

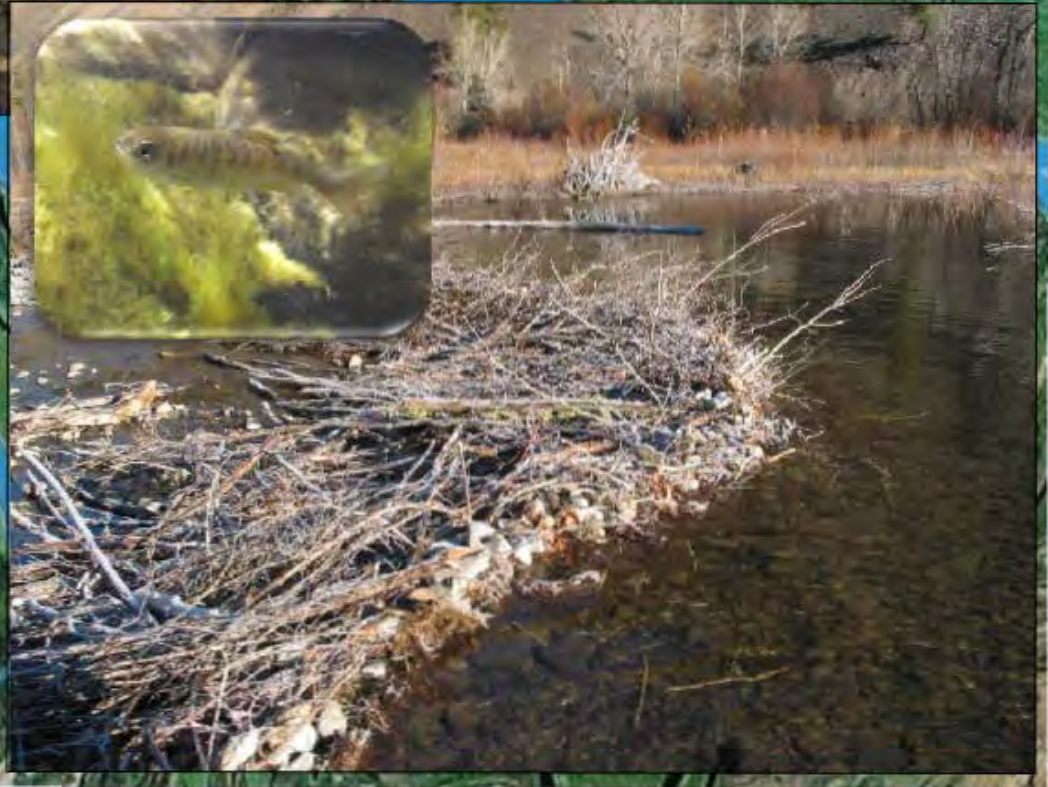
The Floodplain Food Web Mosaic: A Study of its Importance to Pacific Salmon, with Implications for their Restoration

