Scaling Revealed by Spatial Cross-Correlation Analysis of Aquatic Communities and Environmental Drivers Using R-EMAP Data

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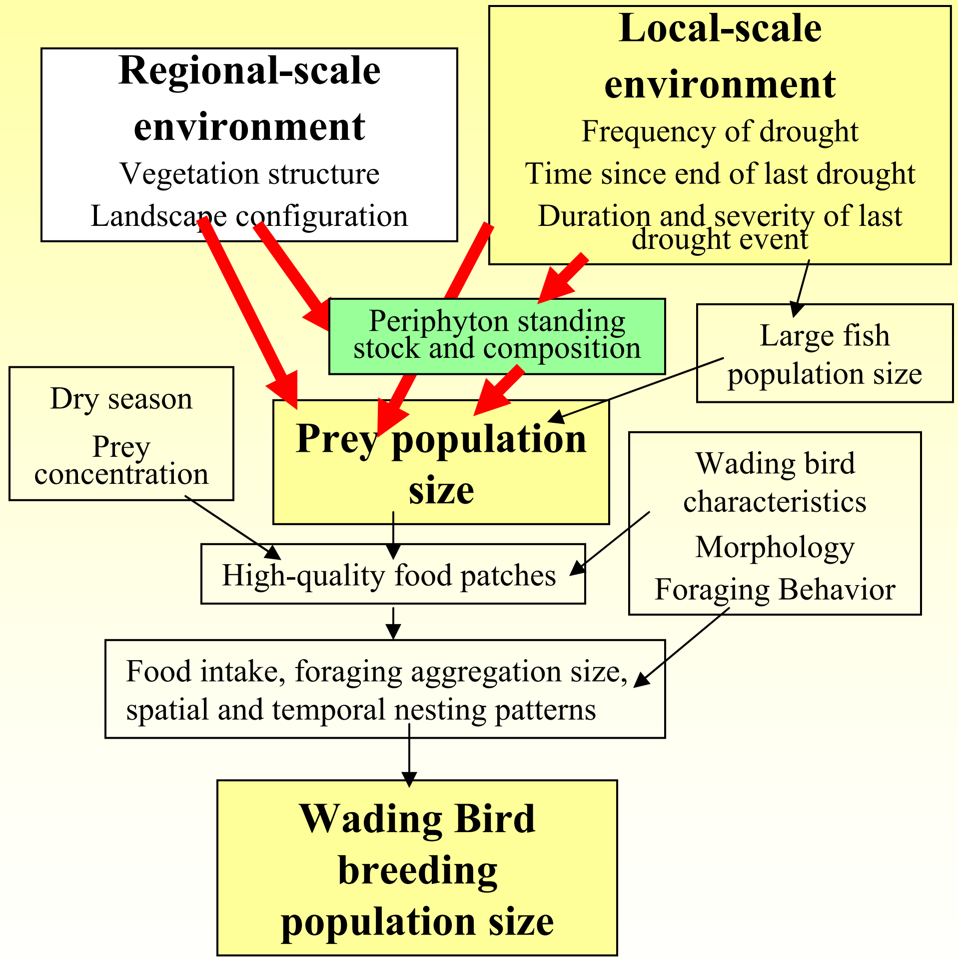
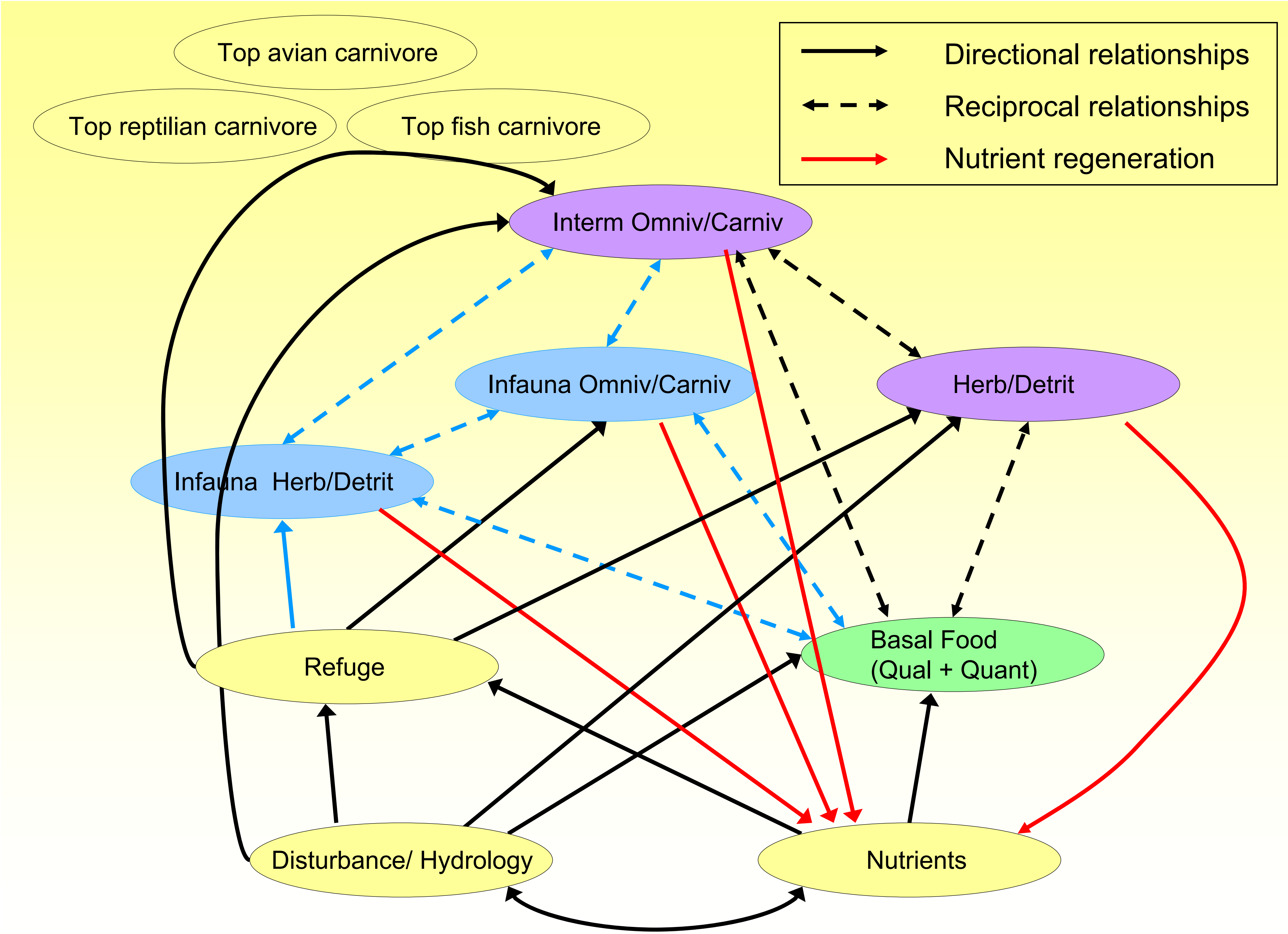
CERP Trophic Hypothesis

- Aquatic fauna are monitored because of their role linking environmental drivers controlled by management and wading birds
- Annual or semi-annual life cycles yield real-time responses to management
- Linkage of periphyton mats to prey populations is a key CERP hypothesis in the causal model

