# The Nature Conservancy - Africa Region
# Continental Prioritization and Decision Support

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***Executive Summary***

The Nature Conservancy is relatively new to Africa conservation. In order to achieve maximum impact on a large, complex, and highly threatened continent with globally significant biological diversity, the Conservancy's Africa Regional Team identified a long-term vision to narrow the focus of their efforts over the next decade. Their vision is to conserve large, intact areas of high biodiversity value where critical natural processes persist and can be maintained for the long-term. A continental assessment was conducted to help support programmatic decisions necessary to refine and implement this vision. Two key questions emerged: First, where are the priority geographies that best advance this vision? Second, what information can help to evaluate new opportunities within these geographies for this young and growing program?

Priority geographies were identified via a multi-staged process that explicitly incorporated key components of the long-term vision. First, terrestrial and freshwater ecoregions of globally outstanding biological diversity were identified based on the extensive continental assessments conducted by the World Wildlife Fund. Using similar methods, a new suite of globally outstanding coastal/marine ecoregions were developed. Second, the most recent global and continental information was gathered to assess three criteria important for selecting priorities: 1) habitat condition, 2) conservation management, and 3) future threats. From one to several databases were combined into a single rating for each of these three criteria. Third, to improve the chances of successful conservation, all ecoregions with the poorest criteria rating (i.e., in the lowest 25% of all ecoregions for each criteria) were removed as potential priorities. Fourth, the priority of all remaining ecoregions were rated based on the number of criteria met. Ecoregions of globally outstanding biodiversity value and in the most favorable status (upper 75%) for all criteria (habitat condition, conservation management, and future threat) were identified as the highest priority level. This resulted in a total of 38 of 237 (16%) ecoregions selected as priorities, distributed across terrestrial, freshwater and marine ecoregions (i.e., 26 (22%) terrestrial, 6 (7%) freshwater, and 6 (19%) coastal/marine ecoregions). Finally, 17 of 38 (45%) priority ecoregions overlapped, and were considered the highest priorities for global biodiversity conservation.

We selected three issues to illustrate how continental information will be used to evaluate new opportunities within these priority areas. Others issues, such as public and private potential for conservation success, will be the focus of further assessments. First, we selected countries that captured ecoregional priorities and ranked them according to their governance quality as an indicator of successful long-term investment. Ten countries were identified as high priorities for investment (all six countries where the Conservancy currently works as well as South Africa, Lesotho, Gabon, and Malawi). Five additional countries (Swaziland, Cameroon, Ethiopia, Burundi, and Congo) presented slightly lower priorities for long-term investment. Second, several of these potential expansion countries (e.g., Gabon, Congo, Cameroon) presented alternatives for diversifying the Conservancy's current partnership portfolio. Third, we proposed introducing principles of experimental design to learn more about climate adaptation strategies. We illustrated one example of two projects working on similar climate adaptation strategies across a gradient of projected changes in temperature and precipitation, and proposed that approach would improve our ability to learn more about how robust these adaptation strategies would be to differing amounts of climate change.

### *Introduction*

The continent of Africa is the second largest on the globe in size (one fifth of all land area) and human population (it contains one seventh of all the people the world). There are more countries in Africa than any other continent, and it consistently retains its economic ranking as the poorest of the poor. It is within this context that The Nature Conservancy's Africa Regional Program must navigate to find a course that will produce meaningful conservation results.

In contrast, the Africa Region is the Nature Conservancy's youngest and smallest international program. Initially, investment in Africa was based on a relatively quick assessment of conservation value and partnership opportunities, later matched with organizational capacity and ability to launch a new program on a new continent. Over the first three years of the program, a great deal of additional information, capacity, and experience accrued. A more thorough priority setting process was needed to make the selection of priority areas more transparent, and to incorporate the most recent information to inform decision-making. A flexible information system was needed to more effectively evaluate the relative importance and risk of that new opportunities present, and a means for using this information to chart a more strategic course to achieving the long-term vision.

This document describes how a continental prioritization process was developed, and presents illustrative examples of how this information feeds into a decision support system for the Africa Region. The intent was to explicitly incorporate the most recent continental or global datasets to inform how best to navigate this large and complex continent. The aspiration was to help the Conservancy's Africa Region more effectively achieve its long-term vision, and advance the global mission of The Nature Conservancy.

### *Long-Term Conservation Vision*

The Nature Conservancy's Africa Regional Team recently defined its long-term conservation vision: to conserve large intact areas of high biodiversity value where critical natural processes can be maintained for the long-term. In these places, local people are dependent on natural resources for their survival, and play an integral role in securing important ecological functions that benefit nature and people. The Africa Regional Team believes it is a priority to focus on conserving areas that provide the greatest chance of providing critical ecosystem services in the long-term to a continent struggling with poverty and the provision of basic human needs. It is our assumption that large areas where natural processes persist provide some of the best opportunities to achieve this vision. It is our hope that through successful conservation work in these areas, our efforts will provide significant benefits to people and nature.

### *Conservation Approach*

The Nature Conservancy started working in Africa three years ago, in service of the global mission to conserve the plants, animals, and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. This mission to conserve biological diversity is supported by a long-term goal to conserve a significant portion of all major habitat types on earth. The sheer size of Africa and its spectacular abundance and diversity of wildlife and habitats made the task of identifying priorities for a small and young program challenging. Initially, the Conservancy's main focus was to work in a few places and develop partnerships with other conservation organizations that already had decades of on-the-ground experience. Through these partnerships, the Conservancy could learn what added value we could bring to this vast and impressive continent.

In order to achieve our long-term vision for Africa, we built upon the Conservancy's organizational theory of change (Conservation by Design), and identified four key elements to define a region-specific conservation approach: 1) Select Priority Places, 2) Enable Community Conservation, 3) Sustain Long-Term Commitments and 4) Influence policy for greater leverage and impact. In order to implement this conservation approach, three guiding principles were identified to serve as programmatic anchors for the next five years:

- Work in complementary partnership with local organizations to dramatically increase the impact of all conservation work and influence policy work;
- Increase the capacity of partner organizations and projects by transferring technical tools, skills and resources to achieve long-term conservation results; and
- Advance projects that demonstrate a successful link between conservation and human well-being for replication in other priority areas.

The remainder of this document describes how a continental prioritization process was developed and used to support implementing the Africa Program's Conservation Approach.

***Information and Decision Support***

The first step was to identify the major conservation decisions that would support implementing this Conservation Approach. Given the enormity of Africa as a continent, and the Conservancy's current and limited capacity, two key decisions emerged:

(1) to select a reduced set of geographic conservation priorities that provide our best chance of advancing our long-term vision; and

(2) to evaluate new opportunities that arise within those priority areas.

The following table describes the decision support system developed to advance these two major decisions, including a suite of related questions identified to make these decisions, and the information available at the continental scale to help answer them (Table 1).

***Continental Prioritization Process – Selecting Geographic Priorities***

**Baseline Data Assessment**

The first step in the Africa Region's Conservation Approach is to identify priority places. At the continental scale, these places are ecoregions, defined as large, broad-scale ecological units that of land or water that are relatively homogenous, sharing similar climate, geology, topography, hydrology, soils, vegetation, and disturbance regimes. Ecoregions are the unit of analysis where the most biodiversity information is available.

Building on the rich global datasets assembled by the Conservancy's 2015 Goal process (TNC 2006), and resultant Atlas Project (TNC 2009), additional information was collected from several continental assessments and recently updated global datasets. In particular, the World Wildlife Fund (WWF) conducted extensive continental analyses of Africa for terrestrial ecoregions (Burgess et al., 2004, 2006) and freshwater ecoregions (Thieme et al., 2005), used extensively in this effort (see below). Other global datasets of importance include several continental and global datasets used to construct a comparable ecological assessment of coastal/marine ecoregions (Spalding et. al., 2007) to follow similar methods to the WWF terrestrial and freshwater assessments. Some global information has recently been updated, such as the Wildlife Conservation Society's Human Footprint information (http://www.wcs.org/humanfootprint/ ), and the latest global landcover database (Globcover 2005; http://www.gofc-gold.uni-jena.de/sites/globcover.php ). An overview of the information used in the prioritization process is illustrated in Figure 1, followed by a brief description of the four primary data layers.  A comprehensive list of information used in this analysis is found at the end of this report (Appendix 1).

**Table 1.** Conceptual framework for using continental information to inform decision making for the Conservancy's Africa Region over the next five years.

| Decision | Question | Continental Information |
|---|---|---|
| **Select Geographic Priorities** | Where is Biodiversity value highest? | Ecoregions rated according to an index of biological distinctiveness |
| | Which areas best support natural processes now? | The degree of natural land cover conversion per ecoregion |
| | Which areas are most likely to support biodiversity and natural processes in the future? | The degree of threat per ecoregion |
| | Which areas best support natural resource management? | The extent of protected area systems per ecoregion. |
| **Evaluate New Opportunities** | Which areas have conditions more favorable for investment? | Index of social, political and economic factors by country |
| | Which areas improve our learning about partnerships? | Number and types of NGOs per country, and extent of foreign investment |
| | Which areas improve our ability to learn about adaptation to climate change? | Projected changes in temperature, precipitation, and vegetation stress over the next 50-100 years. |

We included data published in scientific journals or books, posted on the web with suitable metadata, or gathered for the TNC Atlas Project (TNC 2009) to answer the questions in our decision framework.  All remaining information was considered for use in evaluating new opportunities (see below).