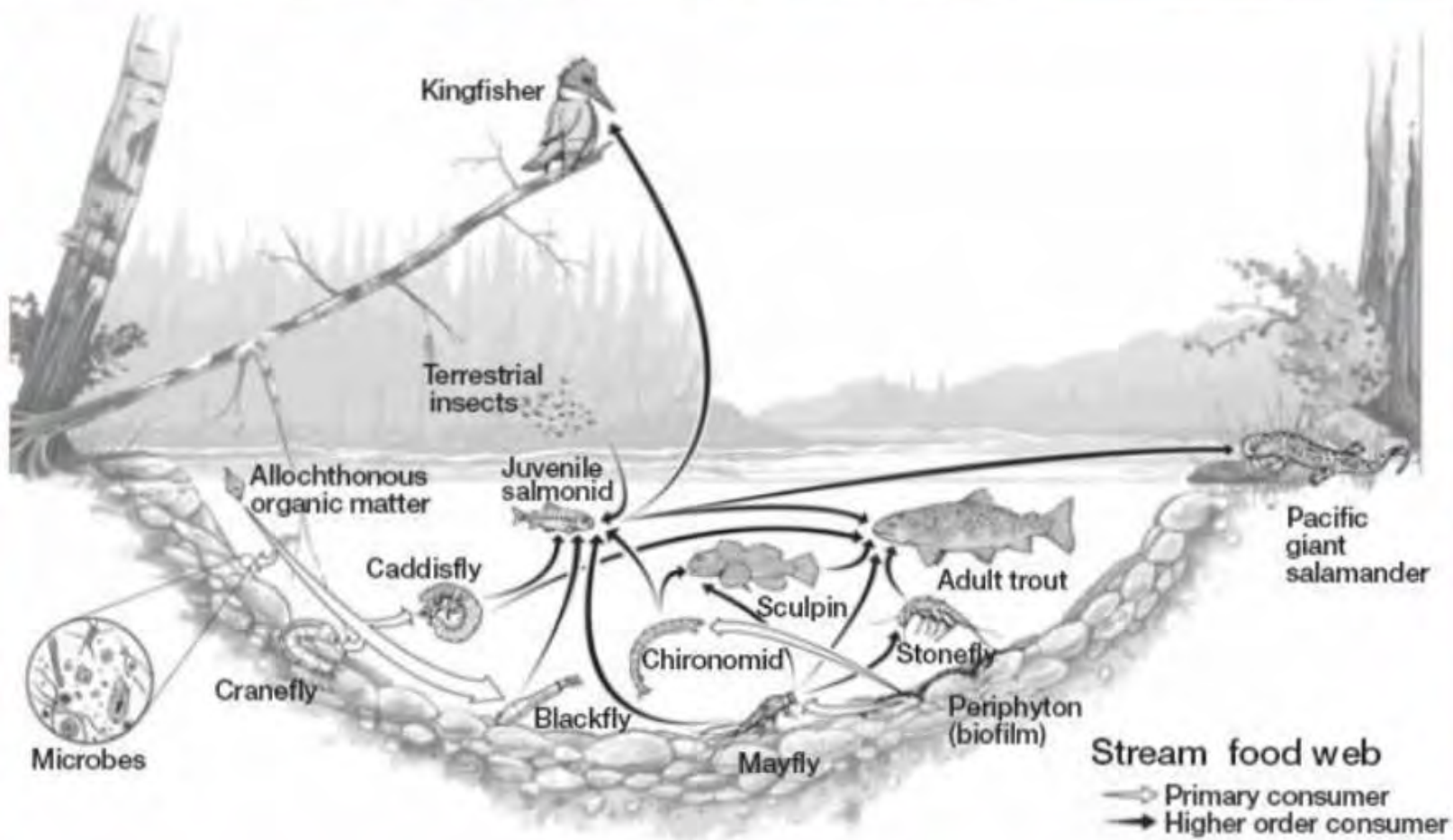


J. Ryan Bellmore^{1,2}, Colden V. Baxter¹, Patrick J. Connolly², and Kyle D. Martens²

¹ Stream Ecology Center, Department of Biological Sciences, Idaho State University

² Columbia River Research Lab, U.S. Geological Survey, Cook, WA





(Macneale et al. 2010)