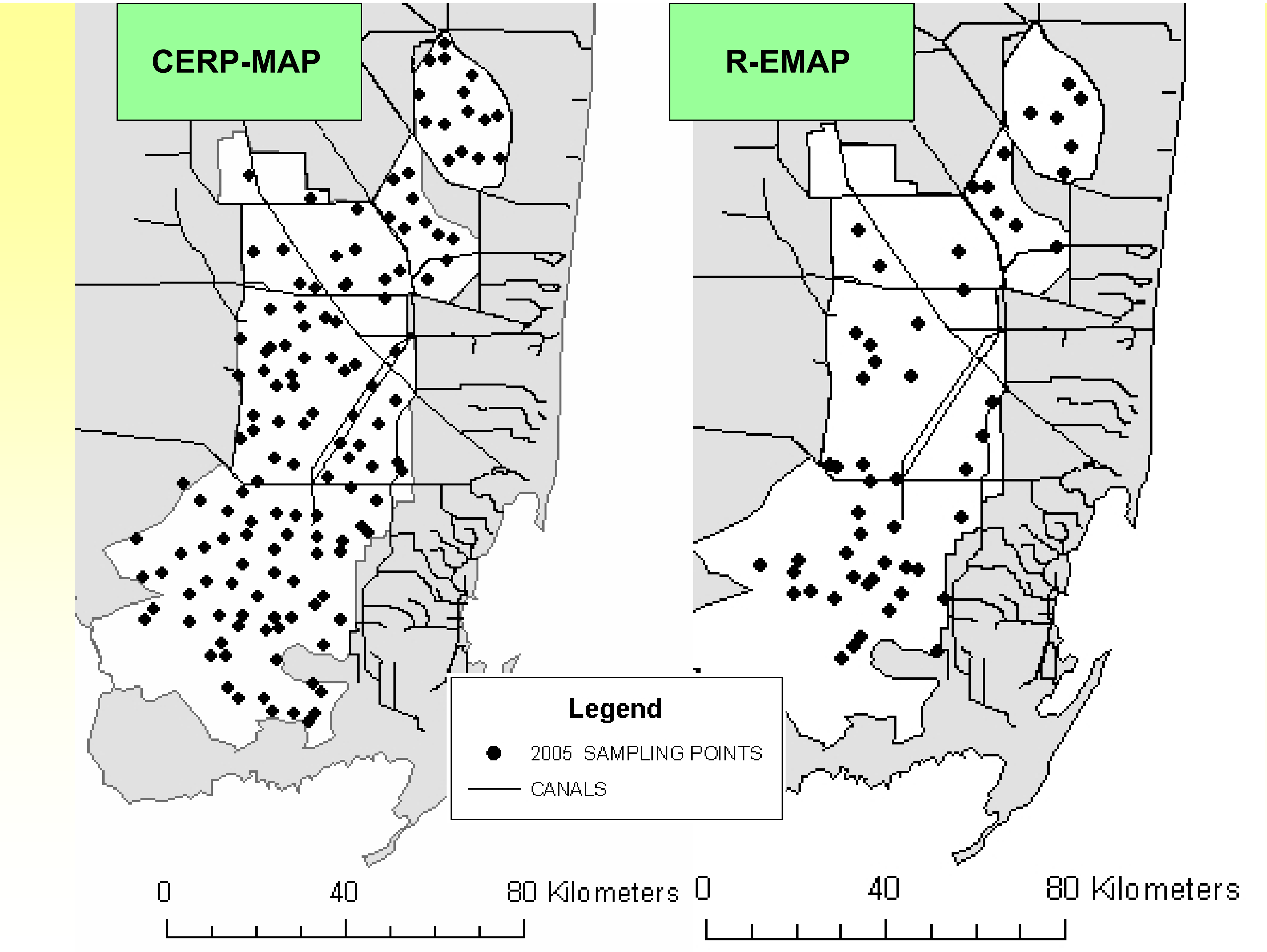




Top avian carnivore
Top reptilian carnivore
Top fish carnivore
Directional relationships
Reciprocal relationships
Nutrient regeneration
Interm Omniv/Carniv
Infauna Omniv/Carniv
Herb/Detrit
Infauna Herb/Detrit
Basal Food
(Qual + Quant)
Refuge
Disturbance/ Hydrology
Nutrients

CERP-MAP and REMAP Aquatic Fauna

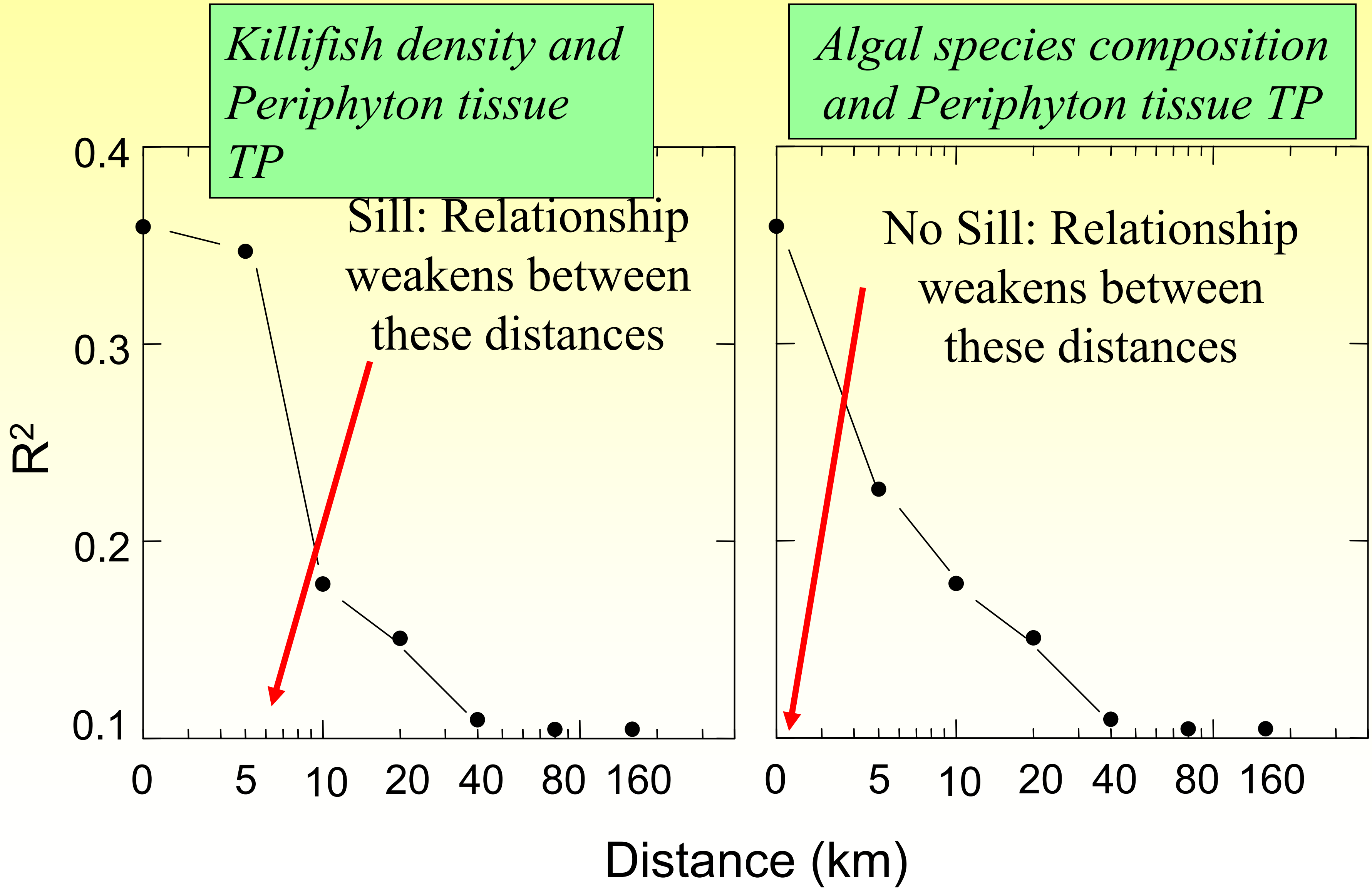
- CERP-MAP aquatic animals/periphyton for wet season 2005
  - 149 sites with three throw-trap/periphyton samples each
- REMAP for wet season 2005
  - 54 sites with three throw-trap samples each
- See Sargeant poster: #26 for path analysis


CERP-MAP
R-EMAP
Legend
2005 SAMPLING POINTS
CANALS
0
40
80 Kilometers
0
40
80 Kilometers

A Little Statistics Jargon
with apologies to normal people

- *Spatial cross-correlation* may be used to evaluate compromises in inter-dataset combinations:
  - *Semivariograms* illustrate the correlation of a single PM between sites at incrementally increasing distances (scaling)
  - *Cross-correlations* illustrate the correlation between two different PMs (or a PM and a ‘driver’ variable) at sites with incrementally increasing distance

Hypothetical Result of Spatial Cross correlation between a Performance Measure and Environmental Driver

