH VT DEC staff).

Trophy/Productivity:

Varying much throughout lake. The lake varies perhaps from oligotrophic microhabits (mostly pelagic-epilimnion, pelagic-hypolimnion, benthic-profundal) in the deeper, distinctly summer-stratified and poorly winter-stratified central portion of the lake with open water in winter to eutrophic microhabits (mostly pelagic-epilimnion, benthic-littoral, benthic-sublittoral) in the shallower, perhaps less distinctly summer-stratified peripheral portions of the lake (e.g., the southern end of the lake, and many shallow bays throughout the lake).

CENTER: NYHP EOR: near-oligotrophic in middle. Middle with low P, N, Cl. D.O. highest in deep areas.
BAYS: NYHP Leads: mesotrophic in bays at N end, eutrophic towards S end.

Substrate Texture: variable. middle with clay and gravelly organic mud.
Other Features: cold in middle.
Landscape Setting: variable.
Other Features:
ELU Signature: Lake. Calcareous to Moderately Calcareous Bedrock; Fine- to Coarse-Grained Dry Flats to Gently Sloping Flats.
Biota: Very high diversity of biota including fish, macroinvertebrates, aquatic macrophytes, phytoplankton and zooplankton. 80 species of native fish. Most diverse macroinvertebrate groups (from NYHP EOR) with associated species numbers include Chironomidae (60), Gastropoda (24), Sphaeriidae (20), Hirundinea (10), Oligochaeta (9) and Trichoptera (6). Most of these may be associated with Benthic-Littoral Mud/Sand microhabitat. Common exotics include Hydrochaeris morsus-ranae, Myriophyllum spicatum, Potamogeton crispus, Dreissena polymorpha.
See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

* Fish Assemblage: **Lake Champlain Fish (LAF6)**

Yellow Perch-Sauger-Burbot-Slimy Sculpin Assemblage
Assemblage Description: (See Fish Assemblage Descriptions)
(VT ACWG, 1998) & NYHP EOR: type description. Native salmon reportedly extirpated, then Atlantic salmon introduced.

Suggested Microhabitat-Association Composition:

1) Benthic Littoral Mud: **Yellow Perch-Sauger-Heteranthera dubia-Lampsilis radiata Association**

Microhabitat Description:
Embayments. dense mussel beds, usually silty (or mixed with sand). Mostly in eu-mesotrophic areas.

*? Plant Assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**

Potamogeton spp.-Ceratophyllum sp.Midwest Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions).
NYHP EORs: rare Armoracia lacustris (shallow muddy areas). Levey & Fiske (1996): typical including Heteranthera dubia. Better crosswalk may be Potamogeton spp.-Ceratophyllum spp. Great Lakes Shoreline Herbaceous Shoreline Vegetation (5152) only in this lake type in STL?

Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Mud Macroinvertebrates (LAM21)**

Elliptio complanata-Lampsilis radiata Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions). Type description.

2) Benthic Littoral Sand: **Yellow Perch-Sauger-Myriophyllum tenellum-Lampsilis ovata Association**
Microhabitat Description: River deltas. high species diversity. Mostly in eu-mesotrophic areas.

*? Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Sandy Flats Macroinvertebrates (LAM22)**
Lampsilis radiata-L. ovata-Potamilus alatus Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions). Type description.

Plant Assemblage: **Sand Flats (LAP8)**
Myriophyllum tenellum-Potamogeton gramineus Herbaceous Vegetation
Assemblage Description: (See Plant Assemblage Descriptions). Myriophyllum alterniflorum reported.

3) Benthic Littoral Rock: **Yellow Perch-Sauger-[algae]-Amnicola limosa Association**
Microhabitat Description:
Shoals (shale/cobble shoreline). Probably includes NYHP proposed "associations": Aquatic Boulder Field and possibly Aquatic Pavement. Fiske & Levey (1996): substrate types predominated by boulders, cobble and coarse gravel. Levey & Fiske (1996) studied examples in 2-4 m depth range; Species richness highest at mesotrophic sites.

*? Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Rocky Shoal Macroinvertebrates (LAM23)**
Elliptio complanata-Lampsilis radiata-Amnicola limosa Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions). Type description.

Macroinvertebrate Assemblage: **Oligotrophic/Mesotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM7)** =LAM23?
Amnicola-Physidae-Stenonoma Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).

Plant Assemblages: sparsely vegetated algae-dominated rocky associations
Assemblage Description:
Green algae likely. All 4 basic sparsely vegetated rocky associations (LAP 12-15) are reported or likely, including **Aquatic Cliff Community (LAP12), Aquatic Pavement (LAP13), Aquatic Talus (LAP14)** and **Aquatic Boulder Field (LAP15).** Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

4) Benthic Profundal-Sublittoral: **Burbot-Slimy Sculpin-Stylodrilus heringianus-Pyganodon cataracta Non Vegetated Association**

*? Macroinvertebrate Assemblage: **Lake Champlain Sublittoral Macroinvertebrates (LAM24)**
Pyganodon cataracta-P. grandis Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions). Type description.

*? Macroinvertebrate Assemblage: **Lake Champlain Profundal Macroinvertebrates (LAM20)** =LAM5?
Stylodrilus heringianus-Peloscolex variegatus-Sphaeridae Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions). NYHP EOR: type description.

possibly? Macroinvertebrate Assemblage: **Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM3)**
Pisidium-Amphipoda Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).

possibly? Macroinvertebrate Assemblage: **Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM4)**
Hexagenia-Pisidium Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).

possibly? Macroinvertebrate Assemblage: **Eutrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM5)**
Chaoborus-Oligochaeta-Chironomus Assemblage
Assemblage Description: (See Macroinvertebrate Assemblage Descriptions).

5) Pelagic Epilimnion: **Yellow Perch-Sauger-Melosira-Limnocalanus Non-Vegetated Association**

Phytoplankton Assemblages:
NYHP EOR: diatoms, flagellates, blue green algae dominate. Dominant flagellates include Cryptomonas ovata, C. erosa and Rhodomonas lacustris.
*? Plant Assemblage: **Lake Champlain Summer/Fall Epilimnion Phytoplankton (LAP18)**
Fragilaria spp.-Anabaena spp. Assemblage
Assemblage Description: (See Plant Assemblage Descriptions). type description.

* Plant Assemblage: **Lake Champlain Winter/Spring Epilimnion Phytoplankton (LAP20)**
Melosira spp.-Cryptomonas ovata Assemblage
Assemblage Description: (See Plant Assemblage Descriptions). type description.

Zooplankton Assemblages:
NYHP EOR: dominated by copepods, cladocerans, rotifers. Common associated cladocerans include Bosmina longirostris, Eubosmina coregoni, Holopedium gibberum and Leptodora kindtii. Rotifers are dominated by Keratella spp., Polyarthra spp. and Kellicottia spp.
*? Zooplankton Assemblage: **Lake Champlain Summer/Fall Epilimnion Zooplankton (LAZ4)**

Daphnia spp.-Diaptomus spp. Assemblage
Assemblage Description: (See Zooplankton Assemblage Descriptions). type description.

* Zooplankton Assemblage: **Lake Champlain Winter/Spring Epilimnion Zooplankton (LAZ5)**
Limnocalanus macrurus-Cyclops becuspidatus thomasi Assemblage
Assemblage Description: (See Zooplankton Assemblage Descriptions). type description.

6) Pelagic Hypolimnion: **Burbot-Slimy Sculpin-zooplankton Non-vegetated Association**
Zooplankton Assemblage: Hypolimnion Zooplankton
Assemblage Description: unknown, characteristic assemblage suspected, but not broken out on NYHP EOR/summary forms.

Potential Macrohabitat Variants:

Only 1 EO suspected, no macrohabitat variants known or suspected. Large intraEO variation spanning much of oligotrophic to eutrophic range.

Distribution: NY: NAPn, STLy; VT: NAPn, STLy

Undoubtedly none of this macrohabitat type in NAP.

NY Examples:

MACROHABITAT:

EORs: NYESSE Lake Champlain.

MESOTROPHIC BAY MICROHABITATS:

EORs: NYCLIN Ausable Delta, NYCLIN Kings Bay, NYCLIN Point Au Roche Swamp, NYCLIN Valcour Island

Leads: NYWASH Lake Champlain Ticonderoga, NYCLIN Rouses Point, NYWASH Lachute River Delta.

VT Examples:

MACROHABITAT:

Lake Champlain.

Sources:

NYHP BCD Community EORs (2002), NYHP BCD Significant Habitat EORs (2002), Reschke (1990), Widoff (1986), Fiske and Levey (1996), Levey and Fiske (1996), VT ACWG (1998).

Basic Macrohabitat Type #11: **SUMMER-STRATIFIED MONOMICTIC LAKE**

Macrohabitat Name: **Great Lakes Summer-Stratified Monomictic Lake (LM26)** Last Update: December 10, 2002

Synonymy/Affinities/Crosswalk:

=NYHP: GREAT LAKES DEEPWATER COMMUNITY
=VTHP (89): no equivalent (not in Vermont)
=VT ACWG 98: no equivalent (not in Vermont)
=Widoff: possibly no equivalent/not addressed (not in New England).
= GLB (2000): various nearshore lake types. Entire macrohabitat and deepwater areas apparently not addressed.

Suggested Alliance Name: (unknown characteristic fish-plant-macroinvertebrates) Alliance
TO BE MORE FULLY DEVELOPED IN GL ECOREGION PLANNING EFFORTS (SEE ALSO Lake Ontario NYHP EOR).

Macrohabitat Description (including parameters for use in ELU analysis):

Skeletal description. See Lake Ontario NYHP EOR to expand.

Scale: very large ("matrix").
Watershed Sized: very large, >> 4,000 mi^2
Microhabitat Composition:

Depth/Substrate microhabitat: all depth and substrate zones; very well-developed profundal zone. Light regime microhabitat: all above-ground. Flow microhabitat: all pool.

Water Permanence: permanent.
Depth/Surface Area/Morphometry: very deep, very large surface area.
Turnover/Temperature Regime: Stratified only in summer, not in winter (no ice formation).
Water/Substrate Acidity/Alkalinity: neutral to basic/hardwater.
Trophy/Productivity: eutrophic?
Substrate Texture: variable.
Landscape Setting: variable
Other Features:
ELU Signature: Lake.
Biota: TO BE MORE FULLY DEVELOPED IN GL ECOREGION. (SEE ALSO Lake Ontario NYHP EOR).

See also Reschke (1990)/NYHP BCD ELDESCRIP and NYHP BCD EOSPECS.

* Fish Assemblage: See Lake Ontario NYHP EOR
Assemblage Description: See Lake Ontario NYHP EOR. Matches GLB (2000): Great Lakes Fish Community (GLB Fish Type GL1).

Suggested Microhabitat-Association Composition:
TO BE MORE FULLY DEVELOPED IN GL ECOREGION. See Lake Ontario NYHP EOR

1) Benthic Littoral Mud/Sand: [fish]-[plant]-[macroinvertebrate] Association
2) Benthic Littoral Rock: [fish]-[plant]-[macroinvertebrate] Association
3) Benthic Profundal-Sublittoral: [fish]-[plant]-[macroinvertebrate] Association
4) Pelagic Epilimnion: [fish]-[plankton] Non-vegetated Association
5) Pelagic Hypolimnion: [fish]-[plankton] Non-vegetated Association

Plant Assemblages: See Lake Ontario NYHP EOR
Assemblage Description: See Lake Ontario NYHP EOR

Macroinvertebrate Assemblages: See Lake Ontario NYHP EOR
Assemblage Description: See Lake Ontario NYHP EOR

Potential Macrohabitat Variants (Needing further evaluation as separate macrohabitats with substantial biological differences; Prime factors to use in stratification during portfolio selection):

1) Regional Variants. (out of only 5 global EOs)

Distribution: NY: NAPn, STLy (peripheral); VT: NAPn, STLn

NY Examples: EORs: Lake Ontario (GL/STL). Leads: Lake Erie (GL).
VT Examples: not known or suspected.

Sources: NYHP BCD Community EORs (2002), Reschke (1990).

PERIPHERAL MACROHABITATS POTENTIALLY IN STL.

B. NAP MACROHABITATS PERIPHERAL IN OR ABSENT FROM STL
(Most descriptions partially developed in earlier drafts of NAP/STL classification; only summaries presented here)
(Full descriptions pending 2nd iteration ecoregional planning for NAP in 2003)

Macrohabitat Name: **NAP Subterranean Lake** (not yet designated; presence uncertain or rare)
Macrohabitat Name: **NAP Vernal Pool** (acidic) (previously developed: see below)
Macrohabitat Name: **NAP Sinkhole Pond** (not yet designated; presence uncertain or rare)
Macrohabitat Name: **NAP Meromictic Lake** (rare type) (previously developed: see below)
Macrohabitat Name: **NAP Acidic Pond** (oligotrophic) (previously developed: see below)
Macrohabitat Name: **NAP Tarn Pond** (oligotrophic) (previously developed: see below)
Macrohabitat Name: **NAP Alkaline Pond** (eutrophic) (previously developed: see below)
Macrohabitat Name: **NAP Oxbow Pond** (acidic) (previously developed: see below)
Macrohabitat Name: **NAP Flow-Through Pond** (acidic) (previously developed: see below)
Macrohabitat Name: **NAP Acidic Dimictic Lake** (oligotrophic) (previously developed: see below)
Macrohabitat Name: **NAP Winter-Stratified Monomictic Lake** (alkaline) (previously developed: see below)
Macrohabitat Name: **NAP Eutrophic Alkaline Dimictic Lake** (previously developed: see below)

C. GL MACROHABITATS PERIPHERAL IN OR ABSENT FROM STL
(Most descriptions to be developed elsewhere)
(Deferred to GL ecoregional planning efforts)

Macrohabitat Name: **GL Salt Pond** (previously developed: see below)
Macrohabitat Name: **GL Vernal Pool** (calcareous) (not yet developed, but designated as target in STL portfolio)
Macrohabitat Name: **GL Oxbow Pond** (calcareous) (not yet developed, but designated as target in STL portfolio)
Macrohabitat Name: **GL Flow-Through Pond** (not yet designated)

D. ESTUARINE MACROHABITATS POSSIBLE FROM QUEBEC STL/ABSENT IN NY & VT STL
(Descriptions not yet developed)

Macrohabitat Name: **Coastal (NAC) Salt Pond**
Macrohabitat Name: **Acadian Freshwater Tidal Bay**
Macrohabitat Name: **Acadian Brackish Tidal Bay**
Macrohabitat Name: **Acadian Marine Tidal Bay**

Summary of 1) Information Available Elsewhere and 2) Presence in STL:

Basic Macrohabitat Type #1: **LACUSTRINE CAVE COMMUNITY**
Macrohabitat Name: **Northern Appalachian Subterranean Lake (LM.)** Last Update: December 16, 2002
Suggested Alliance Name: TO BE DEVELOPED IN NAP ECOREGION PLANNING EFFORTS.

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy?, STLn?; VT: NAPy?, STL?; ME: NAPy?; NH: NAP?
NOTE: A NAP equivalent is not yet suspected based on expert interviews, at least in NY, or only very small examples are known. ME has "cave pool communities" (MEHP, 1991), but NYHP is not sure if these are in NAP or lacustrine in nature (as opposed to riverine).

Basic Macrohabitat Type #2A: **INTERMITTENT POND/VERNAL POOL**

Macrohabitat Name: **Northern Appalachian (acidic) Vernal Pool (LM2)** Last Update: February 23, 2001
Suggested Alliance Name: Eleocharis acicularis-Mosquito-Aquatic Beetle-Ambystoma maculatum Fishless Alliance

ADDRESSED IN STL PORTFOLIO, WITH GAPS.

Distribution: NY: NAPy, STLn? (peripheral); VT: NAPn?, STLy (peripheral); NH: NAPy?; ME: NAPy?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #2B: **INTERMITTENT POND/SINKHOLE POND**

Macrohabitat Name: **NAP Sinkhole Pond (LM.)**

Suggested Alliance Name: TO BE DEVELOPED IN NAP ECOREGION PLANNING EFFORTS.

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAP?, STLn?; VT: NAP?, STLn?; ME: NAP?; NH: NAP?

Probably some chance that the basic Sinkhole Pond lake type could be in NAP (non-aquatic sinkholes have been seen in NY NAP; some apparent sinkholes are seen on aerial photos at the periphery of NAP). NAP examples could be different but no known examples. No equivalent NAP type is yet designated; NAP sinkholes need more field observations for evaluation.

Basic Macrohabitat Type #5: **MEROMICTIC LAKE**

Macrohabitat Name: **Northern Appalachian Meromictic Lake (LM8)** Last Update: April 24, 2000
Suggested Alliance Name: Brown Bullhead-Freshwater Sponge-Synura-Diaphanasoma brachyurium Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STLn?; VT: NAP?, STLn; ME: NAPy?; NH: NAP?
Apparently/assume none of this macrohabitat type in STL. If so, may be a new type. One possible NYHP lead (expert report) from Black River Watershed may be in STL but need specific site location.

Basic Macrohabitat Type #7: **ACIDIC (MONOMICTIC) POND**

Macrohabitat Name: **Northern Appalachian Acidic Pond (LM9)** Last Update: February 23, 2001
Suggested Alliance Name: (unknown characteristic fish)-Eriocaulon aquaticum-Notonectidae-Tabellaria Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STL?; VT: NAPy, STLn; ME: NAPy?; NH: NAPy?
No unique STL Acidic Pond type (formerly tracked as "St. Lawrence-Champlain Valley Acidid Pond (LM10)") is known or suspected. Any examples of NAP Acidic Pond in STL would be considered as simply peripheral EOs of this macrohabitat characteristic of NAP.

Basic Macrohabitat Type #7: **ACIDIC (MONOMICTIC) POND**

Macrohabitat Name: **Northern Appalachian Tarn (Oligotrophic) Pond (LM. - to be split from LM9)** Last Update: February 23, 2001
Newly Proposed Alliance Name:
(unknown characteristic fish)-Potamogeton confervoides-Utricularia geminiscapa-Notonectidae-Tabellaria Alliance

NOT ADDRESSED IN STL PORTFOLIO. GOOD CONSENSUS BETWEEN EXISTING STATES CLASSIFICATIONS TO SPLIT OFF HIGH ELEVATION TYPE. NEED FORMAL DISCUSSION FOR FINAL DECISION AS PART OF NAP ECOREGIONAL PLANNING EFFORTS. Preliminary description possibly prepared for ANC NAP 2002 Aquatic Conservation Meeting. To be more fully developed during 2nd iteration of NAP plan.

Distribution: NY: NAPy, STLn; VT: NAPy, STLn; ME: NAPy; NH: NAPy

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Basic Macrohabitat Type #10A: **ALKALINE (MONOMICTIC) POND**

Macrohabitat Name: **Northern Appalachian Alkaline Pond (LM11)** Last Update: April 24, 2000
Suggested Alliance Name:
(unknown characteristic fish)-Potamogeton spp.-(unknown characteristic macroinvertebrates)-Chrysosphaerella longispina Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STL?; VT: NAP?, STL?; ME: NAPy?; NH: NAP?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #3: **OXBOW (MONOMICTIC) POND**

Macrohabitat Name: **Northern Appalachian (Acidic) Oxbow Pond (LM15)** Last Update: April 24, 2000
Suggested Alliance Name: (unknown characteristic fish)-Nymphaea-Odonata Alliance

ADDRESSED IN STL PORTFOLIO, WITH GAPS.

Distribution: NY: NAPy, STL?; VT: NAPy?, STL?; ME: NAP?; NH: NAP?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #4: **FLOW-THROUGH (MONOMICTIC) POND**

Macrohabitat Name: **Northern Appalachian (Acidic) Flow-Through Pond (LM17)** Last Update: April 24, 2000
Suggested Alliance Name: (unknown characteristic fish-plant-macroinvertebrates) Alliance

Synonymy/Affinities:
= NYHP (1990): OLIGOTROPHIC POND (in part)
= MEHP (1991): Deadwater Community (in part)

ADDRESSED IN STL PORTFOLIO, WITH GAPS.

Distribution: NY: NAPy, STLn?; VT: NAPy?, STL?; ME: NAPy?; NH: NAPy?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #8: **ACIDIC DIMICTIC LAKE**

Macrohabitat Name: **Northern Appalachian Acidic (Oligotrophic) Dimictic Lake (LM21)** Last Update: April 25, 2000
Suggested Alliance Name: Lake Trout-Eriocaulon aquaticum-Isoetes lacustris-Notonectidae Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STL?; VT: NAPy?, STL.; ME: NAPy?; NH: NAPy?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #9: **WINTER-STRATIFIED MONOMICTIC LAKE**

Macrohabitat Name: **Northern Appalachian Winter-Stratified Monomictic Lake (LM19)** Last Update: April 24, 2000
Suggested Alliance Name: Yellow Perch-Potamogeton-Dinobryon-Planorbidae Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STLn?; VT: NAPn?, STLn?; ME: NAP?; NH: NAP?

Basic Macrohabitat Type #12B: **EUTROPHIC ALKALINE DIMICTIC LAKE**

Macrohabitat Name: **Northern Appalachian Eutrophic (-Mesotrophic) Alkaline Dimictic Lake (LM23)** Last Update: April 25, 2000
Suggested Alliance Name: Largemouth Bass-Potamogeton spp.-Chironomus-Dinobryon-Daphnia Alliance

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPy, STL?; VT: NAP?, STL?; ME: NAPy?; NH: NAP?
Peripheral examples suspected from STL, but none known, look for ELU signature.

Basic Macrohabitat Type #10C: **ALKALINE (MONOMICTIC) POND/SALT POND**

Macrohabitat Name: **Great Lakes Salt Pond (LM14)** Last Update: April 24, 2000
Suggested Alliance Name: TO BE DEVELOPED IN GREAT LAKES ECOREGION PLANNING EFFORTS.