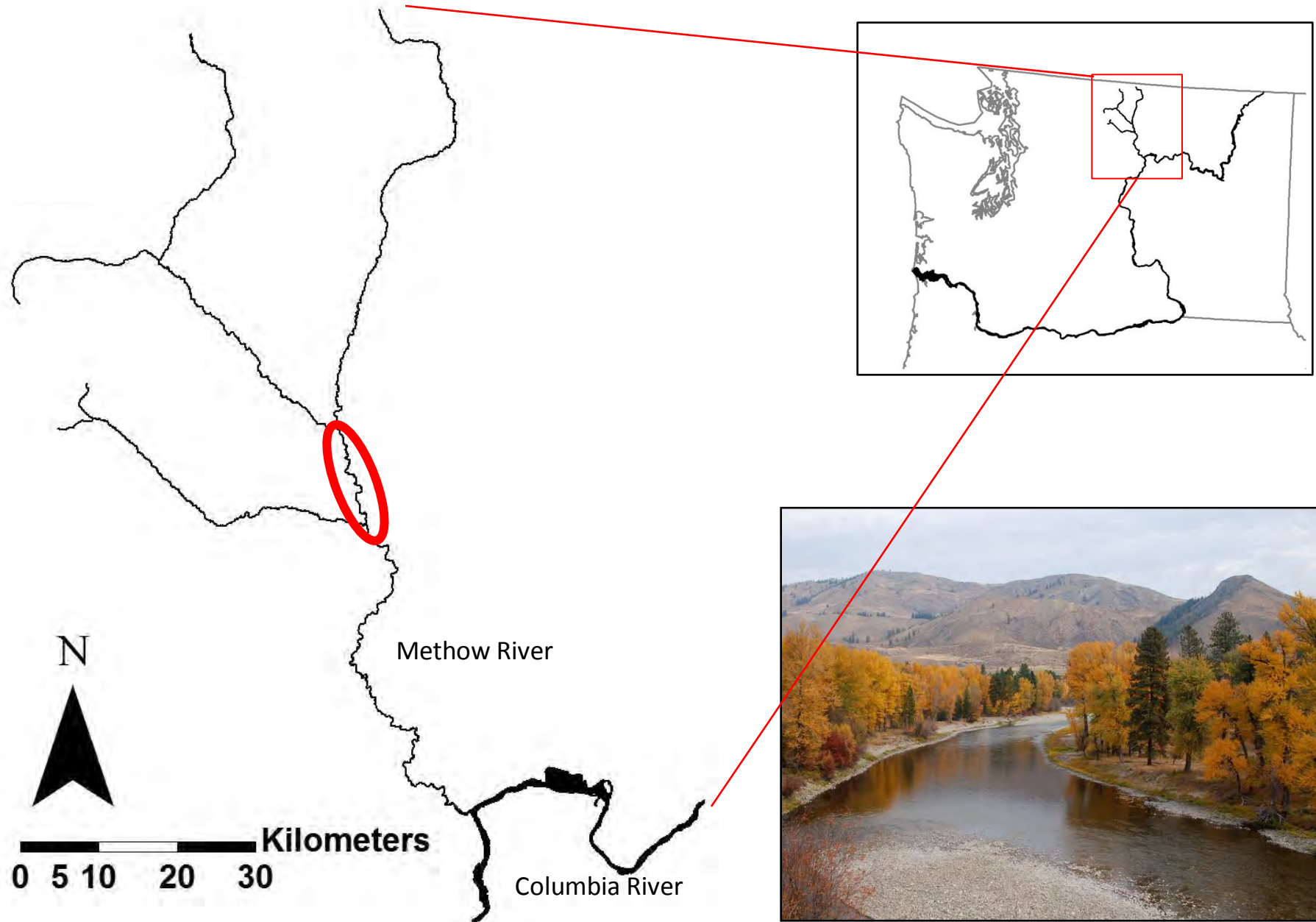


Photo courtesy of Doug Ray

Study Goal

Evaluate the flows of energy that sustain fish production (including salmon and steelhead) in a heterogeneous floodplain landscape.

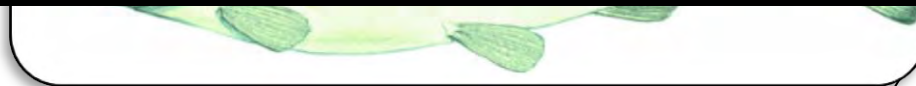
Study Location: *Methow River*



Study Location: *Methow River*



- 1) Do the flows of energy that support fishes, vary among aquatic habitats in this floodplain mosaic?
- 2) What are the implications of these different food webs for Chinook salmon and steelhead populations, and proposed habitat restoration?



