

# Mahale Mountains National Park as a model for conserving aquatic habitats and biodiversity

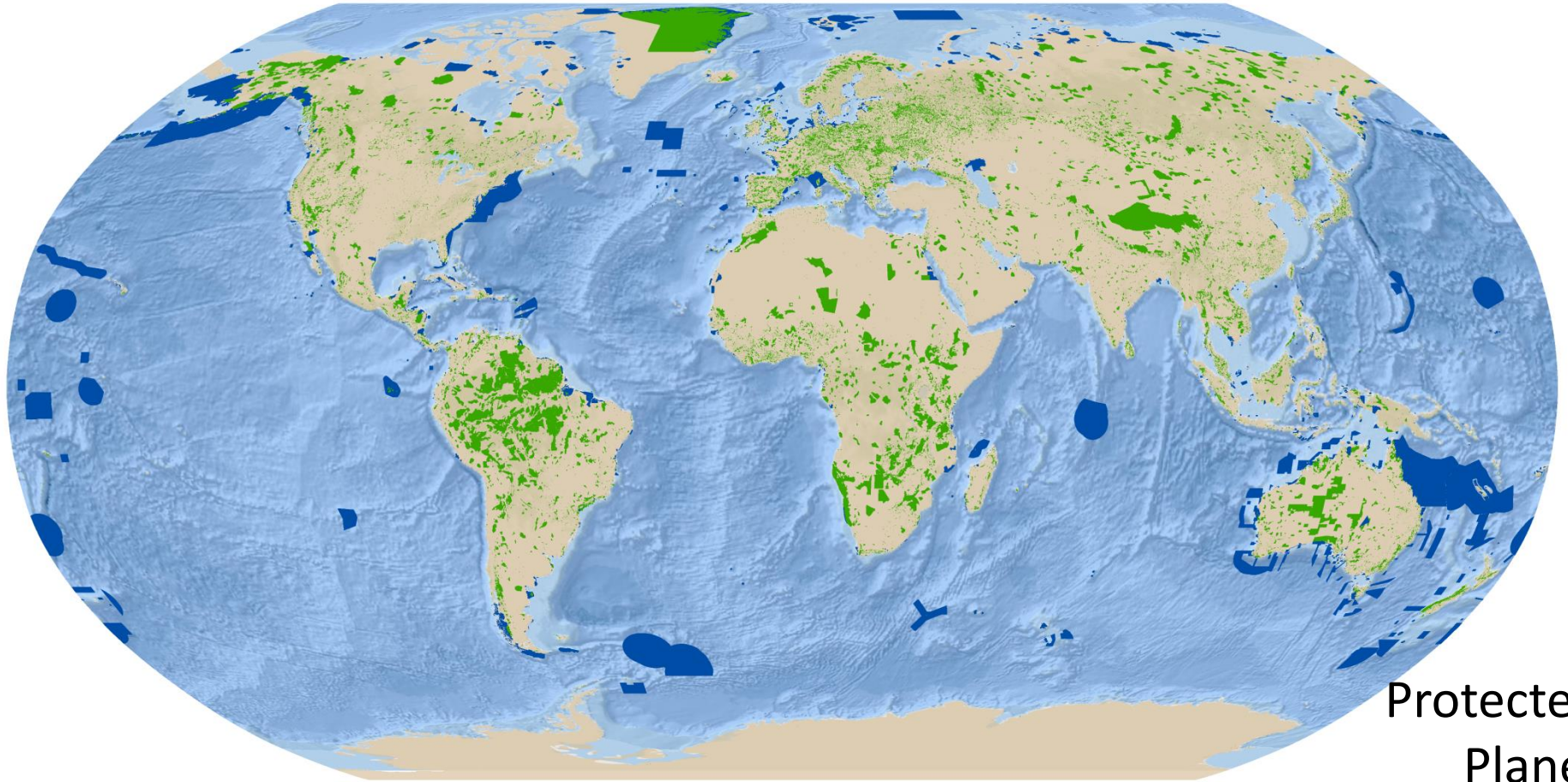
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Kazumbe, Ellen Hamann, Benjamin M. Kraemer,  
Vanessa Constant, Huruma Mgana, Gadiel  
Moshi, Yvonne Vadeboncoeur, Renalda Munubi,  
Lesley Kim, Ryan Satchell, Catherine E. Wagner,  
Ellinor Michel, Jonathan Todd, Colin Apse

The Nature  
Conservancy



MacArthur  
Foundation

# Protected Areas



Protected Planet

Source: IUCN and UNEP-WCMC (2016). The World Database on Protected Areas (WDPA) [On-line], April 2016, Cambridge, UK: UNEP-WCMC. Available at [www.protectedplanet.net](http://www.protectedplanet.net)



Terrestrial protected areas

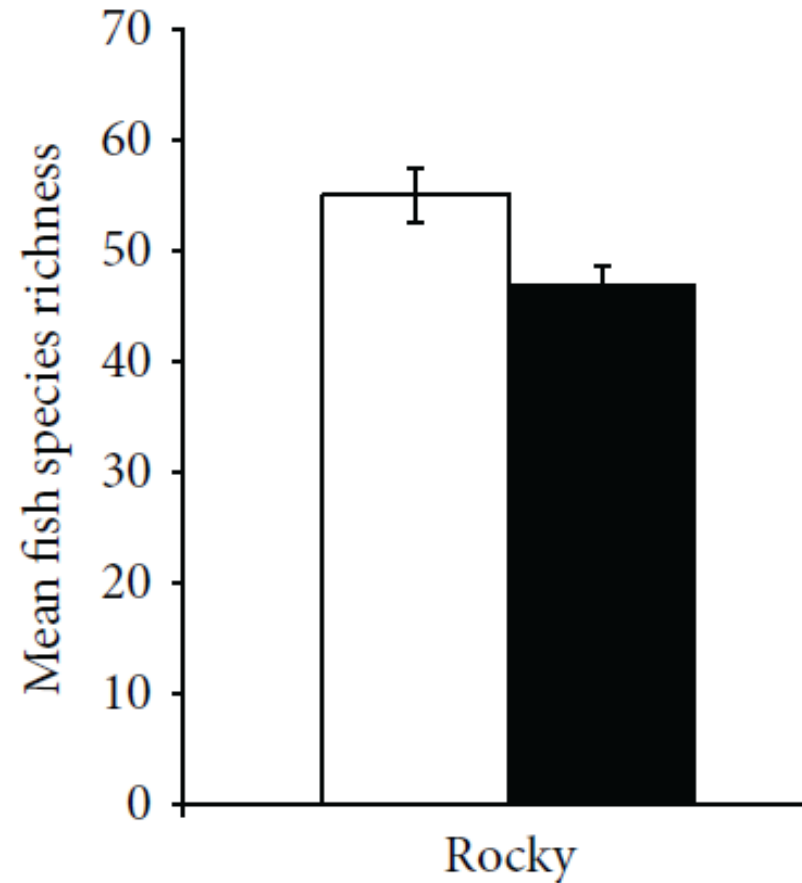


Marine and coastal protected areas



Freshwater concerns: too few, wrong places,  
exclude watersheds, poor management

