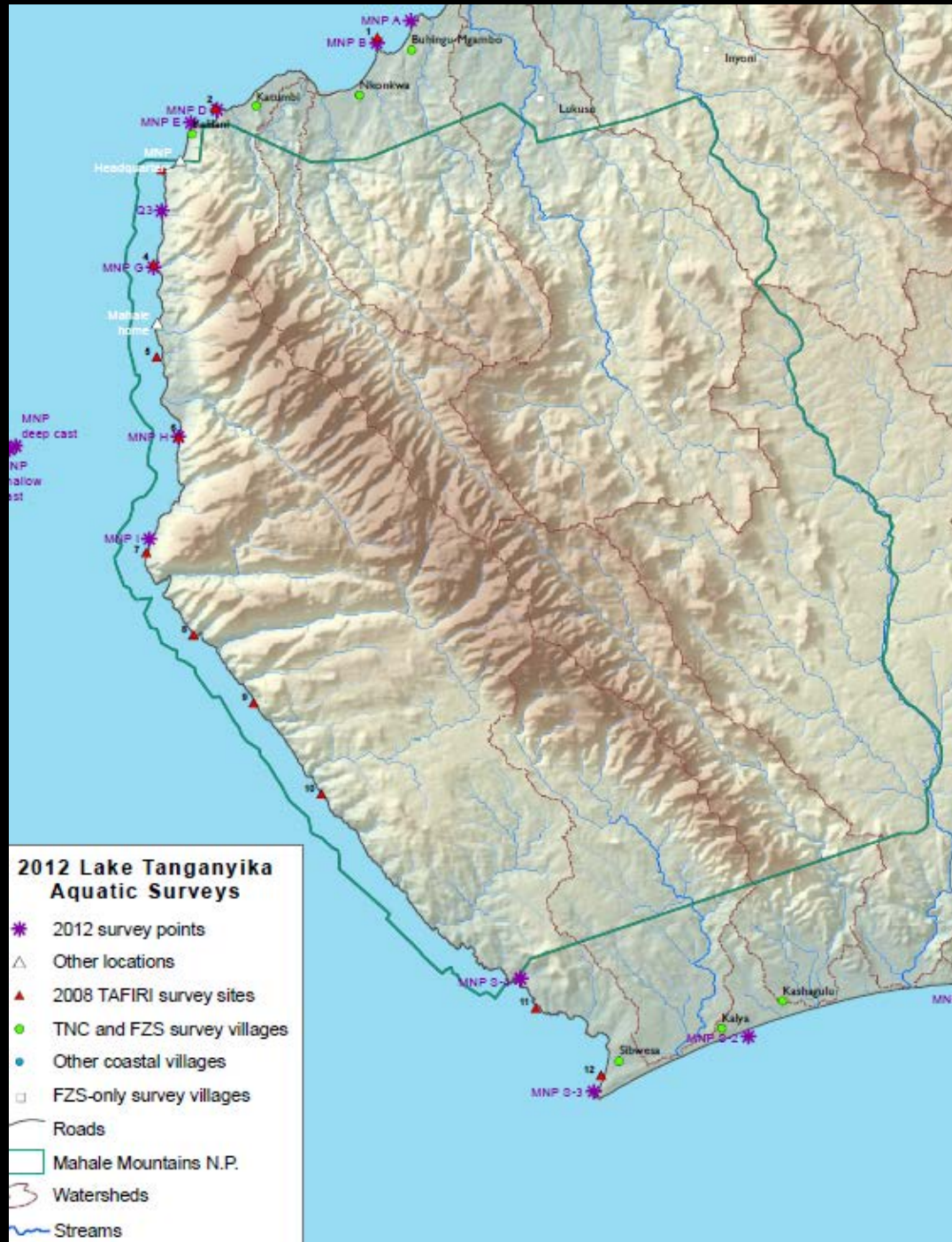


Tuungane Baseline Freshwater Ecological Survey



Survey Approach:

- Focus on comparison of rocky habitats in near-shore inside and outside of MMNP
- Intensive study sites in North, some data N & S: 13 total
- Tried to repeat past sites
- Gill netting and visual census for fish species
- Visual and quantitative assessment of sedimentation and habitat
- Snail surveys at various depths
- Water quality (nutrient samples)
- Snail carbon isotope analysis
- Algal primary productivity
- Fish breeding site interviews and mapping
- Video transects (3 per Northern site)