Study Design and Objectives

Main Channel



Connected Up
& Downstream



Connected
Downstream



Disconnected w/
Large Pool



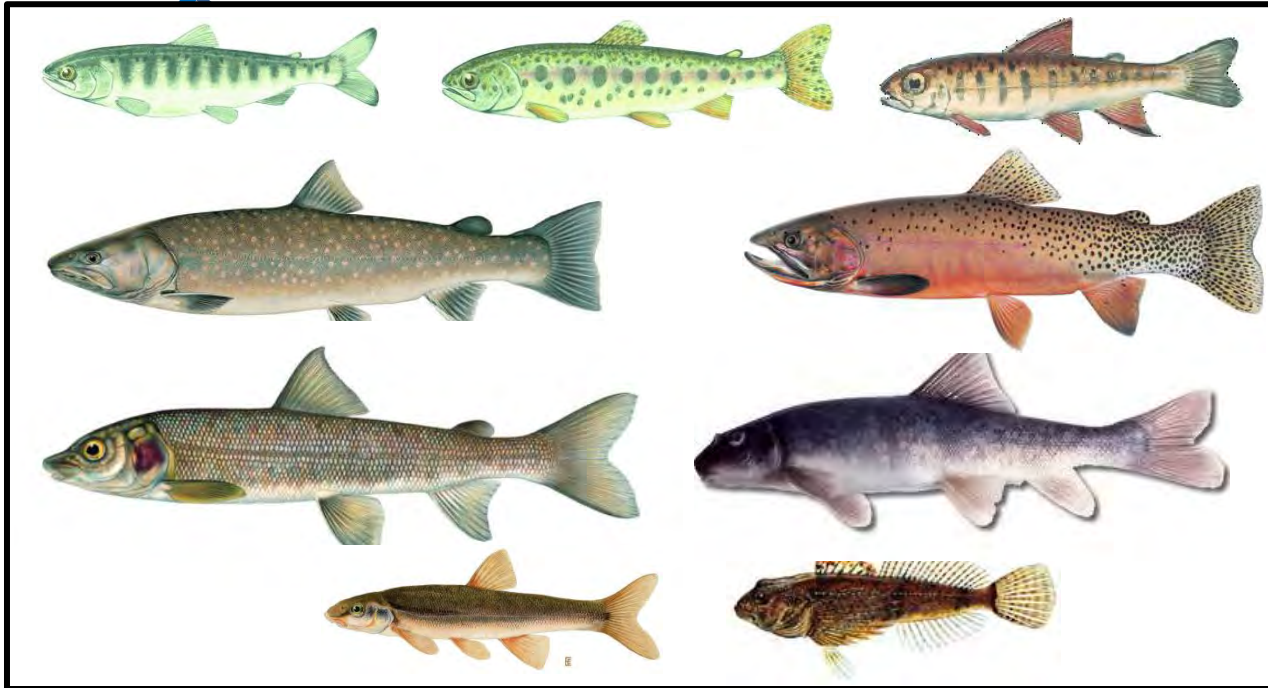