# Mahale Mountains NP

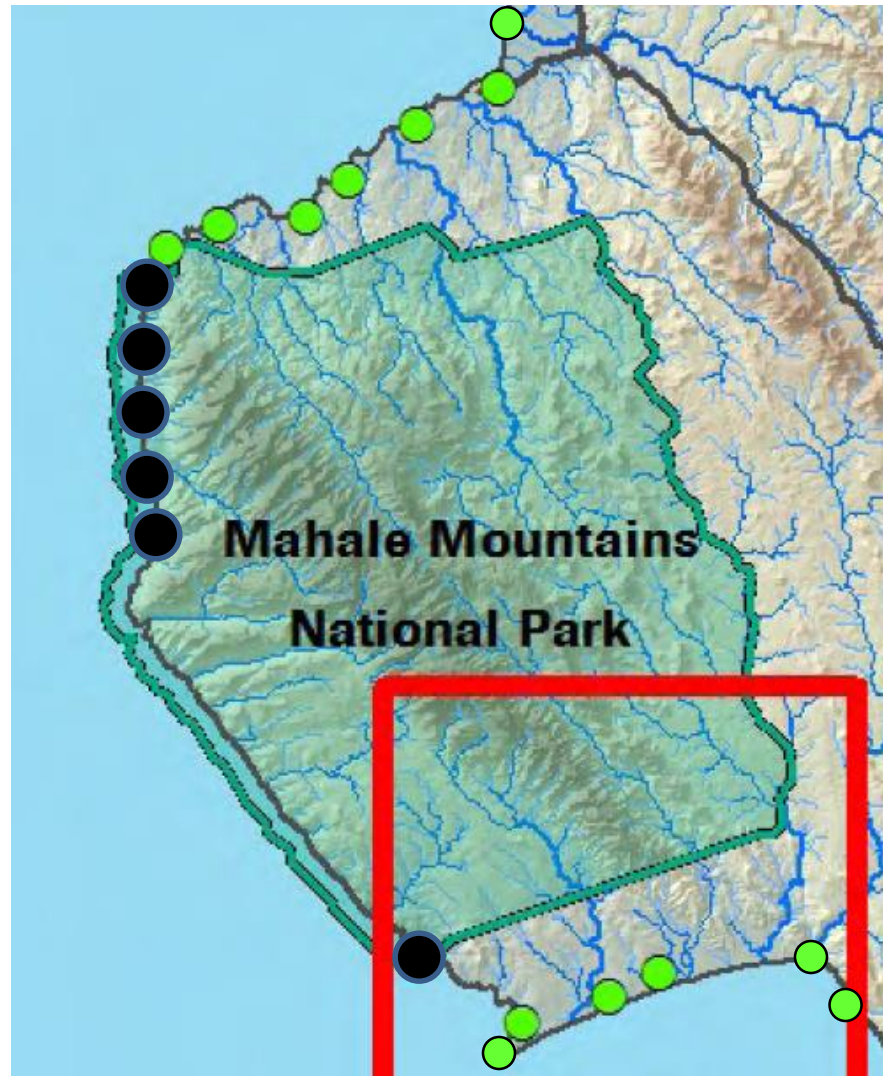
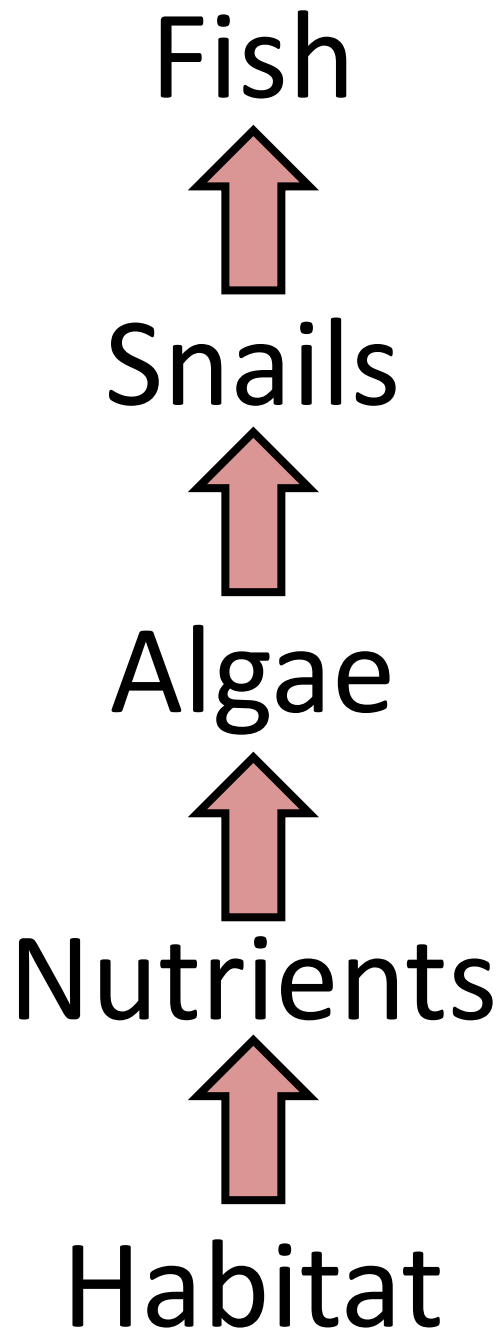