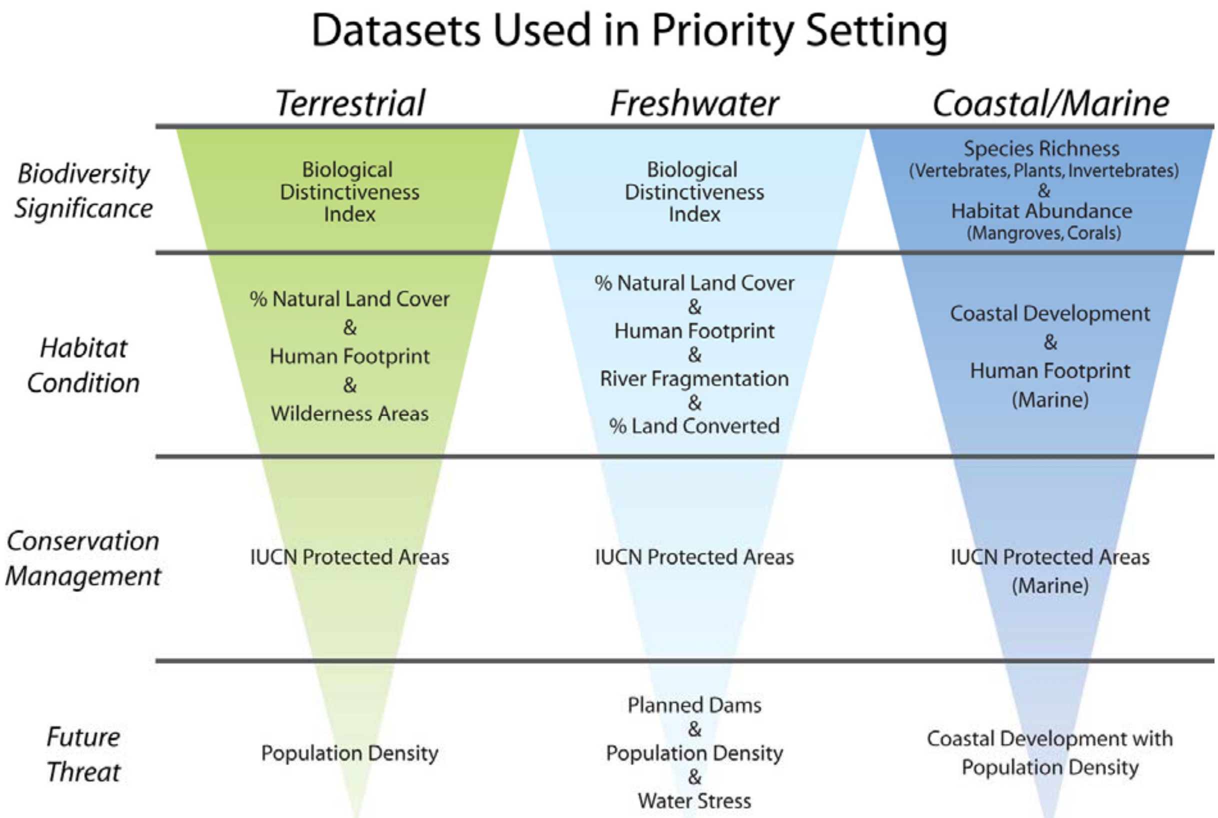


**Figure 1.** Datasets used in identifying priority ecoregions for each of the three major ecoregion types: terrestrial, freshwater, and marine. The sequential process in which these datasets were combined (from top to bottom) resulted in progressively fewer ecoregions with each step.

**Prioritization Methods**

The prioritization model used four primary data layers that were assembled in the following order: (1) Biodiversity Significance, (2) Habitat Condition, (3) Conservation Management Status, and (4) Future Threats. The rationale for this sequencing, and the data used is described briefly as follows:

*1) Biodiversity Significance*

Grounded by our mission to conserve the plants, animals and natural communities that represent the diversity of life on earth, our most important factor in prioritizing ecoregions was biodiversity value. Based on the extensive published work of the World Wide Fund for Nature (WWF) for terrestrial (Burgess et al., 2004, 2006) and freshwater (Thieme et al., 2005) ecoregions, we adopted their biological distinctiveness index (BDI). This index was based primarily on species richness (number of species) and endemism (uniqueness of species), as well as other globally outstanding criteria such as ecological phenomena (e.g., large population assemblages), wilderness areas, evolutionary phenomena, rare habitats, etc. primarily identified via expert review and input.

Based on the long-term vision for the region, all terrestrial ecoregions defined by Burgess et al. (2004) as wilderness areas (large and intact) and contain globally outstanding ecological phenomena (e.g., wildlife migrations and large population assemblages) were elevated as globally significant in this analysis (Appendix 2). This information was used to override inappropriate habitat condition assessments (see below) due to misclassification of these ecoregions as non-natural habitat/cultivated lands.

We adapted Thieme et. al.'s (2005) freshwater BDI approach for coastal marine ecoregions, and using the coastal/marine ecoregions for Africa identified by Spaulding et al. (2007). Comparable coastal/marine ecoregional BDI values were generated using continental and global datasets. Species richness values were derived separately for each of the three taxonomic groups (vertebrates, invertebrates, and plants) due to the significant differences in numbers of species (orders of magnitude) among these groups. The species richness values included marine mammals and seabirds (vertebrates), seagrass and mangroves (plants), and coral (invertebrates). Using Jenks natural breaks, all ecoregions were rated on a scale of one (low) to three (high) for each taxonomic group, with a range of values from three to nine. These scores were then divided into quartiles, selecting only the highest rated ecoregions (upper 25%). Global habitat abundance estimates for coral and mangrove cover were used to identify globally outstanding ecoregions (i.e., in the highest quartile of all ecoregions in the globe), and were added to the list of ecoregions selected for species richness. A detailed list is of the information used in this analysis is available in Appendix 1.

*2) Habitat Condition*

The second most important factor in our prioritization sequence was current habitat condition. As habitat fragmentation and land conversion are considered the most significant problems for conservation, we used this data layer to exclude those ecoregions in the poorest current condition. The intent is to focus on those ecoregions that are relatively less degraded and therefore have a higher chance of continuing to function for nature and for people. This approach increases our chance of successful implementation of any project that we might undertake in a priority ecoregion. With limited resources, the Regional Team did not want to devote substantial resources toward habitat restoration in the near term, but instead make sure that priority areas functioning now do not degrade further.

We used natural land cover data (GlobCover 2005) to determine what percent of each ecoregion was still in natural land cover. We also used the Human Footprint (2003) data layer to address the degree of human influence and fragmentation. For freshwater ecoregions we also examined river fragmentation, and for marine ecoregions we evaluated the extent of coastal development in combination with the marine human footprint. In contrast to the selection of the most significant biodiversity values, for habitat condition and the other two layers (see Conservation Management and Future Threats below), ecoregions rated the poorest (the lowest quartile) were removed as priorities from this process.

*3) Conservation Management*

One of the fundamental guiding principles of The Nature Conservancy's Africa Region is that protected area systems provide a crucial building block for conservation, but alone are not sufficient to achieve long-term success. With limited capacity, the Conservancy intends to focus efforts on those places where a protected areas system is in place, and work to address local issues in and around the protected areas.

Protected areas are defined as *"*an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (http://www.unep-wcmc.org/protected_areas/categories/index.html). Under this definition, the World Commission on Protected Areas defines six categories of protected areas (WCPA 2009). Categories I to III are mainly concerned with the protection of natural areas where direct human intervention and modification of the environment has been limited;  in categories IV, V and VI significantly greater intervention and modification will be found (Table 2).

**Table 2.** International protected area categories, primary management obectives, and definitions.

| IUCN Category | Title | Primary Management Objective | Definition |
|---|---|---|---|
| I | Strict Nature Reserve / Wilderness Area | Strict protection: science or wilderness protection | Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring. |
| II | National Park | Ecosystem protection and recreation | Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible. |
| III | Natural Monument | Conservation of specific natural features | Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance. |
| IV | Habitat/ Species Management Area | Cconservation through active management | Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species. |
| V | Protected Landscape/ Seascape | Landscape/ seascape conservation and recreation | Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area. |
| VI | Managed Resource Protected Area: | Sustainable use of natural ecosystems | Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs. |

This third data layer was composed of those ecoregions with the largest percentage of protected area systems. Based on the latest World Database on Protected Areas (WDPA 2009), we selected those ecoregions with the greatest portion of their area currently designated as protected areas. Based on expert opinion in areas where we currently work, we focused our assessment on protected areas I-IV , as the information for categories V an VI was not considered reliable. We removed those ecoregions that rated the lowest across the continent (i.e., in the lowest quartile) for percent of land and water in protected areas.

We recognize that cumulative size of all protected areas is a crude metric. By definition, these categories are not a comment on their management effectiveness. We expect that additional information currently available on protected area systems in Africa that is not consistent or complete enough for use in continental assessments, such as non-traditional protected areas (IUCN classes V-VI), and conservation management effectiveness surveys, will be useful when evaluating opportunities (see below).

*4) Future Threats*

Our fourth and final data layer included modeled information that projected a future condition of potentially negative impact to conservation – i.e., a future threat. For all three ecoregion types projected population density in 2015 was a foundational data layer. In addition, we added in planned dams and projected water stress for freshwater ecoregions, and projected coastal development in combination with high projected population growth for coastal/marine ecoregions.

As with the other data layers mentioned above, we removed those ecoregions with the poorest rating (i.e., in the lowest quartile for combined threats). Given that this data layer is composed of entirely modeled data, we had less confidence than with other data layers where ground-truthing occurred. Therefore, we placed it last in our prioritization sequence, which reduced its importance in the priority level rating scheme. It is noteworthy that we did not use information on threatened species in this layer as have previous assessments (e.g., Burgess et al., 2004, 2006; Thieme et al., 2005) because in our view, this information did not present a future threat, but rather represents a current condition. This information was used to evaluate new opportunities – and to develop strategies to address threatened species where the threatened status (low or declining numbers) was the consequence of human action, and not due to natural rarity, uniqueness, or other natural factors (e.g., restricted range) that might account for low population numbers.

**Identifying Priority Ecoregions**

To find the highest priority ecoregions within each ecoregion type that support the Conservancy's biodiversity mission, a four step sequential process was developed that included the most important elements first, and least important last. The first step was to select a subset of ecoregions with the highest biodiversity value (i.e., rated globally outstanding). The next step removed those ecoregions with the poorest habitat condition (lowest quartile) on the continent relative to other ecoregions. This process of removing ecoregions was repeated next for protected area systems, and finally for future threats. The sequential process resulted in a progressive decrease in the number of ecoregions eligible to become an ecoregional priority (Fig. 2).