Disconnected w/
Small Pool



Disconnected w/
No Scour



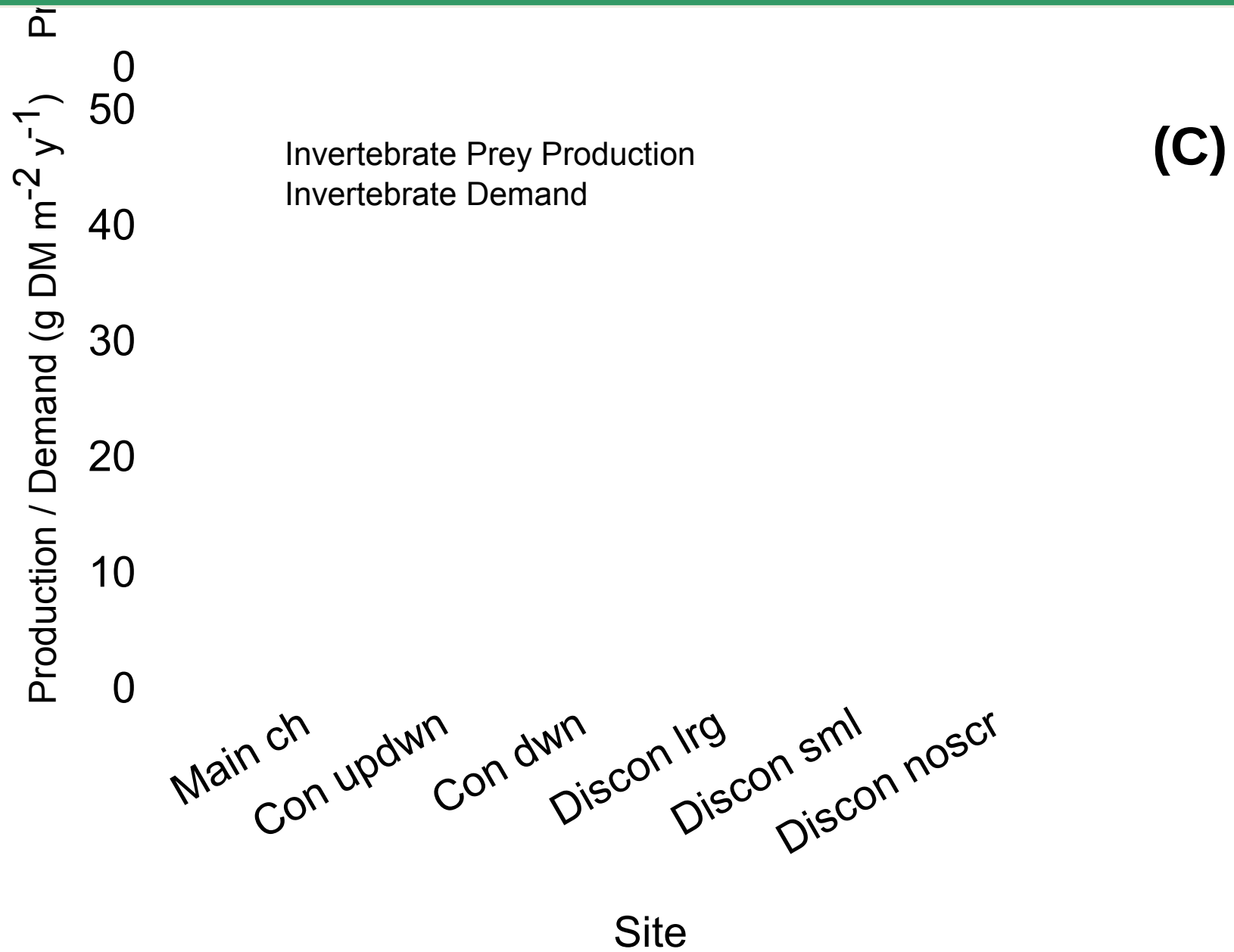
Methods



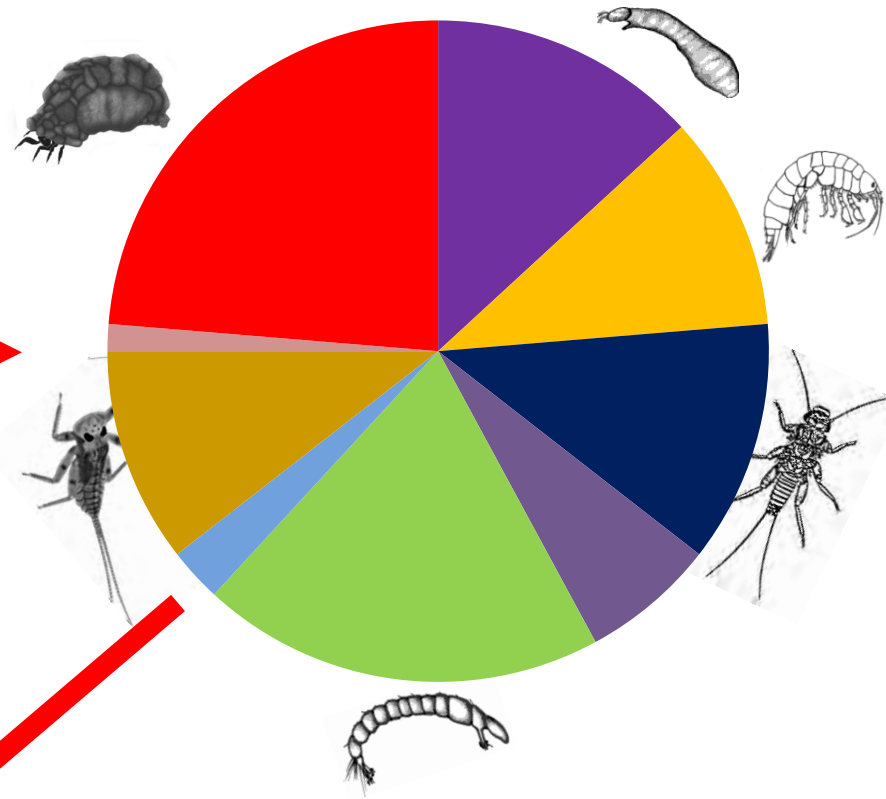
Fish production