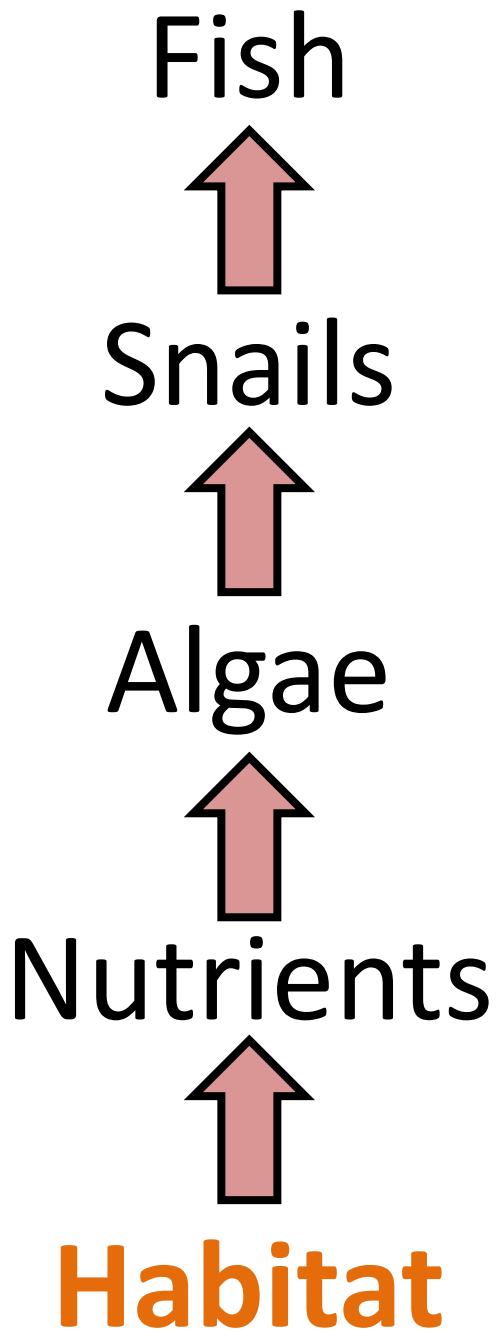
- Protected
- Unprotected

Sweke et al. 2013

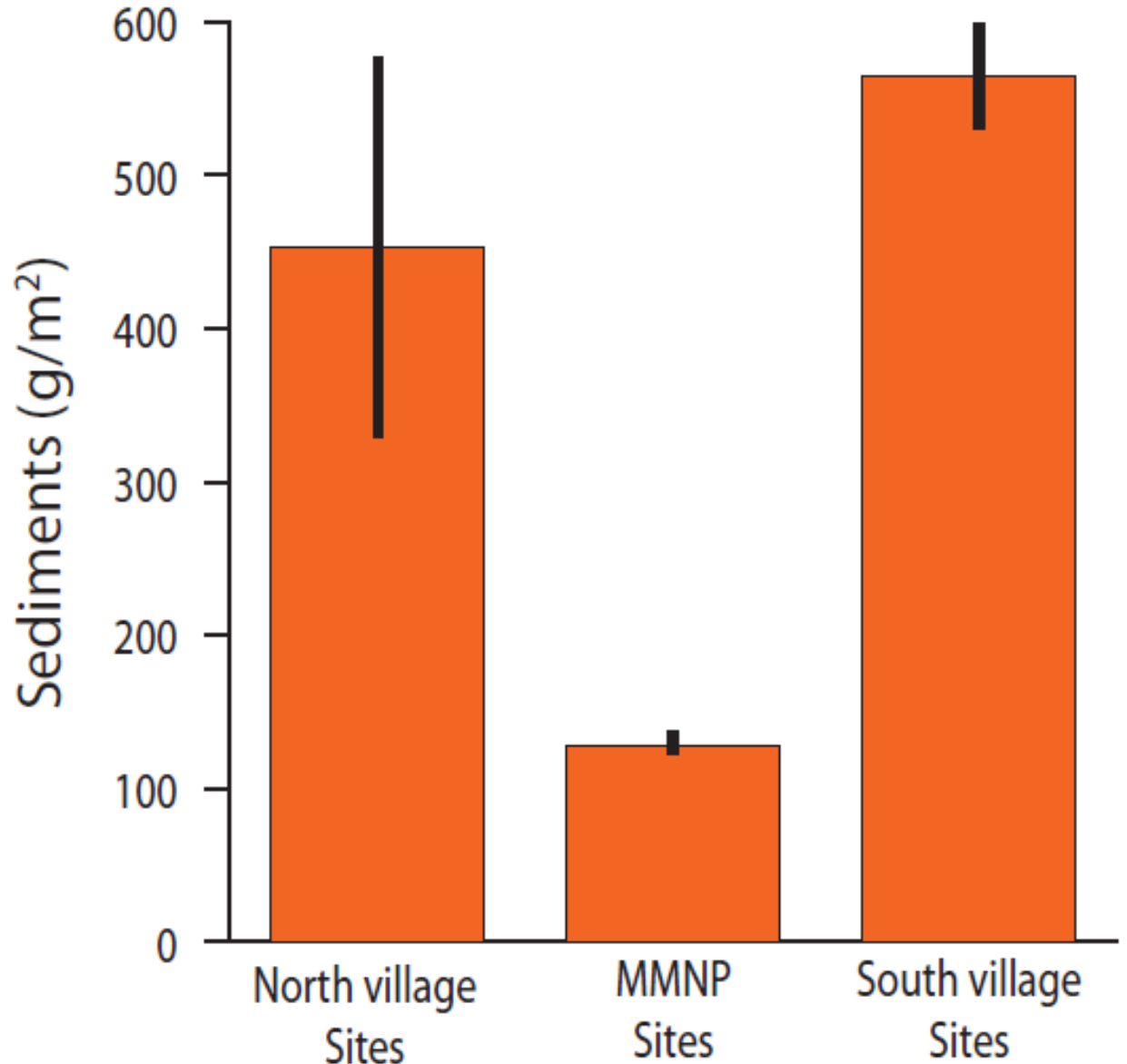
# Ecosystem Indicators

Approach:

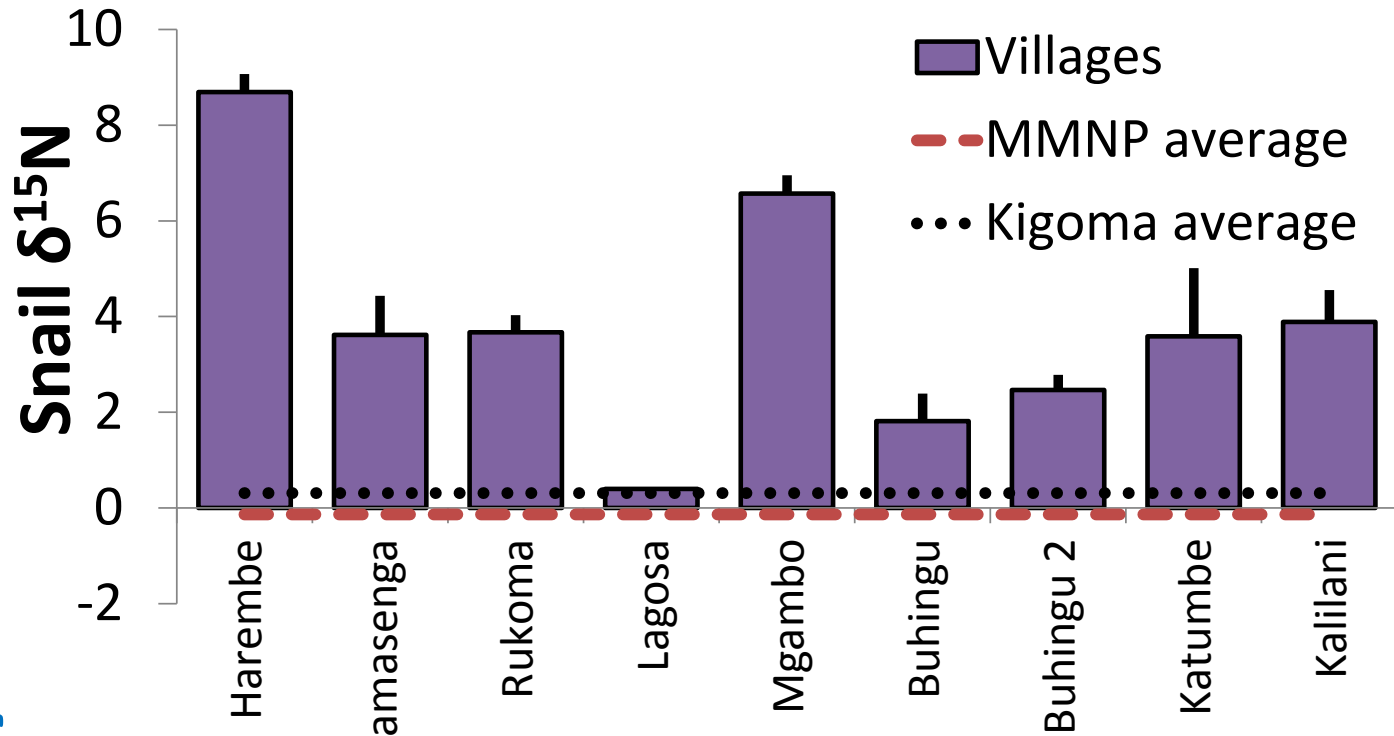
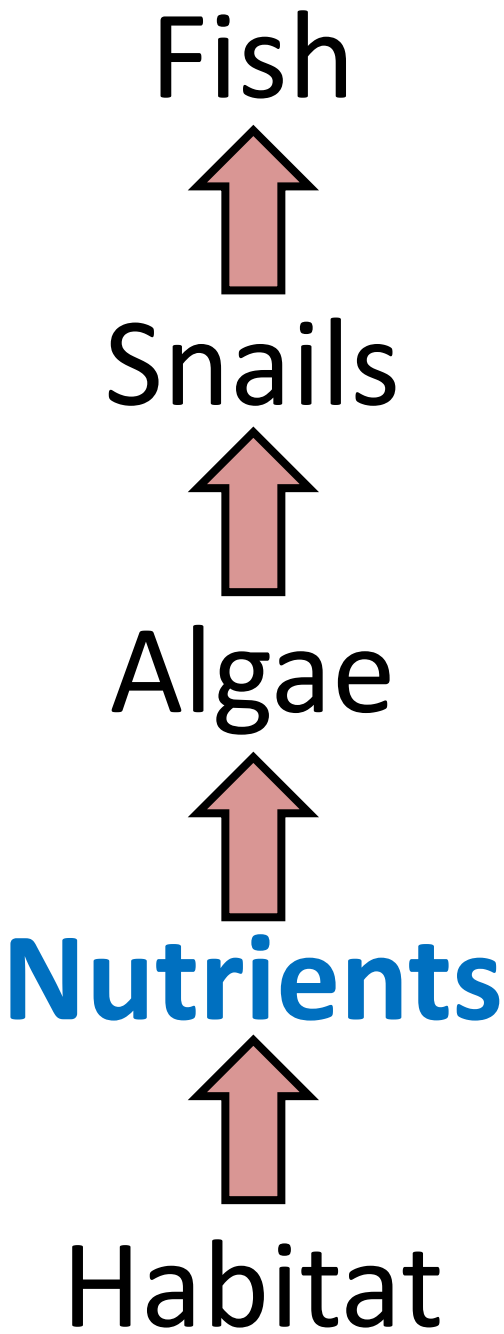