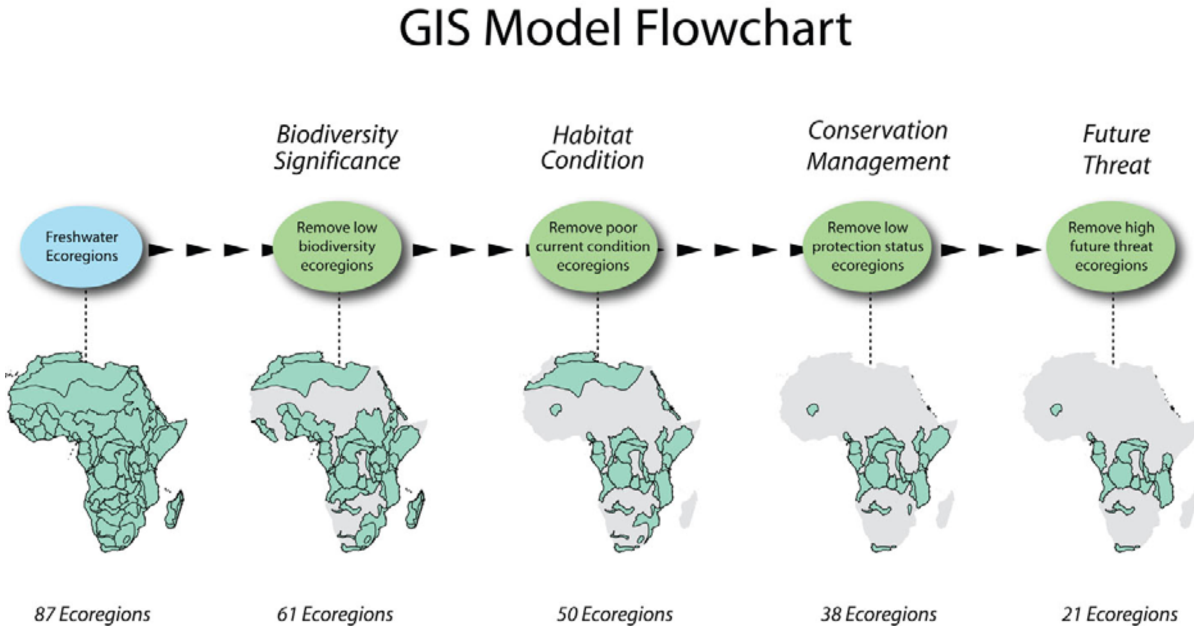


**Figure 2.** Illustration of the progressive reduction of priority freshwater ecoregions during the sequential prioritization process.

ArcGIS ModelBuilder and Spatial Analyst were used to create a GIS model to identify those ecoregions with the highest priority status (Fig. 3). We divided all ecoregions within each ecoregion type into four priority level categories according to how many of the four criteria were met as follows: Very High = met all four criteria, High = met first three criteria, Medium = met first two criteria, Low = met first criteria only (ie., biodiversity significance). Ecoregions that met none of the prioritization criteria were not a priority. Threshold values used in this model are provided in Appendix 3.

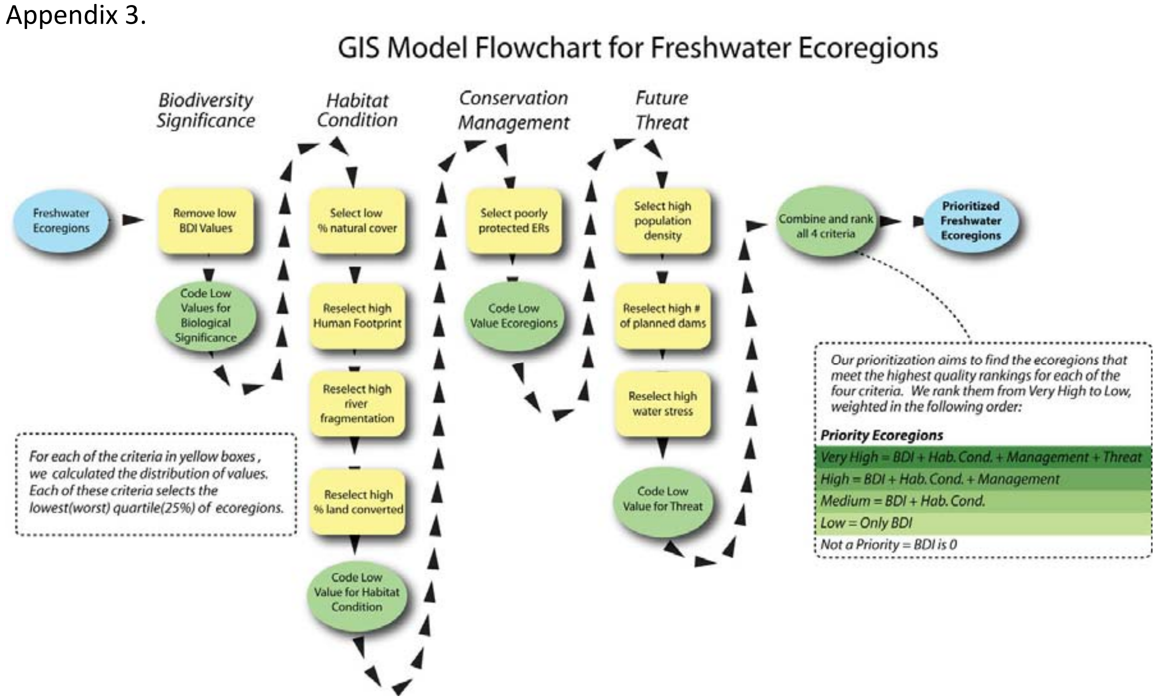


**Figure 3.** Schematic of the GIS model used to combine continental information from four primary data sets (biodiversity value, habitat condition, conservation management, and threat) in a sequential process to identify freshwater ecoregional priorities. Similar models were used for terrestrial and coastal/marine assessments.

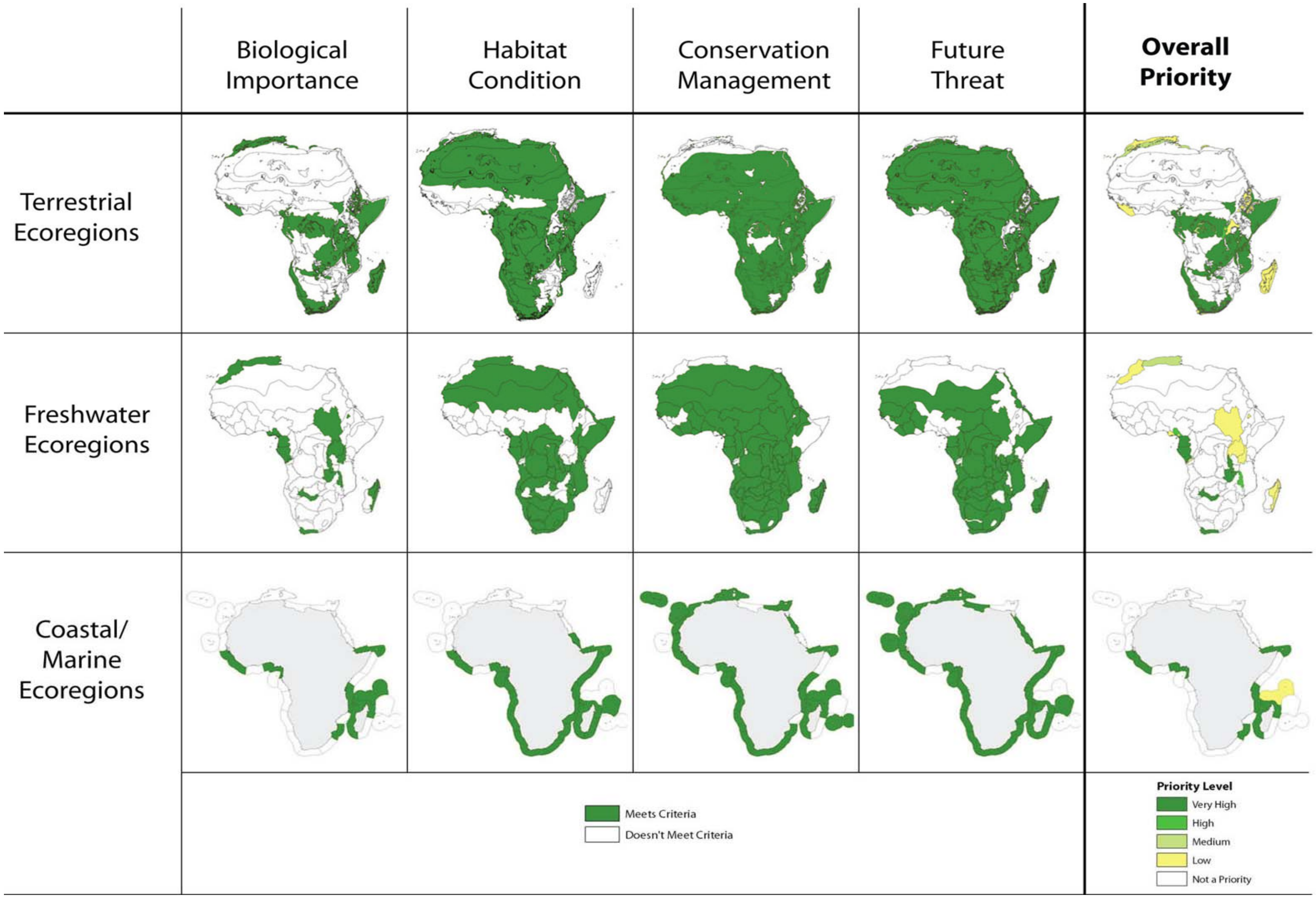


**Figure 4.** Criteria used to establish ecoregional priority levels for each ecoregional type (terrestrial, freshwater, and coastal/marine ecoregions). When all four criteria were met (i.e., biological importance, habitat condition, management, and threats), an ecoregion attained the highest priority level (i.e., very high status). Thresholds for each criteria are found in Appendix 3.

