Influence of Experimental Sheet Flow on Aquatic Food Webs of the Central Everglades

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Florida Coastal Everglades Long Term Ecological Research

Water and Nutrients in the Everglades

- A main goal of Everglades restoration is to return the historical ***quality***, ***quantity***, ***timing***, and ***sheet flow*** of water
  - Increase the <u>connectivity</u> of habitats
  - <u>Redistribute</u> organic matter and nutrients

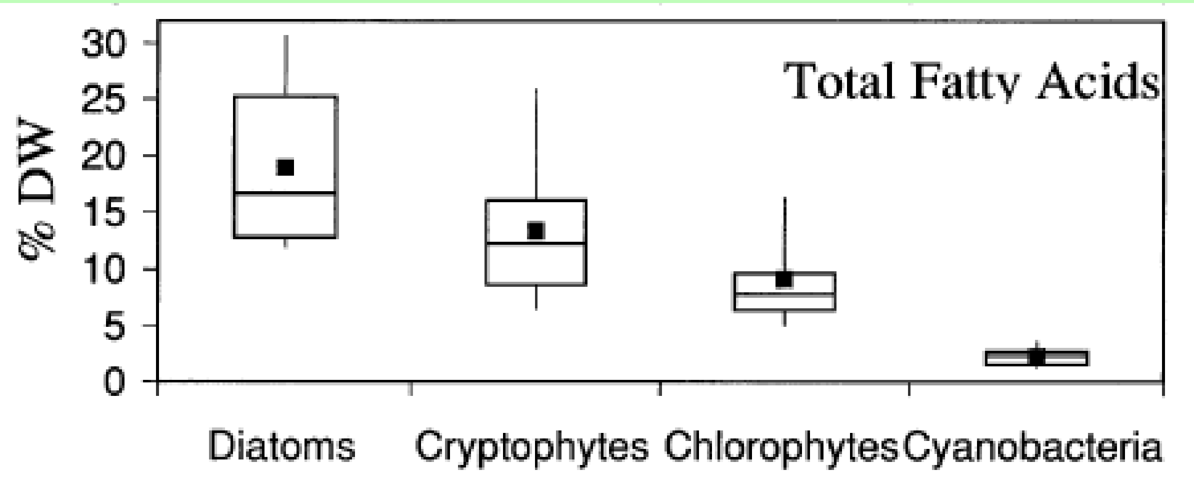
- Increased flow may cause ***nutrient enrichment*** by ***loading*** to recipient environments
  - Potential to alter the <u>taxonomic</u> and <u>biochemical</u> composition of periphyton

- The biochemical composition of primary food resources may affect important driver of food-web dynamics
  - Secondary production
  - Consumer, growth, reproduction, other physiological responses