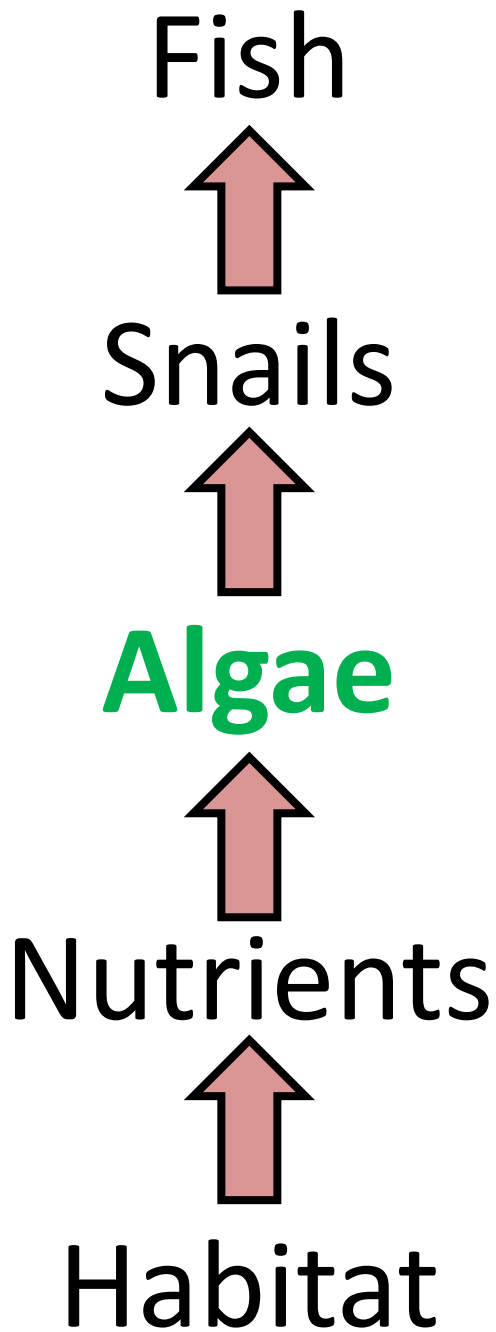
# Habitat



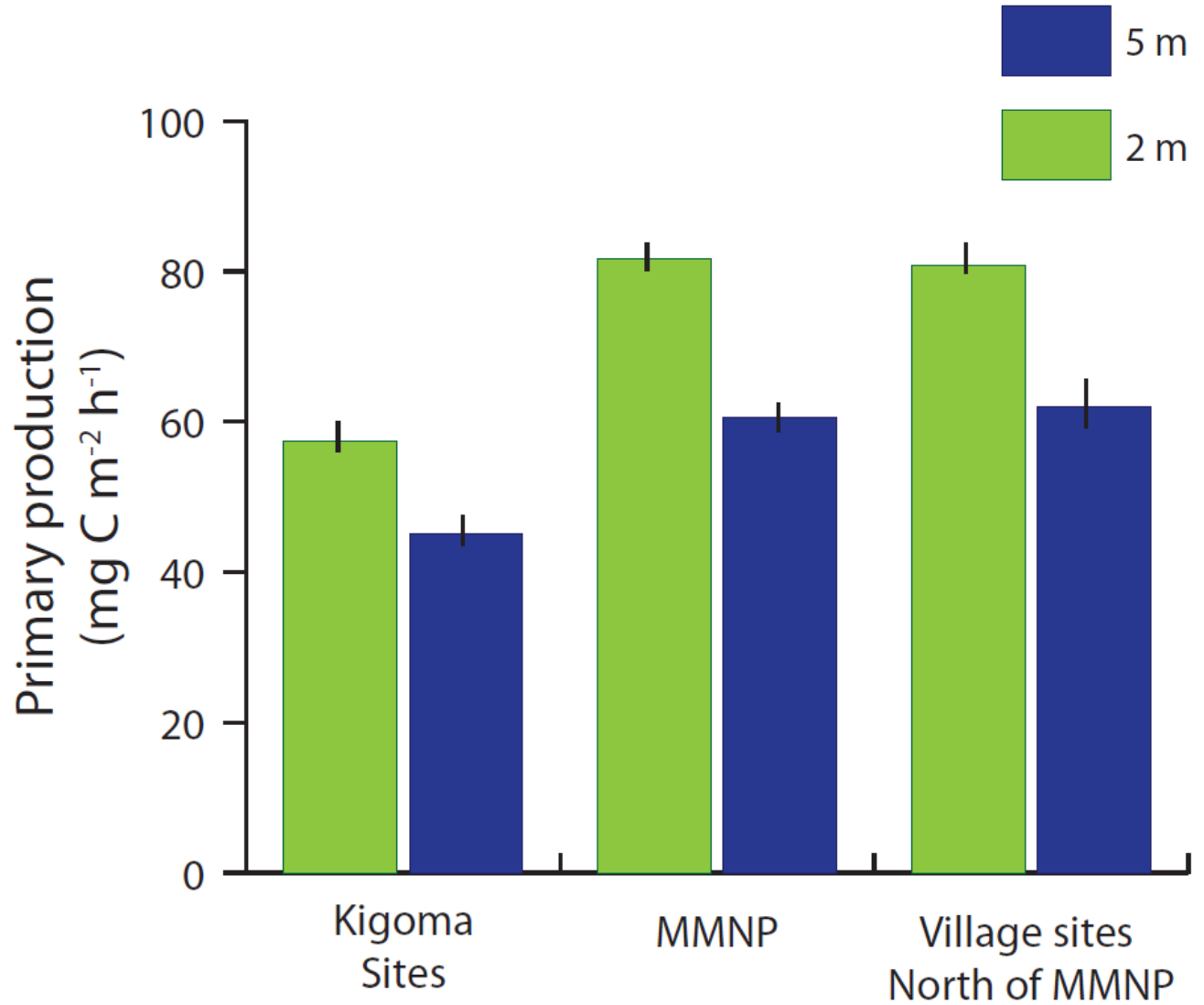
# Nutrients

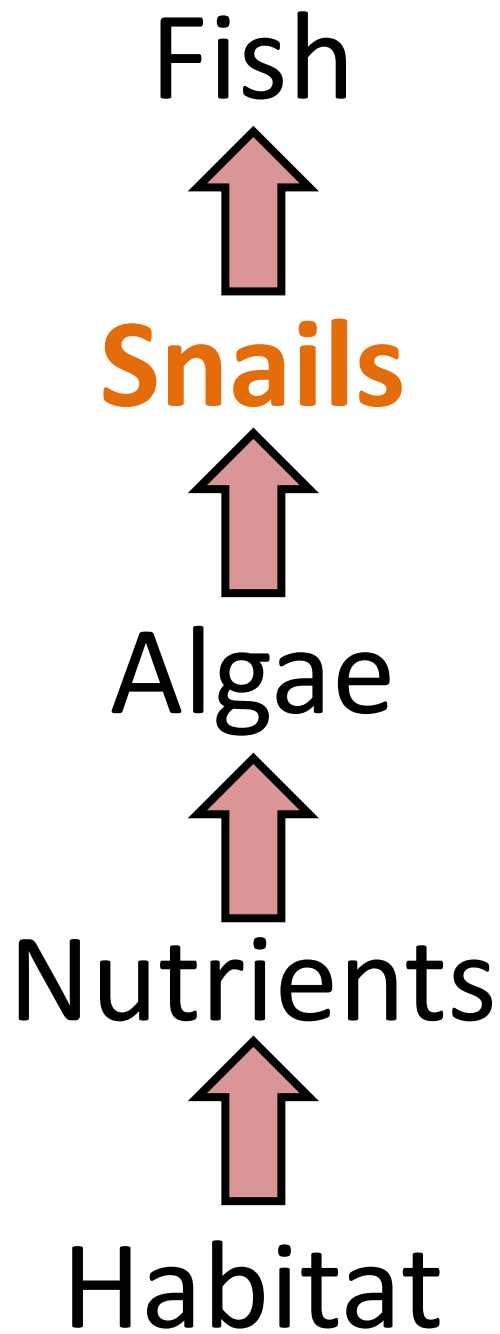


NO<sub>3</sub> – up to 4x higher  
SRP – up to 8x higher

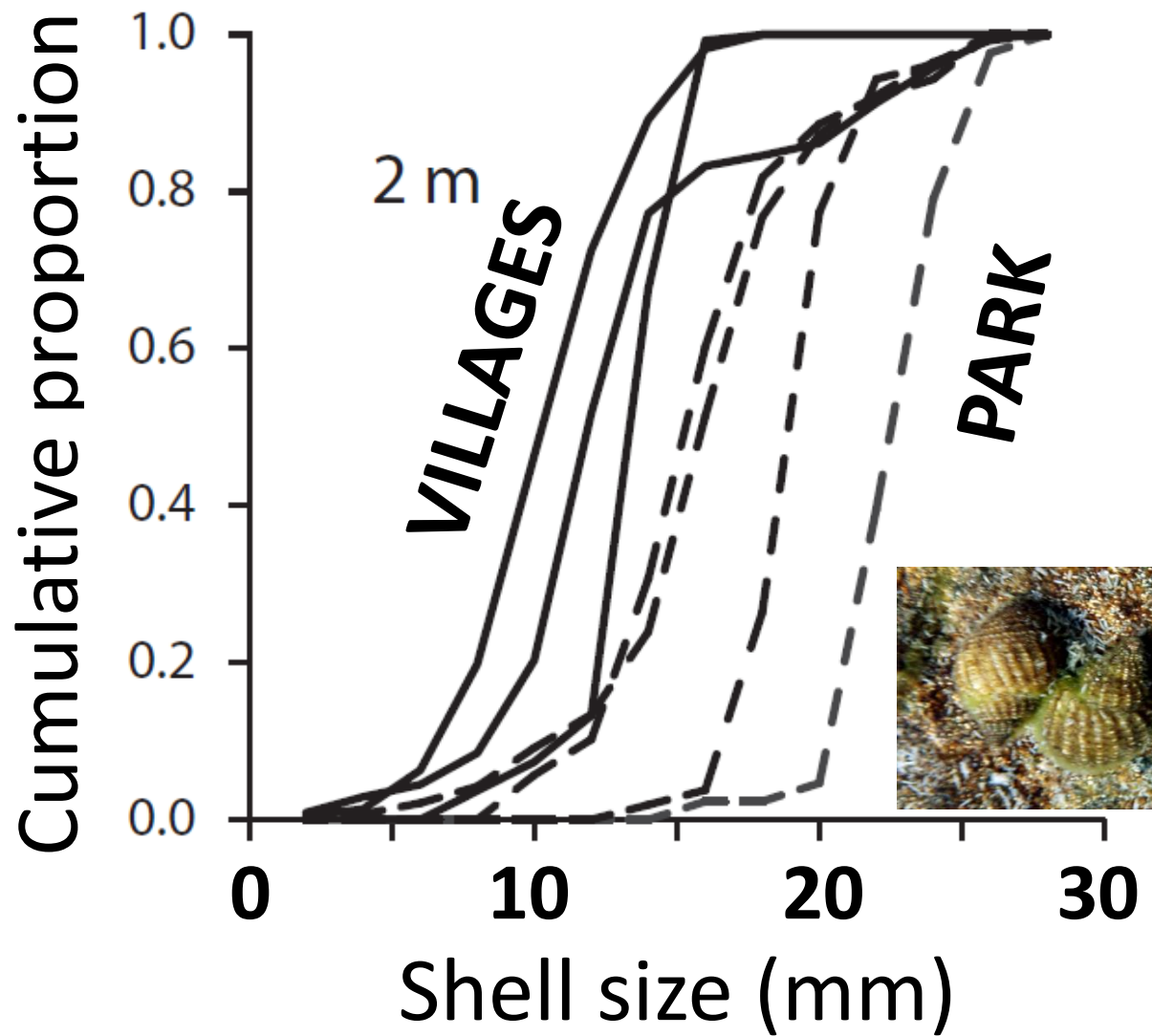


# Algae



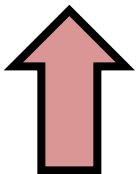