We selected those ecoregions that met all criteria (i.e., very high priority level) for each of the three major ecological types (terrestrial, freshwater, and coastal/marine) (Fig. 4), and further assessed if priority ecoregions of one type overlapped spatially with priority ecoregions of another type (Fig. 5).

We created a hierarchical set of priority ecoregions. Areas that contained overlapping priority ecoregions from the freshwater, terrestrial, and/or coastal/marine assessments were considered the highest level of priority for biodiversity conservation (Table 3).

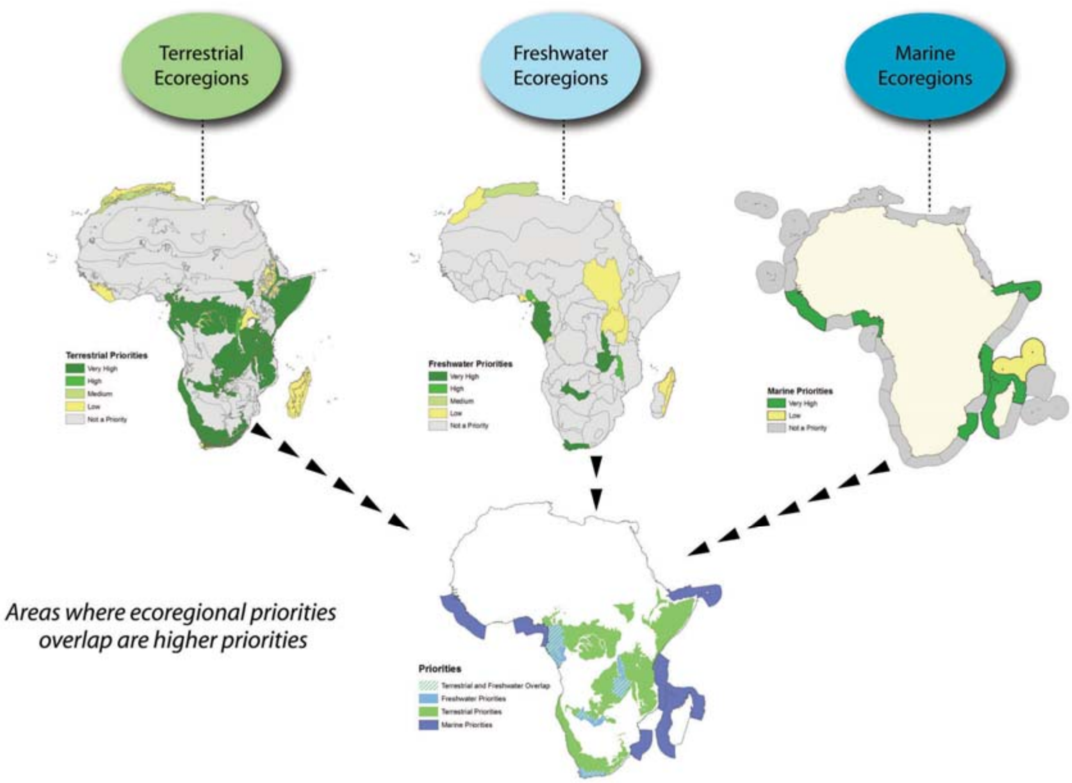


**Figure 5.** Spatial relationship of terrestrial, freshwater, and coastal/marine priority ecoregions. Areas of overlapping priority ecoregions were considered the highest priorities for global biodiversity conservation.

***Evaluating Opportunities***

The intent of developing a hierarchy of priority ecoregions (i.e., for combined or individual ecoregion types), and a gradient of priority levels within each ecoregion type (from very high to low) was to help focus efforts that would advance ***global*** conservation priorities in Africa. The following section describes how additional information could be used to evaluate opportunities to conserve these priority areas. In the rest of this report, we focus on three issues: 1) assessing the probability of achieving long-term conservation outcomes, 2) diversifying our approach to partnerships, and 3) learning how best to address the potential impacts of climate change. These three issues are illustrative only, offered merely as examples of how information can be explicitly incorporated into making programmatic decisions.

**Table 3.** Continental priority ecoregions for each of the three major ecoregion types. Each of these ecoregions met all criteria for each of the four prioritization categories (i.e., global biodiversity significance, habitat condition, management status, and threats), which resulted in the highest rating status (very high). Ecoregions that overlap spatially were identified, and those areas of overlap are considered of greatest importance within this select group of priorities.

| Ecoregion Type | Highest Priority Ecoregions | Spatial overlap with other priority Ecoregions? (yes or no) |
|---|---|---|
| Terrestrial | Albany thickets | Yes |
| | Atlantic Equatorial coastal forests | Yes |
| | Cameroonian Highlands forests | No |
| | Central Congolian lowland forests | No |
| | Central Zambezian Miombo woodlands | Yes |
| | Cross-Sanaga-Bioko coastal forests | Yes |
| | Drakensberg montane grasslands, woodlands and forests | No |
| | Eastern Arc forests | No |
| | Eastern Miombo woodlands | No |
| | Kaokoveld desert | No |
| | Montane fynbos and renosterveld | Yes |
| | Nama Karoo | Yes |
| | Namib desert | No |
| | Namibian savanna woodlands | No |
| | Northeastern Congolian lowland forests | No |
| | Northern Zanzibar-Inhambane coastal forest mosaic | No |
| | Northwestern Congolian lowland forests | Yes |
| | Saharan flooded grasslands | No |
| | Serengeti volcanic grasslands | No |
| | Somali Acacia-Commiphora bushlands and thickets | No |
| | Southern Acacia-Commiphora bushlands and thickets | No |
| | Southern Rift montane forest-grassland mosaic | No |
| | Succulent Karoo | Yes |
| | Western Congolian swamp forests | No |
| | Zambezian Baikiaea woodlands | Yes |
| | Zambezian flooded grasslands | Yes |
| Freshwater | Bangweulu - Mweru | Yes |
| | Cape Fold | Yes |
| | Lake Tanganyika | Yes |
| | Ogooue - Nyanga - Kouilou - Niari | Yes |
| | Okavango | Yes |
| | Southern Gulf of Guinea Drainages - Bioko | Yes |
| Coastal/ Marine | Delagoa | No |
| | East African Coral Coast | Yes |
| | Gulf of Aden | No |
| | Gulf of Guinea Central | Yes |
| | Gulf of Guinea West | No |
| | Western and Northern Madagascar | No |

The information gathered for this portion of our decision support system includes data on social, political, and economic factors in addition to ecological aspects of conservation. As with the prioritization process, we relied on published information available in scientific journals, as well as datasets published on the web. It is relevant to restate that information used to evaluate opportunities is done in the context of the priority areas, and is not constructed to exclude any area from consideration (as in the prioritization process). Therefore, we were less restrictive on our data standards, recognizing this information will likely be assessed for multiple uses depending on the opportunity (e.g., for regional rather than continental comparisons, for strategy development rather than prioritization). A detailed description of the information gathered to date is included in Appendix 4.

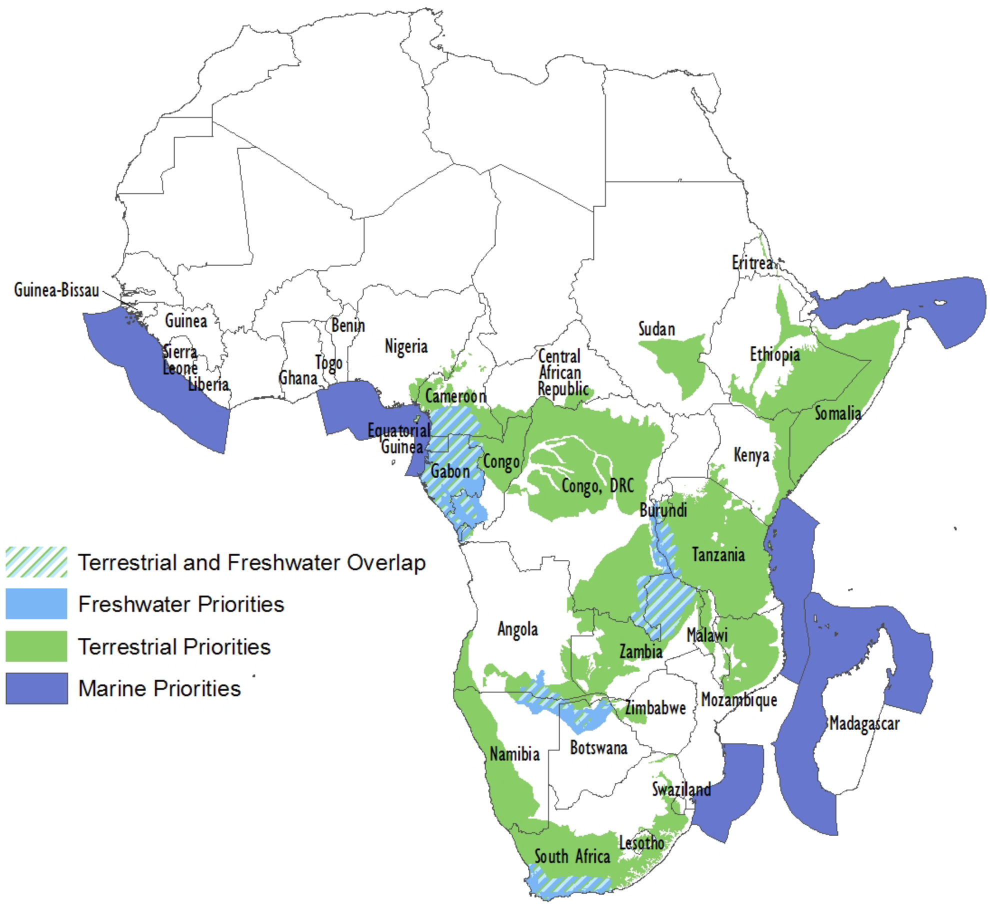


**Figure 6**. Priority Ecoregions and their relationship to national boundaries.

**Probability of Return on Investment**

As The Nature Conservancy enters its second half-century as a conservation organization, it is clear that conservation is a long-term investment. Social, political, and economic uncertainty is acute on the Africa continent, and plays a significant role in the potential for long-term investments to be realized. Understanding what the political context of our continental priorities is and likely will be is critical to making decisions about new investments, particularly in new geographies where the Conservancy has no track record.