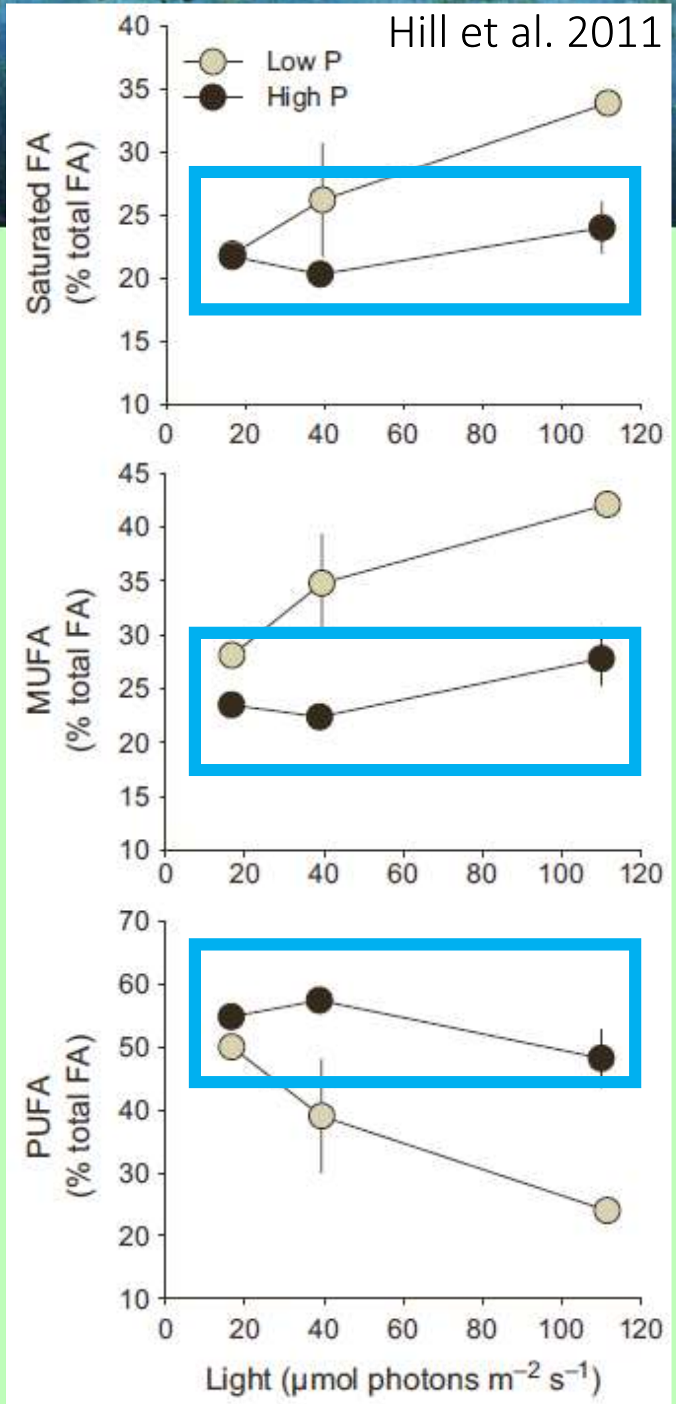
Periphyton as a Bioindicator

- Nutrient enrichment alters the taxonomy and biochemical composition of algae
  - Decrease in cyanobacteria, increase in chlorophytes
  - Increase essential PUFAs (poly-unsaturated fatty acids)

- High-light and low-nutrient environments may produce algae deficient in nutrients and PUFAs, including essential FAs (EFAs).



Brett and Müller-Navarra 1997



Hill et al. 2011

Questions

Nutrient Loading:

- Will ***nutrient loading*** occur with increased sheet flow without increases to the concentration of the limiting nutrient phosphorus (P)?

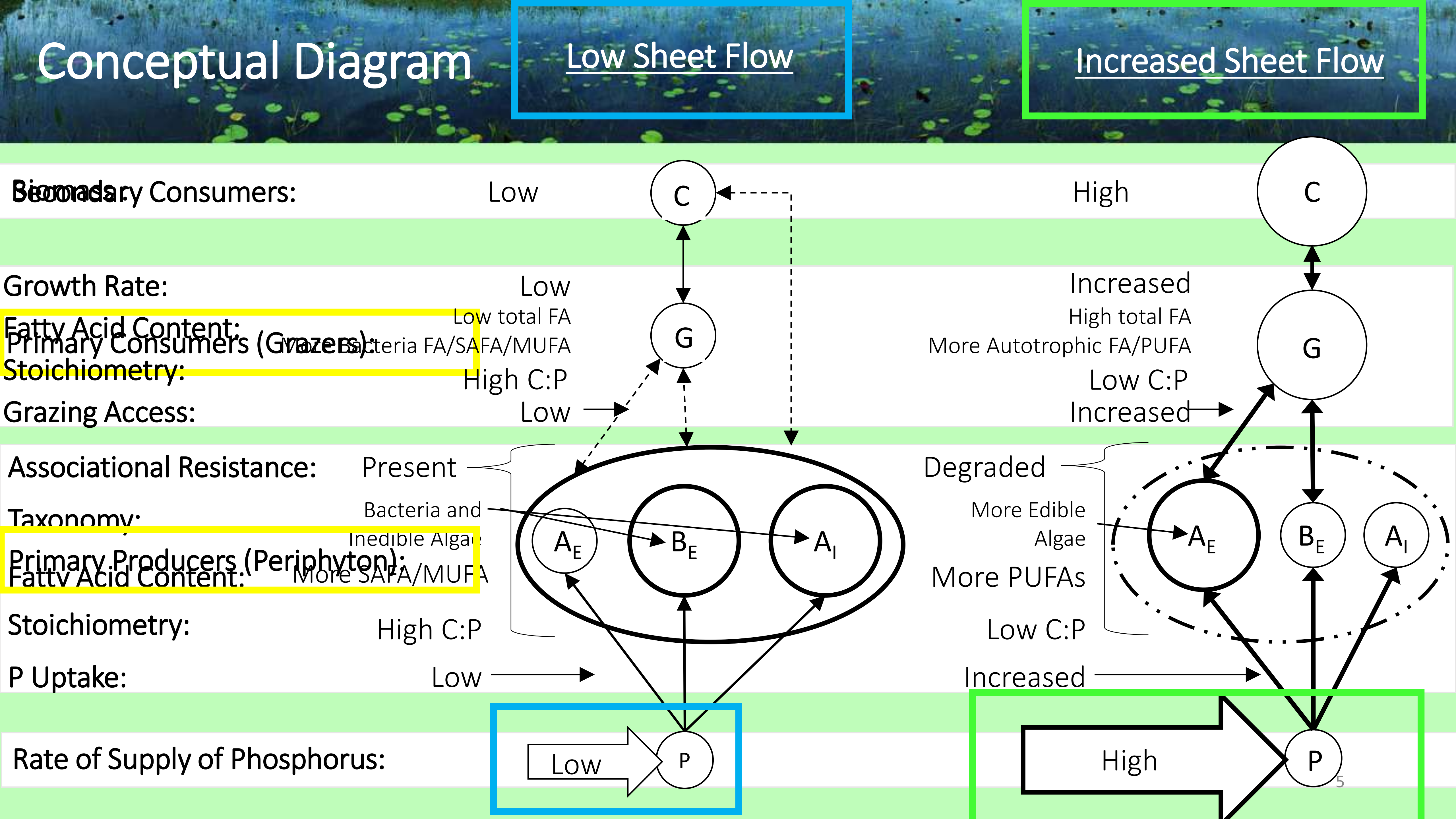
Basal Energy Shift:

- Will loading increase the ***dietary quality*** the primary source of organic matter for consumers?

Trophic Effects:

- Will effects transfer through the food web to improve ***consumer body condition and growth***?

Conceptual Diagram

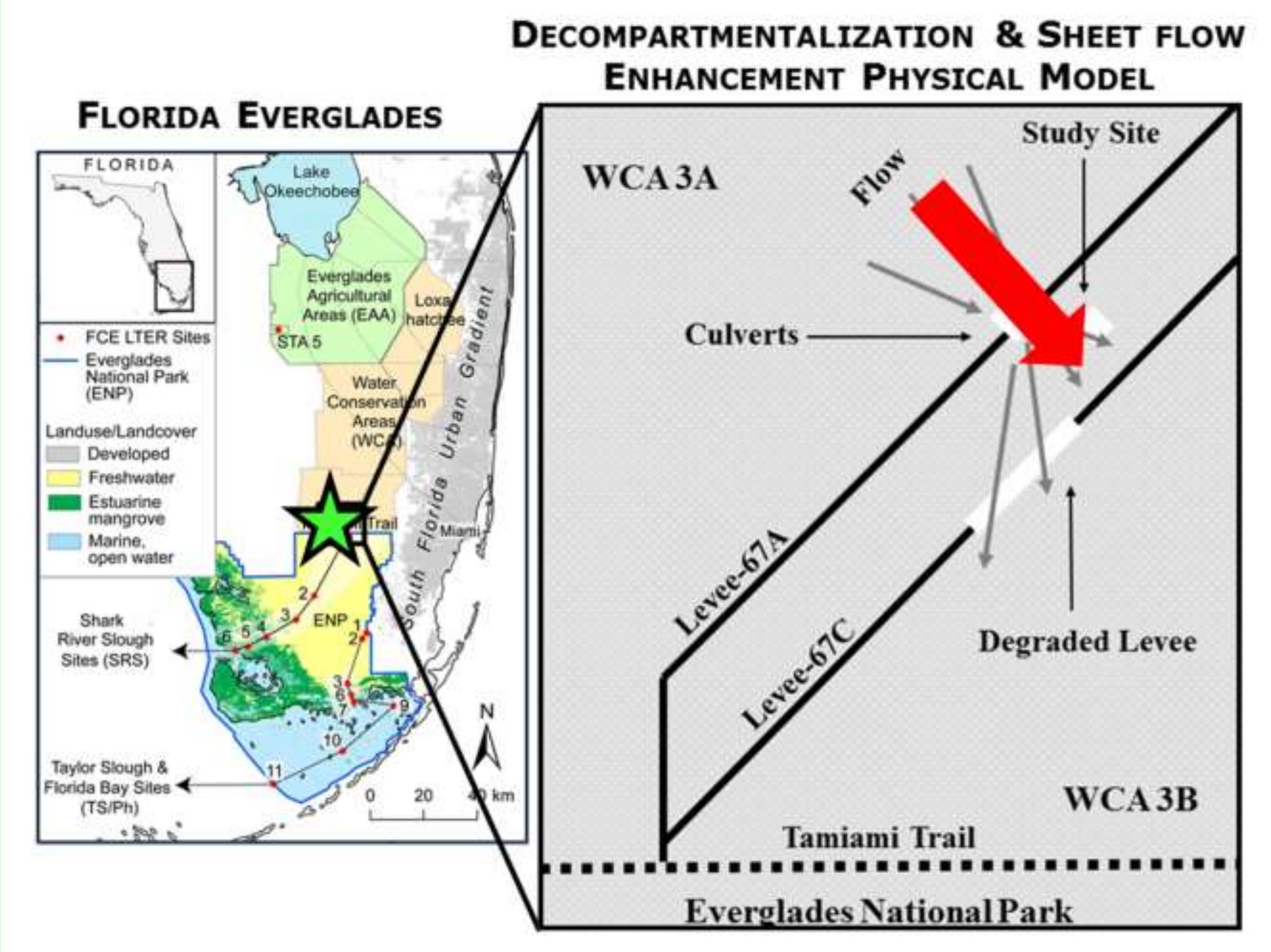


Methods: Food Web Manipulation

- 20 - 1x1m enclosure cages
  - 2000 ml periphyton mat from surrounding marsh