NOT ADDRESSED IN STL PORTFOLIO.

Distribution: NY: NAPn, STLn, GLy; VT: NAPn?, STLn?
Included for NAP/STL analysis because of very slight possibility of presence in far W part of STL ecoregion.

APPENDIX 3.

SAINT LAWRENCE/CHAMPLAIN VALLEY ECOREGION (STL) & NORTHERN APPALACHIAN ECOREGION (NAP) RIVERINE SPECIES ASSEMBLAGES

Known and Suspected, Extant and Extirpated Elements
Crosswalked to Current and Potential State and National Classifications

WORKING DRAFT (Not Yet Comprehensive for Ecoregions)
Original: March 22, 2000; David Hunt, New York Natural Heritage Program
Update: January 10, 2003; David Hunt, Ecological Intuition & Medicine

LIST OF SPECIES ASSEMBLAGES FOR STL AND NAP.

1. Vegetation Assemblages (**R**iver **A**ssemblages: **P**lants)

RAP1 Golden Saxifrage Spring (STL/LNE)
RAP2 American Eelgrass NAP Herbaceous Vegetation
RAP3 American Eelgrass STL Herbaceous Vegetation
RAP4 Riverweed Herbaceous Vegetation (STL/LNE)
RAP5 Broadleaf Pondlily NAP Herbaceous Vegetation
RAP6 Broadleaf Pondlily STL Herbaceous Vegetation
RAP7 Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (widespread)
RAP12 Main Channel Stream Fontinalis Bryophyte Vegetation (widespread)
RAP8 Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (NAP)
RAP9 Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (NAP/STL)
RAP10 Intermittent Calcareous Stream Bryophyte Vegetation (NAP/STL)
RAP11 Subalpine Intermittent Stream Scapania Bryophyte Vegetation (NAP)
RAP13 Midreach Epilithic Alga Vegetation (widespread)
RAP14 Non-Vegetated Stream (widespread)
RAP15 Phytoplankton Vegetation (STL/GL)

2. Macroinvertebrate Assemblages (**R**iver **A**ssemblages: **M**acroinvertebrates)

RAM1 Acid-Tolerant Leaf Shredder Insects (NAP)
RAM2 Acid-Intolerant Leaf Shredder Insects (STL)
RAM3 Algae Shredders/Scrapers (NAP)
RAM4 Coleoptera-Dominated Warm, Basic Stream Fauna (STL)
RAM5 Cold Sandy Marsh Fauna (NAP)
RAM6 Odonata-Dominated Floodplain Fauna
RAM7 Diptera-Dominated Basic Stream Fauna
RAM8 Upper Great Lakes Glacial Refugia Mollusks
RAM9 Filter Collectors
RAM10 Cold Sandy Spring Fauna
RAM11 Water Boatman-Dominated Pool Fauna
RAM12 Diving Beetle-Dominated Pool Fauna
RAM13 Water Strider-Dominated Pool Fauna
RAM15 NAP Marsh Headwater Stream Run Fauna
RAM17 Subterranean Stream Fauna
RAM18 Oligochaete Deep Benthic Fauna

3. Fish Assemblages (**R**iver **A**ssemblages: **F**ish)

RAF1 Brook Trout Assemblage (RAF1) (NAP)
RAF2 Brook Trout-Slimy Sculpin Assemblage (RAF2) (NAP)
RAF3 Brook Trout-Blacknose Dace Assemblage (RAF3) (NAP)
RAF4 Blacknose Dace-Common Shiner Assemblage (RAF4)
RAF5 Bluntnose Minnow-Creek Chub Assemblage (RAF5)
RAF6 Pumpkinseed-Bluntnose Minnow Assemblage (RAF6)
RAF7 Iowa Darter-Pugnose Shiner Assemblage (RAF7) (STL)
RAF8 Lake Sturgeon Riverine Assemblage (RAF8) (STL/GL)
RAF9 Fishless Aquatic Areas (RAF9) (widespread)

4. Herptile Assemblages (**R**iver **A**ssemblages: **H**erptiles)

RAH1 Spring Salamander-Northern Two-Lined Salamander Intermittent Stream Fauna
RAH2 STL Marsh Headwater Stream Fauna

COMMONLY USED ACRONYMS & SOURCES:

Ecoregions

- NAP Northern Appalachians
- STL St. Lawrence/Lake Champlain
- GLB Great Lakes
- LNE Lower New England
- HAL High Allegheny Plateau

NAC National Aquatic Community Classification
BCD Biological and Conservation Databases (of the Heritage Network and The Nature Conservancy)
EOR Element Occurrence Records (on BCD)

NYHP (New York Natural Heritage Program). 1990: Reschke (1990)
VTHP (Vermont Natural Heritage Program). 1989: Thompson (1989); 1996: Vermont Nongame and Natural Heritage Program (1996)
NHHP (New Hampshire Natural Heritage Program). 1992: Sperduto (1992)
MEHP (Maine Natural Heritage Program). 1991: Maine Natural Areas Program (1991)
VT ACWG (1998): Vermont's Aquatic Classification Work Group (1998)
GLB (Great Lakes Basin). 1998: Higgins et al. (1998). 2000: Great Lakes Expert Meeting, NY State, Handouts (2000)

NY Counties
NWWASH = Washington, NYESSE = Essex, NYCLIN = Clinton, NYFRAN = Franklin, NYSTLA = Saint Lawrence, NYJEFF = Jefferson, NYLEWI = Lewis, NYONEI = Oneida, NYOSWE = Oswego.

National Aquatic Classification (NAC): "Assemblage Units"

1. Vegetation Assemblages **(National Vegetation Classification (NVC): "Associations")** Last Update: December 10, 2002

NVC Formation: V.B.2.N.f Saturated Temperate or Subpolar Perennial Forb Vegetation

Plant Assemblage: **Golden Saxifrage Spring (RAP1)**

Chrysosplenium americanum Herbaceous Vegetation (CEGL006193)

Synonymy/Affinities:

Riverine expression of this association fits best under Sneddon et al. (1994) Chrysosplenium americanum-Nasturtium officinale Herbaceous Alliance (8E2A4), but this alliance has now been lumped into CEGL006193. It may be better classified under "permanently flooded" (e.g. through designation of a new association/alliance).

In NY statewide community crosswalk.

Assemblage Description:

Uncertain if in NAP or STL. Sometimes described as including Nasturtium officinale (e.g., VTHP, 1986, Sneddon et al. 1994) and Equisetum spp. (VTHP, 1996). May be a peripheral LNE type. NY STL occurrences suspected but none known; need expert interviews.

Macrohabitat Crosswalk: STL Spring?, NAP Spring?, STL Marsh Headwater Stream?

Microhabitats: pool-run; littoral; above-ground

Related Assemblages: RAF9

Distribution: NY: NAPy?p, STLy?p?; VT: NAP., STL.

NY Examples: Occurrences suspected but none known; need expert interviews.

Sources: Hunt (1999c), Sneddon et al. (1994), Sneddon et al. (1998), VTHP (1996).

NVC Formation: V.C.2.N.a Permanently Flooded Temperate or Subpolar Hydromorphic Vegetation

NVC Alliance: Vallisneria americana Permanently Flooded Alliance

Plant Assemblage: **American Eelgrass NAP Herbaceous Vegetation (RAP2)** (NEW to Anderson et al., 1998)

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)

Synonymy/Affinities:

Probably a broadly-defined association with ecoregional variants.

Possibly also related to Potamogeton sp.-Ceratophyllum sp. Midwest Herbaceous Vegetation (CEGL002282).

A unique NAP association is proposed.

Compare to lacustrine assemblage: **NAP Benthic Littoral Tapegrass-Pondweed Bed (LAP6A)**

Assemblage Description:

Submergent vascular plants dominant. Potamogeton is apparently more abundant and consistent than Vallisneria; Vallisneria is probably not present in many examples. Also includes Najas sp., Potamogeton epihydrus, P. natans, P. spirillus, Sparganium fluctuans, S. angustifolium, Myriophyllum farwellii, Utricularia sp.

Macrohabitat Crosswalk: NAP Marsh Headwater Stream, NAP Confined River?, NAP Unconfined River, NAP Backwater Slough.

Microhabitats: pool-run; littoral; above-ground

Related Assemblages: RAM6, RAM12

Distribution: NY: NAPy, STLn?; VT: NAP., STL.

NY Examples:

NYFRAN Raquette River Harrietstown, NYHAMI W. Branch Sacandaga River, NYHAMI Red River Inlet, NYHAMI Moose River, NYHAMI Shingle Shanty Brook.

Sources:

NYHP BCD Community EORs (2002), NYHP BCD Plant EORs (2002), Hunt (1999c), Sneddon et. al (1998), Anderson et al. (1998).

Plant Assemblage: **American Eelgrass STL Herbaceous Vegetation (RAP3)** (NEW to Anderson et al., 1998)

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) (in part)

Synonymy/Affinities:

Probably related to Potamogeton sp.-Ceratophyllum sp. Midwest Herbaceous Vegetation (CEGL002282).

Probably a broadly-defined association with ecoregional variants.

New association proposed by D. Faber-Langendoen: **Potamogeton sp.-Ceratophyllum sp. "Eastern" Herbaceous Vegetation**. NYHP EOs may represent more than 1 association, corresponding to 2 or more macrohabitats (needs further evaluation).

Compare to lacustrine assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**

Assemblage Description:

Potamogeton is possibly more abundant and consistent than Vallisneria; uncertain if Vallisneria is present in all examples. May include Armoracia lacustris, Callitriche hermaphroditica, Sagittaria sp., Potamogeton hillii, P. filiformis, Najas minor, Hippuris vulgaris, Elodea sp., Myriophyllum spp., Utricularia sp., Bidens beckii, and green algae, with Cardamine pensylvanica in shallow areas. Needs better review by Susan Warren (dominant versus rare "indicator" species).

Macrohabitat Crosswalk: STL Marsh Headwater Stream, STL Unconfined River, GL Deepwater River, STL Backwater Slough.

Microhabitats: pool, run; littoral; above-ground

Related Assemblages: RAM6, RAF6?, RAF8?

Distribution: NY: NAPy?p?, STLy; VT: NAP., STL.

NY Examples:

NYSTLA Coles Creek, NYSTLA Tibbetts Creek, NYSTLA Little River Canton, NYSTLA St. Lawrence River, NYSTLA S Beaver Creek, NYWASH Brook S of Dresden, NYWARR Dunham Bay Marsh (NAP), NYESSE Boquet River.

Sources:

Faber-Langendoen (1997); NYHP BCD Plant EORs (2002), NYHP Community Leads (2002), Sneddon et. al (1998), Anderson et al. (1998), Reschke (1990).

Plant Assemblage: **Riverweed Herbaceous Vegetation (RAP4)**

Podostemum ceratophyllum Herbaceous Vegetation (CEGL004331)

Synonymy/Affinities:

Probably a broadly-defined association with ecoregional variants.

Need to evaluate equivalency to/distinction from other vegetation (RAP) assemblages, especially RAP3, RAP12 and RAP13.

Assemblage Description:

Includes codominant Cladophora (green algae). Reportedly monospecific (Sneddon et al., 1998). NYHP has poor community inventory data on this assemblage.

Macrohabitat Crosswalk: STL Unconfined River.

Microhabitats: pool, riffle; littoral; above-ground

Related Assemblages: RAM8, RAF6?, RAF8?

Distribution: NY: NAPn?, STLy; VT: NAP., STL.

NY Examples: NYJEFF Indian River, NYSTLA Grass River, NYCLIN Ausable River.

Sources:

NYHP BCD Plant EORs (2002), NYHP Community Leads (2002), Hunt (1999c), Sneddon et. al (1998), Anderson et al. (1998).

Plant Assemblage: **Broadleaf Pondlily NAP Herbaceous Vegetation (RAP5)** (NEW to Anderson et al., 1998)

Nuphar lutea ssp. advena Herbaceous Vegetation (CEGL004324) (in part)

Synonymy/Affinities:

Probably a broadly-defined association with ecoregional variants.

A unique NAP association is proposed: **Nuphar-Utricularia Herbaceceous Vegetation.**

Need to evaluate difference between riverine and lacustrine settings; compare to lacustrine assemblage: **NAP Dystrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5A)**

Assemblage Description:

Dominated by floating-leaved vascular plants. Utricularia is abundant. May also include Brasenia schreberi and, in shallow areas, Sparganium natans and Alisma triviale.

Macrohabitat Crosswalk: NAP Marsh Headwater Stream, NAP Unconfined River.

Microhabitats: run, pool?; littoral; above-ground

Related Assemblages: RAM1, RAM15, RAF2, RAF3, RAF5

Distribution: NY: NAPy, STL?; VT: NAP., STL.

NY Examples:

NYSTLA Main Branch Oswegatchie River, NYLEWI S Branch Mad River, NYLEWI E Branch Fish Creek Midreach, NYLEWI W Fork Salmon River, NYHERK Middle Branch Oswegatchie River.

Sources:

NYHP BCD Community EORs (2002), NYHP BCD Plant EORs (2002), Sneddon et. al (1998), Anderson et al. (1998), M. Anderson (1998).

Plant Assemblage: **Broadleaf Pondlily STL Herbaceous Vegetation (RAP6)** (NEW to Anderson et al., 1998)

Nuphar lutea ssp. advena Herbaceous Vegetation (CEGL004324) (in part)

Synonymy/Affinities:

Probably a broadly-defined association with ecoregional variants.

A unique STL association is proposed: **Nuphar-Nymphaea Herbaceous Vegetation.**

Need to evaluate difference between riverine and lacustrine settings; compare to lacustrine assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**

Assemblage Description: Nymphaea is abundant. May also include Pontederia cordata in shallow areas.

Macrohabitat Crosswalk: STL Marsh Headwater Stream.

Microhabitats: pool; littoral; above-ground

Related Assemblages: RAM16, RAF7

Distribution: NY: NAPn?, STLy; VT: NAP., STL.

NY Examples: NYJEFF French Creek, NYJEFF Perch River.

Sources: NYHP BCD Animal EORs (2002), Sneddon et. al (1998), Anderson et al. (1998).

NVC Group: VI.A.1 Temperate or Subpolar Bryophyte Vegetation

NVC Formation: VI.A.1.N.? Permanently Flooded Bryophyte Vegetation (NEW to Anderson et al., 1998)

NVC Alliance: Fontinalis sp. alliance (NEW to Anderson et al., 1998)

Plant Assemblage: **Lowland Perennial Acidic Stream Fontinalis Bryophyte Vegetation (RAP7)** (NEW to Anderson et al., 1998)

Fontinalis sp.-epilithic green algae Bryophyte Vegetation

Synonymy/Affinities:

Need evaluation of potentially multiple associations across diverse macrohabitat types.

Need evaluation of equivalency to other vegetation (RAP) assemblages (RAP8, RAP11, RAP12).

Assemblage Description: Bryophytes in moderate amounts, epilithic green algae typically at 50% to 75% cover.

Macrohabitat Crosswalk:

NAP Acidic Intermittent Stream?, NAP Rocky Headwater Stream, NAP Confined River??, NAP Unconfined River?, STL Unconfined River? NAP Backwater Slough?

Microhabitats: run?, riffle?; littoral; above-ground

Related Assemblages: RAM1, RAM3?, RAF5

Distribution: NY: NAPy, STLy?; VT: NAP., STL.

NY Examples:

NYESSE Roaring Brook, NYESSE Allen Brook, NYESSE Opalescent River Headwaters, NYLEWI E Fork Salmon River, NYLEWI W Fork Salmon River, NYLEWI E Branch Fish Creek.

Sources: NYHP BCD Community EORs (2002), NYHP Community Leads (2002), Hunt (1999c).

Plant Assemblage: **Main Channel Stream Fontinalis Bryophyte Vegetation (RAP12)** (NEW to Anderson et al., 1998)
Fontinalis sp. Bryophyte Vegetation
Synonymy/Affinities: Very uncertain association. Need comparison to RAP 7.
Assemblage Description: NYHP has poor community inventory data on this assemblage.
Macrohabitat Crosswalk: NAP Unconfined River?, STL Unconfined River?
Microhabitats: run?; littoral; above-ground
Related Assemblages:
Distribution: NY: NAP?, STLy?; VT: NAP., STL.
NY Examples: (Compare to RAP7).
Sources: NYHP Community Leads (2002).

NVC Alliance: Brachythecium spp.-Eurynchium ripariodes alliance (NEW to Anderson et al., 1998)

Plant Assemblage: **Mid-Elevation Perennial Acidic Stream Brachythecium-Eurynchium Bryophyte Vegetation (RAP8)** (NEW to Anderson et al., 1998)
Brachythecium rivulare-Eurynchium ripariodes-Hygroamblystegium tenax Bryophyte Vegetation
Synonymy/Affinities:
Need to evaluate equivalency to/distinction from other vegetation assemblages (RAP7, RAP11).
Need to evaluate slight differences across macrohabitats in Slack analysis (no obvious species differences noted).
Uncertain if only perennial or also intermittent.
Assemblage Description:
Dominants listed in association name. Also includes Bracythecium plumosum, Hygrohypnum ochraceum, H. eugyrium, and epilithic green algae.
Macrohabitat Crosswalk:
NAP Acidic Intermittent Stream, NAP Calcareous Intermittent Stream?, STL Intermittent Stream?, NAP Rocky Headwater Stream.
Microhabitats: riffle; littoral; above-ground
Related Assemblages:
Distribution: NY: NAPy, STLn?; VT: NAP., STL.
NY Examples:
NYESSE Porter Mountain, NYESSE Cascade Mountain, NYESSE Johns Brook, NYESSE Johns Brook Tributary, NYESSE Schroon Lake Tributary, NYESSE W Branch Ausable River Tributary.
Sources: Reschke (1990), Hunt (1999c), Slack (1985).

NVC Alliance: Rhytidium sp. alliance (NEW to Anderson et al., 1998)

Plant Assemblage: **Perennial Calcareous Stream Rhytidium Bryophyte Vegetation (RAP9)** (NEW to Anderson et al., 1998)
Rhytidium sp. Bryophyte Vegetation
Synonymy/Affinities:
Need to evaluate potential equivalency with RAP10: (Uncertain if intermittent or perennial. Lead from published report with uncertainty about presence of Rhytidium in aquatic or terrestrial setting.)
Assemblage Description:
May include other calcareous bryophytes. NYHP has poor information on this and other potentially related assemblages. Uncertain if assemblage same in NAP and STL or different.
Macrohabitat Crosswalk:
NAP Calcareous Intermittent Stream, STL Intermittent Stream?, NAP Rocky Headwater Stream?, STL Rocky Headwater Stream.
Microhabitats: riffle?; littoral; above-ground
Related Assemblages:
Distribution: NY: NAPy, STLy?; VT: NAP., STL.
NY Examples: NYESSE Gay Brook.
Sources: NYHP Community Leads (2002), Hunt (1999c).

NVC Formation: VI.A.1.N.? Intermittently Flooded Bryophyte Vegetation (NEW to Anderson et al., 1998)
NVC Alliance: unknown bryophyte alliance

Plant Assemblage: **Intermittent Calcareous Stream Bryophyte Vegetation (RAP10)** (NEW to Anderson et al., 1998)
Cryptogramma stelleri Bryophyte Vegetation
Synonymy/Affinities: Provisional name. Cryptogramma may not be in stream. Better to have an aquatic bryophyte in name.
Assemblage Description: NYHP has poor community inventory data on this assemblage.
Macrohabitat Crosswalk: NAP Calcareous Intermittent Stream, STL Intermittent Stream?
Microhabitats: riffle; littoral; above-ground
Related Assemblages: RAM14?, RAF9

Distribution: NY: NAPy, STLn?; VT: NAP., STL.
NY Examples: NYESSE Cascade Lakes.
Sources: NYHP Community Leads (2002).

NVC Alliance: Scapania nemorosa Alliance (NEW to Anderson et al., 1998)

Plant Assemblage: **Subalpine Intermittent Stream Scapania Bryophyte Vegetation (RAP11)** (NEW to Anderson et al., 1998)
Scapania nemorosa-Bryum pseudotriquetrum-Hygrohypnum ochraceum-Chiloscyphus polyanthos-Isopterigyium muelleriana Bryophyte Vegetation
Assemblage Description:
Acid-tolerant bryophytes. Also includes Plagiothecium laetum, Sphagnum girgensohnii, possibly Bryhnia novae-angliae.
Macrohabitat Crosswalk: NAP Acidic Intermittent Stream.
Microhabitats: riffle; littoral; above-ground
Related Assemblages: RAM11, RAF9
Distribution: NY: NAPy, STLn?; VT: NAP., STL.
NY Examples: NYESSE Chicken Coop Brook.
Sources: NYHP BCD Community EOR (2002).

NVC Subclass: VI.C Alga Vegetation
NVC Group: VI.C.? Temperate or Subpolar Alga Vegetation (NEW to Anderson et al., 1998)
NVC Formation: VI.C.?.N.? Permanently Flooded Alga Vegetation (NEW to Anderson et al., 1998)
NVC Alliance: Epilithic Green Filamentous Alga alliance (NEW to Anderson et al., 1998)

Plant Assemblage: **Midreach Epilithic Alga Vegetation (RAP13)** (NEW to Anderson et al., 1998)
Synonymy/Affinities: Algal associations may differ across ecoregions, macrohabitats and microhabitats.
Assemblage Description:
Typically with 50% epilithic green cover algae, limited bryophytes (e.g., Fontinalis sp. at <1% cover), limited vascular plants (<<1% cover).
Macrohabitat Crosswalk: NAP Rocky Headwater Stream, NAP Confined River, STL Confined River?
Microhabitats: riffle-run, pool; littoral; above-ground
Related Assemblages: RAM1, RAM3, RAM13, RAF3, RAF5
Distribution: NY: NAPy, STLy?; VT: NAP., STL.
NY Examples:
NYLEWI E Branch Fish Creek Midreach, NYLEWI E Branch Fish Creek, NYLEWI W Fork Salmon River, NYHERK Middle Branch Oswegatchie River.
Sources: NYHP BCD Community EORs (2002).