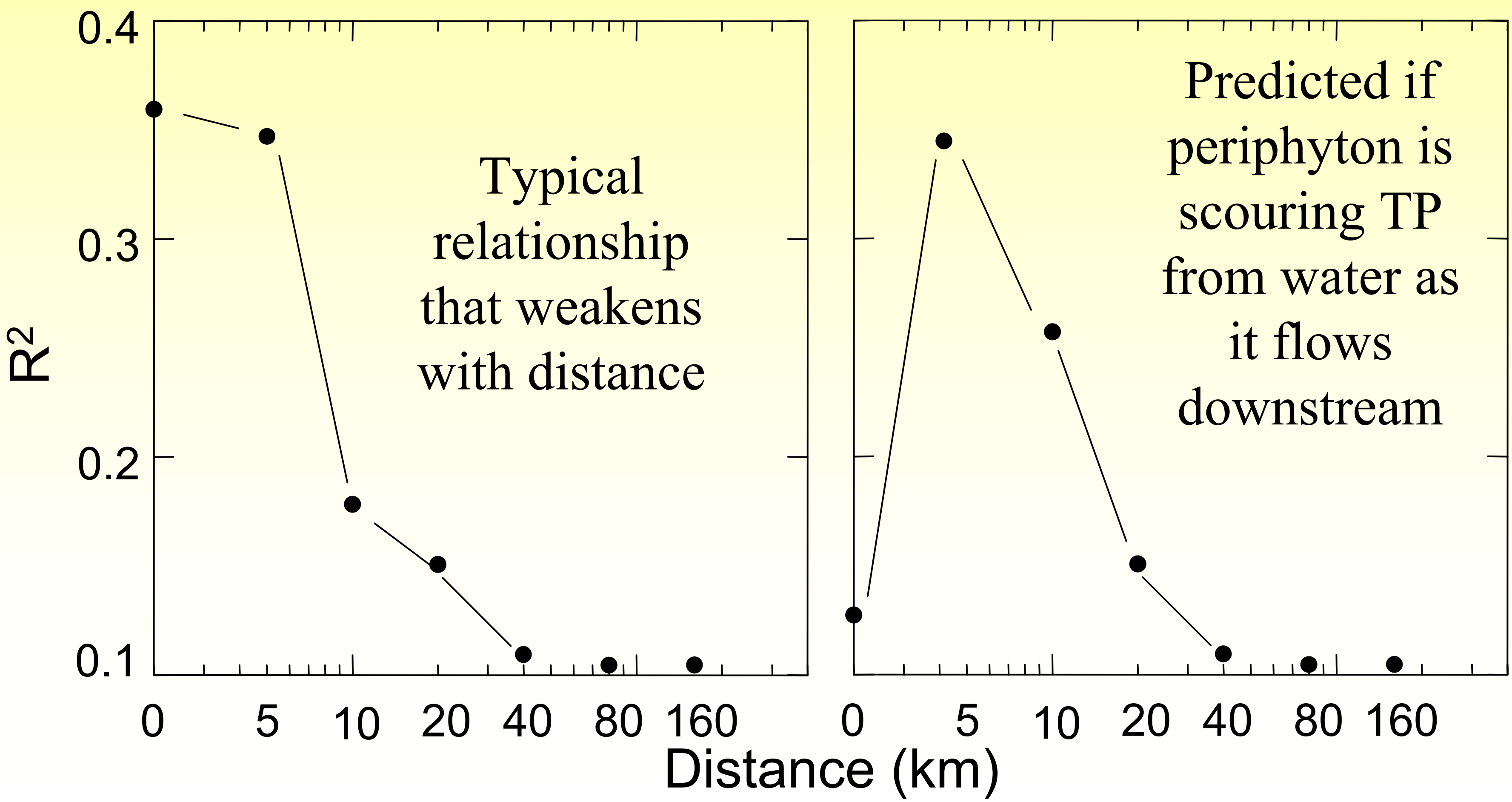


Hypothetical Result of Spatial Cross correlation #2

Anisotropy (directional bias) is possible in flow-linked parameters

Periphyton TP with Water TP measured perpendicular to flow

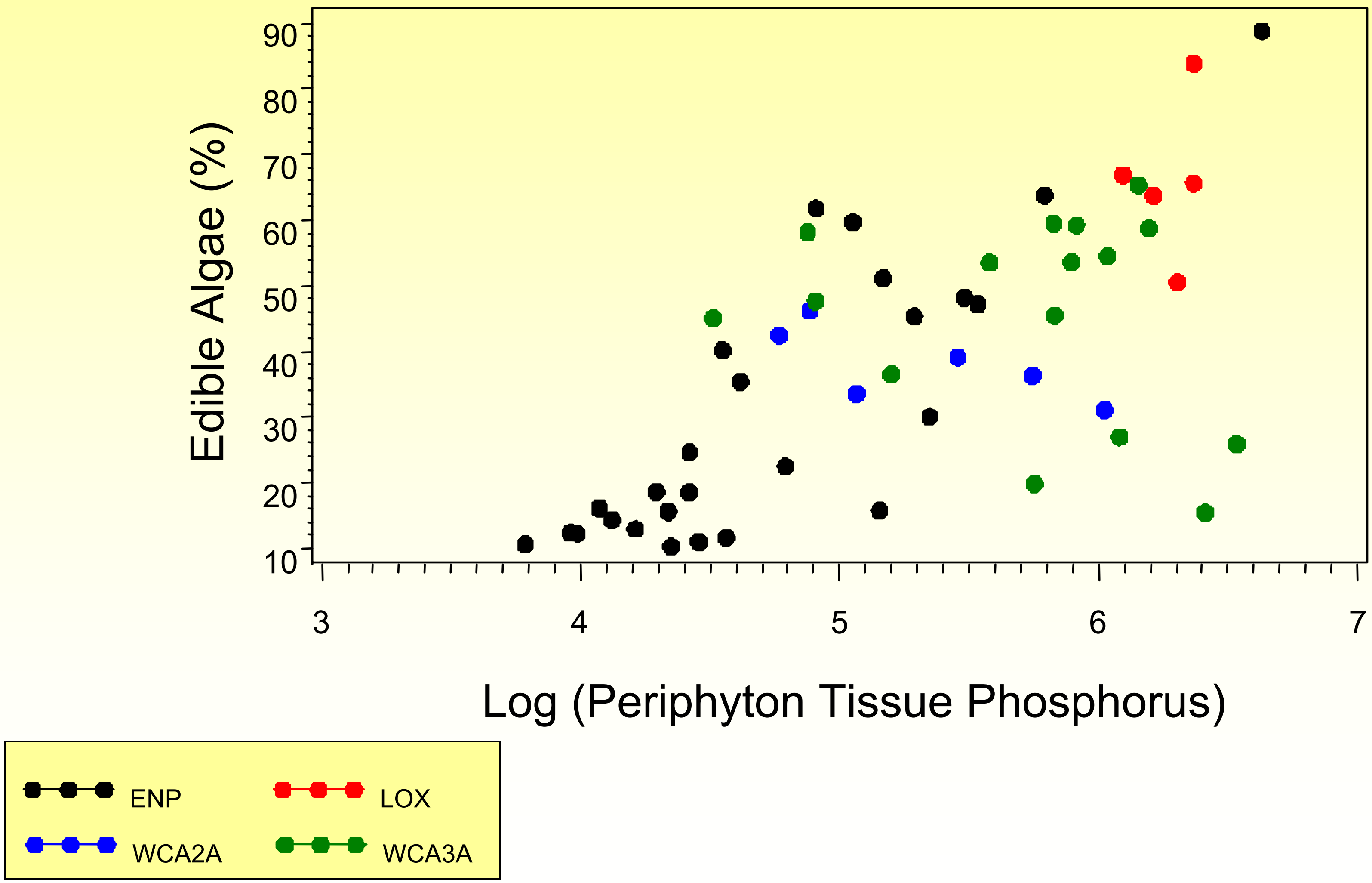
Periphyton TP with Water TP measured upstream



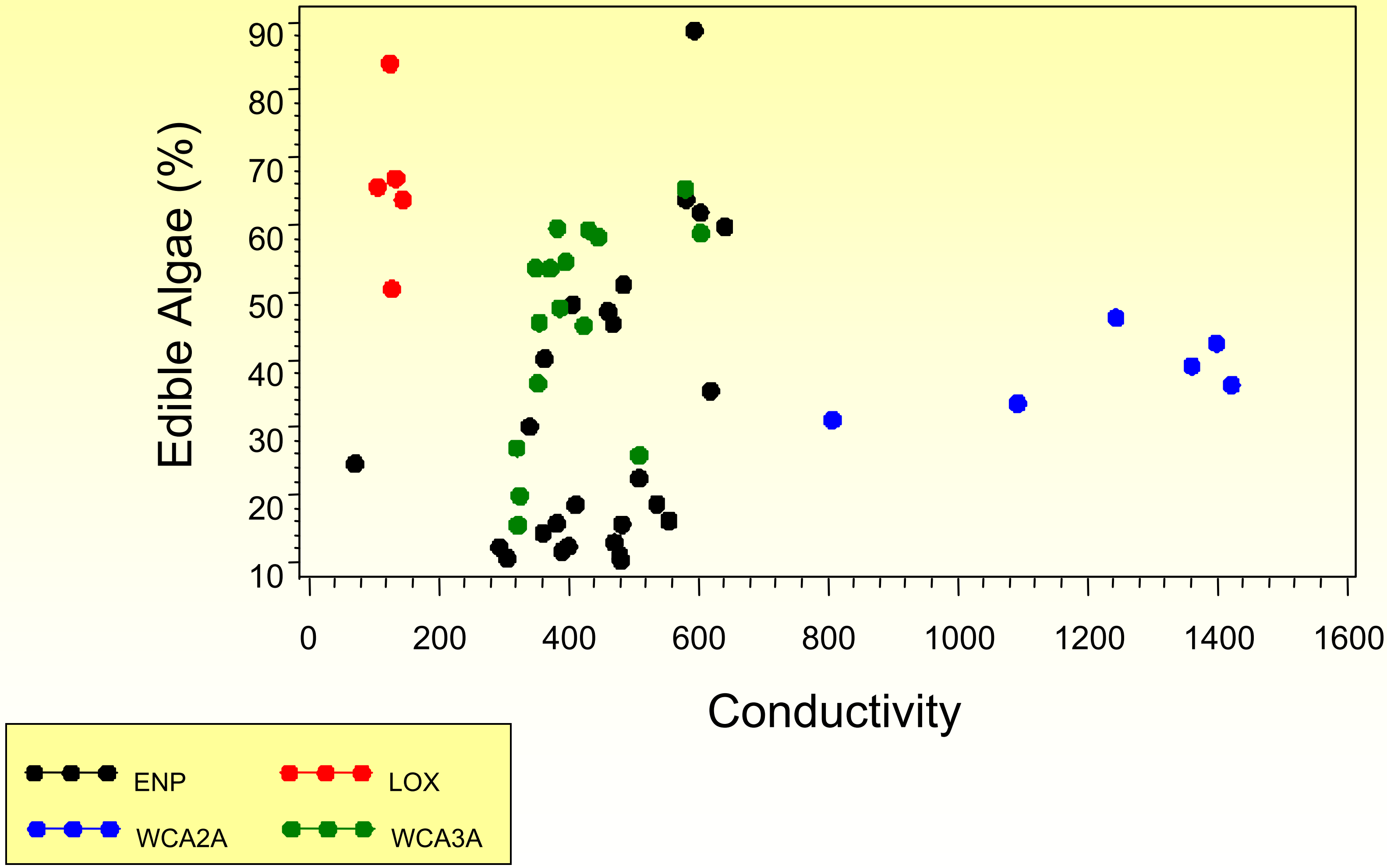
Edible Algae (%)