# Snails

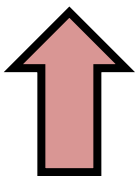




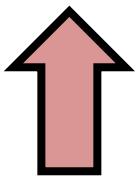
**Fish**



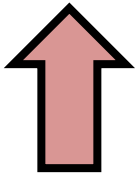
Snails



Algae

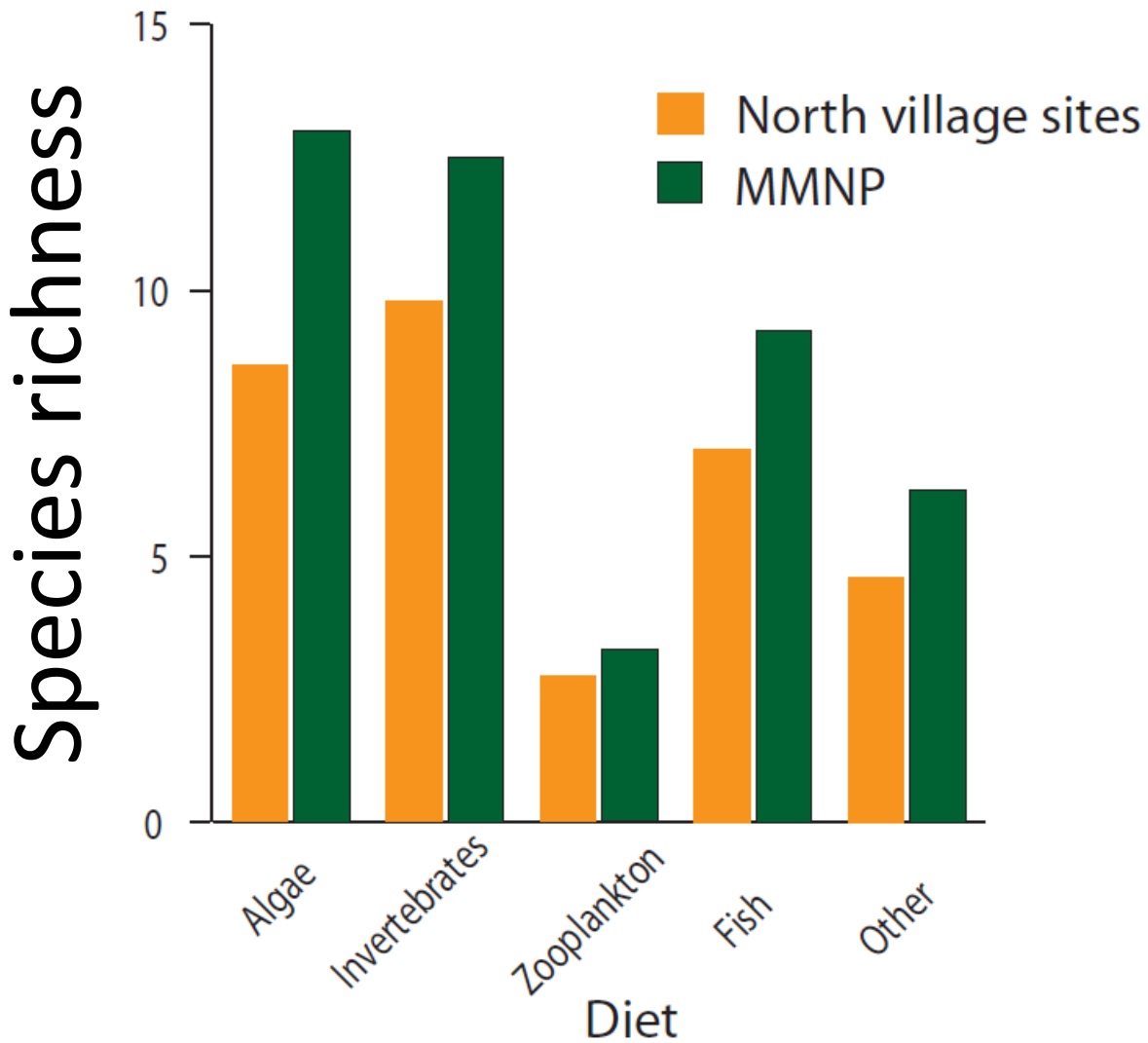


Nutrients

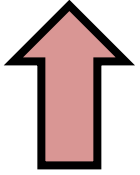


Habitat

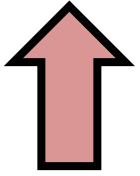