NVC Class: VII Sparse Vegetation
NVC Subclass: VII.A Consolidated Rock Sparse Vegetation
NVC Group: VII.A.1 Sparsely Vegetated Cliffs
NVC Formation: VII.A.1.N.? Permanently Flooded Sparsely Vegetated Cliffs (NEW to Anderson et al., 1998)
NVC Group: VII.A.2 Sparsely Vegetated Pavement
NVC Formation: VII.A.2.N.? Permanently Flooded Sparsely Vegetated Pavement (NEW to Anderson et al., 1998)
NVC Subclass: VII.B Boulder, Gravel, Cobble, Talus Sparse Vegetation
NVC Group: VII.B.? Permanently Flooded Boulder, Gravel, Cobble, Talus Sparse Vegetation (NEW to Anderson et al., 1998)
NVC Subclass: VII.C Unconsolidated Material Sparse Vegetation
NVC Group: VII.C.? Permanently Flooded Unconsolidated Material Sparse Vegetation (NEW to Anderson et al., 1998)

NVC Alliances?: non-vegetated stream (NEW to Anderson et al., 1998)

Plant Assemblage: **Non-Vegetated Stream (RAP14)** (NEW to Anderson et al., 1998)
Assemblage Description:
May include aquatic cliff, aquatic pavement, aquatic boulder field, aquatic talus and aquatic unconsolidated flats (see above for potential new groups/formations/alliances).
Macrohabitat Crosswalk:
All types: NAP Acidic Intermittent Stream, NAP Calcareous Intermittent Stream, STL Intermittent Stream, STL Spring, NAP Spring, NAP Rocky Headwater Stream, STL Rocky Headwater Stream, NAP Marsh Headwater Stream, STL Marsh Headwater Stream, NAP Confined River, STL Confined River, NAP Unconfined River, STL Unconfined River, NAP Backwater Slough, STL Backwater Slough, STL Subterranean Stream, NAP Subterranean Stream, GL Deepwater River.
Microhabitats: riffle, run, pool; littoral, sublittoral, profundal, pelagic; above-ground, subterranean.
Subtypes: flat bedrock, vertical bedrock, boulder/cobble, talus, sand, soil
Related Assemblages: RAM11, RAM17, RAF9
Distribution: NY: NAPy, STLy; VT: NAP., STL.
NY Examples: NYESSE Chicken Coop Brook, NYESSE Burroughs Cave.
Sources: Hunt (1999c).

PROVISIONAL/UNCERTAIN IF WARRANTING VEGETATION ASSOCIATION (SEE MARK ANDERSON)
Plant Assemblage: **Phytoplankton Vegetation (RAP15)** (NEW to Anderson et al., 1998)
Synonymy/Affinities: Phytoplankton associations may differ across ecoregions, macrohabitats and microhabitats.
Assemblage Description: dense populations of phytoplankton.
Macrohabitat Crosswalk: STL Unconfined River, NAP Unconfined River?, GL Deepwater River.
Microhabitats: run-pool; pelagic-epilimnion; above-ground
Related Assemblages:
Distribution: NY: NAP?, STLy?; VT: NAP., STL.
NY Examples: probably several.
Sources: D. Hunt (speculation based on standard aquatic ecology references).

Macroinvertebrate Assemblage: **Acid-Tolerant Leaf Shredder Insects (RAM1)**

Trichoptera (Parapsyche, Palegapetus)-Plecoptera (Capniidae)-Chironomidae (Eukiefferella) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 1)

Assemblage Description:

Low species richness (VT ACWG, 1998). Other indicator species (VT ACWG, 1998): Ephemeroptera (Eurylophella). Preferential Taxa (VT ACWG, 1998): Trichoptera? (Symphitpsyche), Plecoptera (Leuctridae, Taenionema, Chloroperlidae, Peltoperla). NY additions (assumes same assemblage at listed sites): Megaloptera, Coleoptera (Psephenidae), Mollusca (Elliptio), Ephemeroptera (Heptagenidae)

Macrohabitat Crosswalk: NAP Rocky Headwater Stream, STL Rocky Headwater Stream???

Microhabitats: run-riffle; littoral; above-ground

Related Assemblages: RAP5, RAP7, RAP13, RAF1, RAF5

Distribution: NY: NAPy, STL?; VT: NAPy, STL?

NY Examples:

NYESSE Opalescent River Headwaters, NYLEWI E Branch Fish Creek, NYLEWI E Fork Salmon River, NYLEWI W Fork Salmon River.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Acid-Intolerant Leaf Shredder Insects (RAM2)**

Ephemeroptera (Rithrogenia)-Trichoptera (Symphitopsyche?, Glossosoma)-Diptera (Simulium, Antocha) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 2)

Assemblage Description:

Preferential Taxa (VT ACWG, 1998): Plecoptera (Peltoperla, Chloroperlidae, Malikrekus, Capniidae, Agnetina), Coleoptera (Oulimnius, Optioservus, Ectopria), Chironomidae (Crictopus, Polypedilum), Ephemeroptera (Ephemerella, Serratella), Diptera (Hexatoma).

Macrohabitat Crosswalk: STL Rocky Headwater Stream?

Microhabitats: riffle?; littoral; above-ground

Related Assemblages: RAF1, RAF2

Distribution: NY: NAPy?, STLy?; VT: NAPy, STLy?;

NY Examples: none known, no data readily available.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Algae Shredders/Scrapers (RAM3)**

Plecoptera (Chloroperlidae)-Trichoptera (Dolophilodes, Rhychophila)-Diptera (Hexatoma)-Coleoptera (Oulimnius) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 3)

Assemblage Description:

Generally poor mussel diversity, with acid-tolerant species. Preferential Taxa (VT ACWG, 1998): Trichoptera (Brachycentrus, Lepidostoma, Apatania, Symphitopsyche?, Polycentropus), Coleoptera (Promoresia, Optioservus), Chironomidae (Eukiefferella, Tvetenia, Parachaetocladius, Micropsectra, Microtendipes, Polypedilum), Ephemeroptera (Epeorus, Rhithrogena), Odonata (Gomphidae), Plecoptera (Capniidae, Peltoperla, Leuctridae, Agnetina, Isogenoides). NY additions (assumes same assemblage at listed sites): Coleoptera (Psephenidae), Megaloptera (Corydalidae), Odonata (good diversity; Calyopterygidae), Mollusca (Elliptio, Pyganodon, Sphaerium, questionably Margaritifera), Ephemeroptera (Ephemeridae), Crustacea (Cambaridae). K. Schneider interview: Margaritifera characteristic of "acidic" (DH: circumneutral?) Rocky Headwater Streams in NAP, especially Adirondack foothills; rare in VT, S2 in NY. DH: Margaritifera is dominant mollusk and at high density in Tug Hill RM5 (NAP Rocky Headwater Streams) grading to RM9 (NAP Confined River).

Macrohabitat Crosswalk:

STL Rocky Headwater Stream, NAP Rocky Headwater Stream, NAP Confined River, STL Confined River?, STL Backwater Slough? NAP Backwater Slough?

Microhabitats: pool, run-riffle; littoral; above-ground

Related Assemblages: RAP7?, RAP13, RAF2, RAF3, RAF4, RAF5

Distribution: NY: NAPy, STLy?; VT: NAP?, STL?

NY Examples:

NYLEWI E Branch Fish Creek Midreach, NYESSE E Branch Ausable River, NYESSE W Branch Ausable River, NYESSE Boquet River, NY Upper Hudson River, NYWARR Northwest Bay Brook, NYHERK Middle Branch Oswegatchie River, NYCLIN Great Chazy River?

Sources:

VT ACWG (1998); NYHP BCD Community EORs (2002), NYHP BCD Animal EORs (2002), NYHP Community Leads (2002); K. Schneider, NYHP (mollusk expert).

Macroinvertebrate Assemblage: **Coleoptera-Dominated Warm, Basic Stream Fauna (RAM4)**

Coleoptera (Promeresia, Stenelmis)-Plecoptera (Neoperla)-Trichoptera (Chimara) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 4)

Assemblage Description:

Preferential Taxa (VT ACWG, 1998): Ephemeroptera (Isonychia), Chironomidae (Polypedilum), Coleoptera (Dubiraphia, Promoresia). Poor NYHP understanding of assemblage. Possible NY equivalents (e.g., Poultney River, possibly Grass River per P. Novak) have Odonata (Gomphidae/e.g., Ophiogomphus compressa: a riffle species).

Macrohabitat Crosswalk: STL Confined River, STL Rocky Headwater Stream.

Microhabitats: riffle-run?; littoral; above-ground
Related Assemblages: RAF4, RAF5
Distribution: NY: NAP?, STLy?; VT: NAP?, STL?
NY Examples: ?? NYWASH Poultney River (w/ Odonata/Gomphidae) ?? uncertain if same assemblage.
Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Cold Sandy Marsh Fauna (RAM5)**

Mollusca (Pisidium)-Trichoptera (Polycentropus)-Ephemeroptera (Litobrancha)-Odonata (Cordulegaster) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 5)

Assemblage Description:

NY additions (assumes same assemblage at listed sites): beaver. Poor NYHP understanding of assemblage.

Macrohabitat Crosswalk: NAP Marsh Headwater Stream, NAP Confined River?

Microhabitats: run; littoral; above-ground

Related Assemblages: RAF2, RAF3

Distribution: NY: NAPy?, STL?; VT: NAPy, STL?

NY Examples: NYSTLA S Branch Grass River?, NYFRAN Osgood River?, NYHAMI Bog River?

Sources: VT ACWG (1998), NYHP Community Leads (2002).

Macroinvertebrate Assemblage: **Odonata-Dominated Floodplain Fauna (RAM6)**

Coleoptera (Dubiraphia)-Chironomidae (Polypedilum)-Ephemeroptera (Leptophelbidae)-Mollusca (Pisidium)-Odonota (Aeshnidae, Calopterygidae, Coenargionidae, Gomphidae)-Trichoptera (Hydaphylax) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 6)

Assemblage Description: NY additions: Plecoptera (finer scale taxonomic data not collected).

Macrohabitat Crosswalk: NAP Unconfined River, STL Unconfined River.

Microhabitats: run; littoral; above-ground

Related Assemblages: RAP2, RAP3, RAF3, RAF4

Distribution: NY: NAPy?, STLy; VT: NAP?, STL?

NY Examples: NYFRAN Raquette River Harrietstown, NYESSE Boquet River, NYESSE Schroon River.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), NYHP BCD Animal EORs (2002).

Macroinvertebrate Assemblage: **Diptera-Dominated Basic Stream Fauna (RAM7)**

Diptera (Tipula, Atherix, Simulum)-Chironomidae (Apsectrotnypus, Rheocricotopus)-Crustacae (Hyallela)-Mollusca (Pisidium)-Ephemeroptera (Stenonema) Assemblage

Synonymy/Affinities:

= VT ACWG (1998): (VT River Macroinvertebrate Type 7)

Need to assess equivalency to/distinction from macroinvertebrate assemblage RAM16.

Assemblage Description: VT ACWG (1998): lacking large mussels, with beaver.

Macrohabitat Crosswalk: STL Marsh Headwater Stream, STL Unconfined River, STL Backwater Slough.

Microhabitats: pool; littoral; above-ground

Related Assemblages: RAP4, RAF5, RAF6

Distribution: NY: NAPn?, STLy; VT: NAPn, STLy

NY Examples:

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Upper Great Lakes Glacial Refugia Mollusks (RAM8)**

Mollusca (Potamilus, Lampsilis, Leptodea, Pyganodon, Sphaerium, Pisidium)-Ephemeroptera (Hexagenia)-Coleoptera (Dubiraphia)-Trichoptera (Phylocentropus) -Crustacea (Gammarus)-Chironomidae (Polypedilum)-Diptera (Spheromias, Culicoides) Assemblage

Synonymy/Affinities:

= VT ACWG (1998): (VT River Macroinvertebrate Type 8)

Good confidence in NY-VT equivalency.

Per K. Schneider (NYHP): NY sites listed under this assemblage may represent two similar assemblages: 1) the typical assemblage of VT ACWG (1998) in the Lake Champlain Valley occurring on stream bottoms with deep sands with mollusks burrowing deep into the sand; 2) a more diverse assemblage in the St. Lawrence River Valley occurring on rocky stream bottoms with mollusks in shallow sands in bedrock cracks. These two assemblages are supported by "basin" assemblages shown in Strayer (1995).

Assemblage Description:

High species diversity of mollusks (bivalves and gastropods). NY additions: Odonata (Gomphidae), Mollusca (Alasmidonta, Strophitus, Elliptio, Ligumia, Campeloma, Pyganodon, Lasmigona, Margaritifera, Anodontoides). KS interview re: mollusks: many recent EORs with Margaritifera from M. Gretch surveys; more data on mollusk part of assemblage in D. Smith (1985) (which discusses Great Lakes drainage vs. Atlantic Slope drainage) and Metcalfe-Smith (1999). Alasmidonta undulata may be a rare indicator species not present in VT.

Macrohabitat Crosswalk: STL Confined River, STL Unconfined River.

Microhabitats: run; littoral; above-ground

Related Assemblages: RAP4, RAF6

Distribution: NY: NAPn?, STLy; VT: NAPn, STLy

NY Examples:

NYWASH Poultney River, NYSTLA Grass River, NYSTLA St. Regis River, NYSTLA Raquette River, NYSTLA Little River, NYSTLA Harrison Creek?, NYSTLA Line Creek, NYSTLA Tanner Creek, NYSTLA Elm Creek.

Sources:

VT ACWG (1998), NYHP BCD Animal EORs (2002), NYHP Community Leads (2002), Erickson (1995), D. Smith (1985), Metcalfe-Smith (1999), K. Schneider, NYHP (mollusk expert).

Macroinvertebrate Assemblage: **Filter Collectors (RAM9)**

Diptera (Simulidae)-Trichoptera (Hydropsyche, Cheumatopsyche, Symphytopsyche?)-Chironomidae (Tanytarsini) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 9)

Assemblage Description:

VT ACWG (1998): blackflies dominant in spring/summer, caddisflies dominant in summer/fall. Poor NYHP understanding of assemblage (seems to describe a lacustrine/riverine ecotone). Additional description from S. Fiske: Restricted to a "submicrohabitat", part of the run microhabitat along short reaches of less than 200 meters and typically about 20 to 60 meters downstream of lake outlets; "hyperdominance" of filter feeders with low species richness; fingernail clams are also characteristic. See Bob Bode, NYSDEC for more information (drift organisms?).

Macrohabitat Crosswalk: STL Marsh Headwater Stream, NAP Marsh Headwater Stream?

Microhabitats: run-pool?; littoral; above-ground

Related Assemblages: RAF3, RAF4

Distribution: NY: NAPy?, STLy?; VT: NAP?, STL?

NY Examples: may be some examples listed under RAM7, RAM15, RAM16.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Cold Sandy Spring Fauna (RAM10)**

Trichoptera (Limnephilidae)-unknown group (Tricladida) Assemblage

Synonymy/Affinities: = VT ACWG (1998): (VT River Macroinvertebrate Type 10)

Assemblage Description:

VT ACWG (1998): low productivity. NY additions: may be correlated with characteristic vascular plants (e.g., ones seen in E Branch Fish Creek). Poor NYHP understanding of assemblage. Suspected to occur at very small scales.

Macrohabitat Crosswalk: NAP Spring, STL Spring?, NAP Rocky Headwater Stream?, STL Rocky Headwater Stream???

Microhabitats: run-pool?; littoral; above-ground

Related Assemblages: RAF1, RAF9

Distribution: NY: NAPy, STL?; VT: NAP?, STL?

NY Examples: NYLEWI E Branch Fish Creek?

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Water Boatman-Dominated Pool Fauna (RAM11)**

Hemiptera (Arctocorixa, Gerridae)-Trichoptera Assemblage

Synonymy/Affinities: Need to assess equivalency to assemblages in VT ACWG (1998).

Assemblage Description:

NYHP proposed assemblage. Prominent neuston fauna and depauperate benthic epifauna. Also includes Diptera (Tipula, Simulidae).

Macrohabitat Crosswalk: NAP Acidic Intermittent Stream.

Microhabitats: pool; littoral; above-ground

Related Assemblages: RAP11?, RAP14

Distribution: NY: NAPy, STLn?; VT: NAP., STL.;

NY Examples: NYESSE Chicken Coop Brook.

Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Diving Beetle-Dominated Pool Fauna (RAM12)**

Coleoptera (Dytiscus) Assemblage

Synonymy/Affinities: Need to assess equivalency to assemblages in VT ACWG (1998).

Assemblage Description: NYHP proposed assemblage. Also includes muskrat, odonates.

Macrohabitat Crosswalk: NAP Backwater Slough.

Microhabitats: pool; littoral; above-ground

Related Assemblages: RAP2

Distribution: NY: NAPy, STLn?; VT: NAP., STL.

NY Examples: NYFRAN Raquette River Harrietstown.

Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Water Strider-Dominated Pool Fauna (RAM13)**

Hemiptera (Gerridae, Vellidae, Mesovellidae) Assemblage

Synonymy/Affinities: Need to assess equivalency to assemblages in VT ACWG (1998) including RAM1, RAM3, RAM5, RAM9, RAM15.

Assemblage Description: NYHP proposed assemblage. Prominent neuston fauna and depauperate benthic epifauna.

Macrohabitat Crosswalk:

Probably widespread; known from NAP Rocky Headwater Stream, NAP Marsh Headwater Stream?, NAP Confined River, NAP Subterranean Stream.

Microhabitats: pool; littoral; above-ground, subterranean (entrance)

Related Assemblages: RAP13, RAF3, RAF5

Distribution: NY: NAPy, STL?; VT: NAP., STL.

NY Examples:
NYLEWI E Branch Fish Creek Midreach, NYLEWI E Branch Fish Creek, NYLEWI W Fork Salmon River, NYESSE Opalescent River Headwaters.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **NAP Marsh Headwater Stream Run Fauna (RAM15)**
Hemiptera (Nepidae)-Mollusca (Sphaerium)-Chironomidae Assemblage
Synonymy/Affinities:
Need to assess equivalency to/distinction from assemblages in VT ACWG (1998), especially RAM5.
Assemblage Description: NYHP proposed assemblage. Also includes Coleoptera (Psephenidae), beaver, possibly Odonata.
Macrohabitat Crosswalk: NAP Marsh Headwater Stream.
Microhabitats: run; littoral; above-ground
Related Assemblages: RAP5
Distribution: NY: NAPy, STL?; VT: NAP., STL.
NY Examples: NYLEWI S Branch Mad River, NYHERK Main Branch Oswegatchie River, NYSTLA S Branch Grass River.
Sources: NYHP BCD Community EORs (2002), NYHP Community Leads (2002).

Macroinvertebrate Assemblage: **Subterranean Stream Fauna (RAM17)**

Crustacea (Cambaridae)-Coleoptera (Carabidae)-Trichoptera Assemblage

Synonymy/Affinities: Need to assess equivalency to assemblages in VT ACWG (1998).

Assemblage Description: NYHP proposed assemblage. Apparently a depauperate fauna. Cambaridae possibly with albino forms.

Macrohabitat Crosswalk: NAP Subterranean Stream.

Microhabitats: riffle, run, pool; littoral; subterranean (dark, twilight)

Related Assemblages: RAP14, RAF9

Distribution: NY: NAPy, STL?; VT: NAP., STL.

NY Examples: NYESSE Burroughs Cave.

Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Oligochaete Deep Benthic Fauna (RAM18)**

Oligochaeta (unknown families/genera) Assemblage

Synonymy/Affinities: Need to assess equivalency to assemblages in VT ACWG (1998).

Assemblage Description: NYHP proposed assemblage. Probably a depauperate fauna.

Macrohabitat Crosswalk: GL Deepwater River.

Microhabitats: run, pool; sublittoral?, profundal?; above ground

Related Assemblages: RAP14, RAF8?

Distribution: NY: NAPn?, STLy?; VT: NAP., STL.

NY Examples: NYSTLA St. Lawrence River.

Sources: D. Hunt (speculation based on similar lacustrine profundal associations).

Fish Assemblage: **Brook Trout (NAP) Assemblage (RAF1)**

Brook Trout Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Brook Trout Assemblage (VT River Fish Type 1)

= GLB (1998): Brook Trout-Slimy Sculpin Alliance (GLB Fish Alliance 5) (in part?)

= GLB (2000): Cool Headwaters (GLB Fish Community H1) (in part)

Assemblage Description:

VT ACWG (1998): Stenothermic coldwater species. No other fish species present.

Macrohabitat Crosswalk: High-elevation streams of multiple major drainages. NAP Rocky Headwater Stream.

Microhabitats: riffle?, pool?; benthic-littoral?; above-ground

Related Assemblages: RAM1 (strong correlation), RAM2, RAM10

Distribution: NY: NAPy, STLn?; VT: NAPy, STLn

NY Examples: Probably many examples surrounding High Peaks. No data readily available/analyzed.

Sources: VT ACWG (1998), Reschke (1990), Higgins et al. (1998), GLB (2000).

Fish Assemblage: **Brook Trout-Slimy Sculpin (NAP) Assemblage (RAF2)**

Brook Trout-Slimy Sculpin Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Brook Trout-Slimy Sculpin Assemblage (VT River Fish Type 2)

= GLB (1998): Brook Trout-Slimy Sculpin Alliance (GLB Fish Alliance 5) (in part?)