Africa contains more countries (53) than any other continent. A first step was to place the ecoregional priorities within this political context (Fig. 6). As a global conservation organization new to this continent, some of the first decisions must be where to start work. Currently, the Africa Region works in six countries (Kenya, Tanzania, Zambia, Mozambique, Botswana and Namibia). Each contains a significant portion of land area and/or coastline in priority ecoregions.

**Table 4.** Relative amounts of countries captured within priority ecoregions.

| COUNTRY | Total area of priority Terrestrial and/or Freshwater ecoregions (sq. km.) | Percent of country in priority Terrestrial and/or Freshwater ecoregions (%) | Total Length of coastline in priority Coastal/ Marine Ecoregion (km) | Percent of shoreline in Priority Coastal/ Marine Ecoregion (%) |
|---|---|---|---|---|
| Equatorial Guinea | 26,494 | 99 | 480 | 100 |
| Gabon | 259,451 | 99 | 786 | 43 |
| Tanzania | 841,736 | 90 | 1985 | 100 |
| Congo | 283,250 | 82 | -- | -- |
| Somalia | 513,152 | 80 | 1131 | 34 |
| Burundi | 20,863 | 77 | -- | -- |
| Zambia | 519,539 | 69 | -- | -- |
| Congo, DRC | 1,418,890 | 61 | -- | -- |
| Namibia | 444,020 | 54 | -- | -- |
| South Africa | 652,924 | 54 | 143 | 1 |
| Lesotho | 16,252 | 53 | -- | |
| Cameroon | 243,537 | 52 | 815 | 100 |
| Malawi | 59,030 | 50 | -- | -- |
| Swaziland | 7,170 | 42 | -- | -- |
| Ethiopia | 456,505 | 41 | -- | -- |
| Mozambique | 283,309 | 36 | 2572 | 53 |
| Kenya | 150,282 | 26 | 520 | 55 |
| Angola | 243,264 | 20 | | |
| Botswana | 105,091 | 18 | -- | -- |
| Central African Republic | 64,500 | 10 | -- | -- |
| Zimbabwe | 33,865 | 9 | -- | -- |
| Sudan | 178,562 | 7 | -- | -- |
| Eritrea | 4,934 | 4 | 118 | 8 |
| Nigeria | 25,525 | 3 | 2028 | 100 |
| Rwanda | 124 | 0 | -- | -- |
| Madagascar | -- | -- | 5484 | 84 |
| Guinea-Bissau | -- | -- | 1812 | 100 |
| Sierra Leone | -- | -- | 1107 | 100 |
| Guinea | -- | -- | 820 | 100 |
| Liberia | -- | -- | 727 | 100 |
| Djibouti | -- | -- | 323 | 100 |
| Ghana | -- | -- | 316 | 45 |
| Benin | -- | -- | 115 | 100 |
| Togo | -- | -- | 47 | 100 |

If significant opportunities arise to work in new countries outside the current country portfolio, what information can help assess where investment in a country might result in a conservation project or projects of global importance to biodiversity conservation? Clearly, some countries have larger portions of ecoregional priorities than others (Table 4). Countries with very high percentages of land area or coastline captured within the highest priority ecoregions suggest, at a macro-level, a higher probability that conservation efforts in that country (if successful) would contribute significantly to advancing our long-term vision and mission.

As stated earlier, investment in conservation is a long-term proposition. What information is available to help assess if investments in different countries have a higher chance of success? The Ibrahim Index of African Governance (http://site.moibrahimfoundation.org/the-index.asp ) that provides a comprehensive ranking of governance quality in Africa (Fig. 7).

The Ibrahim Index is updated on an annual basis for all sub-saharan countries, and includes such factors as safety and security, transparency and corruption, human rights, and economic development. This index is widely used, and is valuable for its component data layers and the composite score. Given that the Africa Program's Conservation Approach emphasizes the importance of local people's and partners to improve nature conservation and human livelihoods, this index was considered particularly appropriate.

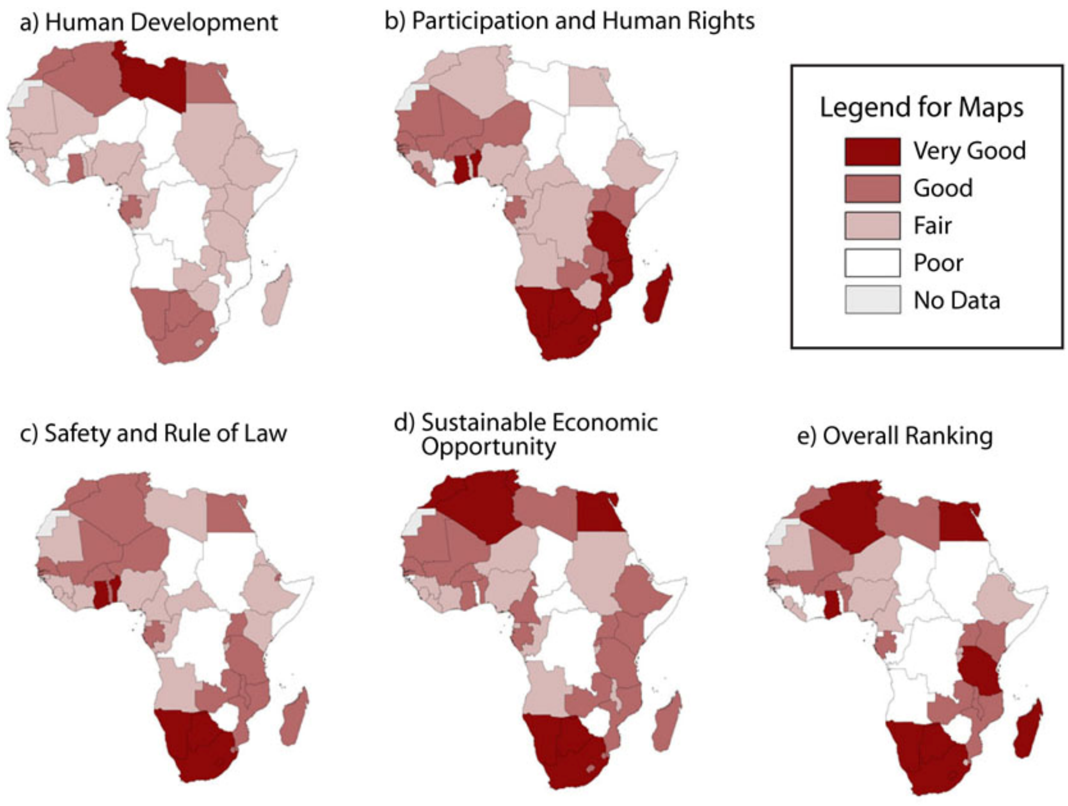


**Figure 7**. Information from four key areas (a-e) incorporated into the overall Ibrahim Index (f). Data were divided into quartiles, with lowest values (red) and highest values (dark green) indicating enabling conditions less or more favorable for long-term conservation results.

Based on the coarse nature of this continental assessment, we selected the overall Ibrahim index for an initial comparison of countries where ecoregional priorities were found as a surrogate for their potential to achieve long-term conservation outcomes. We compared the Ibrahim Index scores for all countries where ecoregional priorities were found (Fig. 8).

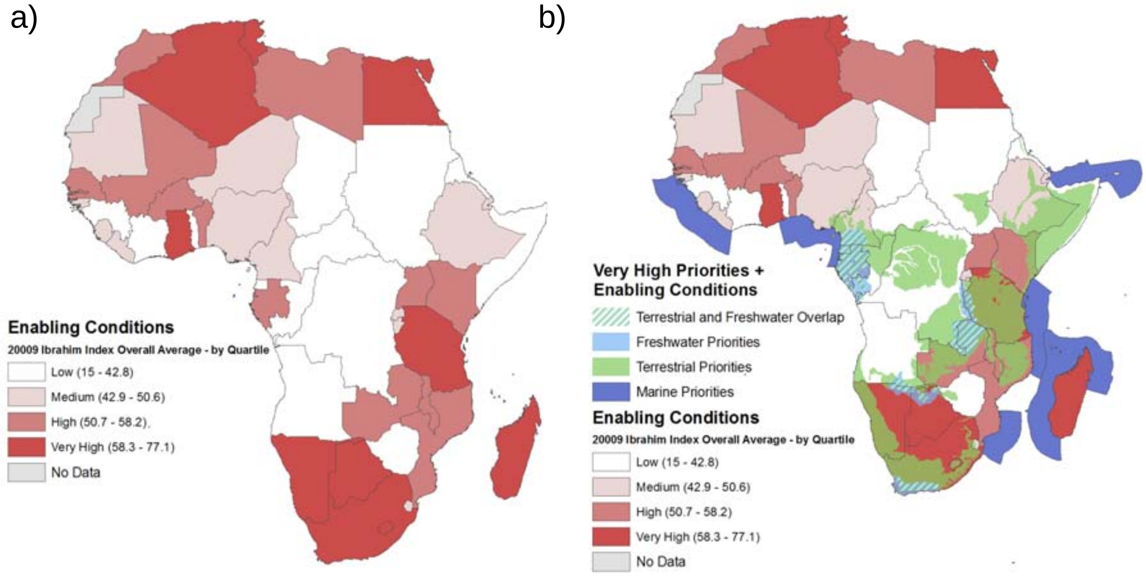


**Figure 8**. Evaluating the probability of a return on a long-term conservation investment by looking at enabling socio-political conditions. The Ibrahim Index incorporates five key areas of social and justice indicators into an overall ranking of governance quality. This index was divided into quartiles (a), and displayed in spatial overlap with priority ecoregions (b).