- Measured as the relative abundance of green algae and diatoms from mat samples
- Though some bluegreens are palatable, this split is consistent with many literature sources
- Experimental studies from the Everglades support this designation (Geddes and Trexler 2004, Chick et al. 2008, and others)

Edible Algae (%) = Periphyton Tissue TP (ug/g)

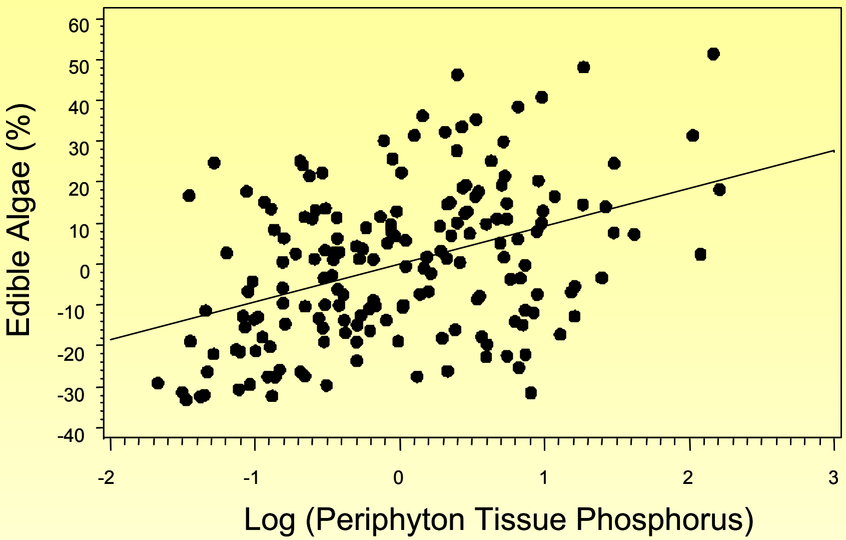


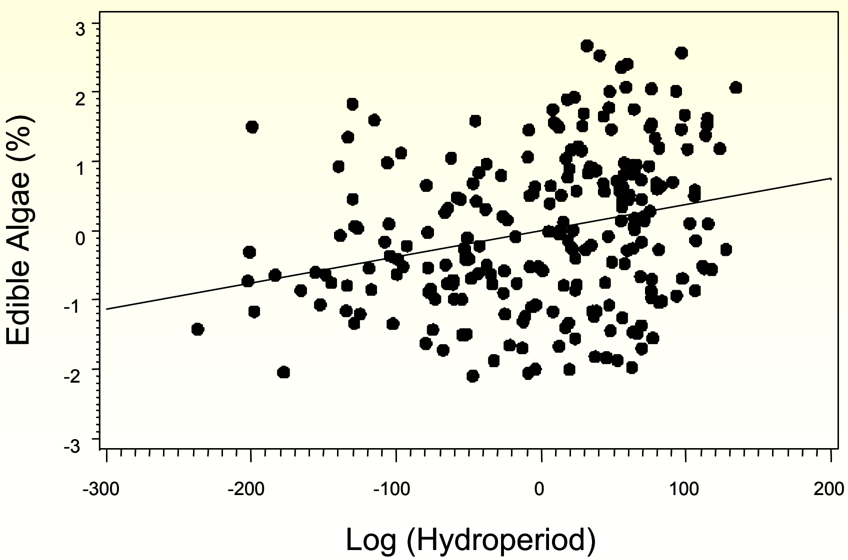
Edible Algae (%) = Conductivity (umhos/cm)



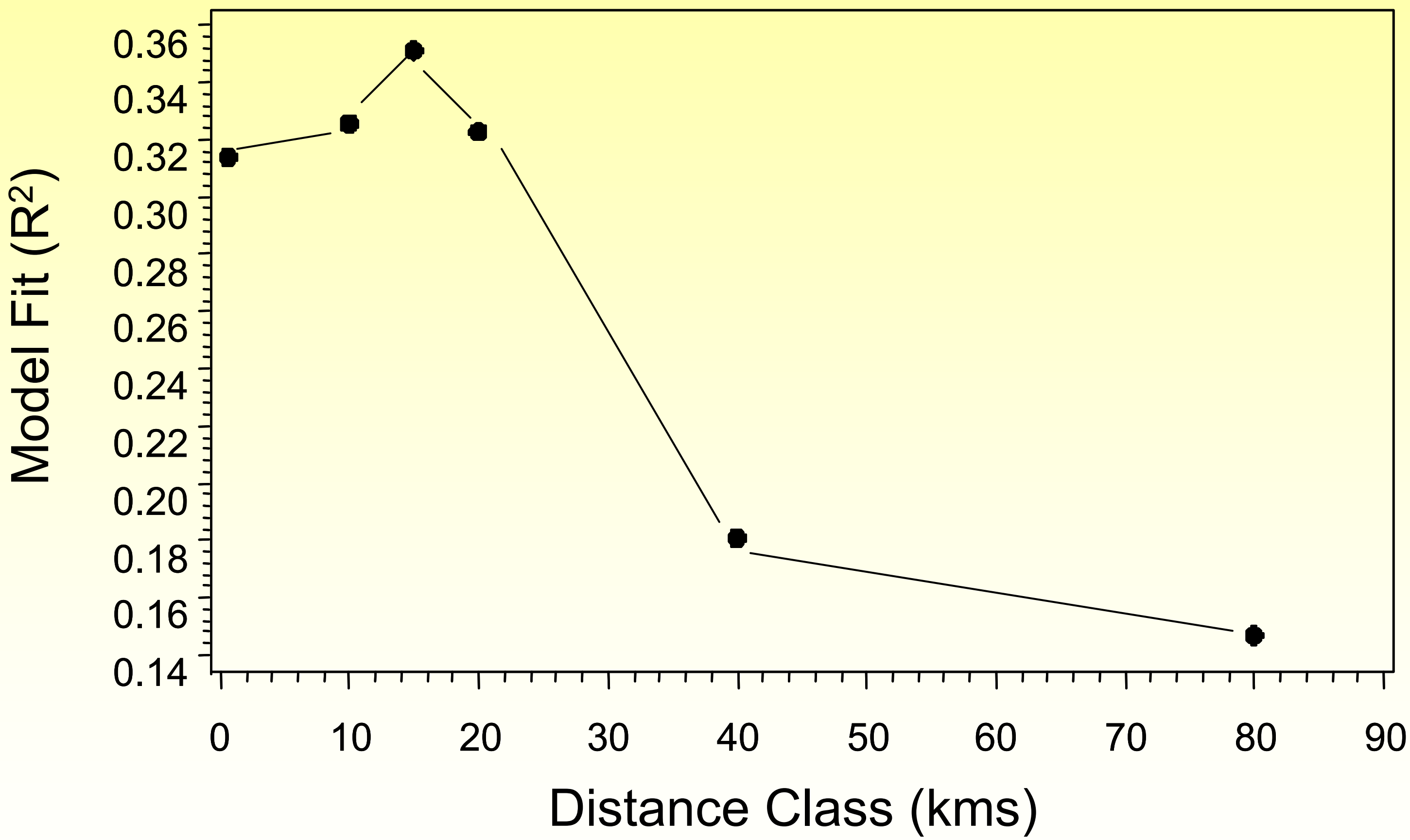
Edible Algae (%)

- Initial model = TP + hydroperiod + DSD + stem density
- Final model:
  - Tissue TP + Hydroperiod
  - $R^2 = 0.327$
- Partial Regression plots