= GLB (2000): Cool Headwaters (GLB Fish Community H1) (in part)

Assemblage Description:

Stenothermic coldwater species. Low diversity, averaging about 5 species (GLB, 1998). Dominated by brook trout and slimy sculpin and also includes blacknose dace (VT ACWG, 1998). Possible additions: GLB (2000): mottled sculpin; NY EORs & Leads: Atlantic salmon.

Macrohabitat Crosswalk:

High-elevation streams of multiple major drainages. NAP Rocky Headwater Stream, NAP Marsh Headwater Stream?, NAP Confined River?

Microhabitats: run?, riffle?; benthic-littoral?; above-ground

Related Assemblages: RAP5, RAM2, RAM3, RAM5

Distribution: NY: NAPy, STLn?; VT: NAPy, STLn

NY Examples:

NYSTLA Main Branch Oswegatchie River, NYHAMI Bog Stream?, NYWARR Northwest Bay Brook, NYESSE W Branch Ausable River?

Sources:

VT ACWG (1998), NYHP BCD Community EORs (2002), NYHP Community Leads (2002), Reschke (1990), Higgins et al. (1998), GLB (2000).

Fish Assemblage: **Brook Trout-Blacknose Dace (NAP) Assemblage (RAF3)**

Brook Trout-Blacknose Dace Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Brook Trout-Blacknose Dace Assemblage (VT River Fish Type 3)

= GLB (1998): Creek Chub-Blacknose Dace-Mottled Sculpin-White Sucker Alliance (GLB Fish Alliance 4) (in part?)

= GLB (2000): Cool Headwaters (GLB Fish Community H1) (in part; apparently the best match)

=? GLB (2000): Cool Mainstem (GLB Fish Community M1) (in part)

Poor distinction seen from NY data with much overlap among assemblages RAF3, RAF4, RAF5.

Assemblage Description:

Stenothermic coldwater species. Moderate diversity, averaging about 13 species (GLB, 1998). With 7 codominant natives species, dominated by brook trout and blacknose dace, with other frequent species including slimy sculpin, longnose dace, creek chub, longnose sucker (northern hog sucker?), white sucker, exotic trout (VT ACWG, 1998). Less frequent species include northern redbelly dace (VT ACWG, 1998; Carlson, 1993). Possible additions: GLB (2000): mottled sculpin; Carlson (1993; from Deer River): redside dace, pearl dace (these may be western species suggesting a split between two similar regional assemblages: 1) Typical NAP (Adirondacks and east) vs. Tug Hill NAP, with affinities to HAL communities, or 2) Lake Champlain/Hudson River drainage vs. Lake Ontario/St. Lawrence River drainage). Need further evaluation of these differences.

Macrohabitat Crosswalk:

Mid- to high-elevation streams of multiple major drainages. NAP Marsh Headwater Stream?, NAP Confined River.

Microhabitats: riffle, run, pool; littoral?, pelagic?; above-ground

Related Assemblages: RAP5, RAP13, RAM3, RAM5, RAM6, RAM9, RAM13

Distribution: NY: NAPy, STL?; VT: NAPy?, STLy?

NY Examples:

NYSTLA Main Branch Oswegatchie River, NYLEWI E Branch Fish Creek Midreach, NYWARR Northwest Bay Brook?, NYESSE W Branch Ausable River?, NYLEWI Deer River Tributaries.

Sources:

VT ACWG (1998), NYHP BCD Community EORs (2002), NYHP Community Leads (2002), Reschke (1990), Higgins et al. (1998), GLB (2000), Carlson (1993).

Fish Assemblage: **Blacknose Dace-Common Shiner (NAP/STL) Assemblage (RAF4)**

Blacknose Dace-Common Shiner Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Common Shiner-Blacknose Dace Assemblage (VT River Fish Type 4)

= GLB (1998): Creek Chub-Blacknose Dace-Mottled Sculpin-White Sucker Alliance (GLB Fish Alliance 4) (in part?)

= GLB (2000): Cool Mainstem (GLB Fish Community M1) (in part; apparently the best match)

=? GLB (2000): Warm Headwaters (GLB Fish Community H2) (in part)

Poor distinction seen from NY data with much overlap among assemblages RAF3, RAF4, RAF5.

Assemblage Description:

Transition water fishery. Good diversity, with 14 codominant species, dominated by blacknose dace, common shiner, longnose dace, white sucker, common shiner, and creek chub, and other frequent species including fathead minnow, bluntnose minnow, brook trout, burbot, longnose sucker (=? northern hogsucker), fallfish, and slimy sculpin (VT ACWG, 1998). Less frequent species include tesselated darter, and cutlips minnow (VT ACWG, 1998). NY EORs and Leads additions: possibly trout and salmon spawning areas. GLB (2000) additions (for Fish Community H2): hornyhead chub, johnny darter, central stoneroller, and brook stickleback (these may be western species suggesting a split between two similar regional assemblages: 1) Typical NAP (Adirondacks and east) vs. Tug Hill NAP, with affinities to HAL communities, or 2) Lake Champlain/Hudson River drainage vs. Lake Ontario/St. Lawrence River drainage). Need further evaluation of these differences.

Macrohabitat Crosswalk:

Mid-elevation streams of multiple major drainages, possibly including warm headwater streams characteristic of western STL originating within STL and mid to lower reaches of cooler mainstem streams in eastern STL originating in NAP. STL Rocky Headwater Stream, NAP Confined River, STL Confined River, NAP Unconfined River.

Microhabitats: riffle-run-pool?; littoral?, pelagic?; above-ground

Related Assemblages: RAM3, RAM4, RAM6

Distribution: NY: NAPy?, STL?; VT: NAPy?, STLy?

NY Examples: NYWARR Northwest Bay Brook?

Sources: VT ACWG (1998), NYHP Community Leads (2002), Reschke (1990), GLB (2000), Higgins et al. (1998).

Fish Assemblage: **Bluntnose Minnow-Creek Chub (STL/GL) Assemblage (RAF5)**

Bluntnose Minnow-Creek Chub Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Bluntnose Minnow-Creek Chub Assemblage (VT River Fish Type 5)

=? GLB (2000): Warm Headwaters (GLB Fish Community H2) (in part)

=? GLB (2000): Warm Mainstem (GLB Fish Community M2) (in part)

=? GLB (1998): Stonecat-Northern Hogsucker-Creek Chub-Hornyhead Chub Alliance (GLB Fish Alliance 2)

Some similarities, but three of four diagnostic species apparently lacking from STL/NAP ecoregions (Smith, 1985).

Poor distinction seen from NY data with much overlap among assemblages RAF3, RAF4, RAF5.

Assemblage Description:

Eurythermal warmwater species, lacking most coldwater species. Very high diversity with 15 codominant species, dominated by bluntnose minnow, creek chub, tesselated darter, white sucker, and blacknose dace, with other frequent species including pumpkinseed, common shiner, smallmouth bass, rock bass, cutlips minnow, and brown bullhead (VT ACWG, 1998). Other less frequent species include golden shiner (VT ACWG, 1998), brook stickleback (VT ACWG, 1998; GLB, 2000, Fish Community H2), and fallfish (GLB, 2000, Fish Community M2). GLB (2000) additions (for Fish Community H2): hornyhead chub, johnny darter, central stoneroller (these may be western species suggesting a split between two similar regional assemblages: 1) Typical NAP (Adirondacks and east) vs. Tug Hill NAP, with affinities to HAL communities, or 2) Lake Champlain/Hudson River drainage vs. Lake Ontario/St. Lawrence River drainage). Need further evaluation of these differences.

Macrohabitat Crosswalk:

Possibly mid- to low-elevation streams, potentially of multiple major drainages, possibly including warm headwater streams characteristic of western STL originating within STL and mid to lower reaches of mainstem streams throughout STL originating in NAP. STL Rocky Headwater Stream, NAP Rocky Headwater Stream, STL Marsh Headwater Stream, STL Confined River, NAP Confined River?, STL Unconfined River, NAP Unconfined River?, STL Backwater Slough?

Microhabitats: riffle, pool; littoral?, pelagic?; above-ground

Related Assemblages: RAP5, RAP7, RAP13, RAM1, RAM3, RAM4, RAM7, RAM13

Distribution: NY: NAPy, STLy?; VT: NAPn, STLy

NY Examples:

Known from the Tug Hill EOs. NYLEWI E Branch Fish Creek, NYLEWI E Fork Salmon River, NYLEWI W Fork Salmon River.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), Reschke (1990), Higgins et al. (1998), GLB (2000), Smith (1985)

Fish Assemblage: **Pumpkinseed-Bluntnose Minnow (STL/GL) Assemblage (RAF6)**

Pumpkinseed-Bluntnose Minnow Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Pumpkinseed-Bluntnose Minnow Assemblage (VT River Fish Type 6)

=? GLB (2000): Warm Mainstem (GLB Fish Community M2) (in part)

=? GLB (2000): Lowland River (GLB Fish Community LR) (in part)

=? GLB (1998): Stonecat-Northern Hogsucker-Creek Chub-Hornyhead Chub Alliance (GLB Fish Alliance 2)

Some similarities, but three of four diagnostic species apparently lacking from STL/NAP Ecoregions (Smith, 1985).

Assemblage Description:

Eurythermal warmwater fish concentrations. Very high diversity, averaging about 22 species (GLB, 1998). With 19 codominant species, dominated by pumpkinseed, bluntnose minnow, and yellow perch, and with other frequent species including golden shiner, and brown bullhead (VT ACWG, 1998). Other less frequent species include smallmouth bass, chain pickerel (VT ACWG, 1998). NY EOR and Leads additions: largemouth bass, northern pike, possibly walleye spawning runs. GLB (2000) additions: several (see RAF7; GLB Fish Community M2 may be closer to RAF7 than RAF6). Potential differences in species composition between VT ACWG (1998) and GLB (1998, 2000) may suggest a split between two similar regional assemblages: 1) one characteristic of western STL and the Lake Ontario/St. Lawrence River drainage and 2) one characteristic of eastern STL and the Lake Champlain drainage. Need further evaluation of these differences.

Macrohabitat Crosswalk:

Low-elevation streams, potentially restricted to Lake Ontario/St. Lawrence/Lake Champlain drainages, and possibly including warm headwater streams characteristic of western STL originating at low elevations within STL and lower reaches of mainstem streams throughout STL. STL Rocky Headwater Stream, STL Marsh Headwater Stream, STL Confined River?, NAP Confined River?, NAP Unconfined River?, STL Unconfined River, STL Backwater Slough.

Microhabitats: riffle-run-pool?; littoral, sublittoral?, pelagic?; above-ground

Related Assemblages: RAP3? RAP4?, RAM7, RAM8

Distribution: NY: NAPy?, STLy?; VT: NAPn, STLy

NY Examples: NYFRAN Saranac River, NYJEFF Indian River?, NYSTLA Bog River?

Sources:

VT ACWG (1998), Reschke (1990), NYHP BCD Significant Habitat EORs (2002), NYHP Community Leads (2002), GLB (2000), Higgins et al. (1998), Smith (1985).

Fish Assemblage: **Iowa Darter-Pugnose Shiner (GL/STL) Assemblage (RAF7)**

Iowa Darter-Pugnose Shiner Assemblage

Synonymy/Affinities:

=? VT ACWG (1998): Pumpkinseed-Bluntnose Minnow Assemblage (VT River Fish Type 6) (in part)

= GLB (1998): Channel Catfish-Walleye-Black Crappie-Spotfin Shiner Alliance (GLB Fish Alliance 1) (in part?)

=? GLB (2000): Warm Mainstem (GLB Fish Community M2) (in part)

=? GLB (2000): Lowland River (GLB Fish Community LR) (in part, apparently the best match)

=? GLB (1998): unnamed Alliance (GLB Fish Alliance 3)

Many similarities, but several species apparently lacking from STL/NAP Ecoregions (Smith, 1985).

Likely to be equivalent to RAF6 (need to combine?) per Mark Ferguson, VTHP.

Assemblage Description:

NYHP proposed assemblage. Eurythermal warmwater fish concentrations. Very diverse, averaging about 30 species (GLB, 1998), probably with numerous codominant species. Species most indicative of habitat (lowest elevation streams of the St. Lawrence/Lake Ontario drainage) are thought to include Iowa darter and pugnose shiner. Similar indicator species which may be rare or lacking from the eastern part of STL (and thus Vermont) or are more characteristic of the St. Lawrence River (and are present here because of the proximity to that river and/or deep and slow enough connecting waters) also include mooneye, black crappie, spottail shiner, largemouth bass, muskellunge, and johnny darter (NYHP EORs), as well as native brook lamprey GLB (2000; experts meeting notes/from Doug Carlson). Also includes blackchin shiner, northern pike, smallmouth bass, white perch, yellow perch, bluegill, pumpkinseed, brown bullhead, walleye, rock bass, longnose sucker (=? northern hog sucker), white sucker, and banded killifish (NYHP EORs). GLB (2000, Fish Community M2) additions: shorthead redhorse, common shiner, cutlips minnow, fallfish. GLB (2000, Fish Community LR) additions: channel catfish, quillback sucker, bowfin. Contains many fish of GLB (1998) Alliance 1 except blackside darter.

Macrohabitat Crosswalk:

Possibly restricted to lowest elevations of St. Lawrence River/Lake Ontario drainage in the western part of STL. STL Marsh Headwater Stream, STL Unconfined River.

Microhabitats: run, pool; littoral, sublittoral?, pelagic-epilimnion; above-ground

Related Assemblages: RAP6

Distribution: NY: NAPn?, STLy; VT: NAP., STL.

NY Examples:

NYSTLA Coles Creek, NYSTLA Brandy Brook, NYSTLA Tibbetts Creek, NYSTLA Sucker Brook, NYSTLA Chippewa Creek, NYSTLA Crooked Creek, NYJEFF French Creek, NYJEFF Cranberry Creek, NYJEFF Mud Creek Cape Vincent.

Sources:

NYHP BCD Animal EORs (2002), NYHP BCD Significant Habitat EORs (2002), NYHP Community Leads (2002), Higgins et al. (1998), GLB (2000), VT ACWG (1998).

Fish Assemblage: **Lake Sturgeon (GL/STL) Riverine Assemblage (RAF8)**

Lake Sturgeon-Greater Redhorse-Channel Darter Assemblage

Synonymy/Affinities:

= GLB (1998): Channel Catfish-Walleye-Black Crappie-Spotfin Shiner Alliance (GLB Fish Alliance 1) (in part?)

=? GLB (2000): Lowland River (GLB Fish Community LR)

=? GLB (2000): Warm Mainstem (GLB Fish Community M2)

=? GLB (2000): Great Lakes (GLB Fish Community GL1)

Equivalent to Pumpkinseed-Bluntnose Minnow Assemblage (RAF6) per Mark Ferguson (VTHP).

Assemblage Description:

NYHP proposed assemblage. Eurythermal warmwater fish concentrations. Species most indicative of habitat (lowest elevation, deepwater streams of the St. Lawrence/Lake Ontario drainage) are thought to be lake sturgeon, greater redhorse, and channel darter. Similar indicator species which may be rare or lacking from the eastern part of STL (and thus Vermont) or are more characteristic of lacustrine communities (and are present here because of the deep, slow water?) include blackchin shiner, Iowa darter, mooneye, lake trout (NY EORs). Also includes eastern sand darter, possibly Atlantic salmon, possibly walleye (spawning runs), possibly smallmouth bass (NY EORs). Contains many fish of GLB (1998) Alliance 1 except blackside darter. GLB (2000) expert meeting notes: also spawning area for lake sturgeon and mooneye.

Macrohabitat Crosswalk:

STL Unconfined River, GL Deepwater River. Lowest elevations, deepwater streams in St. Lawrence/Lake Ontario drainage, restricted to St. Lawrence River, adjacent mouths of its largest tributaries, and its upstream transition into Lake Ontario.

Microhabitats: run, pool; littoral, sublittoral, profundal?, pelagic-epilimnion, pelagic-hypolimnion?; above-ground

Related Assemblages: RAP3?, RAP4?

Distribution: NY: NAPn, STLy; VT: NAP., STL.

NY Examples:

NYSTLA St. Lawrence River, NYJEFF Indian River, NYFRAN Salmon River, NYFRAN Little Salmon River, NYSTLA Oswegatchier River, NYWASH Poultney River, NYWASH Mettawee River, NYCLIN Great Chazy River.

Sources:

VT ACWG (1998), NYHP BCD Animal EORs (2002), NYHP BCD Significant Habitat EORs (2002), Higgins et al. (1998), GLB (2000).

Fish Assemblage: **Fishless Aquatic Areas (RAF9)**

Fishless Aquatic Areas

Assemblage Description:

NYHP proposed assemblage. Environmental features too limiting to support fish (e.g., water too shallow, light intensity too low, slope too steep).

Macrohabitat Crosswalk:

NAP Acidic Intermittent Stream, NAP Calcareous Intermittent Stream, STL Intermittent Stream, NAP Spring?, STL Spring?, NAP Subterranean Stream?, STL Subterranean Stream?

Microhabitats: run, riffle, pool; littoral; above-ground, subterranean

Related Assemblages: RAP1, RAP10, RAP11, RAP14, RAM10, RAM14, RAM17

Distribution: NY: NAPy, STLy?; VT: NAPy?, STLy?

NY Examples: NYESSE Cascade Lakes, NYESSE Chicken Coop Brook, NYESSE Burroughs Cave.

Sources: NYHP BCD Community EORs (2002), NYHP Community Leads (2002).

Note: VT ACWG (1998) Classification Fish Assemblage 7 appears to be characteristic of LNE Ecoregion and absent from NAP and STL Ecoregions. If peripherally present in part of NAP, southern parts of the Hudson River (e.g. reaches between Warrensburg and Glens Falls) should be evaluated for presence of this assemblage.

Herptile Assemblage: **Spring Salamander-Northern Two-lined Salamander-Green Frog Intermittent Stream Fauna (RAH1)**

Gyrinophilus porphyriticus-Eurycea bislineata-Rana clamitans Assemblage

Synonymy/Affinities:

= VT ACWG (1998): 1st to 2nd Order Streams (VT Amphibian Type)

Need to evaluate potential acidic/calcareous split.

Assemblage Description:

NYHP proposed assemblage. Possibly corresponding more to a microhabitat level, similar to macroinvertebrate assemblages. Probably/reportedly also correlated with Crustacea (Cambaridae), other characteristic invertebrates, possibly other salamander species in more calcareous sites. VTHP (1996): also includes dusky salamander (Desmognathus fuscus). VT ACWG: includes Rana clamitans and R. sylvatica.

Macrohabitat Crosswalk: NAP Acidic Intermittent Stream, NAP Calcareous Intermittent Stream, NAP Spring, STL Spring.

Microhabitats: riffle, pool?; littoral; above-ground

Related Assemblages: RAP10?, RAF9

Distribution: NY: NAPy, STLn?; VT: NAP., STL.

NY Examples: NYESSE Breisch Property, NYESSE Cascade Lakes?, NYESSE Chapel Pond?

Sources: NYHP Community Leads (2002), VTHP (1996), VT ACWG (1998).

Macroinvertebrate Assemblage: **STL Marsh Headwater Stream Fauna (RAH2)**

Blanding's Turtle-Beaver Assemblage

Synonymy/Affinities:

Need to assess equivalency to assemblages in VT ACWG (1998), especially RAM7.

Formerly coded as "RAM16"

Assemblage Description:

NYHP proposed assemblage. Possibly corresponding more to a microhabitat level, similar to macroinvertebrate assemblages.

Macrohabitat Crosswalk: STL Marsh Headwater Stream.

Microhabitats: pool, run; littoral; above-ground

Related Assemblages: RAP6

Distribution: NY: NAPn?, STLy; VT: NAP., STL.

NY Examples: NYJEFF Cranberry Creek, NYJEFF Black River, NYJEFF French Creek, NYJEFF Perch River.

Sources: NYHP BCD Animal EORs (2002).

APPENDIX 4.

SAINT LAWRENCE/CHAMPLAIN VALLEY ECOREGION (STL) & NORTHERN APPALACHIAN ECOREGION (NAP) LACUSTRINE SPECIES ASSEMBLAGES

Known and Suspected, Extant and Extirpated Elements
Crosswalked to Current and Potential State and National Classifications

WORKING DRAFT (Not Yet Comprehensive for Ecoregions)
Original: David Hunt, NY Natural Heritage Program; April 27, 2000
Update: David Hunt, Ecological Intuition & Medicine; January 10, 2003

LIST OF LACUSTRINE SPECIES ASSEMBLAGES FOR STL AND NAP.