To assess the relative return on long-term conservation investments, we compared the relative probability that an investment in a country would produce a conservation outcome of global importance (indicated by the percentage of a country in priority ecoregions) with the relative probability that socio-political conditions would remain favorable enough (indicated by the governance ranking) to achieve long-term conservation success (Table 5). Those countries with the highest percentages in ecoregional priorities and the highest governance ratings suggest a higher potential return on investment and higher chances of success in the next 5 years of our program.

**Table 5**. The potential for long-term conservation outcomes based on the percent of a country that contains ecoregional priorities and the enabling conditions for conservation as indicated by governance quality. Countries with the lowest percentage (lowest quartile) of priority ecoregions and enabling conditions (according to governance quality ratings) were not considered as potential priorities for expansion in the next five years.

| COUNTRY | Percent of country in Priority Terrestrial and/or Freshwater ecoregions (%) | Percent of shoreline in Priority Coastal/ Marine Ecoregions (%) | Enabling Conditions – Ibrahim Index of governance quality - (range 15-77) | Long-term Quality Rating Category[a] | Trend Category[b] | TNC Investment Status |
|---|---|---|---|---|---|---|
| Botswana | 18 | ---- | Very High (74) | Highest | | Approved for work |
| Namibia | 54 | 0 | Very High (69) | Highest | | Working in Country |
| South Africa | 54 | 1 | Very High (69) | Highest | | Priority for Expansion |
| Lesotho | 53 | ---- | Very High (61) | Highest | | Priority for Expansion |
| Tanzania | 90 | 100 | Very High (59) | | | Working in Country |
| Zambia | 69 | ---- | High (55) | | Most improvement | Working in Country |
| Gabon | 99 | 43 | High (54) | | | Priority for Expansion |
| Kenya | 26 | 55 | High (54) | | | Working in Country |
| Malawi | 50 | ---- | High (53) | | | Priority for Expansion |
| Mozambique | 36 | 53 | High (52) | | Greatest decline | Working in Country |
| Swaziland | 43 | ---- | Medium (49) | | | Priority for Expansion |
| Cameroon | 52 | 100 | Medium (47) | | | Priority for Expansion |
| Ethiopia | 40 | ---- | Medium (46) | | | Priority for Expansion |
| Burundi | 77 | ---- | Medium (45) | | Most improvement | Priority for Expansion |
| Congo | 82 | 0 | Medium (43) | | | Priority for Expansion |
| Angola | 19 | 0 | Low (41) | | Most improvement | Not a priority |
| Equatorial Guinea | 99 | 100 | Low (39) | Lowest | | Not a priority |

| | | | | | | |
|---|---|---|---|---|---|---|
| Congo, DRC | 61 | 0 | Low (33) | | | Not a priority |
| Somalia | 80 | 34 | Low (15) | Lowest | | Not a priority |
| Central African Republic | 10 | ---- | Low (35) | Lowest | | Not a priority |
| Zimbabwe | 9 | ---- | Low (31) | Lowest | | Not a priority |
| Sudan | 7 | 0 | Low (33) | Lowest | | Not a priority |
| Eritrea | 4 | 8 | Low (37) | Lowest | Greatest decline | Not a priority |
| Nigeria | 3 | 100 | Medium (47) | Lowest | | Not a priority |

[a] Long-term rating category based on persistence of a country's index score in the in the "highest" (top 10) or "lowest" (bottom 10) categories over a minimum of the past 6 years.
[b] Trend category based on the net change in country index rank between 2001 and 2008, reflecting change in governance quality relative to 53 African countries included in the index. Countries whose rank changed by > 5 are indicated here.

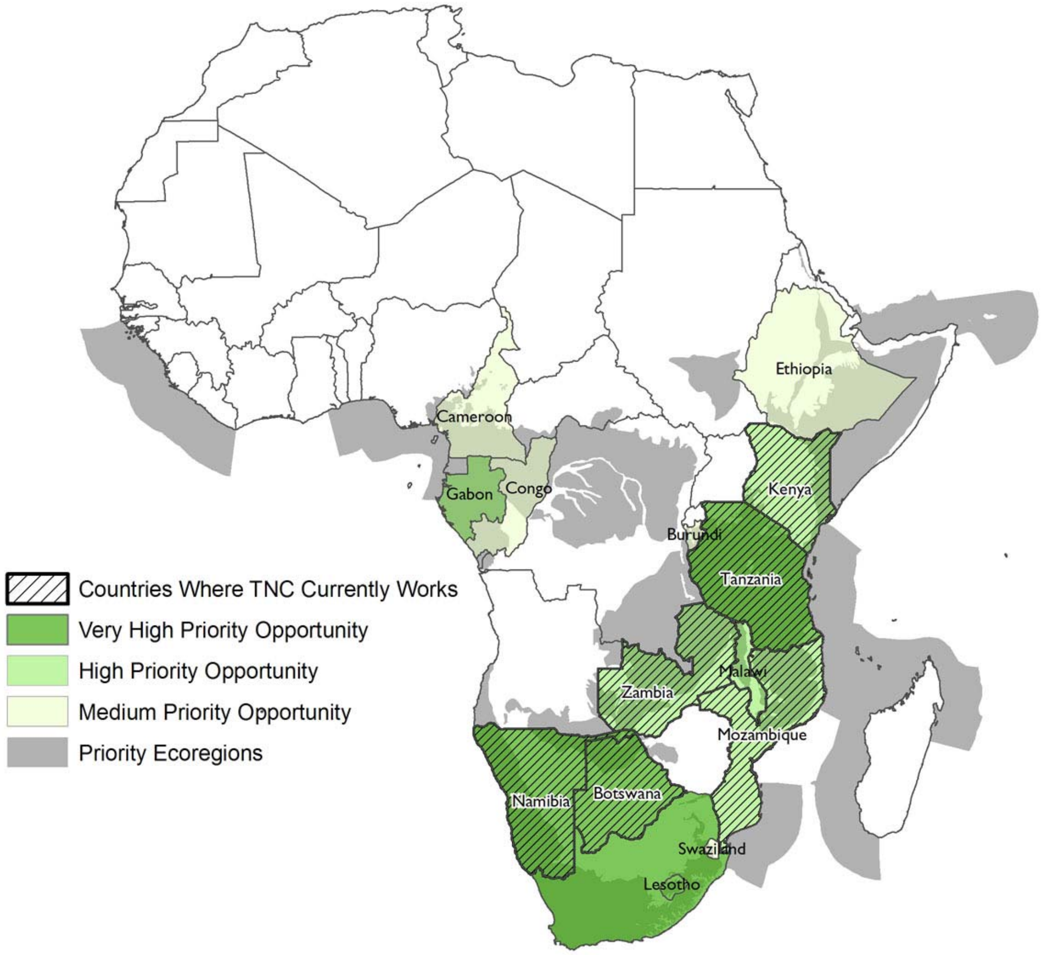


**Figure 9.** The potential for long-term conservation investment based on high quality governance ratings and high percentages of a country containing priority ecoregions. All countries where The Nature Conservancy currently works were identified as high priorities for investment, with four countries (South Africa, Lesotho, Gabon, and Malawi) of similar priority level. Five other countries (Swaziland, Cameroon, Ethiopia, Burundi, and Congo) were rated as a medium priority level for investment. (NOTE: We need to revisit this rating scheme and colors).

**Partnerships**

Evaluating the potential for achieving long-term conservation outcomes (above) does not include information about how such outcomes might be achieved. Another key component of the Africa Region's Conservation Approach is to explicitly work with partners to help build capacity, experience, and promote innovation. Given the commitment to work in and around a system of protected areas, it is important to consider whether there are local organizations to work with. A recent review of non-governmental organizations and African wildlife conservation (Scholfield and Brockington, 2008) provides a wealth of information on the NGO community (Fig. 10). The Conservancy is currently working in countries that are relatively "rich" with NGOs. In order to improve the Conservancy's understanding about how best to work with partners, one strategy could include a purposeful diversification of the current portfolio to work in countries with fewer NGOs. For example, each of the high priority countries for investment on the west coast (i.e., Gabon, Congo, and Cameroon) have far fewer environmental NGOs than the six countries where TNC is currently working or has internal approval to work.

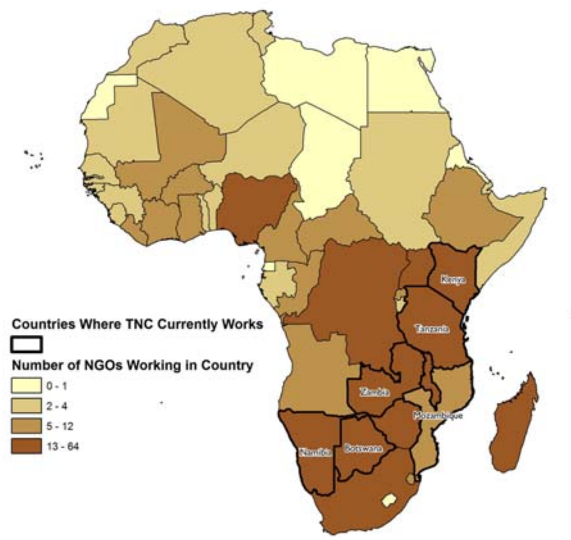


**Figure 10**. The number of non-governmental organizations working in Africa on conservation based on data from Sholfield and Brockington (2008). Countries where The Nature Conservancy currently works or has approval to work (i.e., Botswana) are highlighted.

**Climate Change**

Climate change is considered by many to pose the most significant threat to achieving long-term conservation success. It has created a political and social battle front, as rich and poor nations debate how best to mitigate against increasing concentrations of greenhouse gases in the atmosphere. As this political battle continues, a second front has emerged for conservation. Regardless how effective we are at reducing greenhouse gases, the climate is already changing, and will continue to change (e.g., Solomon et al., 2009). Conservation must figure out how best to help critical ecosystems adapt to these inevitable, yet uncertain changes in climate.