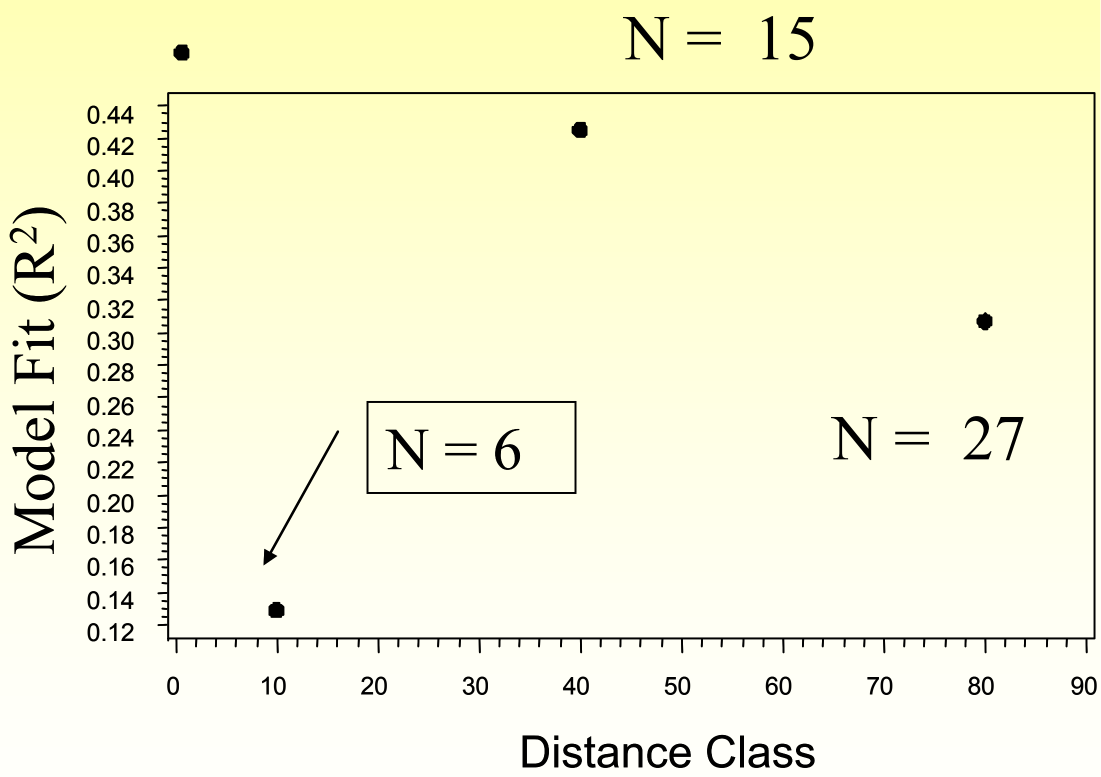
Edible Algae (%) = Tissue TP + Hydroperiod (days)



* Isotropic tests, only

REMAP only
Edible Algae

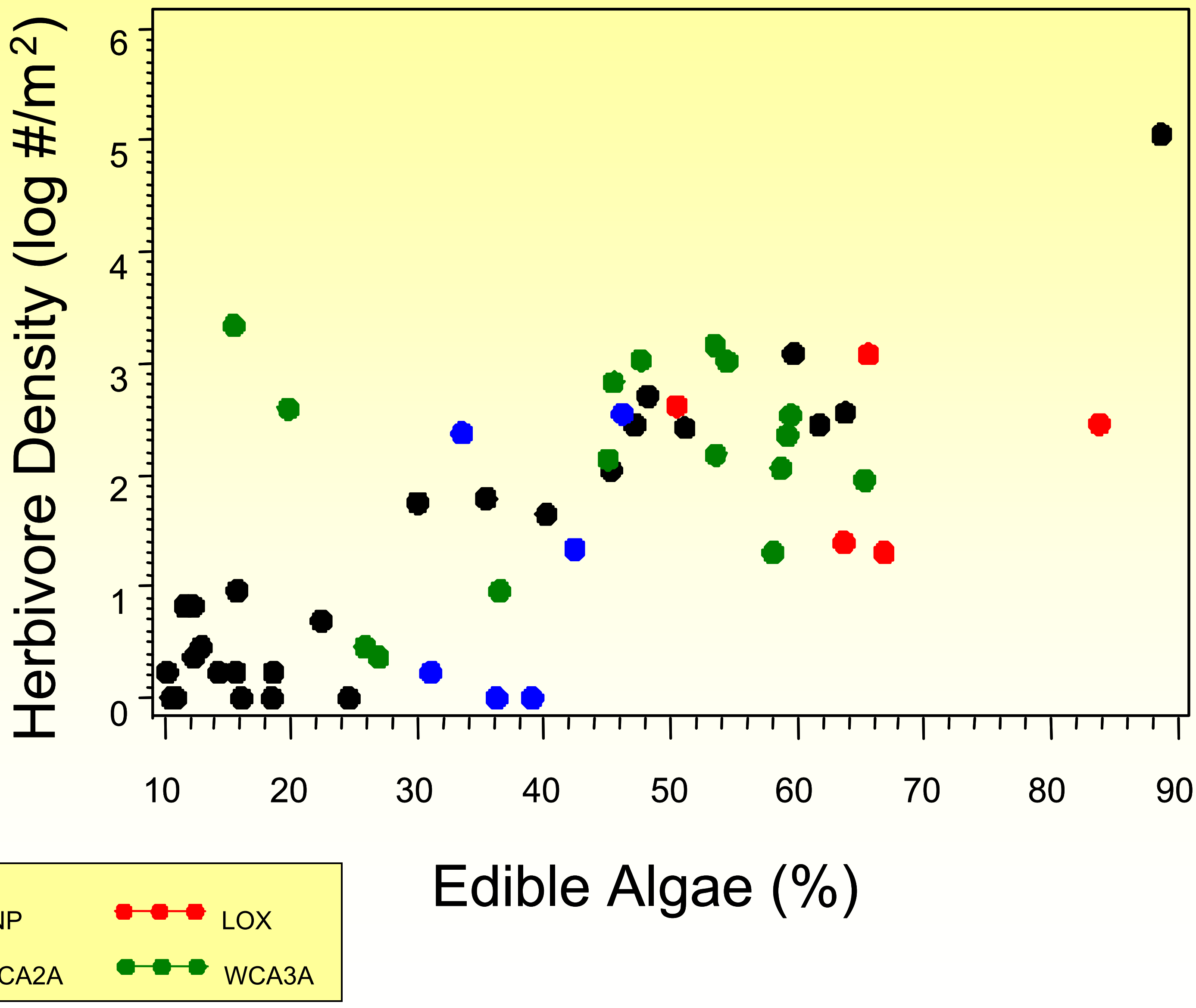
- Final model TP + hydroperiod
- $R^2 = 0.4899$
- Low sample sizes at shorter distance classes
- Results suspect



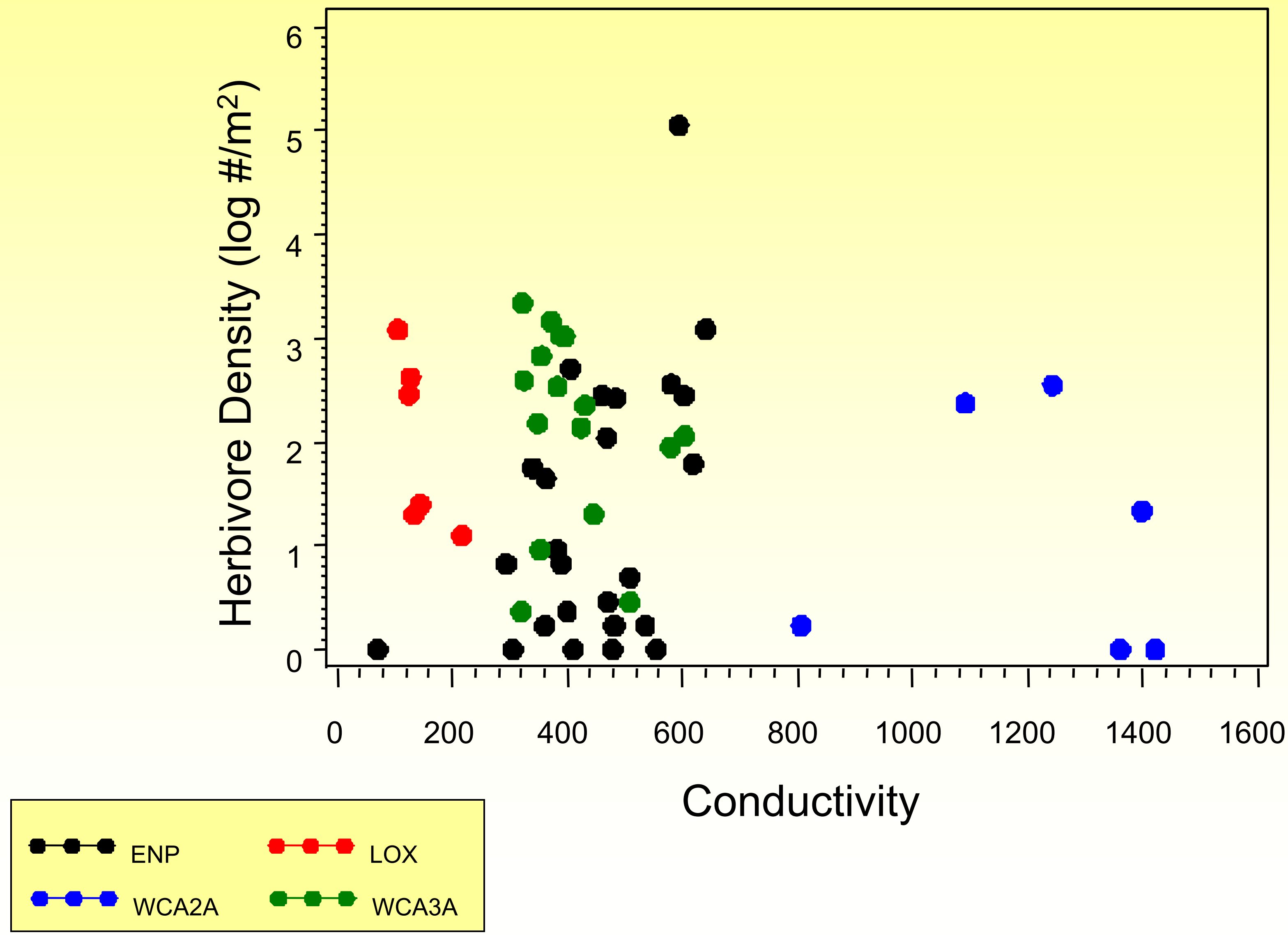
Herbivores (#/m^2)