Surprising Results on Nutrients in Nearshore

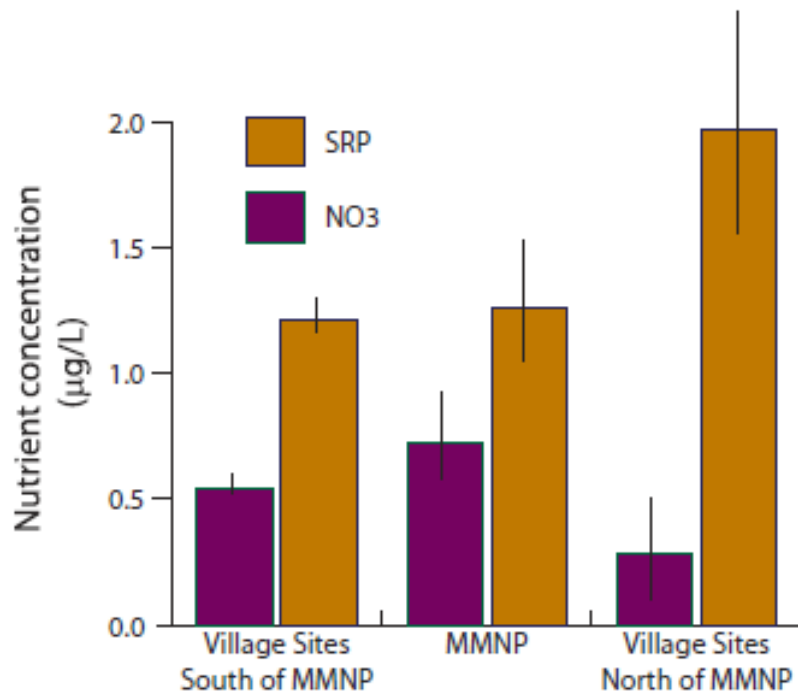
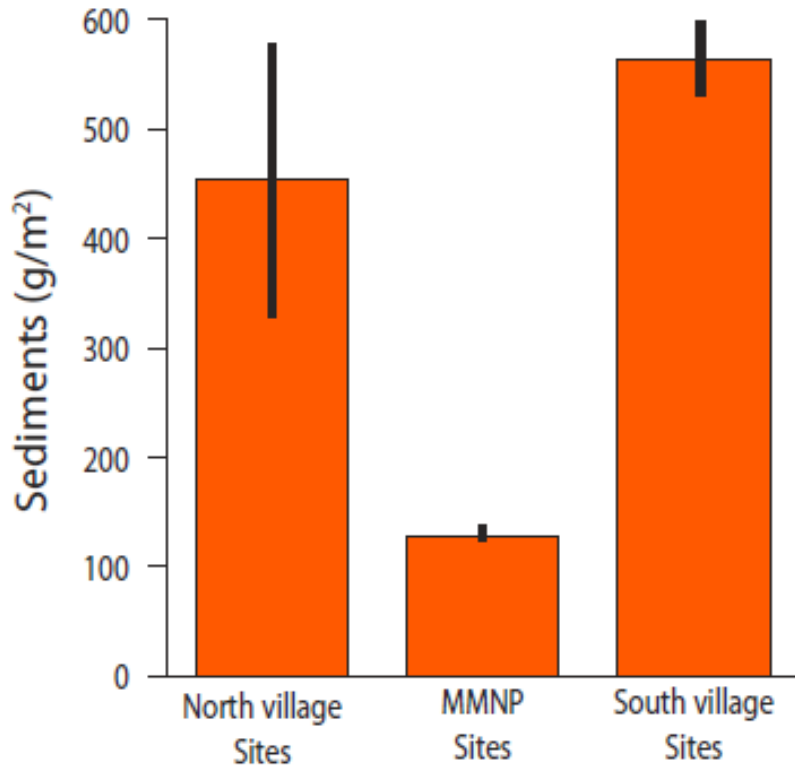


Figure 1. Nitrogen and phosphorus are critical nutrients for algal growth. At high concentrations they can cause nuisance algal blooms and lead to ecosystem degradation. Nutrient concentrations were very low at all sites and are typical of lakes that are not influenced by human sewage

The stable isotope analysis of snails collected at all sites detected no evidence that nitrogen from human waste is entering the food web