1. Vegetation Assemblages (**L**ake **A**ssemblages: **P**lants)

Vascular Plant Dominated Assemblages

LAP2 NAP Vernal Pool Plants
LAP3) STL Vernal Pool Plants
LAP4) Marl Pond Plants
LAP5A NAP Dystrophic Benthic Littoral Water Lily Herbaceous Vegetation
LAP5B STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation
LAP6A NAP Benthic Littoral Tapegrass-Pondweed Bed
LAP6B STL Tapegrass-Pondweed Bed
LAP7 (NAP) Benthic Littoral Pipewort-Water Lobelia Shoal
LAP8 (NAP/STL) Sand Flats
LAP9 (NAP) Quillwort Meadow
LAP11 Inland Salt Pond Plants

Macroscopic Non-Vascular Plant Dominated Assemblages

LAP10 (NAP/STL) Sublittoral Nitella Bed
LAP22 Deep Sublittoral Dichotomosiphon Tuberosus Bed
LAP12 Aquatic Cliff Community
LAP13 Aquatic Pavement
LAP14 Aquatic Talus Slope
LAP15 Aquatic Boulder Field
LAP1 Non-Vegetated Lake

Phytoplankton Assemblages

LAP16 Eutrophic Pond? Phytoplankton
LAP17 Meromictic? Phytoplankton
LAP18 Lake Champlain Summer/Fall Epilimnion Phytoplankton
LAP19 Winter-Stratified Epilimnion? Phytoplankton
LAP20 Lake Champlain Winter/Spring Epilimnion Phytoplankton
LAP21 Oligotrophic Pond? Phytoplankton
LAP23 Oligotrophic Lake? Phytoplankton
LAP24 Eutrophic Lake? Phytoplankton

2. Macroinvertebrate Assemblages (**L**ake **A**ssemblages: **M**acroinvertebrates)

LAM1 Dystrophic Benthic Profundal-Sublittoral Macroinvertebrates
LAM2 Clear, Acidic/Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates
LAM3 Moderately Alkaline Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates
LAM4 Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates
LAM5 Eutrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates
LAM6 Acidic Dystrophic/Oligotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates
LAM7 Oligotrophic/Mesotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates
LAM8 Acidic Dystrophic/Oligotrophic Benthic Littoral Mud-Sand Macroinvertebrates
LAM9 Clear Acidic/Oligotrophic Benthic Littoral Mud-Sand Macroinvertebrates
LAM10 Subterranean Macroinvertebrates
LAM11 NAP Temporary Palustrine Macroinvertebrates
LAM12 STL Temporary Palustrine Macroinvertebrates
LAM13 NAP Outwash Plain Temporary Palustrine Macroinvertebrates
LAM14 NAP Acidic Odonates
LAM15 NAP Neutral (Alkaline) Odonates
LAM16 NAP Meromictic? Macroinvertebrates
LAM17 NAP Acidic Pond? Macroinvertebrates
LAM18 Riverine Odonates?
LAM19 NAP Winter-Stratified Monomictic? Macroinvertebrates
LAM20 Lake Champlain Profundal Macroinvertebrates
LAM21 Lake Champlain Benthic Littoral Mud Macroinvertebrates
LAM22 Lake Champlain Benthic Littoral Sandy Flats Macroinvertebrates
LAM23 Lake Champlain Benthic Littoral Rocky Shoal Macroinvertebrates
LAM24 Lake Champlain Sublittoral Macroinvertebrates

3. Fish Assemblages (**L**ake **A**ssemblages: **F**ish)

LAF1 Dystrophic/High Elevation Acidic Lake Fish
LAF2 Oligotrophic Lake Fish
LAF3 Mesotrophic-Eutrophic Lake Fish
LAF3A (STL?) Eutrophic/Warmwater Lake Fish
LAF4 Oligotrophic Epilimion/Pond Fish
LAF5 Eutrophic-Mesotrophic Epilimnion/Pond Fish
LAF6 Lake Champlain Fish
LAF7 Fishless Lakes

4. Herptile Assemblages (**L**ake **A**ssemblages: **H**erptiles)

LAH1 STL Vernal Pool Herpetofauna

LAH2 NAP Vernal Pool Herpetofauna

5. Zooplankton Assemblages (**L**ake **A**ssemblages: **Z**ooplankton)

LAZ1 NAP Dystrophic Zooplankton
LAZ2 NAP Meromictic? Zooplankton
LAZ3 NAP Acidic Pond? Zooplankton
LAZ4 Lake Champlain Summer/Fall Epilimnion Zooplankton
LAZ5 Lake Champlain Winter/Spring Epilimnion Zooplankton
LAZ6 Oligotrophic-Mesotrophic Lake? Zooplankton
LAZ7 Eutrophic Lake? Zooplankton

COMMONLY USED ACRONYMS & SOURCES:

Ecoregions

- NAP Northern Appalachians
- STL St. Lawrence/Lake Champlain
- GLB Great Lakes
- LNE Lower New England
- HAL High Allegheny Plateau

NAC National Aquatic Community Classification
BCD Biological and Conservation Databases (of the Heritage Network and The Nature Conservancy)
EOR Element Occurrence Records (on BCD)

NYHP (New York Natural Heritage Program). 1990: Reschke (1990)
VTHP (Vermont Natural Heritage Program). 1989: Thompson (1989); 1996: Vermont Nongame and Natural Heritage Program (1996)
NHHP (New Hampshire Natural Heritage Program). 1992: Sperduto (1992)
MEHP (Maine Natural Heritage Program). 1991: Maine Natural Areas Program (1991)
VT ACWG (1998): Vermont's Aquatic Classification Work Group (1998)
GLB (Great Lakes Basin). 1998: Higgins et al. (1998). 2000: Great Lakes Expert Meeting, NY State, Handouts (2000)
ALS (Adirondack Lake Survey)

National Aquatic Classification (NAC): "Assemblage Units"

1. Vegetation Assemblages (**National Vegetation Classification (NVC): "Associations"**) Last Update: December 10, 2002

Vascular Plant Dominated Assemblages

Plant Assemblage: **Non-Vegetated Lake (LAP1)**

Non-Vegetated Lake (NEW to Anderson et al., 1998)

Synonomy/Affinities: under NVC Formation: V.C.2.N.a Permanently Flooded Temperate or Subpolar Hydromorphic Vegetation. Assemblage Description:

Vegetation absent or very sparse. Typically described as having aquatic macrophytes less than 1% cover, but more broadly applied here. Plants are considered as the set of vascular plants and non-vascular plants, the latter including bryophytes and various groups of macroscopic algae. Due to the ubiquitous nature of lower plants, non-vegetated areas are essentially confined to areas of low light intensity: in lakes these are subterranean areas and the profundal zone. Phytoplankton (the smallest form of plants) are common in the pelagic zones; macroalgae (e.g., Nitella) can be common in the sublittoral zone. Attached/epilithic algae can be abundant in "sparsely-vegetated" littoral areas (e.g., boulder fields).

Macrohabitat Crosswalk: various Subterranean Lakes, profundal zone of varoius deep lakes.

Microhabitats: hypolimnion; above-ground/subterranean.

Sources: Anderson et al. (1998).

Plant Assemblage: **NAP Vernal Pool Plants (LAP2)**

NAP Eleocharis acicularis Assemblage (NEW to Anderson et al., 1998)

Synonomy/Affinities:

Part of Eleocharis acicularis Seasonally Flooded Herbaceous Vegetation Alliance. Probably similar to Eleocharis acicularis Herbaceous Vegetation (1832) of W U.S., but recommend new NE U.S. or ecoregional NVC association.

Assemblage Description:

NAP variant of alliance. NYHP EOR: Eleocharis acicularis dominant (20% cover). Other species include Sparganium americanum (15%), Lemna minor, Najas sp., Ludwigia palustris. Bryophytes collected from 1 NYHP EOR remain to be identified, but may be NAP indicators distinguishing from STL macrohabitat.

Macrohabitat Crosswalk: NAP Vernal Pool.

Microhabitats: littoral; above-ground.

Sources: Anderson et al. (1998), NYHP BCD Community EORs (2002).

Plant Assemblage: **STL Vernal Pool Plants (LAP3)**

Eleocharis acicularis-Sium suave Assemblage (NEW to Anderson et al., 1998)

Synonomy/Affinities:

Part of Eleocharis acicularis Seasonally Flooded Herbaceous Vegetation Alliance. Probably similar to Eleocharis acicularis Herbaceous Vegetation (1832) of W U.S., but recommend new NE U.S. or ecoregional NVC association.

Assemblage Description:

STL variant of alliance. NYHP EOR: Eleocharis acicularis (10%), Sium suave (1%), exotic Hydrochaeris morus-ranae (15%). Unusual bryophytes reported from one potential example.

Macrohabitat Crosswalk: STL Vernal Pool, STL Sinkhole Pond.

Microhabitats: littoral; above-ground.

Sources: Anderson et al. (1998), NYHP BCD Community EORs (2002).

Plant Assemblage: **Marl Pond Plants (LAP4)**

Potamogeton filiformis-P. strictifolius-Chara sp. Assemblage (NEW to Anderson et al., 1998)

Synonomy/Affinities:

May be closest to Potamogeton filiformis Herbaceous Vegetation (2008) of CO and NV; Recommend new NE U.S. or ecoregional NVC association.

Assemblage Description:

MEHP (1991): Chara sp., Potamogeton filiformis, P. vaginatus (only in ME EOs, absent from NY). VTHP (1989): also P. pectinatus, P. strictifolius and Ranunculus trichophyllus (aquatilis). Need to determine if Didymodon tophaceus, an indicator moss, and characteristic cyanobacteria, both listed in Reschke (1990), are present in NAP/STL.

Macrohabitat Crosswalk: Marl Pond.

Microhabitats: littoral; above-ground.

Sources: Anderson et al. (1998), MEHP (1991), Reschke (1990), VTHP (1989).

Plant Assemblage: **NAP Dystrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5A)**

Nymphaea odorata-Brasenia schreberi Association (NEW to Anderson et al., 1998)

Synonymy/Affinities/Crosswalk:

Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation Alliance (in part)
similar to?: Brasenia schreberi Herbaceous Vegetation (4527; SEUS association)
similar to?: Nuphar lutea ssp. advena Herbaceous Vegetation (4324)
Need comparison to similar riverine assemblage: Broadleaf Pondlily NAP Herbaceous Vegetation (RAP5)
= VT ACWG (1998): Dystrophic Plants (VT Lake Macrophyte Type 1)
= VT ACWG (1998): Oligotrophic Plants (VT Lake Macrophyte Type 3) (in part: also in dimictic lakes)
= NHHP (1999): Yellow Pond Lily-Pickerelweed-Pondweed Aquatic Bed (in part)

Assemblage Description:

Floating-leaved aquatics dominate including Potamogeton epihydrus (var. ramosus), P. oakesianus, P. confervoides, P. bicupulatus, Nuphar variegata, Nymphaea odorata, Brasenia schreberi. Associated plants include Isoetes echinospora, Utricularia cornuta, U. geminiscapa, Sparganium fluctuans, Scirpus subterminalis and submersed Glyceria borealis. Other species may include Scapania sp. and macroscopic green algae. NAP indicators may include Potamogeton epihydrus (var. ramosus), P. oakesianus, P. confervoides, P. bicupulatus, Brasenia schreberi and U. geminiscapa. Species cited from many NAP (Oligotrophic) Acidic Ponds seem similar and include Utricularia geminiscapa, Scirpus subterminalis, Potamogeton confervoides, Sphagnum spp., all reportedly good acidic/oligotrophic indicators.

Macrohabitat Crosswalk: Low enery lakes including NAP Bog Lake, may also be in NAP (Oligotrophic) Acidic Pond.

Microhabitats: littoral; above-ground.

Sources: VT ACWG (1998), VTHP (1989), NHHP (1999), MEHP (1991), NYHP BCD Community EORs (2002), Roberts et al. (1995).

Plant Assemblage: **STL Eutrophic Benthic Littoral Water Lily Herbaceous Vegetation (LAP5B)**

Nuphar lutea ssp. advena-Nymphaea odorata Herbaceous Vegetation (2386) (apparently best match)
= "Central Waterlily Aquatic Wetland" (GL Regional Crosswalk, with range listed as MI to ON)
May want separate NE U.S. or ecoregional NVC association of 2386.

Synonymy/Affinities/Crosswalk:

Similar to?: Nuphar lutea ssp. advena Herbaceous Vegetation (4324)
Crosswalked here in Great Lakes terrestrial crosswalk meeting (1997), GL Regional Crosswalk, NAP Crosswalk (Anderson), Sneddon et al. (1998).
Need comparison to similar riverine assemblage: Broadleaf Pondlily STL Herbaceous Vegetation (RAP6).
= NHHP (1999): Yellow Pond Lily-Pickerelweed-Pondweed Aquatic Bed (in part)
= VT ACWG (1998): Oligotrophic Plants (VT Lake Macrophyte Type 3) (in part)
= VT ACWG (1998): Mesotrophic-Eutrophic Plants (VT Lake Macrophyte Type 4) (in part)

Assemblage Description:

Mixed floating-leaved and submergent aquatic plants. Floating-leaved plants include Nymphaea odorata (including ssp. tuberosa) and Nuphar variegata, with the former in greater abundance. Other floating aquatics reported include Lemna minor and Spirodela polyrhiza (the latter species a good STL indicator). Brasenia schreberi may be more common in mesotrophic to oligotrophic lakes and is a better NAP indicator. Other plants, potentially less common, include Utricularia vulgaris, Lemna trisulca. Only minor differences suspected between NAP & STL EOs in non-acidic settings.

Macrohabitat Crosswalk:

Large percentages of small ponds in NAP including Eutrophic, Oligotrophic (?), Oxbow and Pine Barrens Vernal Ponds; Small percentages of larger lakes, where restricted to nutrient rich portions, shallow coves, wetland edges and sheltered portions, inlet mouths, including STL Eutrophic Alkaline Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake, NAP Eutrophic and Oligotrophic Dimictic Lakes, and large monomictic lakes such as STL Winter-Stratified Monomictic Lake. Occurrence size increases towards eutrophic end of trophic state spectrum.

Microhabitats: littoral; above-ground.

Sources: VTHP (1989), VT ACWG (1998), NYHP BCD Community EORs (2002), GL terrestrial crosswalk (1997).

Plant Assemblage: **NAP Benthic Littoral Tapegrass-Pondweed Bed (LAP6A)**

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (6196) (apparently best match)
NAP Classification (Anderson, ca. 1998) crosswalked open water marsh here.
Listed as a river alliance/association in Sneddon et al. (1998).
Add a NAP indicator to the name? (e.g., Utricularia sp.)

Synonymy/Affinities/Crosswalk:

=? Potamogeton spp.-Ceratophyllum spp.-Elodea spp. Permanently Flooded Herbaceous Alliance (in part)
similar to: Potamogeton spp.-Ceratophyllum spp. Midwest Herbaceous Vegetation (2282)
Need comparison to similar riverine assemblage: American Eelgrass NAP Herbaceous Vegetation (RAP2).
= VT ACWG (1998): Oligotrophic Plants (VT Lake Macrophyte Type 3) (in part)

Assemblage Description:

Diverse assemblage of strap-shaped submergent aquatics including Potamogeton epihydrus, P. amplifolius, P. bicupulatus, Vallisneria americana, Najas flexilis, Ceratophyllum demersum, Chara sp., Isoetes sp., Elodea sp., Ranunculus longirostris. NAP indicators might include Potamogeton epihydrus, P. bicupulatus, Utricularia vulgaris; Apparently less diverse than STL equivalent.

Macrohabitat Crosswalk:

Large parts of nutrient rich shallows. Common in small ponds in NAP including Eutrophic, Oligotrophic, Oxbow and Pine Barrens Vernal Ponds. Small percentages of larger lakes, where restricted to nutrient rich portions (eutrophic and mesotrophic), shallow coves, wetland edges and sheltered portions, inlet mouths, including NAP Eutrophic and Oligotrophic Dimictic Lakes and large monomictic lakes. Occurrence size increase towards eutrophic end of trophic state spectrum.

Microhabitats: littoral; above-ground.

Sources: NYHP BCD Community EORs (2002), VT ACWG (1998), MEHP (1991).

Plant Assemblage: **STL Tapegrass-Pondweed Bed (LAP6B)**

Potamogeton spp.-Ceratophyllum sp. Midwest Herbaceous Vegetation (2282)

Crosswalked here at GL-NY terrestrial crosswalk meeting (1997)

Synonymy/Affinities/Crosswalk:

= Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (FROM LAKE GEORGE REPORT; see below)

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) of Sneddon et al. (1998).

= Heteranthera dubia Herbaceous Vegetation (2279) (originally a Mid-Atlantic type)

Merged into association above in Sneddon et al. (1998).

"Isoetes echinospora-Potamogeton perfoliatus-Vallisneria americana community" of Collins et al. (1981).

= VT ACWG (1998): Mesotrophic-Eutrophic Plants (VT Lake Macrophyte Type 4) (in part)

Need comparison to similar riverine assemblage: American Eelgrass STL Herbaceous Vegetation (RAP3).

Similar to Potamogeton spp.-Ceratophyllum spp. Great Lakes Shoreline Herbaceous Shoreline Vegetation (5152)

This may be an appropriate place to crosswalk STL Summer-Stratified Monomictic Lake: potential distinguishing species in this community (from NYHP EORs) may include Potamogeton natans, P. spirillus, Ceratophyllum echinatum, Alisma graminea (in very shallow water), Ranunculus trichophyllus and Eleocharis acicularis.

Assemblage Description: (see also Lake George Report description below)

Diverse and dense "weed-filled" assemblage of submergent aquatics, with rosette-leaved plants absent or in low abundance. Apparently much more diverse than NAP equivalent (LAP6A above). Includes abundant Potamogeton pectinatus, P. perfoliatus, P. pusillus, P. richardsonii, P. zosteriformis, P. nodosus, P. praelongus. P. robbinsii, Vallisneria americana, Ceratophyllum spp. (demersum and echinatum), Elodea canadensis, Heteranthera dubia, Najas flexilis. Less common species include Potamogeton obtusifolius, P. illinoensis, P. friesii, Myriophyllum heterophyllum, M. sibericum, Ranunculus longirostris and the NY state-rare Armoracia lacustris. STL indicators/diagnostic species separating from NAP equivalent might include Ceratophyllum demersum, C. echinatum, Heteranthera dubia, Potamogeton friesii, P. gramineus, P. nodosus, P. obtusifolius, P. illinoensis, P. pectinatus, P. praelongus, P. richardsonii, P. zosteriformis, and NY state-rare Callitriche hermaphroditica and Bidens (Megalodonta) beckii. Lake George and nearby Oligotrophic (moderately alkaline) Dimictic Lakes in peripheral NAP may be closer to this STL association than the NAP equivalent. Bidens (Megalodonta) beckii, in such NAP examples, is apparently not a good NAP indicator but rather a STL indicator species. Potamogeton amplifolius, P. gramineus, and Chara spp. are not listed from any known NY STL EOs, but are suspected to be abundant if lakes near Lake George are this type. Potamogeton alpinus and P. strictifolius may be NY state-rare species in this assemblage.

Macrohabitat Crosswalk:

Large parts of nutrient rich shallows. Probably common in small ponds in STL (poor data) including STL Oxbow Pond. Moderate areas of larger lakes in nutrient rich portions (eutrophic and mesotrophic), shallow coves, wetland edges and sheltered portions, inlet mouths. Lake types include STL Eutrophic and Oligotrophic Alkaline Dimictic Lakes and large monomictic lakes including STL Summer-Stratified Monomictic Lake and STL Winter-Stratified Monomictic Lake, possibly some Eutrophic Dimicitic Lakes to Oligotrophic Dimictic Lakes in nearby NAP. Occurrence size increases towards eutrophic end of trophic state spectrum.

Microhabitats: littoral; above-ground.

Sources:

VT ACWG (1998), Reschke (1990), NYHP BCD Community EORs (2002), VTHP (1989), Hunt (1999a), Levey & Fiske (1996).

Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (FROM LAKE GEORGE REPORT; Appears closest to STL type)

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

Clearly belongs in Vallisneria americana Permanently Flooded Temperate Herbaceous Alliance of Sneddon et al. (1998), described as "consists of aquatic vegetation in rivers dominated by Vallisneria americana". If Vallisneria americana-Potamogeton perfoliatus Herbaceous Vegetation (CEGL006196) is intended exclusively for riverine settings, it may be useful to create a lacustrine association such as Vallisneria americana-Potamogeton amplifolius Herbaceous Vegetation. This lacustrine association is likely to be widespread over several ecoregions in the NE U.S.

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, silty, shallow littoral bottoms sheltered from strong wave influence in ponds and lakes. Soils are deep, circumneutral silt loam to silty clay. Water is circumneutral and has high transparency and high dissolved oxygen. Water depth ranges from about 1.5m to 4.0 (5.0)m with high light intensity. Dominant substrate types are bare soil, litter and duff and woody debris.

Vegetation: (FROM LAKE GEORGE REPORT)

Vegetation is dominated by submerged vascular plants susceptible to high wave energy. Submerged vascular plant layer is dense (averaging 75% cover), tall (averaging 0.8m) and diverse, dominated by Vallisneria americana (tapegrass; 25% cover), Potamogeton amplifolius (pondweed; 15%), P. gramineus (pondweed; 10%), P. robbinsii (pondweed; 10%) and Elodea canadensis (waterweed; 10%). Other characteristic vascular plants at lower abundance include Sagittaria graminea (grass-leaf sagittaria), Najas flexilis (naiad), Potamogeton perfoliatus (pondweed), P. zosteriformis (pondweed), Ceratophyllum demersum (coontail) and possibly Heteranthera dubia (water stargrass). Dominant non-vascular plants include suspended algae (Mougeotia sp., Nostoc sp.), epiphytic filamentous green algae and gelatinous epipelic green algae.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Very diverse assemblage of fish, clams and snails including fish such as minnows, pumpkinseed (Lepomis gibbosus), johnny darter (Etheostoma nigrum), golden shiner (Notemigonus crysoleucas) and yellow perch (Perca flavescens), Lampsilis radiata (eastern lamp-mussel) as the dominant clam, and snails such as Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn). A variety of worms may be characteristic benthic fauna.

Plant Assemblage: **(NAP) Benthic Littoral Pipewort-Water Lobelia Shoal (LAP7)**

Eriocaulon aquaticum-Lobelia dortmanna Herbaceous Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonymy/Affinities/Crosswalk:

=? Eleocharis spp.-Eriocaulon aquaticum Semipermanently Flooded Herbaceous Vegetation Alliance (in part)

Eriocaulon aquaticum-Lobelia dortmanna Herbaceous Vegetation (CEGL006346) of Sneddon et al. (1998).

Eriocaulon septangulare Sparsely Vegetated (10 Erio sep or EsSv) of Anderson (1998).