- Measured as the sum of all snails, grass shrimp, herbivorous fish (sailfin mollies and flagfish) and tadpoles
- Isotope values grass shrimp suggest animal prey is consumed, but algae is seen in gut
- Isotope values for other consumers in list support herbivory or detritivory (Williams and Trexler, Loftus et al.)

Herbivores = Edible Algae (%)

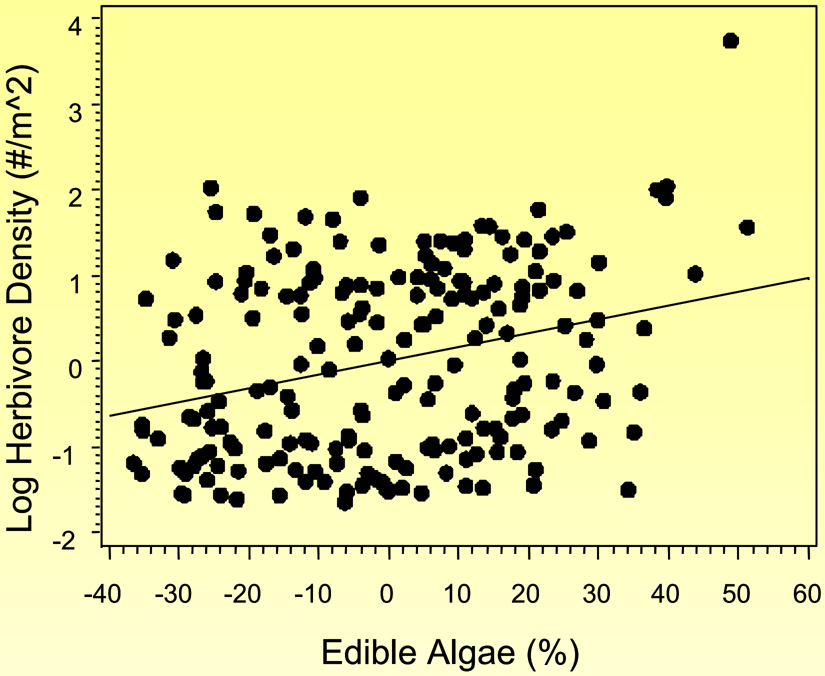


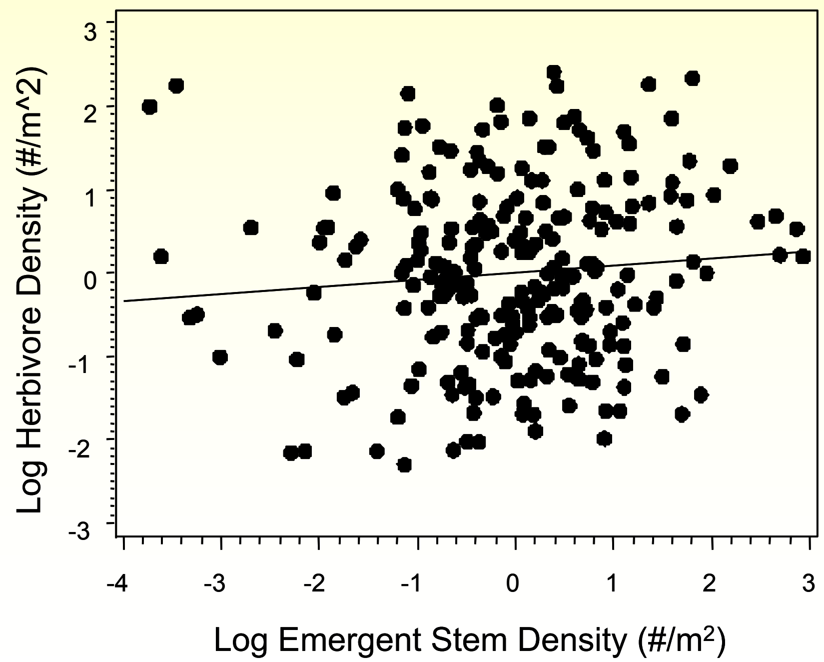
Herbivores = Conductivity (umhos/cm)



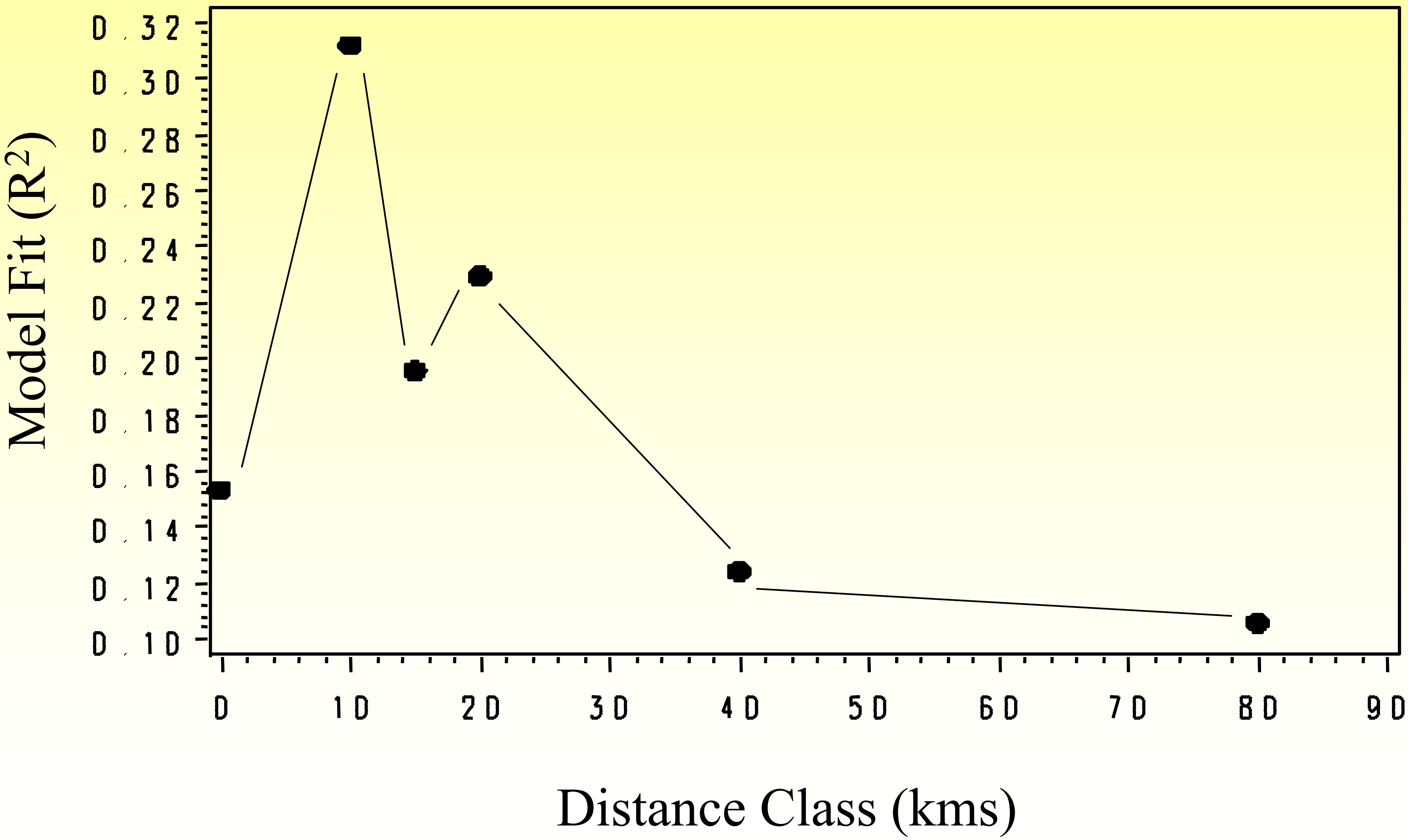
Herbivore Density ($\#/m^2$)