This second front is perhaps the most difficult challenge that has ever faced conservation. While climate change is a threat of growing significance and magnitude, it has been confounding because the complexity and uncertainty of the science has hampered the development of appropriate, adaptation-based strategies. Climate change models themselves have provided conflicting information. For example, while global circulation models have been projecting a wetter climate for portions of eastern Africa, a recent USGS climate change model that incorporated local effects suggested much drier conditions would prevail (Funk et al. 2008). Studies that define climate envelopes for individual birds species in Europe have been shown to be no better than chance over half the time (Beale et al. 2008). And finally, an extensive review of adaptation strategies to address climate change showed that in some cases strategies that worked to counteract each other were selected, and there has been limited success (Heller and Zavaleta, 2009). In short, the science and conservation efforts send a message that uncertainty is the most certain aspect of this new area of conservation work.

We assumed uncertainty as a dominant factor when considering climate change information. Therefore, we allocated the use of climate change information in our decision support system toward evaluating new opportunities as opposed to identifying priorities. We used information generated from ClimateWizard (http://www.climatewizard.org ) to develop a continental assessment of projected changes in temperature and climate at the end of the century based on the median value of multiple global circulation models (Fig. 11). We compared two similar projects to assess the ability to learn more about adaptation strategies by placing them in the context of climate change information. The Conservancy currently works with two community-based projects that enhance a set of existing protected areas where pastoralism is an important source of livelihood for local people. In order for adaptation strategies to be successful in these areas, they must be able to address related issues that pastoralism will face as well. This assessment illustrated that these two projects– one in Namibia and one in Northern Kenya – are on different ends of the climate change gradient. At the end of the century, Namibia is projected to have the most severe (highest quartile) increases in temperature and decreases in precipitation across the continent, whereas Northern Kenya is projected to be in the areas of limited temperature and precipitation change (lowest quartiles).

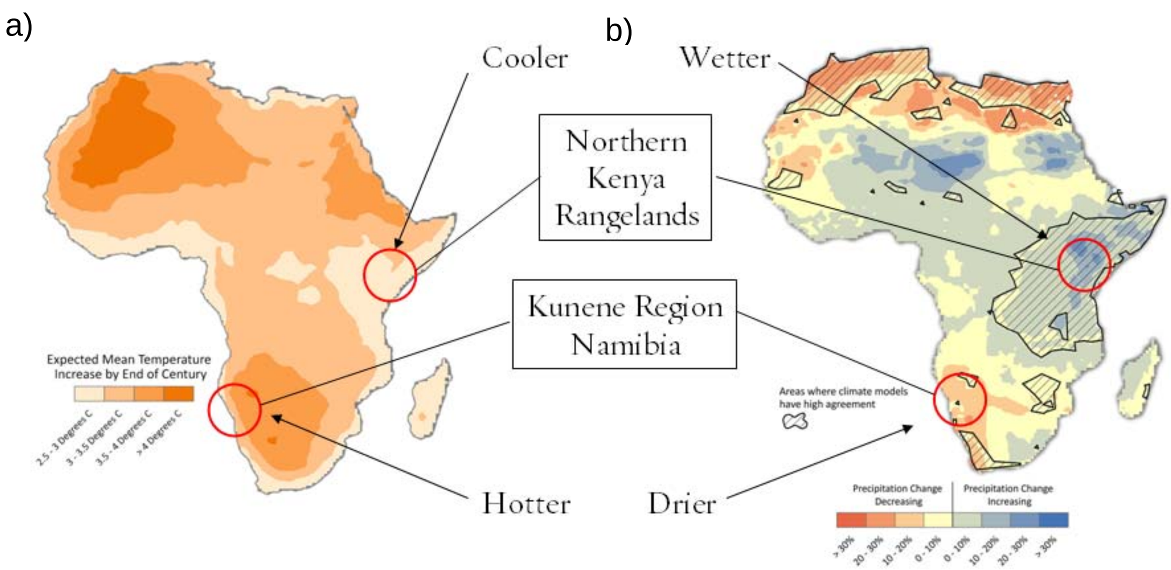


**Figure 11**. Projected changes in climate at the end of this century for temperature (a) and precipitation (b). Two current projects (Kunene Region, Namibia and Northern Kenya Rangelands) represent two community-based conservation projects that work directly with pastoralists, but have modeled climate trajectories at different ends of projected temperature and precipitation change gradients.

It is our contention that designing a suite of projects to learn across climate change gradients could help improve our ability to learn about adaptation strategies. In this case, two similar community-based conservation strategies working with pastoralists and protected areas systems provides an important opportunity to learn how robust these strategies are in the face of very different projected climate change patterns.

**Conclusion**

The Conservancy's young and small Africa Regional Team must set a strategic course if it is to achieve meaningful conservation results in Africa. The Africa Regional Team undertook a continental assessment to make better use of existing information to guide decision making. This assessment supported the implementation of a new long-term conservation vision by implementing a region-specific Conservation Approach designed to make best use of the Conservancy's strengths. The results of this assessment were used to select a smaller set of geographic priorities, and to inform future decisions about new opportunities to conserve these priority areas.

Thecontinental assessment produced a hierarchical set of ecoregional priorities. Within each of the three ecoregional types (i.e., terrestrial, freshwater, and coastal/marine), all ecoregions were rated across a gradient of priority levels. Only those ecoregions that achieved the highest priority level were selected for consideration as global biodiversity conservation priorities for the next five years. Overall, 38 of 237 (16%) ecoregions were selected as priorities. These were distributed across terrestrial (26 of 119; 22%), freshwater (6 of 87; 7%) and coastal/marine ecoregions (6 of 31; 19%) ecoregions. Areas of greatest importance to global biodiversity conservation were selected where ecoregional priorities of multiple types overlapped. Nearly half (17 of 38; 45%) of these priority ecoregions overlapped, accounting for a small portion (7%) of all possible ecoregions to be identified as the highest priorities for the Conservancy's global biodiversity conservation efforts.

To help the Africa Regional Team be more strategic in its efforts to achieve the long-term conservation vision within these priority areas, three key issues were addressed to illustrate how this information system can help to guide decision making.

First, we identified countries with better enabling socio-political conditions that we considered would support the Africa Region's Conservation Approach, and hence might provide a better return on long-term conservation investment. We selected countries containing priority ecoregions, and from this group used higher governance ratings as an indicator of greater likelihood of long-term conservation success. A subset of 15 countries (28%) were identified as priorities for long-term conservation investment. This included all six countries where The Nature Conservancy currently works (Kenya, Tanzania, Zambia, Mozambique, Botswana and Namibia). Nine additional countries were identified for potential expansion, and were divided into two groups: four countries (South Africa, Lesotho, Gabon, and Malawi) rated as very high or high priorities for investment on par with the countries where the Conservancy is currently active, and five countries (Swaziland, Cameroon, Ethiopia, Burundi, and Congo) rated as a slightly lower (i.e., medium) priority level for investment.

Second, some countries identified as potential priorities for expansion (e.g, Gabon, Cameroon, and Congo) present a dramatically different landscape of environmental non-governmental organizations (e.g., far fewer) than where the Conservancy is currently active. This might present new opportunities to learn more about partnerships by diversifying the Conservancy's current partnership portfolio.

Finally, projected climate change information (at the turn of this century) was used to evaluate adaptation strategies of specific projects. Given the uncertainties around climate change projections and adaptation strategies, using the principles of experimental design to select projects that will help to improve how we learn about adaptation was suggested.  Using one illustrative comparison, two current projects with similar adaptation strategies were shown to be located in areas at either ends of projected climate change gradients (for temperature and precipitation change).  Using climate change information to create an experimental design framework for testing adaptation strategies may help to assess how well specific strategies achieve their objectives.

We recognize this continental assessment representes a very coarse filter for identifying conservation priorities,  and takes a biased global perspective.  Consequently, it has the most applicability in helping the Conservancy's Africa Region mature its strategic approach, refine its priorities, and set a narrower, more strategic course for implementation. We acknowledge this is just one small portion of a suite of conservation assessments needed on the continent, and that finer-scale investigations conducted at regional and local scales will be necessary to identify the specific places and strategies within and across these priority ecoregions.  We anticipate that some mixture of ecoregional and conservation action planning will be necessary to more accurately evaluate specific opportunities and define priorities within the highest priority ecoregions, and to explicitly incorporate climate change into our thinking.  As capacity and need grows, the Africa Regional Team will begin to work with partners to conduct these assessments, and identify new on-the-ground and in-the-water conservation efforts necessary to achieve desired  long-term conservation outcomes.

Finally, this analysis and associated datasets are intended to serve as a decision support system for the Africa Program as it moves forward to implement its new long-term conservation vision. We expect that over time, datalayers will be updated, new information of regional and local scales will be added, and new analyses will be conducted so that management decisions will have the benefit of the most current information.  The goal is for the Africa Program to use this information system to adaptively manage its efforts, to get progressively more effective and efficient over time, so that collectively, conservation efforts achieve greater conservation impact.