  - Artificial vegetation for biofilm growth
  - Consumers added at ambient marsh densities
    - Sailfin Molly, E. Mosquitofish, Riverine Grass Shrimp
    - Base lined body conditions in laboratory

- Two time periods
  - October: Pre-Flow (<1 cm sec^{-1})
  - November: During-Flow (>3 cm sec^{-1})

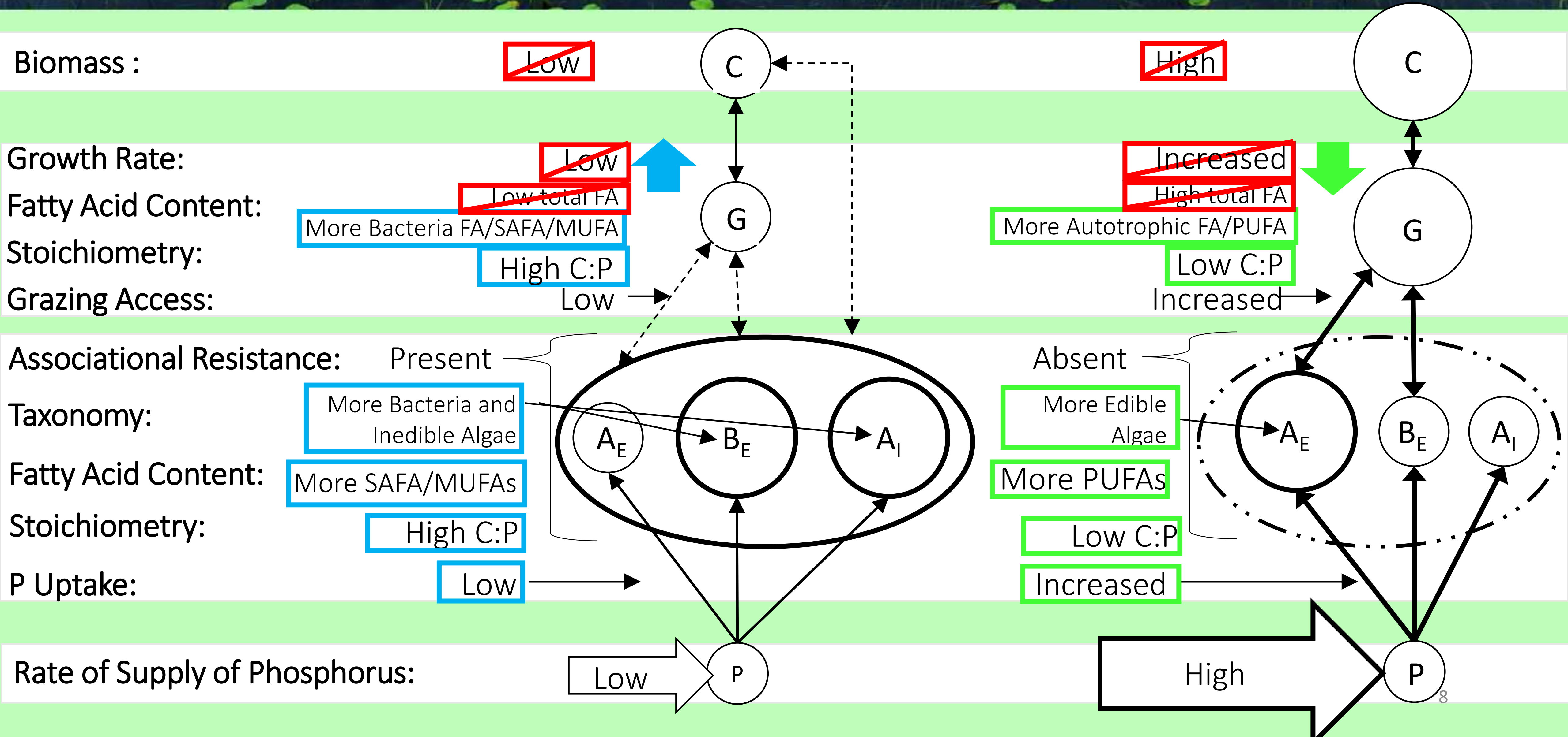
- Periphyton and consumers sampled at 0 and 3 weeks, biofilm sampled only at 3 weeks.