**Fish**



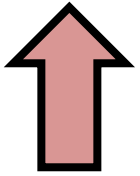
**Fish**



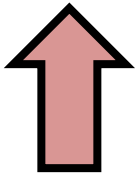
Snails



Algae



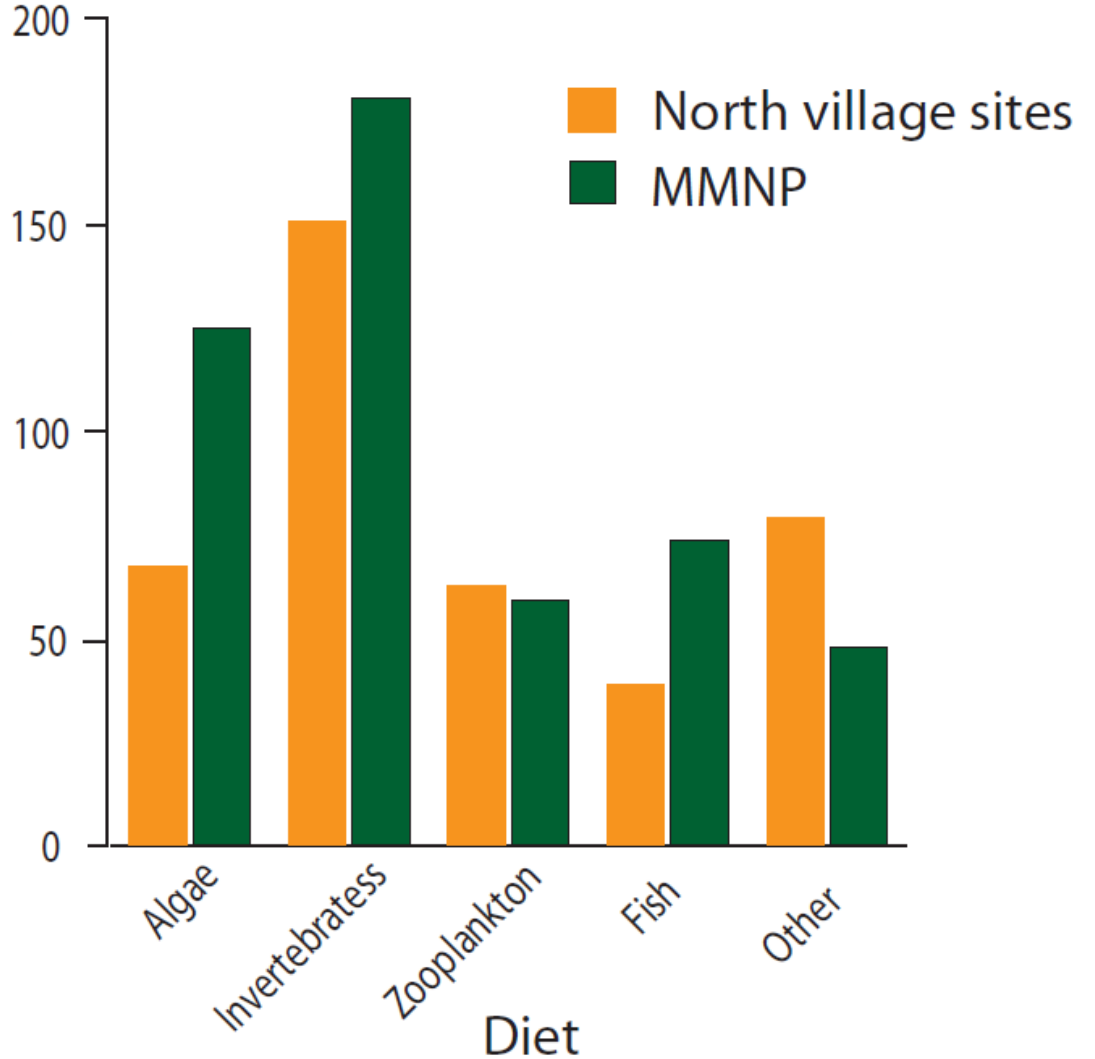
Nutrients



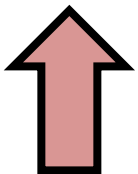
Habitat

**Fish**

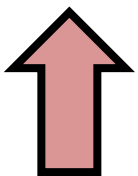
Density (ind/56 sq.m)