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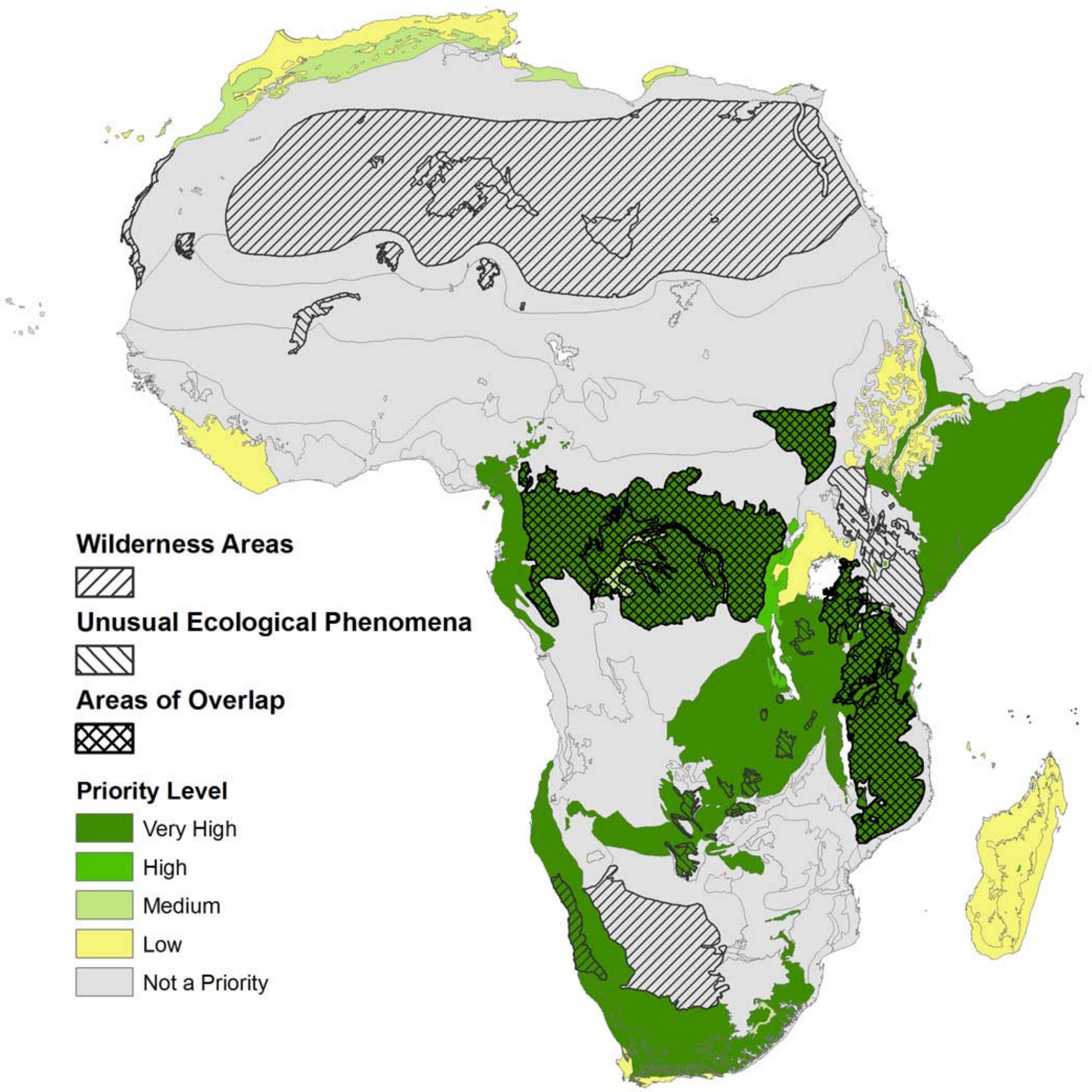
**Appendix 1** – Ecological Information used in identifying global priorities on the Africa Continent.

| Information Category | Ecoregion Type | Description | Reference (Link) |
|---|---|---|---|
| **Biodiversity Value** | Terrestrial | WWF Terrestrial Biological Distinctiveness Index | Burgess et al. 2004, 2006. |
| | Freshwater | WWF Freshwater Biological Distinctiveness Index | Theime et al. 2005. |
| | Coastal/Marine | Marine Mammal Richness | http://sea.unep-wcmc.org/isdb/marine_mammals/. |
| | Coastal/Marine | Seabird species Richness | Harrison, P. 1983. |
| | Coastal/Marine | Area of Mangrove Forest | Spalding et al. 1997, in prep. |
| | Coastal/Marine | Mangrove species richness | Spalding et al. 1997, in prep. |
| | Coastal/Marine | Seagrass species richness | Green and Short 2003, Spalding et al. 2003. |
| | Coastal/Marine | Coral Richness | |
| | Coastal/Marine | Coral abundance | |
| **Habitat Condition** | Terrestrial/ Freshwater | Percent of Natural Landcover | Globcover 2005. (http://www.gofc-gold.uni-jena.de/sites/globcover.php) |
| | Terrestrial/ Freshwater | WCS Human Footprint | WCS 2008 (http://www.wcs.org/humanfootprint/) |
| | Coastal/Marine | Human Footprint | NCEAS 2008. (http://www.nceas.ucsb.edu/globalmarine) |
| | Freshwater | River Fragmentation<br>Disruption of Natural River Flows | Nilsson et al. 2005 |
| **Conservation Management** | Terrestrial/ Freshwater | IUCN World Database on Protected Areas (WDPA) | WDPA 2009 (http://www.wdpa.org/AnnualRelease.aspx) |
| | Coastal/Marine | Percent of Marine Protected Area on Shelf | Spalding et al. *In prep*. |
| **Threat** | Terrestrial/ Freshwater/ Coastal/Marine | Population Density in 2015 | CEISIN 2008. (http://sedac.ciesin.columbia.edu/gpw) |
| | Freshwater | Planned dams | TNC 2009. |
| | Freshwater | Water Stress | Alcamo et al. 2003. |
| | Coastal/Marine | Coastal Development | CEISIN 2008. (http://sedac.ciesin.columbia.edu/gpw) |

**Appendix 2.** Wilderness areas and globally outstanding ecological phenomena (i.e., wildlife migrations and large population assemblages) defined by Burgess et al. (2004). These ecoregions were elevated as globally significant regardless of their habitat condition assessment. Some of these ecoregions were originally excluded based on low habitat condition scores due to their classification as containing significant portions of non-natural habitat/cultivated lands.



**Appendix 3**. Threshold values for each step in the models developed to identify priority ecoregions. Each of the data sets analyzed was first summarized to the ecoregion. The threshold values were determined by ranking all ecoregions, and removing those ecoregions in the lower quartile (25%) from the analysis. The specific values that identified this separation are provided in the table below. Criteria with continuous data were ranked in descending order, and the threshold value was selected based on the value associated with the ecoregion at the upper end of the lowest quartile (25%) of all ecoregions. Categorical data was selected based on the lowest single value following the same ranking process. When multiple datasets were used within a given criterion, ecoregions that occurred in the upper 75% of all ecoregions remained as a priority.

| Criteria | Terrestrial | Freshwater | Marine |
|---|---|---|---|
| **Biodiversity Significance** | 1. BDI = "Globally Outstanding" | 1. BDI = "Globally Outstanding" | 1. Species Richness Index > 6<br><br>2. add ecoregions that are identified as having<br>Mangrove or Coral Abundance = "Globally Important" |
| **Habitat Condition** | 1. Natural Land Cover > 46%<br><br>2. including only ecoregions where Human Footprint Index < 30<br>3. add ecoregions that are identified as WWF Wilderness Areas | 1. Natural Land Cover > 46%<br><br>2. including only ecoregions where Human Footprint Index < 29<br>3. exclude ecoregions where River Fragmentation = "Poor"<br>4. exclude ecoregions where % Land Converted = "Poor" | 1. Ave. Coastal Development < 12% developed<br>2. including only ecoregions where Marine Human Footprint Index < 10 |
| **Conservation Management** | 1. IUCN I-IV Protected Lands > .69% covered | 1. IUCN I-IV Protected Lands > .81% covered | 1. Protected Areas > .03% covered |
| **Future Threat** | Average Density(2015) < 111 people per sq. km | 1. Average Density(2015) < 74.5 people per sq. km.<br>2. exclude ecoregions where Planned Dams = "High"<br>3. exclude ecoregions where Water Stress = "Poor" | 1. Coastal Development >= 12% developed<br>2. and only include ecoregions where future Population Density in 2015 > 456 people per sq. km. |

**Appendix 4** – Ecological Information reserved for assessing opportunities that occur among or within selected priorities. The information is useful to further rank among selected priorities as well as for strategy development within selected priorities depending on the opportunity.

| Information Category | Ecoregion Type | Description | References (Link) |
|---|---|---|---|
| **Biodiversity Value** | Coastal/Marine | Kelp Abundance by Province | Robinson and Brink 1998. , Robinson and Brink 2006. Sheppard, C, 2000a, b, c. |
| | Coastal/Marine | Upwelling Importance by Province | Robinson and Brink 1998. , Robinson and Brink 2006. Sheppard, C, 2000a, b, c. |
| | Coastal/Marine | Seagrass Abundance by Province | Green and Short . 2003.; Spalding et al. 2003. |
| | Coastal/Marine | Saltmarsh Abundance | Adam 2002 |
| **Habitat Condition** | Coastal/Marine | Change in Mean Trophic Level | Sea Around Us Project, University of British Columbia |
| | Terrestrial | Status of Fire Regimes by Ecoregion | Shlisky et al. 2007. |
| | Freshwater | Disruption of Fish Runs | Reidy Liermann et al. *In Review*. |
| | Coastal/Marine | Change in Sediment Loads | Syvitski et al. 2005. |
| | Terrestrial/ Freshwater | Human Accessibility | Jennings 2006. |
| | Terrestrial | Forest Loss per Year | Hansen et al. 2006. |
| | Freshwater | Dominant Groundwater Feature | Struckmeir and Richts. 2007. |
| | Terrestrial | Human Appropriation | Imhoff et al. 2004. |
| **Protected Areas** | Freshwater | Number of Certified Fisheries | Marine Stewardship Council (MSC). 2008. (www.msc.org ) |
| **Threat** | Terrestrial/ Freshwater/ Coastal/Marine | Number of Threatened Species | World Wildlife Fund. 2006. (www.worldwildlife.org/WildFinder) |
| | Terrestrial/ Freshwater | Climate Change projections | ClimateWizard 2009. (http://www.climatewizard.org/ ) |
| | Terrestrial | Vegetation Shift | Gonzalez et al. 2004; Neilson et al. 1998. |
| | Freshwater | Disruption of Snowmelt Timing | Adam et al. *In Review*. |
| | Coastal/Marine | Harmful Marine Invaders | Molnar et al. 2008 |
| | Freshwater/ | Change in Nitrogen Delivery | Green et al. 2004. |

| Information Category | Ecoregion Type | Description | References (Link) |
|---|---|---|---|
| | Coastal/Marine | | |
| | Coastal/Marine | Percent of Threatened Reefs | Bryant et al. 1998; Burke and Maidens 2004; Burke et al. 2002. |