Results

		Biofilm	Periphyton	Sailfin Molly	Eastern Mosquitofish	Riverine Grass Shrimp
Stoichiometry:	C:P	▼	ns	▼	ns	ns
	N:P	▼	ns	▼	ns	ns
Algae Composition:	Diatoms	▼	▼	-	-	-
	Cyanobacteria	▼	▼	-	-	-
	Fil. Green	▲	▲	-	-	-
FA Content:		▲	ns	▼	ns	ns
FA Dietary Tracers:	Algae	▲	ns	▲	▲	ns
	Bacteria	▼	ns	▼	ns	▲
FA Saturation:	SAFA	▼	ns	ns	ns	▼
	MUFA	▼	ns	▼	▼	ns
	PUFA	▲	ns	▲	▲	▲
Growth Rate:		-	-	▼	ns	ns

Conceptual Diagram



Discussion : Food Web Manipulation

- Two deviations from the hypothesis:

  1) “Higher quality” basal resources in November did NOT increase consumer GR and FA content.

  2) Each species did NOT respond the same to environmental conditions.

1) "Higher quality" basal resources in November did *NOT* increase consumer GR and FA content

Hypothesis:

- Increased sheet flow would increase P, palatable algae, and PUFAs leading to an increase consumer GR and FA content in November.

Observed:

- Low level P loading:
  - Slightly evaluated P content of biofilms compared to oligotrophic regions of WCA-3A.
- No break down in physical structure/associational resistance of mat:
  - Filamentous green portion blooming on exterior of mat diluted other high-quality portions (diatoms) of the grazer diet leading to low FA content and low C:P ratio consumers in Nov.
- Decreased temperature
  - Cooler temperatures decrease Sailfin Molly and E. Mosquitofish growth (Trexler et al. 1990; Vondracek 1988).

2) Each species did NOT respond the same to environmental conditions.

Hypothesis:

- Changes to each consumer species' diet would similarly affect their body condition.

Observed:

- Feeding Guild:
  - Omnivorous E. Mosquitofish and Grass Shrimp showed less variation between months than the herbivorous Sailfin Molly.
  - Herbivores directly consumer primary production whereas omnivores are buffered by homeostatic infauna they consume and may take loner to respond.
- Feeding Mode:
  - Grass Shrimp has a unique feeding method of penetrating periphyton mats to feed more selectively.
  - May be less affected by external changes

Conclusions

- Increased sheet flow velocity leads to nutrient loading that affects food quality
  - Water column TP did not increase during the flow event
  - Observed changes to basal resources were consistent with known eutrophication changes seen in the Everglades
- Nutrient loading caused an increase in autotrophic-derived energy and was evident in biofilms
- Biofilm changes altered consumers body condition in varying degrees depending on trophic level, feeding mode, etc.
  - Demonstrates the complexity of potential effects to food web dynamics
- Future Research Directions:
  - How season may compound or eliminate effects of nutrient loading?
  - How do dietary nutrients and essential molecules in basal resources vary spatially and temporally throughout the Everglades?

Acknowledgements

- This project was funded by the USGS for the DECOMP Physical Model project (Cooperative Agreement G10AC00409) and the Florida Coastal Everglades LTER cite funded by the National Science Foundation (Grant No. DEB-1237517).

- This project was made possible by Joel Trexler, Barry Rosen, Sue Newman, Colin Saunders, and Fred Sklar.

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