Is this also Semipermanently Flooded like 6261? Described as shallow open water marsh with water less than 50 cm deep resistant to wave energy with Harris et al. cited.

"Eriocaulon septangulare-Sagittaria graminea community" of Collins et al. (1981).

Similar to: Eleocharis spp.-Eriocaulon aquaticum Herbaceous Vegetation (6261) (but Permanently Flooded)

= VT ACWG (1998): High Elevation, Acidic Plants (VT Lake Macrophyte Type 2)

= VT ACWG (1998): Oligotrophic Plants (VT Lake Macrophyte Type 3) (in part)

= MEHP (1991): Lacustrine Shallow Bottom Community (ME Lake Community L12)

=? NHHP (1999): Emergent/Aquatic Bed Softwater Pondshore

Assemblage Description:

Dominated by low-growing, submergent rosette/mat-forming plants with flowers emergent at low water. Eriocaulon aquaticum (=E. septangulare) is consistently dominant. Common associates are Lobelia dortmanna, Sagittaria graminea, Nymphoides cordata, Myriophyllum tenellum, Potamogeton confervoides (also NYHP EOR), Isoetes echinospora. Vallisneria americana is common but should not occur at high percent cover. Floating aquatics, if present, are at low abundance and can include Nuphar variegatum. State rare indicator plants reported might include Heteranthera dubia (ME; may be better indicator of Potamogeton-Vallisnera association), Subularia aquatica (ME,NY), and Litorella americana (=uniflora) (ME, VT). Need evaluation of variants; apparent variants include examples in lakes (more diverse) versus ponds (e.g., see VT ACWG 1998 descriptions) and STL vs. NAP variants (the former more diverse with possible STL indicators being Sagittaria graminea, Heteranthera dubia and Subularia aquatica). NAP variant known from LNE/Rensselaer Plateau. Tarn variant may also be different from examples in less acidic settings. Tarn indicators cited in VTHP (1989) may include Nymphoides cordata, Utricularia vulgaris and Sparganium americanum.

Macrohabitat Crosswalk:

Large parts of nutrient poor shallows in moderately high energy lakes. Common in small ponds in NAP including Acidic (Oligotrophic) Pond and possibly in small amounts in shallow mesotrophic lakes including large winter-stratified monomictic lakes and Eutrophic Ponds (Only expected in mesotrophic variant). Small portions of larger nutrient poor lakes (mostly oligotrophic), where restricted to shallow shorelines, shoals. NAP (Oligotrophic) Acidic Dimictic Lake.

Microhabitats: littoral; above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), MEHP (1991), VTHP (1989), Hunt (1999a), NHHP (1999).

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

May represent an alliance with different ecoregional associations. CEGL006346 may be based on a NAC association in coastal plain ponds. Examples in Lake George may be characteristic of NAP & LNE/Rensselaer Plateau in oligotrophic ponds and oligotrophic dimictic lakes. The range beyond these ecoregions is uncertain, but it is suspected to be a "northern" association. Examples in Lake George are densely vegetated and submergent, and thus may not correspond to 10 Erio sep (described as a "sparsely vegetated marsh" present in NAP).

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, sandy, wave-influenced shallow shores and shoals bordering islands and bays in the littoral zone of oligotrophic ponds and oligotrophic dimictic lakes. Soils are shallow, gravelly, circumneutral sand. Water is circumneutral and has high transparency and high dissolved oxygen. Water depth ranges from about 0.5m to 2.0 (3.0)m with high light intensity. Dominant substrate types are sand and large rocks.

Vegetation: (FROM LAKE GEORGE REPORT)

Vegetation is dominated by submerged vascular plants with basal rosettes which have leaves resistant to moderate wave energy. Submerged vascular plant layer is dense (averaging 70% cover), short (averaging 0.15m tall), and dominated by Eriocaulon aquaticum (pipewort; 60% cover) with common associates including Vallisneria americana (tapegrass), Myriophyllum tenellum (slender water milfoil) and Lobelia dortmanna (water lobelia). Other characteristic vascular plants usually at low abundance include Isoetes echinospora (quillwort), Elatine minima (lesser waterwort), Juncus pelocarpus (brown-fruited rush), Ranunculus flammula (creeping spearwort) and possibly Utricularia resupinata (bladderwort), Sagittaria graminea (grass-leaf sagittaria), Ranunculus longirostris (white water-crowfoort) and Heteranthera dubia (water stargrass). Dominant non-vascular plants include filamentous green algae epiphytic on Eriocaulon stalks and gelatinous epipsammic green algae.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Diverse assemblage of fish, clams and snails including fish such as sunfish, smallmouth bass (Micropterus dolomieui), and minnows, clams such as Elliptio complanata (eastern elliptio) and Lampsilis radiata (eastern lamp-mussel), and the snail Viviparus georgianus (banded mystery snail). Crayfish may be characteristic.

Plant Assemblage: **(NAP/STL) Sand Flats (LAP8)**

Myriophyllum tenellum-Potamogeton gramineus Herbaceous Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

Belongs in Herbaceous Vegetation Class, Hydromorphic Rooted Vegetation Subclass, Temperate Group, Permanently Flooded Formation of Sneddon et al. (1998). May correspond to one or more associations listed in Grossman et al. (1998) in the Potamogeton spp.-Ceratophyllum spp.-Elodea spp. Permanently Flooded Herbaceous Alliance.

= Hunt (1999a): Slender Water Milfoil Tributary Delta (Lake George Report, see below)

=? Collins et al. (1981): "Elodea canadensis-Najas flexilis-Potamogeton pusillus community" (reported to be "in regions with high silting rate").

= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3) (in part: non-vegetated sand)

Assemblage Description: (PRIMARILY FROM LAKE GEORGE REPORT)

Vegetation is a very diverse and variable array of submerged vascular plants. Submerged vascular plant layer is sparse to moderately dense (averaging 30% cover) and of variable height. Different species dominate locally, but no one species is apparently dominant overall. The most abundant species (3 to 6% cover each) include Myriophyllum tenellum (slender water milfoil), Potamogeton gramineus (pondweed), Vallisneria americana (tapegrass), Isoetes echinospora (quillwort) and Najas flexilis (naiad). Other characteristic vascular plants at lower abundance include Lobelia dortmanna (water lobelia), Sagittaria graminea (grass-leaf sagittaria), Juncus pelocarpus (brown-fruited rush), and Utricularia resupinata (bladderwort). Non-vascular plants are sparse including Chara spp., epiphytic filamentous green algae, and gelatinous epipsammic green and blue-green algae. Natural disturbances make this association vulnerable to Myriophyllum spicatum infestation. D. Hunt (2000) annotation: Myriophyllum alterniflorum is a good NY state-rare indicator species; possibly 2 or more associations from different physical settings and/or with different physiognomy combined here in this concept: 1) diverse, densely vegetated tributary deltas, 2) sparsely vegetated tributary deltas, 3) sparsely vegetated sand flats far removed from tributary deltas in areas of high wave energy including near mid-lake islands and nearshore areas adjacent to sandy beaches and lake shore associations. Good indicator species include Utricularia resupinata.

Macrohabitat Crosswalk:

NAP/STL Oligotrophic Alkaline Dimictic Lakes, possibly also similar lake types including STL Summer-Stratified Monomictic Lake.

Microhabitats: littoral/sublittoral; above-ground.

Sources: Anderson et al. (1998); Hunt (1999a); Collins et al. (1981).

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, shallow, sandy littoral bottoms at deltas of tributaries to oligotrophic dimictic lakes. Soils are deep circumneutral sand. Water is circumneutral and has high transparency and high dissolved oxygen. Wave energy is usually high and natural disturbances are characteristic (terrestrial derived sedimentation and scouring during flood events). Water depth ranges from about 1.0m to 3.5m with high light intensity. Dominant substrate types are sand and litter and duff.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Characteristic fish include abundant johnny darter (Etheostoma nigrum) and minnows. Clams and snails are also very abundant including clams such as Lampsilis radiata (eastern lamp-mussel), Elliptio complanata (eastern elliptio) and Piganodon cataracta (Newfoundland floater) and snails such as Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn).

Plant Assemblage: **(NAP) Quillwort Meadow (LAP9)**

Isoetes lacustris-Potamogeton robbinsii Herbaceous Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

Belongs in Herbaceous Vegetation Class, Hydromorphic Rooted Vegetation Subclass, Temperate Group, Permanently Flooded Formation of Sneddon et al. (1998). Apparently closest to Potamogeton perfoliatus-Vallisneria americana Alliance. Very different from typical concept of alliance; proposed new NVC alliance or at a minimum a new NVC association.

=? Collins et al. (1981): "Nitella flexilis-Isoetes macrospora community" (in part)

VT ACWG (1998): apparently not addressed in any of the macrophyte types.

Assemblage Description: (PRIMARILY FROM LAKE GEORGE REPORT)

Vegetation is dominated by and restricted to submerged vascular plants tolerant of moderately low light intensity. Submerged vascular plant layer is dense (averaging 60% cover), short (averaging 0.2m tall) and has low diversity. Vascular plants are dominated by Isoetes lacustris (quillwort; 45% cover) and Potamogeton robbinsii (pondweed; 20%). Other characteristic vascular plants at very low abundance include Potamogeton pusillus (pondweed). Dominant non-vascular plants include Nitella flexilis (stonewort) and filamentous epipelic and epiphytic green algae. Reportedly most typical of lakes in NAP but apparently extends outside of NAP into deep, cold ODL lakes in adjacent ecoregions, especially in Canada (B. Hellquist, pers.com.). Isoetes lacustris is potentially rare but very characteristic of this lake type. D. Hunt (1999) supplemental observations suggest that this association is somewhat heterogeneous with typical Isoetes-dominated quillwort meadow occurring on deep littoral sands to sandy loam and Potamogeton robbinsii-dominated areas (often sparsely vegetated) occupying deep littoral silt; Needs further study.

Macrohabitat Crosswalk: NAP/STL Oligotrophic Alkaline Dimictic Lake, possibly also similar lake types.

Microhabitats: littoral (deep): above-ground.

Sources: Anderson et al. (1998); Hunt (1999a); Collins et al. (1981).

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, silty loam, deep littoral bottoms below wave influence in oligotrophic dimictic lakes. Soils are deep circumneutral silt loam. Water is circumneutral and has high transparency and high dissolved oxygen. Water depth ranges from about 4.0m to 7.0 (13)m with only about 20% of the surface light intensity. Substrate type is predominantly bare soil.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Diverse assemblage of fish, clams and snails including fish such as minnows, largemouth bass (Micropterus salmoides) and pumpkinseed (Lepomis gibbosus), clams such as Lampsilis radiata (eastern lamp-mussel) and Elliptio complanata (eastern elliptio), and snails such as Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn). Caddisflies may be characteristic benthic fauna.

Plant Assemblage: **Inland Salt Pond Plants (LAP11)**

Potamogeton pectinatus-Ruppia maritima assemblage (2004)

Assemblage Description: TO BE EXPANDED IN GL ECOREGIONAL PLANNING EFFORTS.

Macrohabitat Crosswalk: GL Inland Salt Pond.

Microhabitats: littoral; above-ground.

Sources: Faber-Langendoen 1997 Great Lakes-New York Crosswalk Meeting Notes, Reschke (1990).

1. Vegetation Assemblages (**National Vegetation Classification (NVC): "Associations"**) Last Update: December 10, 2002

Macroscopic Non-Vascular Plant Dominated Assemblages

Plant Assemblage: **(NAP/STL) Sublittoral Nitella Bed (LAP10)**

Nitella flexilis Non-Vascular Vegetation (NEW to Anderson et al., 1998; proposed to Sneddon in 1999)
(or perhaps "Nitella flexilis-Chara sp. Non-Vascular Vegetation")

Synonomy/Affinities:

Belongs in Non-Vascular Vegetation Class, Alga Subclass, proposed "Temperate" Group, proposed "Permanently Flooded" Formation of Sneddon et al. (1998).
= VT ACWG (1998): Mesotrophic-Eutrophic Plants (VT Lake Macrophyte Type 4) (in part: "Chara-Nitella Mats")
= Ferris et al. (1980): "Nitella Beds"
=? Collins et al. (1981): "Nitella flexilis-Isoetes macrospora community" (in part)

Assemblage Description: (PRIMARILY FROM LAKE GEORGE REPORT)

Vegetation is dominated by and essentially restricted to submerged algae, tolerant of low light intensity. Submerged rooted non-vascular plant layer is dense (averaging 70% cover), short (averaging 0.2m tall), and has very low diversity, essentially entirely Nitella flexilis (stonewort). Other characteristic plants at low abundance include filamentous epipelic and epiphytic green algae. Vascular plants are essentially lacking, intolerant of the low light intensity. VT ACWG (1998): Chara sp. and Nitella sp. greater than 25 feet. D. Hunt (2000) annotation from Lake George mapping project: need more critical ecological evaluation of potential for splits of Nitella- vs. Chara-dominated areas.

Macrohabitat Crosswalk:

NAP/STL Oligotrophic Alkaline Dimictic Lake, possibly also similar lake types including STL Eutrophic Alkaline Dimictic Lake.

Microhabitats: sublittoral; above-ground.

Sources: Anderson et al. (1998); Hunt (1999a); Collins et al. (1981), VT ACWG (1998); Ferris et al. (1980).

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, loamy to silty, moderately deep sublittoral bottoms of oligotrophic dimictic lakes. Soils are deep, circumneutral and variable in texture ranging from sandy loam to silty clay. Water is circumneutral and has high transparency and high dissolved oxygen. Water depth ranges from about 7.5m to 12 (17)m with only about 5% of the surface light intensity. Substrate type is predominantly bare soil.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Includes fish such as pumpkinseed (Lepomis gibbosus), smallmouth bass (Micropterus dolomieui) and largemouth bass (Micropterus salmoides), clams such as Elliptio complanata (eastern elliptio) and Lampsilis radiata (eastern lamp-mussel), and snails such as Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn). A variety of worms may be characteristic benthic fauna.

Plant Assemblage: **Deep Sublittoral Dichotomosiphon Tuberosus Bed (LAP22)**

Dichotomosiphon tuberosus Non-Vascular Vegetation

Macrohabitat Crosswalk: STL Oligotrophic Alkaline Dimictic Lake (possibly others).

Microhabitats: sublittoral; above-ground.

Sources: Hunt (1999a)

Plant Assemblage: **Aquatic Cliff Community (LAP12)**

Filamentous Green Algae Sparsely Vegetated Permanently Flooded Cliff Vegetation
(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3) (in part: non-vegetated rock)
No others found in TNC/Heritage Network or other literature.

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

Belongs in Sparse Vegetation Class, Consolidated Rock Subclass, Sparsely Vegetated Cliffs Group, proposed "Permanently Flooded" Formation of Sneddon et al. (1998). This lacustrine formation is suspected to be of worldwide distribution. Floristic alliances and associations based on dominant algae are suspected to be much more restricted. The association described from Lake George is perhaps restricted to NAP and all adjacent ecoregions. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, shallow to deep littoral to profundal rock walls of deep, steeply sided lakes. Soil is restricted to cracks and ledges on steep bedrock faces which range from 45 to greater than 90 degree slope. Water is circumneutral and has high transparency and high dissolved oxygen. Wave energy is usually very high near the water surface. Water depth can range from 0m reportedly to over 50m, spanning a very broad range of light intensity probably with correlated changes in dominant vegetation.

Vegetation: (FROM LAKE GEORGE REPORT)

Vascular vegetation is sparse (less than 1% cover). Characteristic vascular plants may include Isoetes echinospora (quillwort) and Potamogeton spirillus (pondweed). A dense layer of non-vascular plants (85% cover) coats the rock, dominated by epilithic filamentous green algae and Nostoc sp.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Abundant fish include pumpkinseed (Lepomis gibbosus), smallmouth bass (Micropterus dolomieui) and the characteristic fantail darter (Etheostoma flabellare) and rock bass (Ambloplites rupestris). Snails are abundant including Viviparus georgianus (banded mystery snail), Heliosoma trivolvis (marsh rams-horn) and the characteristic Physa heterostropha (pewter physa). Other characteristic fauna may include abundant hydroids, bryozoans and caddisflies.

Macrohabitat Crosswalk:

Widespread, especially in dimictic lakes and oligotrophic/acidic lakes. Known from STL Oligotrophic Alkaline Dimictic Lake, STL Eutrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake, STL Winter-Stratified Monomictic Lake.

Microhabitats: littoral/sublittoral/profundal: above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), Hunt (1999a).

Plant Assemblage: **Aquatic Pavement (LAP13)**

Myriophyllum alterniflorum-Nostoc sp. Sparsely Vegetated Permanently Flooded Pavement Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3) (in part: non-vegetated rock)

No others found in TNC/Heritage Network or other literature.

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

Belongs in Sparse Vegetation Class, Consolidated Rock Subclass, Sparsely Vegetated Pavement Group, proposed "Permanently Flooded" Formation of Sneddon et al. (1998). This lacustrine formation is suspected to be of worldwide distribution. Floristic alliances and associations based on dominant algae are suspected to be much more restricted. The association described from Lake George is perhaps restricted to NAP and all adjacent ecoregions. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, shallow to deep littoral to sublittoral bedrock ledges of ponds and large lakes. Soil is restricted to cracks and pockets on bedrock ledges which range from flat generally to about 20 degree slope. Small amounts of large rocks or sand may accumulate on the ledges. Water is circumneutral and has high transparency and high dissolved oxygen. Wave energy is usually very high if the ledge is situated near the water surface. Water depth is known from 0m to about 3m, and theoretically can occur at much deeper depths and may span a broad range of light intensity, probably with correlated changes in dominant vegetation.

Vegetation: (FROM LAKE GEORGE REPORT)

Vascular vegetation is sparse (averaging 2% cover). Characteristic vascular plants include Myriophyllum alterniflorum (water milfoil) and Potamogeton spirillus (pondweed). A moderately sparse layer of non-vascular plants (12% cover) coats the rock, dominated by Nostoc sp.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Abundant fish include minnows, pumpkinseed (Lepomis gibbosus) and the characteristic fantail darter (Etheostoma flabellare). Snails are abundant including Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn). Other characteristic fauna include abundant freshwater sponges and hydroids.

Macrohabitat Crosswalk:

Widespread, especially in dimictic lakes and oligotrophic/acidic lakes. Known from STL Oligotrophic Alkaline Dimictic Lake, STL Eutrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake, STL Winter-Stratified Monomictic Lake.

Microhabitats: littoral/sublittoral/profundal: above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), Hunt (1999a).

Plant Assemblage: **Aquatic Talus Slope (LAP14)**

Filamentous Green Algae Sparsely Vegetated Permanently Flooded Talus Slope Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3) (in part: non-vegetated rock)

No others found in TNC/Heritage Network or other literature.

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

Belongs in Sparse Vegetation Class, Consolidated Rock Subclass, Sparsely Vegetated Talus Slope Group, proposed "Permanently Flooded" Formation of Sneddon et al. (1998). This lacustrine formation is suspected to be of worldwide distribution. Floristic alliances and associations based on dominant algae are suspected to be much more restricted. The association described from Lake George is perhaps restricted to NAP and all adjacent ecoregions. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, shallow to deep littoral to sublittoral talus slopes at the base of rock walls bordering steeply sided large lakes. Soil is restricted to cracks and small pockets on boulders or is covered over by multiple layers of boulders averaging about 3 to 4 m wide and occuring on moderately steep slopes of about 20 to 40 degrees. Water is circumneutral and has high transparency and high dissolved oxygen. Wave energy is usually very high near the water surface. Water depth can range from 0m to over 10m, spanning a broad range of light intensity, probably with correlated changes in dominant vegetation.

Vegetation: (FROM LAKE GEORGE REPORT)

Vascular vegetation is sparse (averaging 3% cover). A dense layer of non-vascular plants (65% cover) coats the talus, dominated by epilithic filamentous green algae and Nostoc sp.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Abundant fish include minnows, largemouth bass (Micropterus salmoides), smallmouth bass (Micropterus dolomieui) and the characteristic rock bass (Ambloplites rupestris). Snails are abundant including Viviparus georgianus (banded mystery snail) and Heliosoma trivolvis (marsh rams-horn). Other characteristic fauna may include red spotted newt (Notophthalmus viridescens).

Macrohabitat Crosswalk:

Widespread, especially in dimictic lakes and oligotrophic/acidic lakes. Known from STL Oligotrophic Alkaline Dimictic Lake; suspected from STL Eutrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake, STL Winter-Stratified Monomictic Lake.

Microhabitats: littoral/sublittoral/profundal: above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), Hunt (1999a).

Plant Assemblage: **Aquatic Boulder Field (LAP15)**

Filamentous Green Algae Sparsely Vegetated Permanently Flooded Boulder Field Vegetation

(NEW to Anderson et al., 1998; proposed to Sneddon in 1999)

Synonomy/Affinities:

= VT ACWG (1998): Oligotrophic Lake (VT Lake Macrophyte Type 3) (in part: non-vegetated rock)

No others found in TNC/Heritage Network or other literature.

Taxonomy & Distribution: (FROM LAKE GEORGE REPORT)

Belongs in Sparse Vegetation Class, Consolidated Rock Subclass, Sparsely Vegetated Rock Flats Group, proposed "Permanently Flooded Boulder Field" Formation of Sneddon et al. (1998). This lacustrine formation is suspected to be of worldwide distribution. Floristic alliances and associations based on dominant algae are suspected to be much more restricted. The association described from Lake George is perhaps restricted to NAP and all adjacent ecoregions. Different dominant algae species may vary from ecoregion to ecoregion and across the major physical gradients.