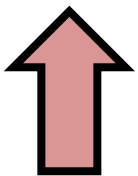
**Fish**



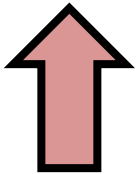
Snails



Algae



Nutrients



Habitat

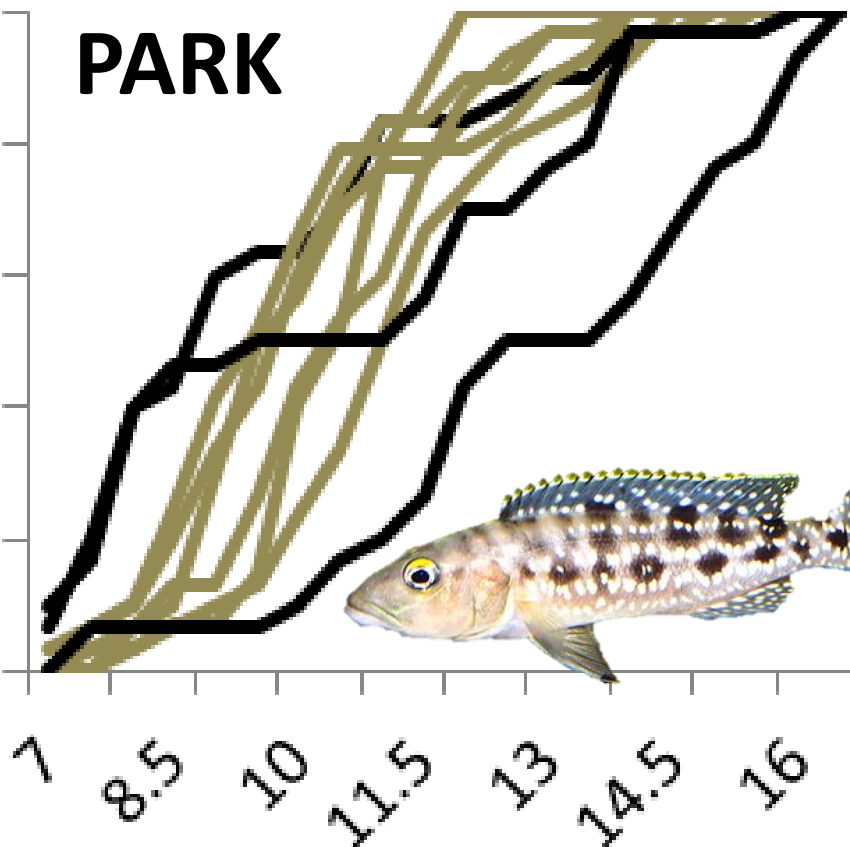
**Fish**

**VILLAGE**

**PARK**

Cumulative proportion

100%  
80%  
60%  
40%  
20%  
0%



Standard length (mm)

Fish

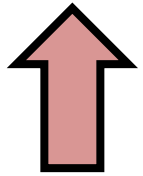


**More species & indiv  
larger sizes**

Snails

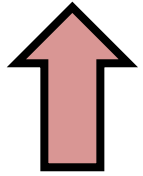


**Fewer, larger indivs.**



Algae

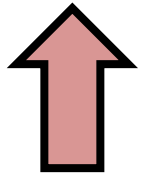
**No effect on GPP**



Nutrients



**Lower loading**



Habitat



**5x less silt**

# Conclusions

**Mahale MNP is effective:**

- *Large extent*
- *Protects watersheds*
- *Fishing prohibited*
- *Some enforcement*

***Transferable model!***



# Conclusions

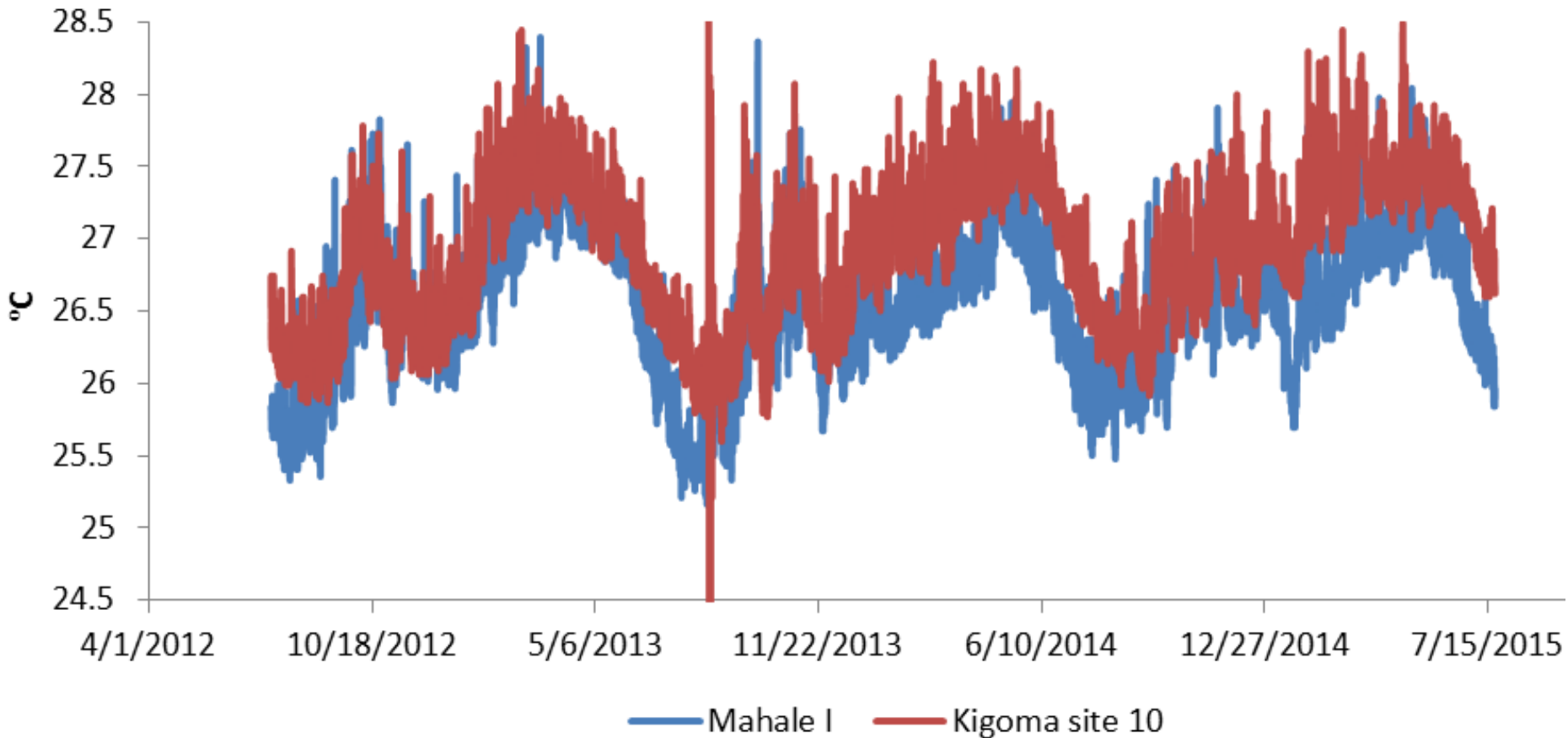
## Ecosystem service benefits:

- *Nearshore fishery spillover*
- *Pelagic fish breeding refuge*
- *Water purification*



# Conclusions

## Climate change resistance?



# THANK YOU!



**2012  
field  
team**



**TUUNGANE**  
creating a healthy future for people and nature