- Initial model = Edible algae + hydroperiod + DSD + stem density
- Final model:
  - Edible algae + stem density
  - $R^2 = 0.147$
- Partial Regression plots





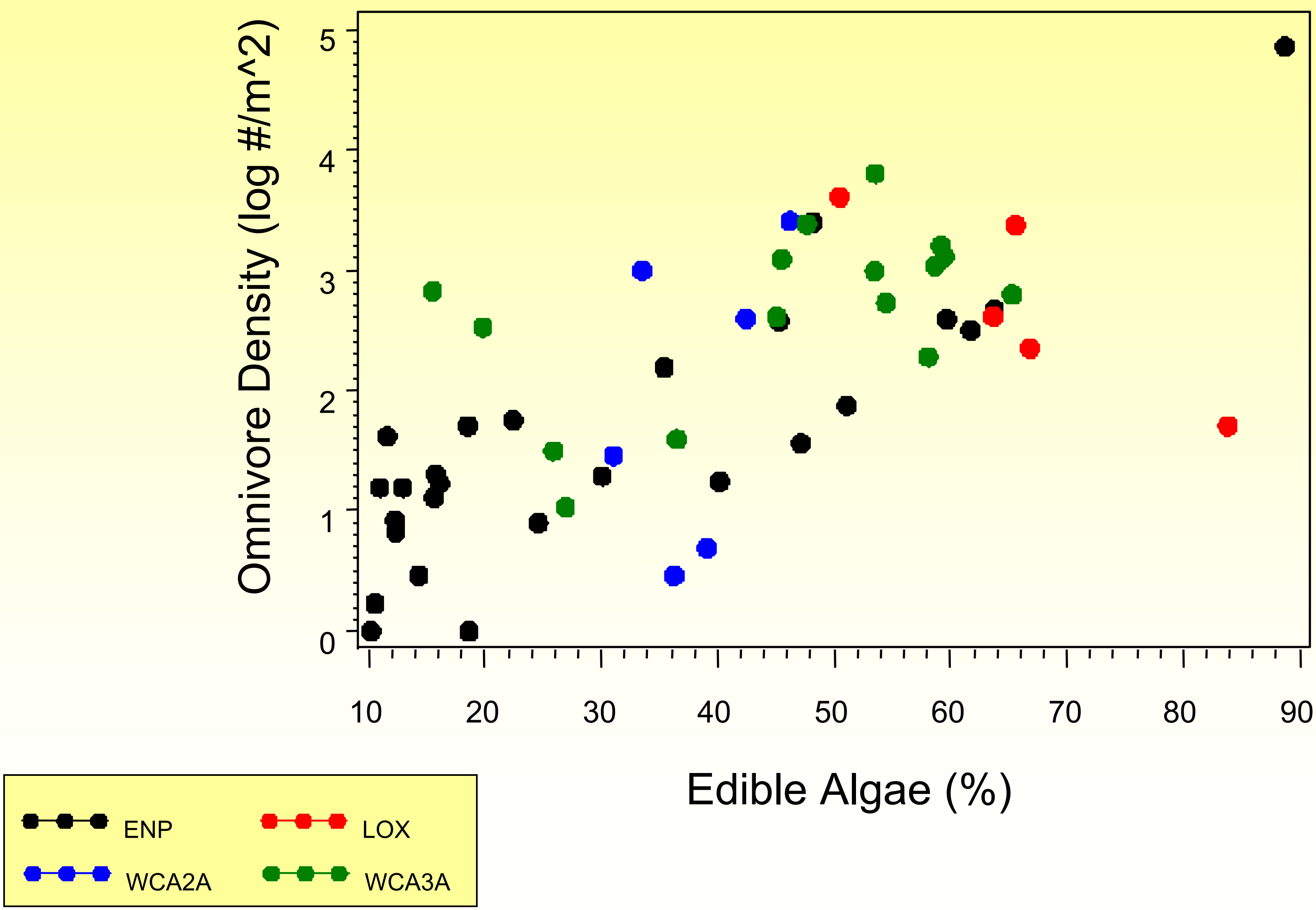
Herbivore Density (#/m^2) = Edible algae (%) + Stem density (#/m^2)



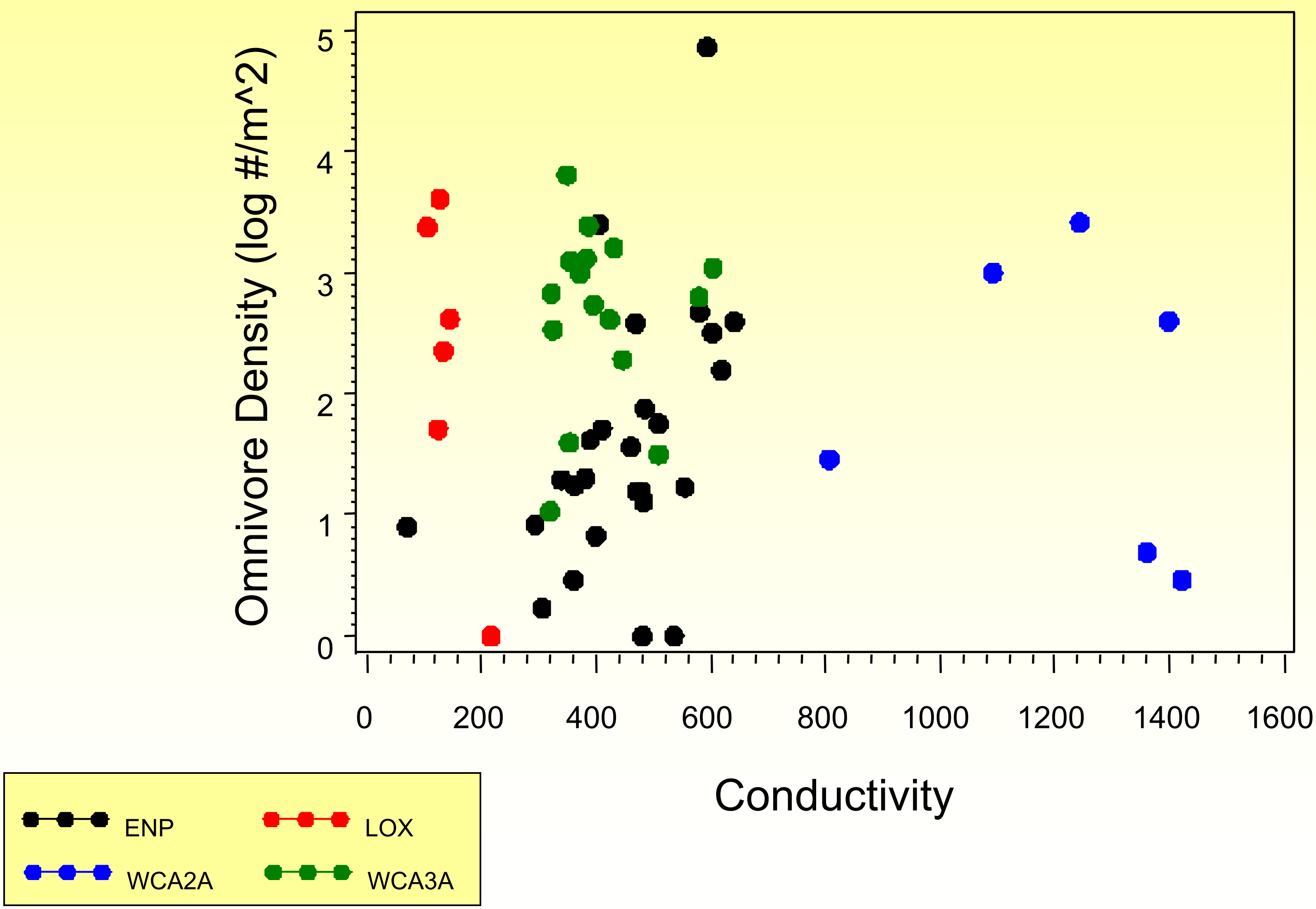
Omnivorous Fishes (#/m^2)

- Measured as the sum of all fishes except herbivores (sailfin mollies and flagfish)
- Isotope values support this designation
- Size limited by throw-trap efficiency to over several mm and under 8 cm
- Crayfish are treated separately. Isotope values for both species support detritivory/omnivory (Loftus et al.)