Description: (FROM LAKE GEORGE REPORT)

Environmental Setting: (FROM LAKE GEORGE REPORT)

Permanently flooded, usually shallow littoral boulder to cobble fields on shores of bays and islands and forming offshore reefs in large lakes. Soil is essentially lacking or covered over by multiple layers of cobbles or boulders averaging about 50 cm wide and occuring on gentle slopes of about 10 degrees. Water is circumneutral and has high transparency and high dissolved oxygen. Wave energy is usually very high and light intensity is high. Water depth is typically 0m to 3m.

Vegetation: (FROM LAKE GEORGE REPORT)

Vascular vegetation is sparse (averaging 3% cover). A characteristic vascular plant is Myriophyllum alterniflorum (water milfoil). A dense layer of non-vascular plants (55% cover) coats the boulders, dominated by epilithic gelatinous green and blue-green algae.

Associated Fauna: (FROM LAKE GEORGE REPORT)

Abundant fish include rock bass (Ambloplites rupestris), smallmouth bass (Micropterus dolomieui) and pumpkinseed (Lepomis gibbosus). Snails are abundant including Viviparus georgianus (banded mystery snail) and the exotic Bithynia tentaculata (faucet snail). Other characteristic fauna include freshwater sponge.

Macrohabitat Crosswalk:

Widespread, especially in dimictic lakes and oligotrophic/acidic lakes. Known from STL Oligotrophic Alkaline Dimictic Lake; suspected from STL Eutrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake, STL Winter-Stratified Monomictic Lake.

Microhabitats: littoral/sublittoral/profundal: above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002), Hunt (1999a).

Plant Assemblage: **Eutrophic Pond? Phytoplankton (LAP16)**
Chrysosphaerella longispina-Ceratium Phytoplankton Assemblage
Synonomy/Affinities: COMPARE TO LAP19, LAP24.
Assemblage Description:
NYHP EOR (Eutrophic Pond): dominated by Chrysosphaerella longispina (20% relative abundance), with Ceratium spp.
Macrohabitat Crosswalk: NAP (Eutrophic) Alkaline Pond.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Meromictic? Phytoplankton (LAP17)**
Synura-Asterionella-Ceratium Phytoplankton Assemblage
Assemblage Description:
NYHP EOR (Meromictic Lake): Synura (very dense), with Asterionella, Peridinium and Ceratium hirundinella. Synura is reportedly a good indicator of dystrophic/acidic water and bog habitats. NAP Bog Lake EO similar.
Macrohabitat Crosswalk: NAP Meromictic Lake, NAP Bog Lake.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Lake Champlain Summer/Fall Epilimnion Phytoplankton (LAP18)**
Fragilaria spp.-Anabaena spp. Assemblage
Assemblage Description:
Dominant species include the diatoms Fragilaria crotonensis and F. capucina, and blue-green algae Anabaena circinalis and A. planctonica.
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Winter-Stratified Epilimnion? Phytoplankton (LAP19)**
Dinobryon-Ceratium Assemblage
Synonomy/Affinities: COMPARE TO LAP16, LAP24.
Assemblage Description:
NYHP EOR: dominated by abundant Dinobryon and Ceratium. With lesser amounts of Asterionella and Melosira.
Macrohabitat Crosswalk: NAP Winter-Stratified Monomictic Lake.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Lake Champlain Winter/Spring Epilimnion Phytoplankton (LAP20)**
Melosira spp.-Cryptomonas ovata Assemblage
Assemblage Description:
Dominant species include the diatoms Melosira islandica, Asterionella formosa, Synedra acus and the flagellate Cryptomonas ovata. Melosira spp. dominate in ice-free areas during the winter. Are there different winter/spring assemblages in ice-free versus frozen parts of Lake Champlain.
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Oligotrophic Pond? Phytoplankton (LAP21)**
Tabellaria-Asterionella-Ceratium Assemblage
Synonomy/Affinities: COMPARE TO LAP23.
Assemblage Description:
NYHP EOR: numerous phytoplankton species dominated by Asterionella, Tabellaria, Ceratium and desmids.
Macrohabitat Crosswalk: NAP (Oligotrophic) Acidic Pond.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Plant Assemblage: **Oligotrophic Lake? Phytoplankton (LAP23)**
Cyclotella-Asterionella Assemblage
Synonomy/Affinities: COMPARE TO LAP21.
Assemblage Description:
Phytoplankton are diverse, dominated by desmids (Staurastrum), chrysophytes (Dinobryum) and diatoms (Tabellaria and Cyclotella) (Reschke, 1990). NYHP EORs: dominated by Asterionella formosa and Cyclotella comta. 46 species in Lake George EO.
Macrohabitat Crosswalk: STL Oligotrophic Alkaline Dimictic Lake.
Microhabitats: epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002), (Reschke, 1990).

Plant Assemblage: **Eutrophic Lake? Phytoplankton (LAP24)**
Ceolosphaerium-Dinobryon-Asterionella Assemblage
Synonomy/Affinities: COMPARE TO LAP16, LAP19.

Assemblage Description:

Reschke (1990) (Eutrophic Dimictic Lake): phytoplankton (characteristic cyanobacteria) abundant, but with low species diversity. NYHP EOR (Mesotrophic Dimictic Lake): dominants include green algae, blue-green algae and diatoms. Dominated by Asterionella. Blue-green algae include cf. Ceolosphaerium. Also with Dinobryon and Tabellaria. NYHP EOR (Eutrophic Dimictic Lake): dominated by Dinobryon, with abundant chrysophytes.

Macrohabitat Crosswalk: NAP Eutrophic Dimictic Lake.

Microhabitats: epilimnion; above-ground.

Sources: NYHP BCD Community EORs (2002), Reschke (1990).

Macroinvertebrate Assemblage: **Dystrophic Benthic Profundal-Sublittoral Macroinvertebrates (LAM1)**

Zalutschia-Chironomus-Musculium Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Dystrophic Tannic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Types 1, 2)

Assemblage Description:

VT ACWG (1998): low oxygen-tolerant, low light-tolerant organisms including midges (Zalutschia, Chironomus), phantom midge (Chaoborus) and bivalve (Musculium). Zalutschia is a good dystrophic indicator species (per Steve Fiske). NYHP: VT's profundal (Type 1) and sublittoral (Type 2) associations seem similar and are tentatively lumped.

Macrohabitat Crosswalk: NAP Bog Lake.

Microhabitats: sublittoral/profundal; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Clear, Acidic/Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM2)**

Sialis-Procladious-Heterotrissocladius Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Clear, Acidic/Oligotrophic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Type 6, 7)

Assemblage Description:

VT ACWG (1998): low oxygen-tolerant, low light-tolerant organisms including alderfly (Sialis), and midges (Procladious, Heterotrissocladius). NYHP: VT's profundal (Type 6) and sublittoral (Type 7) associations seem similar and are tentatively lumped.

Macrohabitat Crosswalk: NAP Oligotrophic Dimictic Lakes, STL Oligotrophic Alkaline Dimictic Lakes?

Microhabitats: sublittoral/profundal; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage:

Moderately Alkaline Oligotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM3)

Pisidium-Amphipoda Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Oligotrophic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Types 11, 12, possibly 13)

Assemblage Description:

VT ACWG (1998): low oxygen-tolerant, low light-tolerant organisms including bivalve (Pisidium) and amphipods (Amphipoda). NYHP: VT's profundal (Type 11), sublittoral (Type 12) and possibly littoral mud-sand (Type 13) associations are suspected to be similar and are tentatively lumped.

Macrohabitat Crosswalk:

NAP Oligotrophic Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake.

Microhabitats: sublittoral/profundal; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Mesotrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM4)**

Hexagenia-Pisidium Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Mesotrophic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Types 16,17,18)

Assemblage Description:

VT ACWG (1998): low oxygen-tolerant, low light-tolerant organisms including mayfly (Hexagenia) and bivalve (Pisidium). NYHP: VT's profundal (Type 16) and sublittoral (Type 17) associations seem identical and may also be similar to the mud-sand (Type 18) littoral assemblage; these are all tentatively lumped.

Macrohabitat Crosswalk:

NAP Eutrophic Dimictic Lake, STL Eutrophic Alkaline Dimictic Lake, STL Winter-Stratified Monomictic Lake, STL Summer-Stratified Monomictic Lake?

Microhabitats: sublittoral/profundal; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Eutrophic Dimictic Benthic Profundal-Sublittoral Macroinvertebrates (LAM5)**

Chaoborus-Oligochaeta-Chironomus Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Eutrophic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Types 21, 22, possibly 23-25)

Assemblage Description:

VT ACWG (1998): low oxygen-tolerant, low light-tolerant organisms including phantom midge (Chaoborus), oligochaetes (Oligochaeta) and midge (Chironomus). NYHP: VT's profundal and sublittoral assemblages appear identical and are tentatively lumped. Also appears similar to dystrophic profundal-sublittoral (LAM1, VT Lake Macroinvertebrate Types 1 and 2: NEED EXPERT COMPARISON). NYHP: oligochaetes are probably good indicator taxa. Reschke (1990): Chironomus and Chaoborus dominate, with a low species diversity assemblage.

Macrohabitat Crosswalk:

NAP Eutrophic Dimictic Lake, STL Eutrophic Alkaline Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake?, STL Summer-Stratified Monomictic Lake?

Microhabitats: sublittoral/profundal; above-ground.

Sources: VT ACWG (1998), Reschke (1990).

Macroinvertebrate Assemblage: **Acidic Dystrophic/Oligotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM6)**

Ferresia californica-Tribelos-Phaenopsectra Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Acidic Dystrophic/Oligotrophic Rocky Littoral Macroinvertebrates (VT Lake Macroinvertebrate Types 5, 10)

Assemblage Description:

VT ACWG (1998): species characteristic of hard substrates (e.g., shale, cobble, possibly woody debris) including snail (Ferresia californica), and midges (Tribelos and Phaenopsectra). NYHP: VT's dystrophic (Type 5) and clear/acidic (Type 10) assemblages appear similar and are tentatively lumped.

Macrohabitat Crosswalk: NAP Oligotrophic Dimictic Lake and (Oligotrophic) Acidic Pond, NAP Bog Lake.

Microhabitats: littoral; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Oligotrophic/Mesotrophic Benthic Littoral/Rocky Shoal Macroinvertebrates (LAM7)**

Amnicola-Physidae-Stenonoma Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Oligo-Mesotrophic Littoral Macroinvertebrates (VT Lake Macroinvertebrate Types 14, 15, 19, 20) =? NAP/STL Classification (2000): LAM23 below.

Assemblage Description:

VT ACWG (1998): species characteristic of hard substrates (e.g., shale, cobble, possibly woody debris) and possibly macrophyte beds associated with coarser substrates including snails (Amnicola limosa, Physidae) and mayfly (Stenonoma). NYHP: VT's rocky littoral and macrophyte assemblages for both oligotrophic and mesotrophic dimictic macrohabitats appear similar and are tentatively lumped. An oligotrophic-mesotrophic/mesotrophic-eutrophic split is suspected but VT shows no eutrophic species assemblages and only limited NY data has been analyzed or is available. If oligotrophic and mesotrophic variants are split, then the split may be based on diversity rather than mutually exclusive sets of species (per interpretation of VT macroinvertebrate assemblages), with the mesotrophic variant being more diverse. NYHP EOR (Lake George): Physa heterostropha is dominant, along with freshwater sponge and hydroids.

Macrohabitat Crosswalk:

NAP Eutrophic Dimictic Lake, STL Eutrophic Alkaline Dimictic Lake, NAP Oligotrophic Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake, STL Summer-Stratified Monomictic Lake, and NAP (Oligotrophic) Acidic Pond.

Microhabitats: littoral; above-ground.

Sources: VT ACWG (1998), NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Acidic Dystrophic/Oligotrophic Benthic Littoral Mud-Sand Macroinvertebrates (LAM8)**

Hyallela azteca-Musculium Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Dystrophic Tannic Mud-Sand Macroinvertebrates (VT Lake Macroinvertebrate Type 3)

Assemblage Description:

VT ACWG (1998) (Mud-Sand Littoral Areas): species characteristic of soft substrates (e.g., mud, possibly sand) including amphipod (Hyallela azteca) and bivalve (Musculium); in mud and sandy areas in littoral zone; in protected coves and bays of large lakes, often associated with macrophyte beds. NYHP EORs & Leads (Bog Lake): abundant or characteristic odonates (Odonata) and water beetles (Dyticidae).

Macrohabitat Crosswalk: NAP Bog Lake, NAP Oligotrophic Dimictic Lake.

Microhabitats: littoral; above-ground.

Sources: NYHP BCD Community EORs (2002), VT ACWG (1998).

Macroinvertebrate Assemblage: **Clear Acidic/Oligotrophic Benthic Littoral Mud-Sand Macroinvertebrates (LAM9)**

Dytiscidae-Corixidae-Notonectidae Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Clear Acidic, Oligotrophic/Dystrophic Tannic Mud-Sand Macroinvertebrates (VT Lake Macroinvertebrate Types 4, 8, 9)

=? NAP/STL Classification (2000): LAM17 below.

Assemblage Description:

VT ACWG (1998): species characteristic of soft substrates (e.g., mud, possibly sand) including water beetles (Dytiscidae), true water bugs (Corixidae and Notonectidae). NYHP: VT's mud-sand littoral for the clear/acidic (ponds) macrohabitat and macrophyte assemblages for both clear/acidic (ponds) and dystrophic macrohabitats appear identical and are tentatively lumped. A correlation with 1 or more specific macrophyte bed types (e.g., Nuphar/Nymphaea bed) and plant assemblages (see LAP assemblages above) is possible (NEED VT EXPERT TO ELABORATE).

Macrohabitat Crosswalk:

NAP (Oligotrophic) Acidic Pond? (CAN THIS ASSEMBLAGE BE FOUND IN THE TARN/HIGH ELEVATION VARIANT OF OLIGOTROPHIC POND?), NAP Oligotrophic Dimictic Lake.

Microhabitats: littoral; above-ground.

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **Subterranean Macroinvertebrates (LAM10)**

[unknown characteristic macroinvertebrates] Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Subterranean Macroinvertebrates (VT Lake Macroinvertebrate Type 28)

Assemblage Description:

VT ACWG (1998): species adapted to darkness. Steve Fiske: Amphipods are suspected. VT has limited data, no species listed. NYHP: no biotic data available or analyzed.

Macrohabitat Crosswalk: various Subterranean Lakes.

Microhabitats: littoral/sublittoral/profundal; subterranean

Sources: VT ACWG (1998).

Macroinvertebrate Assemblage: **NAP Temporary Palustrine Macroinvertebrates (LAM11)**
Mosquito-Caddisfly-Aquatic Beetle Assemblage
Synonymy/Affinities:
= VT ACWG (1998): Temporary Palustrine Macroinvertebrates (VT Lake Macroinvertebrate Type 27)
Assemblage Description:
VT ACWG (1998): species adapted to fluctuating water levels. VT has limited data, no species listed. NYHP: good data from only 1 EOR, suspected to differ from STL assemblage, need more data and evaluation. NYHP EOR: dominant fauna include mosquito larvae, springtails (Collembula) and caddisflies. Other abundant taxa: several types of aquatic beetles (e.g., Dytiscus sp., Gyrinidae/whirligig beetles).
Macrohabitat Crosswalk: NAP Vernal Pool.
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002), VT ACWG (1998).

Macroinvertebrate Assemblage: **STL Temporary Palustrine Macroinvertebrates (LAM12)**
[unknown characteristic macroinvertebrates] Assemblage
Synonymy/Affinities:
= VT ACWG (1998): Temporary Palustrine Macroinvertebrates (VT Lake Macroinvertebrate Type 27)
Assemblage Description:
VT ACWG (1998): species adapted to fluctuating water levels. VT has limited data, no species listed. NYHP: poor data, suspected to differ from NAP assemblage, need more data and evaluation. NYHP: poor data. NYHP EOR (STL Sinkhole Wetland): diverse assemblage of breeding (adult) damselflies, but in pond shore zone; may differ from (loamy) vernal pool and pine barrens vernal pond assemblages, need more data and evaluation.
Macrohabitat Crosswalk: STL Vernal Pool, possibly STL Sinkhole Wetland.
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002), VT ACWG (1998).

Macroinvertebrate Assemblage: **NAP Outwash Plain Temporary Palustrine Macroinvertebrates (LAM13)**
[unknown characteristic macroinvertebrates] Assemblage
Synonymy/Affinities:
= VT ACWG (1998): Temporary Palustrine Macroinvertebrates (VT Lake Macroinvertebrate Type 27)
Assemblage Description:
VT ACWG (1998): species adapted to fluctuating water levels. VT has limited data, no species listed. NYHP: fair data, suspected to differ from (loamy) vernal pool and sinkhole wetland assemblages, need more data and evaluation. NYHP EOR: Gerris sp. (neuston), water beetles (cf. Hydrophilidae).
Macrohabitat Crosswalk: NAP Pine Barrens Vernal Pond.
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002), VT ACWG (1998).

Macroinvertebrate Assemblage: **NAP Acidic Odonates (LAM14)**
Aeshna-Ischnura-Cordulia-Leucorrhinia Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Clear Acidic, Oligotrophic/Dystrophic Tannic Mud-Sand Macroinvertebrates (VT Lake Macroinvertebrate Types 4, 8, 9)
= NAP/STL Classification (2000): LAM9 above.
probably = NAP/STL Classification (2000): LAM17 below.
Assemblage Description:
Karen Frolich's SUNY Albany thesis defense seminar (2000): Acid-tolerant indicators include odonates (Cordulia and Leucorrhinia). Dominant widespread NAP indicators include odonates (Aeshna and Ischnura). Lower odonate diversity than LNE assemblages. Not as well correlated with trophic state as with acidity/alkalinity. In areas of low fish predation.
Macrohabitat Crosswalk:
NAP (Oligotrophic) Acidic Pond. Probably also in related types, but do not have information yet.
Microhabitats: littoral; above-ground.
Sources: VT ACWG (1998), Frolich (2000).

Macroinvertebrate Assemblage: **NAP Neutral (Alkaline) Odonates (LAM15)**
Aeshna-Ischnura-Gomphus-Basiaeschna Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Eutrophic Littoral Macroinvertebrates (VT Lake Macroinvertebrate Types 23-25)
(no dominant or characteristic species listed)
=? NAP/STL Classification (2000): LAM19 below.
=? NAP/STL Classification (2000): LAM21 below.
Assemblage Description:
Karen Frolich's SUNY Albany thesis defense seminar (2000): Acid-intolerant indicators include odonates (Gomphus and Basiaeschna). Dominant widespread NAP indicators include odonates (Aeshna and Ischnura). Lower odonate diversity than LNE assemblages. Not as well correlated with trophic state as with acidity/alkalinity. In areas of low fish predation. NYHP EOR: leeches abundant.
Macrohabitat Crosswalk:
NAP (Eutrophic) Alkaline Pond. Probably also in related types, but do not have information yet.
Microhabitats: littoral; above-ground.
Sources: VT ACWG (1998), Frolich (2000), NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **NAP Meromictic? Macroinvertebrates (LAM16)**
Freshwater Sponge Assemblage
Synonymy/Affinities:
= VT ACWG (1998): apparently no equivalent? (NEED EXPERT REVIEW/ASSESSMENT)
Assemblage Description:
NYHP EOR (Meromictic Lake): Freshwater sponge (Porifera?) predominant. Also dragonflies (Anisoptera), beetles (Coleoptera), true bugs (Hemiptera), dobsonflies (Megaloptera), and caddisflies (Trichoptera). More fauna data in ALS data sets.
Macrohabitat Crosswalk: NAP Meromictic Lake.
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **NAP Acidic Pond? Macroinvertebrates (LAM17)**
Notonectidae-Odonata-Sphaeriidae Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Clear Acidic, Oligotrophic/Dystrophic Tannic Mud-Sand Macroinvertebrates (VT Lake Macroinvertebrate Types 4, 8, 9)
= NAP/STL Classification (2000): LAM9 above.
=? NAP/STL Classification (2000): LAM14 above.
Assemblage Description:
NYHP EOR (Oligotrophic Pond): crayfish (Decapoda), odonates (Odonata), bivalve (Sphaeriidae), amphipods (Amphipoda), mayflies (Ephemeroptera), true bugs (Notonectidae), caddisflies (Trichoptera), beetles (Coleoptera), and water strider (Gerris). See LAM14 for probable characteristic odonates.
Macrohabitat Crosswalk: NAP (Oligotrophic) Acidic Pond.
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Riverine Odonates? (LAM18)**
unknown Odonate Assemblage
Synonymy/Affinities:
= VT ACWG (1998): Odonate-Dominated Floodplain Fauna (VT River Macroinvertebrate Type 6)
(NEED COMPARISON TO RIVER ASSEMBLAGES, especially "RAM6")
Assemblage Description:
NYHP EOR (Oxbow Pond): diverse odonate assemblage reported.
Macrohabitat Crosswalk: NAP Oxbow Pond, NAP Flow-Through Pond.
Microhabitats: pool; littoral; above-ground.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **NAP Winter-Stratified Monomictic? Macroinvertebrates (LAM19)**
Isopoda-Amphipoda-Planorbidae Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Eutrophic Benthic Littoral Macroinvertebrates (VT Lake Macroinvertebrate types 23-24?)
(No information on dominant or characteristic species from VT)
Assemblage Description:
(Eutrophic) NYHP EOR (Winter-Stratified Monomictic Lake): sowbugs (Isopoda), amphipods (Amphipoda), and Ramshorn Snail (Planorbidae). (Mesotrophic) NYHP EOR (Eutrophic Pond): leech (Hirundinea), if same assemblage.
Macrohabitat Crosswalk: NAP Winter-Stratified Monomictic Lake, NAP (Eutrophic) Alkaline Pond?
Microhabitats: littoral; above-ground.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Lake Champlain Profundal Macroinvertebrates (LAM20)**
Stylodrilus heringianus-Peloscolex variegatus-Sphaeridae Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Eutrophic Benthic Profundal Macroinvertebrates (VT Lake Macroinvertebrate Types 21, 22)
= NAP/STL Classification (2000): LAM5 above. (NEED EXPERT ASSESSMENT OF EQUIVALENCY).
Assemblage Description:
NYHP EOR (Summer-Stratified Monomictic Lake): Oligochaeta (Stylodrilus heringianus and Peloscolex variegatus), and bivalve (Sphaeridae).
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.
Microhabitats: profundal; above-ground.
Sources: NYHP BCD Community EORs (2002).

Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Mud Macroinvertebrates (LAM21)**
Elliptio complanata-Lampsilis radiata Assemblage
Synonymy/Affinities:
=? VT ACWG (1998): Eutrophic Benthic Littoral Macroinvertebrates (VT Lake Macroinvertebrate Types 23-25)
(no dominant or characteristic species known)
Assemblage Description:
Fiske & Levey (1996): low diversity, essentially only bivalves (Elliptio complanata and Lampsilis radiata).
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake, STL Oligotrophic Alkaline Dimictic Lake.
Microhabitats: littoral; above-ground.
Sources: Fiske & Levey (1996).

Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Sandy Flats Macroinvertebrates (LAM22)**

Lampsilis radiata-L. ovata-Potamilus alatus Assemblage

Synonymy/Affinities:

=? VT ACWG (1998): Eutrophic Benthic Littoral Sand Macroinvertebrates (VT Lake Macroinvertebrate Type 23)

Assemblage Description:

Low density, but high diversity, mussel assemblage; Elliptio complanata, Lampsilis radiata and several VT rare (& probably also NY rare) mussels; bivalves (Lampsilis ovata, Potamilus alatus and Leptodea fragilis) restricted to this association in lake (Fiske & Levey, 1996). Sandy delta is typical habitat.

Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.

Microhabitats: littoral; above-ground.

Sources: Fiske & Levey (1996).

Macroinvertebrate Assemblage: **Lake Champlain Benthic Littoral Rocky Shoal Macroinvertebrates (LAM23)**

Elliptio complanata-Lampsilis radiata-Amnicola limosa Assemblage

Synonymy/Affinities:

=? VT ACWG (1998): Eutrophic Benthic Littoral Rocky Shoal Macroinvertebrates (VT Lake Macroinvertebrate Type 25)

=? VT ACWG (1998): Oligotrophic Moderately Alkaline Macroinvertebrates (VT Lake Macroinvertebrate Types 14, 15, 19, 20)

= NAP/STL Classification (2000): LAM7 above. (LOOKS SIMILAR AT A GLANCE)

Assemblage Description:

Low mussel diversity, essentially only bivalves (Elliptio complanata and Lampsilis radiata) (Fiske & Levey 96), both at very high abundance Levey & Fiske (1996). Levey & Fiske (1996): most common snail (and organism?) Bithnyia tentaculata (52% relative abundance) is exotic; association prone to zebra mussel invasion. Widespread and numerous taxa include fingernail clams, scuds (amphipods), beetles (Coleoptera), midges (Chironomidae-Microtendipes, Pseudochironomus; 51% relative abundance), caddisflies (Trichoptera; 23% relative abundance). Functional composition dominated by scrapers, primarily snails, with deposit feeders second. Gastropod Amnicola limosa (24% relative abundamce) was second most abundant. See Levey & Fiske (1996) for numerous lesser abundant species; some of the more abundant of these apparently include Oligochaeta (Tubificidae), Gastropoda (Physa heterostropha, Stagnicola catascopium, Valvata tricarinata), Bivalvia (Pisidium casertanum, Sphaerium corneum), Amphipoda (Gammarus fasciatus), Trichoptera (Neophylax), and Coleoptera (Stenelmis).

Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.

Microhabitats: littoral; above-ground.

Sources: Levey & Fiske (1996), Fiske & Levey (1996).

Macroinvertebrate Assemblage: **Lake Champlain Sublittoral Macroinvertebrates (LAM24)**

Pyganodon cataracta-P. grandis Assemblage

Synonymy/Affinities:

=? VT ACWG (1998): Mesotrophic Profundal-Sublittoral Macroinvertebrates (VT Lake Macroinvertebrate Types 16, 17, 18??)

= NAP/STL Classification (2000): LAM4 above. (NEED EXPERT ASSESSMENT OF EQUIVALENCY).

Assemblage Description: bivalves (Pyganodon spp.) suspected on deep muck habitats (Fiske & Levey, 1996).

Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.

Microhabitats: sublittoral; above-ground.

Sources: Fiske & Levey (1996).

Fish Assemblage: **Dystrophic/High Elevation Acidic Lake Fish (LAF1)**

Brown Bullhead-Golden Shiner Assemblage

Synonymy:

= VT ACWG (1998): Dystrophic Lake Fish (VT Lake Fish Type 1)

= VT ACWG (1998): High Elevation, Acidic Lake Fish (VT Lake Fish Type 2)

=? GLB (2000): Small Inland Lakes Fish (GLB Fish Community Type IL2) (in part: poor match)

Assemblage Description:

Low diversity with highly tolerant species including brown bullhead (good indicator species) and golden shiner. Stocked brook trout common (pelagic association). NYHP EOR (Meromictic Lake): yellow perch, brown bullhead, white sucker. Stocked fish reportedly often/usually die in this specific macrohabitat type. Some examples with no fish. May be difficult to sort out pre-settlement assemblages (with little or no fish) from effects of acid rain (possibly reducing fish diversity and abundance). HIGH ELEVATION VARIANT: Lake trout (Salvelinus alpinus) cited in MEHP (1991).

Macrohabitat Crosswalk:

NAP Bog Lake; NAP Meromictic Lake? NAP (Oligotrophic) Alkaline Pond (ONLY IN HIGH ELEVATION TARN VARIANT)?

Microhabitats: pelagic, benthic?; above-ground.

Sources: NYHP BCD Community EORs (2002), MEHP (1991), VT ACWG (1998).

Fish Assemblage: **Oligotrophic Lake Fish (LAF2)**

Lake Trout-Round Whitefish Assemblage

Synonymy:

= VT ACWG (1998): Oligotrophic Lake Fish (VT Lake Fish Type 3)

=? GLB (2000): Small Inland Lakes Fish (GLB Fish Community Type IL2) (in part)

Assemblage Description:

Coldwater fish. Characteristic species include lake trout (Salvelinus namaycush), rainbow smelt, burbot, landlocked Atlantic salmon, and brook trout. Round whitefish (Prosopium cylindraceum) is less common but a good indicator species. Common exotic species include rainbow trout and brown trout.

Macrohabitat Crosswalk:

NAP Oligotrophic Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake. Primarily associated with pelagic part of oligotrophic lakes. Also found in profundal and hypolimnion zones of NAP Eutrophic Dimictic Lake & STL Eutrophic Alkaline Dimictic Lake (eutrophic and mesotrophic variants).

Microhabitats: pelagic, benthic?; above-ground.

Sources: VT ACWG (1998).

Fish Assemblage: **Mesotrophic-Eutrophic Lake Fish (LAF3)**

Chain Pickerel-Golden Shiner-Pumpkinseed-Largemouth Bass Assemblage

Synonymy/Affinities:

= VT ACWG (1998): Mesotrophic-Eutrophic Lake Fish (VT Lake Fish Type 4) (confirmed by R. Langdon)

=? GLB (2000): Small Inland Lakes Fish (GLB Fish Community Type IL2)

(Apparently best match for this type and better match than GLB Fish Community Type IL1; see LAF3A below)

Assemblage Description:

VT ACWG (1998): High diversity assemblage: warmwater to "coolwater" (i.e., "transitional") species. Common species include esocids (e.g., chain pickerel, northern pike), cyprinids (e.g., golden shiner, emerald shiner, mimic shiner, bluntnose minnow, fallfish), white sucker, longnose sucker, brown bullhead, centrachids (e.g., rock bass, bluegill, pumpkinseed, smallmouth bass, largemouth bass) and percids (e.g., yellow perch, walleye). Rarer indicator species may include redfin pickerel. Smallmouth bass and yellow perch may be native to some lakes but have been commonly introduced to other lakes, possibly more oligotrophic lakes where they are restricted to littoral areas. NYHP EOR (NAP Winter-Stratified Monomictic Lake): yellow perch, white sucker, pumpkinseed, brown bullhead (crosswalks best here?). NYHP EOR (STL Oligotrophic Dimictic Lake/Lake George): fantail darter and johnny darter common on rock and sand. GLB Fish Community Type IL2 has similar species and additionally central mudminnow and northern redbelly dace: are these more western species? are they in NAP/STL? if not, is the overall assemblage difference large enough to designate a new type separate from more western parts of the GL Basin?

Macrohabitat Crosswalk:

STL Eutrophic Alkaline Dimictic Lake. Also found in littoral area of NAP Oligotrophic Dimictic Lake and , STL Oligotrophic Alkaline Dimictic Lake. Possibly also NAP Winter-Stratified Monomictic Lake.

Microhabitats: benthic, pelagic?; above-ground.

Sources: NYHP BCD Community EORs (2002), VT ACWG (1998), GLB (2000).

Fish Assemblage: **(STL?) Eutrophic/Warmwater Lake Fish (LAF3A)**

Yellow Perch-Walleye-Northern Pike Assemblage

Synonymy/Affinities:

= variant of LAF3. Significantly more diverse than NAP equivalent?

=? GLB (2000): Large Inland Lakes Fish (GLB Fish Community Type IL1)

(Apparently best match for this type and better match than GLB Fish Community Type IL2; see LAF3 above)

Assemblage Description:

NYHP EOR (NAP Eutrophic Dimictic Lake): abundant yellow perch, bullhead (Ictalus sp.). NYHP Leads & Schiavone (1984): same fish plus very diverse assemblage with species reported in Reschke (1990): walleye, largemouth bass, and additional ones: northern pike, smallmouth bass, muskellunge, white sucker, rock bass, bluegill, pumpkinseed?, longnose gar, channel catfish, black crappie (exotic?). GLB Fish Community Type IL1 has similar species (good correlation) and additionally lake herring and lake whitefish: are these in STL? if not, is the overall assemblage difference large enough to designate a new type separate from more western parts of the GL Basin? R. Langdon: northern pike is a better indicator than muskellunge.

Macrohabitat Crosswalk: STL Winter-Stratified Monomictic Lake, NAP Eutrophic Dimictic Lake.

Microhabitats: benthic; above-ground.

Sources: Schiavone (1984), NYHP BCD Community EORs (2002), NYHP Community Leads (2002), GLB (2000).

Fish Assemblage: **Oligotrophic Epilimion/Pond Fish (LAF4)**

(unknown characteristic fish) Assemblage

Synonymy/Affinities:

=? subset of VT ACWG (1998): Oligotrophic Lake Fish (VT Lake Fish Type 3)

=? GLB (2000): Small Inland Lakes Fish (GLB Fish Community Type IL2) (in part)

Assemblage Description:

Hypothesized assemblage with concept similar to LAF2 but probably containing only epilimnion/littoral species and missing hypolimnion/profundal species. MEHP (1991): lake trout (in high elevation settings; NYHP: not expected in shallow ponds; need expert assessment) Does pond size mean warmwater and thus not LAF2 subset but rather LAF3 subset in oligotrophic ponds? May be difficult to sort out pre-settlement assemblages (with little or no fish) from effects of acid rain (possibly reducing fish diversity and abundance). The combination of acidity and shallowness probably decreases diversity of fish. Some examples with no fish. GLB (2000) crosswalks NAP (Oligotrophic) Acidic Pond and related lakes to GLB Fish Community Type IL2 (= warmwater/eutrophic fish: LAF5 or LAF3 of NAP/STL assemblage classification): need to resolve discrepancy.

Macrohabitat Crosswalk: NAP (Oligotrophic) Acidic Pond, NAP Flow-Through Pond, NAP Oxbow Pond???.

Microhabitats: littoral; epilimnion; above-ground.

Sources: VT ACWG (1998), MEHP (1991), NYHP Community Leads (2002).

Fish Assemblage: **Eutrophic-Mesotrophic Epilimnion/Pond Fish (LAF5)**

(unknown characteristic fish) Assemblage

Synonymy/Affinities:

=? subset of VT ACWG (1998): Mesotrophic-Eutrophic Lake Fish (VT Lake Fish Type 4)

=? GLB (2000): Small Inland Lakes Fish (GLB Fish Community Type IL2) (in part)

Assemblage Description:

Hypothesized assemblage with concept similar to LAF3 but probably containing only epilimnion/littoral species and missing hypolimnion/profundal species. NYHP Leads: coldwater fish (brook trout; D.Hunt annotation: seems suspicious for this type of pond: stocked?)

Macrohabitat Crosswalk: NAP (Eutrophic) Alkaline Pond, STL Alkaline Pond, STL Flow-Through Pond, STL Oxbow Pond.

Microhabitats: littoral, epilimnion; above-ground.

Sources: NYHP Community Leads (2002).

Fish Assemblage: **Lake Champlain Fish (LAF6)**

Yellow Perch-Sauger-Burbot-Slimy Sculpin Assemblage

Synonymy:

= VT ACWG (1998): (VT Lake Fish Type 3) (in part, much more diverse than typical LAF3)

=? GLB (2000): Great Lakes Fish (GLB Fish Community Type GL1)

Assemblage Description:

VT ACWG (1998): Very high diversity assemblage with many unique species not found in other lake types in the region. NYHP EOR (Lake Champlain): 80 native fish species, in order of abundance: yellow perch, rainbow smelt, cisco, rock bass, walleye, brown bullhead, common sucker, northern pike and minnows. (VT ACWG, 1998 & NYHP EOR): Indicator species include sauger, lake sturgeon, burbot, round whitefish, longnose gar, bowfin, mooneye, cisco, quillback, multiple species of redhorses (including greater and black), channel catfish, freshwater drum and several species of minnows (rare blackchin shiner) and darters (including Iowa). Trophic Structure: large predators=Atlantic salmon, lake trout; small predators=gar, bowfin, lamprey; prey fish=minnows, darters, sculpin. GLB (2000): several indicators present in STL including lake whitefish; four additional species apparently lacking from Lake Champlain include lake herring, gizzard shad, alewife and white bass.

Macrohabitat Crosswalk:

STL Summer-Stratified Monomictic Lake, GL Summer-Stratified Monomictic Lake, STL Subterranean Lake.

Microhabitats: benthic/pelagic; above-ground.

Sources: NYHP BCD Community EORs (2002), VT ACWG (1998), GLB (2000).

Fish Assemblage: **Fishless Lakes (LAF7)**

Fishless Lake Assemblage

Assemblage Description:

NYHP proposed assemblage. Environmental features too limiting to support fish (e.g., water too shallow or temporary, light intensity too low, slope too steep).

Macrohabitat Crosswalk:

NAP & STL Vernal Pools and similar intermittent ponds {Pine Barrens Vernal Ponds, Sinkhole Ponds, GL Marl Pond}.

Microhabitats: littoral; above-ground/subterranean.

Sources:

Herpetofauna Assemblage: **STL Vernal Pool Herpetofauna (LAH1)**

Ambystoma (maculatum, jeffersonianum, A. laterale)-Rana sylvatica-Hemidactylium scutatum Assemblage

Synonomy/Affinities:

= VT ACWG (1998): Under 1200 feet Vernal Pool (VT Lake Herptile Type 1)

Assemblage Description:

Widespread species include the amphibians spotted salamander (Ambystoma maculatum), American toad (Bufo americanus), spring peeper (Pseudacris crucifer; = Hyla crucifer), wood frog (Rana sylvatica) and the reptile common garter snake (Thamnophis sirtalis). Limited species include the amphibians Jefferson salamander (Ambystoma jeffersonianum), blue-spotted salamander (A. laterale), four-toed salamander (Hemidactylium scutatum) and the reptile eastern ribbon snake (Thamnophis sauritus). Very limited species include the amphibian Fowler's toad (Bufo woodhousii var. fowleri) and western chorus frog (Pseudacris triseriata) and the reptile spotted turtle (Clemmys guttata). May also include green frog (Rana clamitans), leopard frog (R. pipiens) (NYHP Sinkhole Wetland EOR). May need to develop different assemblage for Pine Barrens Vernal Pond: data for this lake type includes: Dominated by spring peeper (Pseudacris cruciata), with associated Green frog (Rana clamitans), exotic bullfrog (R. catesbyiana); Could Bufo woodhousii (listed in Reschke, 1990 for this community type and in VT ACWG (1998) in this assemblage type) be in NAP/STL examples of this lake type?

Macrohabitat Crosswalk: STL Vernal Pool; STL Sinkhole Pond, NAP Pine Barrens Vernal Pond.

Microhabitats: littoral; above-ground.

Sources: NYHP BCD Community EORs (2002), VTHP (1996), VT ACWG (1998), Reschke (1990).

Herpetofauna Assemblage: **NAP Vernal Pool Herpetofauna (LAH2)**

Ambystoma maculatum-Pseudoacris crucifer-Rana sylvatica Assemblage

Synonomy/Affinities:

= VT ACWG (1998): Over 1200 feet Vernal Pool (VT Lake Herptile Type 2)

Assemblage Description:

Widespread species include the amphibians spotted salamander (Ambystoma maculatum), American toad (Bufo americanus), spring peeper (Pseudacris crucifer), wood frog (Rana sylvatica) and the reptile common garter snake (Thamnophis sirtalis). NYHP EOR: add red spotted newt (Notophthalmus viridescens), green frog (Rana clamitans). Apparently similar to VT Lake Herptile Type 1 but less diverse: lower elevation species missing? no unique higher elevation species?

Macrohabitat Crosswalk: NAP Vernal Pool.

Microhabitats: littoral; above-ground.

Sources: NYHP BCD Community EORs (2002), MEHP (1991), VT ACWG (1998).

Zooplankton Assemblage: **NAP Dystrophic Zooplankton (LAZ1)**
Keratella-Brachionus-Chaoborus Assemblage
Assemblage Description:
NYHP EOR: Rotifers are abundant (dominated by Keratella, associated Brachionus), and Copepod (abundant Chaoborus). Compare VT's Chaoborus in benthic zone of NAP Bog Lake (treated there as a macroinvertebrate instead of zooplankton).
Macrohabitat Crosswalk: NAP Bog Lake.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **NAP Meromictic? Zooplankton (LAZ2)**
Diaphanasoma brachyurium-Ceriodaphnia Assemblage
Assemblage Description:
NYHP EOR (Meromictic Lake): Diaphanasoma brachyurium (70% relative abundance), Ceriodaphnia (20% relative abundamce), Copepods, Nauplii, Holopedium, and Bosmina.
Macrohabitat Crosswalk: NAP Meromictic Lake.
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **NAP Acidic Pond? Zooplankton (LAZ3)**
Keratella-Nauplii Assemblage
Assemblage Description:
NYHP EOR (Oligotrophic Pond): dominants include Rotifers (Keratella) and Naupilus. Suspected to be a low diversity assemblage relative to corresponding dimictic lake assemblage.
Macrohabitat Crosswalk: NAP (Oligotrophic) Acidic Pond.
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **Lake Champlain Summer/Fall Epilimnion Zooplankton (LAZ4)**
Daphnia spp.-Diaptomus spp. Assemblage
Assemblage Description:
Abundant summer zooplankton, dominated by cladocerans (Daphnia retrocurva and D. galeata) and copepods (Diaptomus sicilis, D. minutus and D. oregonensis).
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **Lake Champlain Winter/Spring Epilimnion Zooplankton (LAZ5)**
Limnocalanus macrurus-Cyclops becuspidatus thomasi Assemblage
Assemblage Description:
Sparse spring zooplankton, dominated by copepods (Limnocalanus macrurus and Cyclops becuspidatus thomasi).
Macrohabitat Crosswalk: STL Summer-Stratified Monomictic Lake.
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **Oligotrophic-Mesotrophic Lake? Zooplankton (LAZ6)**
Keratella-Polyarthra-Bosmina-Daphnia Assemblage
Synonomy/Affinities: Appears similar to LAZ2 and LAZ3, but evidently much more diverse.
Assemblage Description:
NYHP EORs (Oligotrophic Dimictic Lake): dominated by Rotifers (including Keratella, Kellicotia, Polyarthra), Cladocerans (Diaphanosoma, Holopedium, Bosmina, Ceriodaphnia and Daphnia spp.), Cyclopoids, Scuds, and Daphnia. Daphnia spp. may be restricted to the moderately alkaline variant. NYHP EOR (Eutrophic Pond): dominated by Cyclopoids and Nauplii, with Rotifers {Keratella, Polyarthra}, and Cladocera {Bosmina, Daphnia, Diaphanasoma}.
Macrohabitat Crosswalk:
NAP Oligotrophic Dimictic Lake, STL Oligotrophic Alkaline Dimictic Lake, NAP (Eutrophic) Alkaline Pond & Winter-Stratified Monomictic Lake (appears similar).
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).

Zooplankton Assemblage: **Eutrophic Lake? Zooplankton (LAZ7)**
Daphnia dubia-Keratella-Diaptomus-Bosmina Assemblage
Synonomy/Affinities: Appears similar to LAZ4 (Need expert assessment of equivalency).
Assemblage Description:
NYHP EOR (Eutrophic Dimictic Lake): dominated by Keratella cf. cochlearis, Diaptomus and Bosmina. Daphnia dubia in small amounts. NYHP EOR (Mesotrophic Dimictic Lake): dominated by Daphnia dubia, with Nauplii.
Macrohabitat Crosswalk: NAP Eutrophic Dimictic Lake.
Microhabitats: littoral, epilimnion; above-ground.
Sources: NYHP BCD Community EORs (2002).