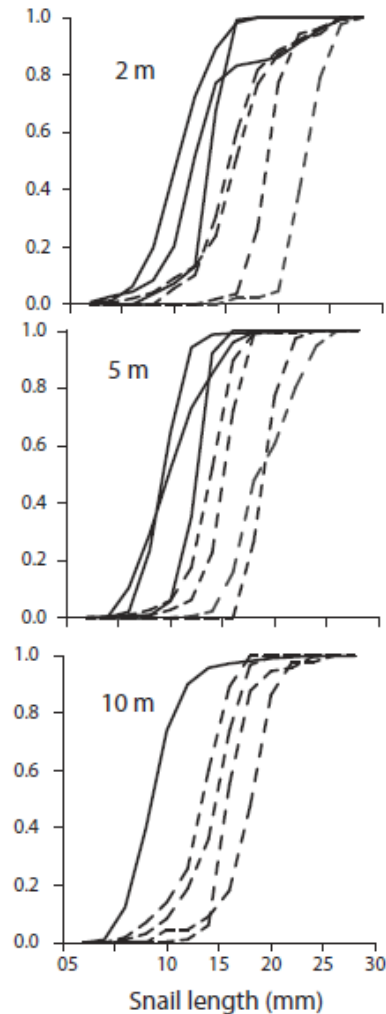
5X as Much Sediment Outside Park



Circumstantial evidence of a negative impact of this sediment on algae, snails and grazing fish

Amazing Snail Diversity, But Sediment Impacts

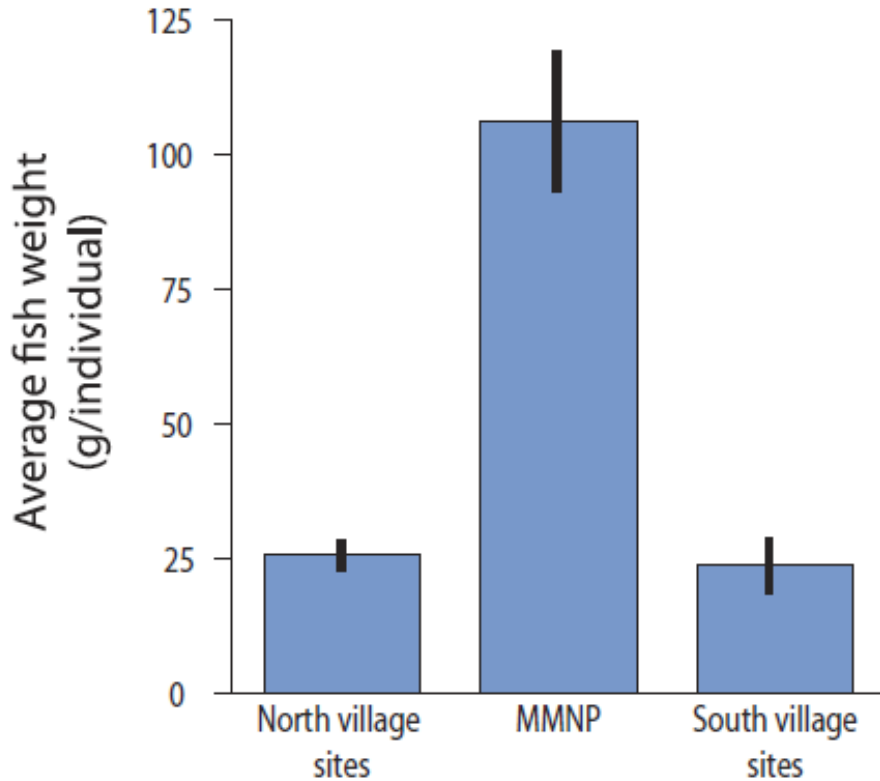
Figure 7. Snails within the park (dotted lines) were bigger than those at the village sites (solid lines). The x-axis is divided into 2 mm size classes and the y-axis shows the proportion of the population that is a \leq that size.



- Snails much smaller with higher densities at the village sites
- Silt on rocks may interfere with snails' feeding leading to lower growth and/or different species