Omnivorous Fish Density = Edible Algae (%)

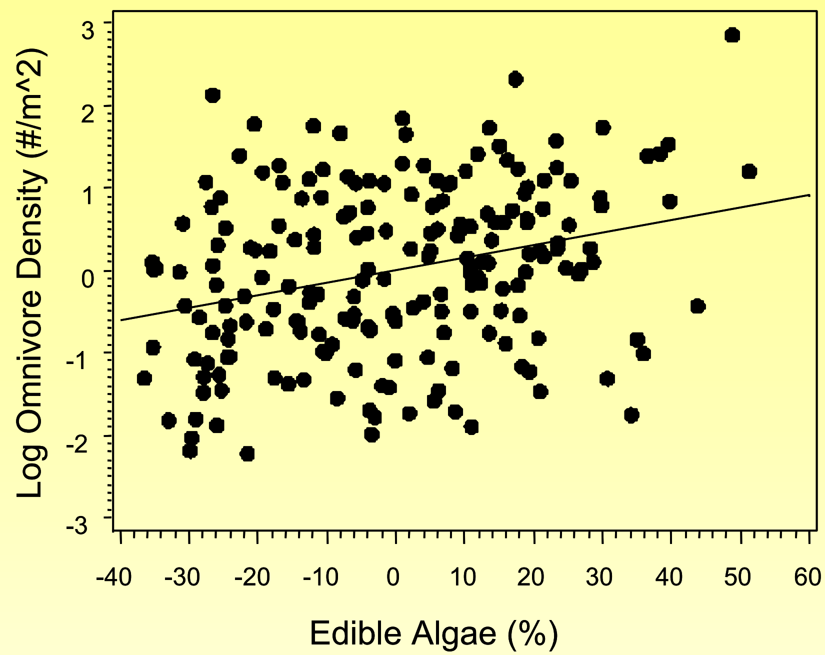


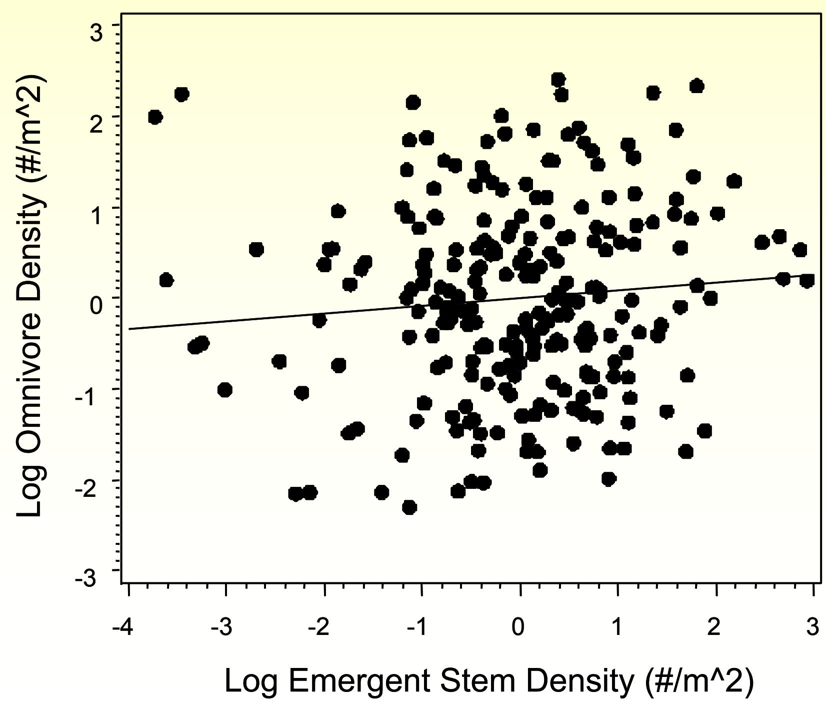
Omnivorous Fish Density = Conductivity (umhos/cm)



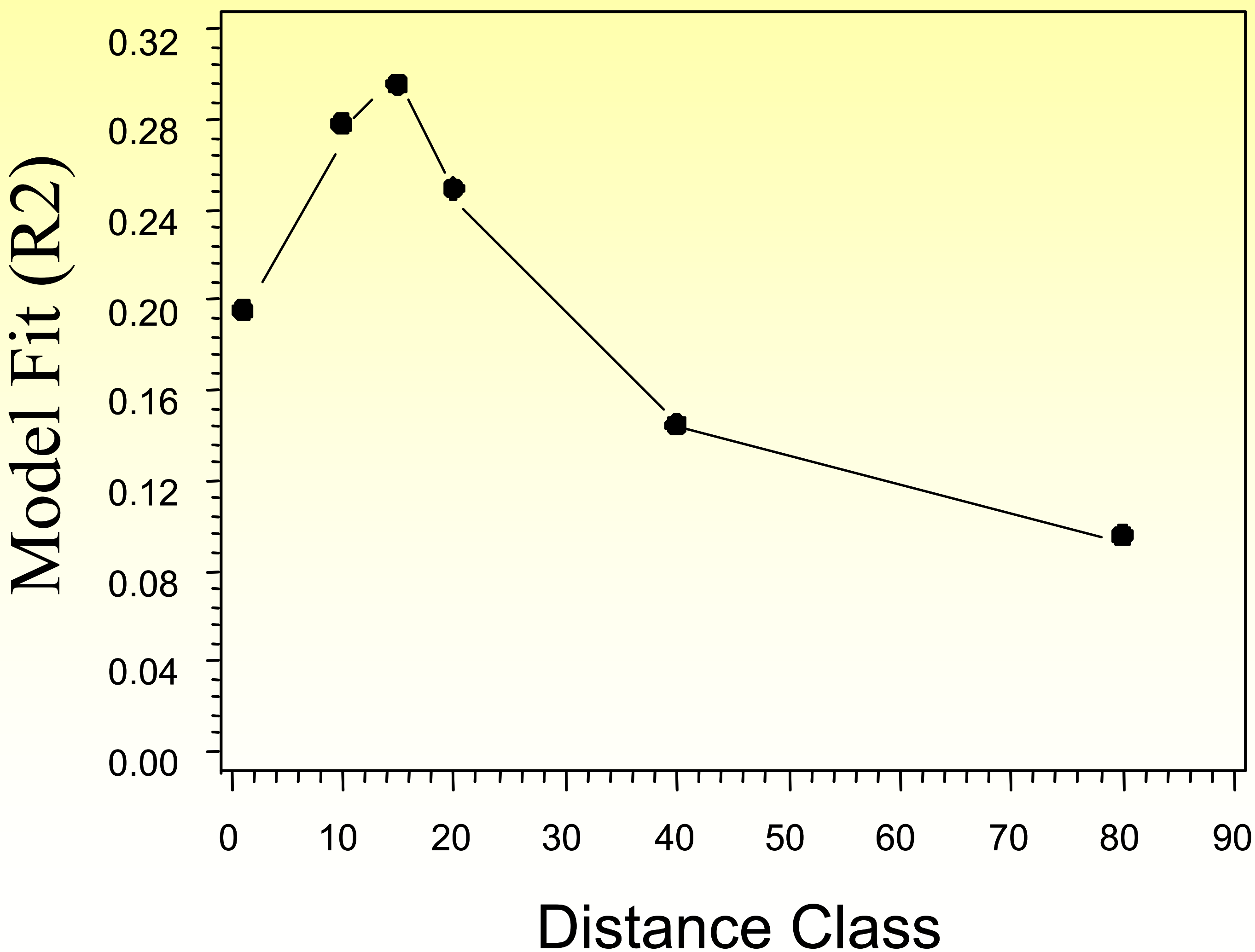
Omnivorous Fish Density (#/m^2)

- Initial model = Edible algae + hydroperiod + DSD + stem density
- Final model:
  - Edible algae + stem density
  - $R^2 = 0.172$
- Partial Regression plots





Omnivore Density (#/m2) = Edible algae (%) + Stem density (#/m^2)



Summary of Spatial Models

Parameter	Final Model	R^2	Max R^2	Distance class (kms)
Edible algae	TP + Hydroperiod	0.3	0.351	10 to 15
Herbivores	Edible algae + stem density	0.1	0.320	1 to 10
Omnivorous fish	Edible algae + stem density	0.2	0.296	10 to 15
Everglades crayfish	Edible algae	0.1	0.266	1 to 10
Slough crayfish	Edible algae	0.1	0.476	10 to 15

Conclusions

- We noted a robust relationship between periphyton mat algal composition relevant to edibility and tissue phosphorus and hydroperiod (more phosphorus and longer hydroperiods yielded more edible algae)

- Density of aquatic herbivores and omnivorous fishes in the size class sampled were positively correlated with algal edibility and density of emergent vascular plants

Conclusions

- Periphyton – TP/hydroperiod relationship was best revealed from syntopic measurements
- Consumer density – periphyton/stem-density relationships were strongest when measured at 1 to 10 km scale
- Periphyton and consumer difference may be tied to effects of consumer movements on scaling

Acknowledgements

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