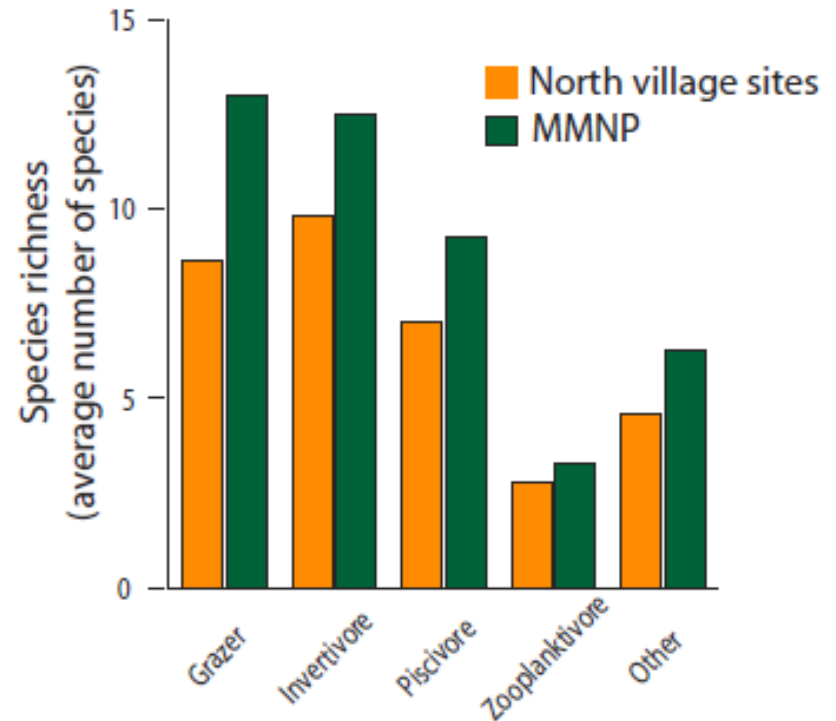
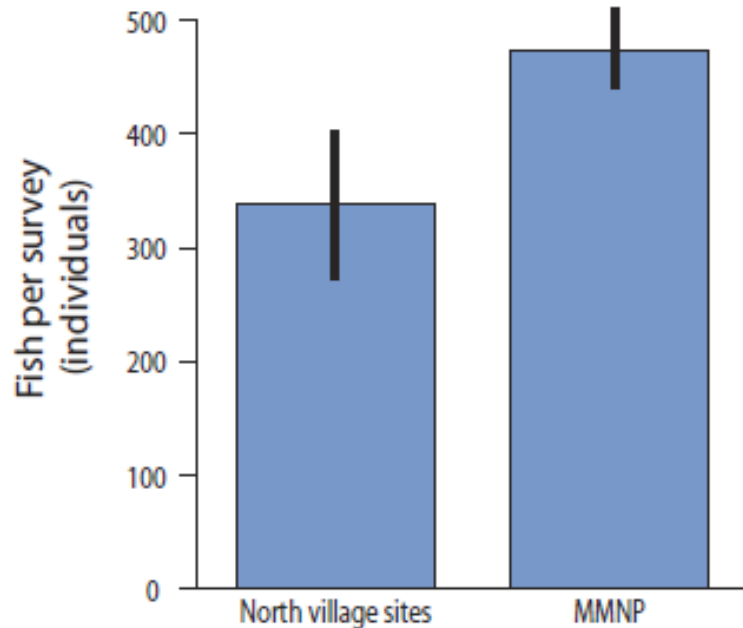


Fish are Much Smaller Outside the Park



The maximum body size of almost every fish species in MMNP was considerably larger than the same species in Kigoma or the villages sites

Lower Fish Density and Richness Outside Park



All of Lake Tanganyika's major evolutionary lineages of fish are represented within the MMNP boundaries, with a similarly high diversity of feeding strategies

Fish Breeding Site Survey

Interviewed 10 villagers per focal village

Identified 8 sites total, 2 in North

Breeding sites for dagaa, *Lates sp*, and various key cichlids

Habitats vary from river mouths, sandy near-shores, and rocks

July to August/September and rainy season always critical

1/2 say threats are beach seines and gill nets with < 3" mesh

Desired "solutions": awareness raising, stopping illegal gear, COCOBAs, improving fishing gear

Most want BMU enforcement and demarcation; some want Fisheries Officer or community police enforcement

2/3 support small-scale protected areas





Northern Village Sites



- **Site A (Buhingu Secondary School) – heavy sediment, turbidity, few algivores, and some fishing impacts**
- **Site B (near Buhingu Health Center) – less sediment impact, relatively high fish density & richness (32 species)**
- **Site B' (island near Buhingu Health Center) - heavy sedimentation, low fish density, beach seine impacts**
- **Site D (Katumbi) – lowest sedimentation (2x Mahale), relatively high richness (38) but low fish density**
- **Site E (Kalilani) – fish richness like Park (43), at lower density, & less skittish, moderate sediment & small snails**

Thoughts on Study



- Secure the Mahale FWPA – sort out demarcation
- Focus on sedimentation as a key threat where it matters most
- Human waste unlikely to be impacting nearshore ecosystem
- Fishing with huge impact on size, abundance – richness may bounce back with interventions
- Basis to move towards meaningful restrictions in breeding areas
- Repeat elements survey every 2-3 years, with additional focus on demarcated breeding sites