PRODUCTION = accrual of biomass over time
grams / meter² / year (g m⁻² y⁻¹)

Results: *Fish Production*



Methods: *Diet Sampling*

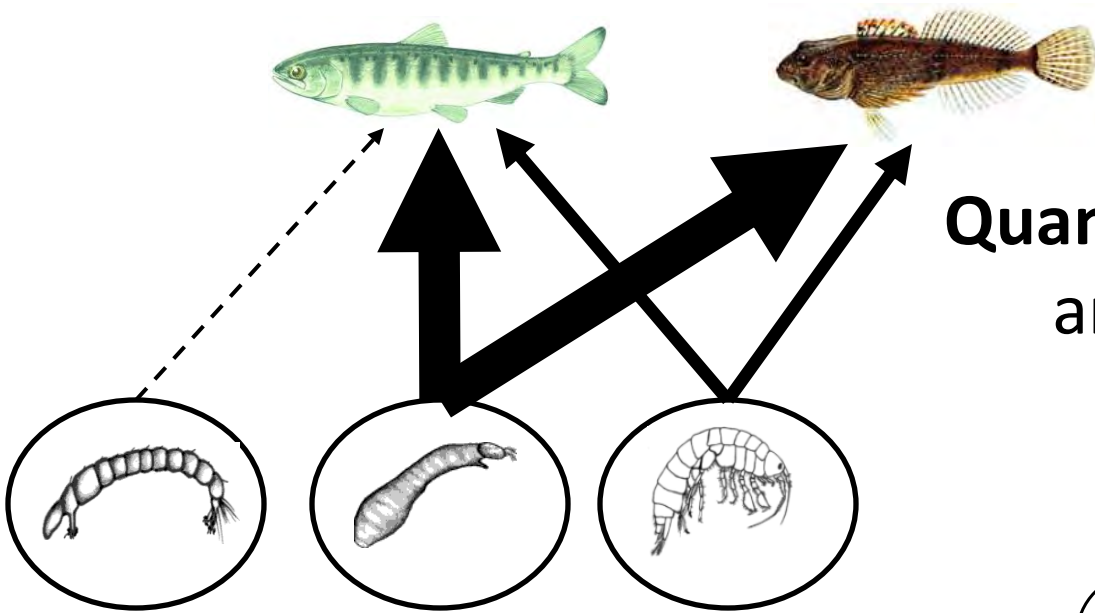


+

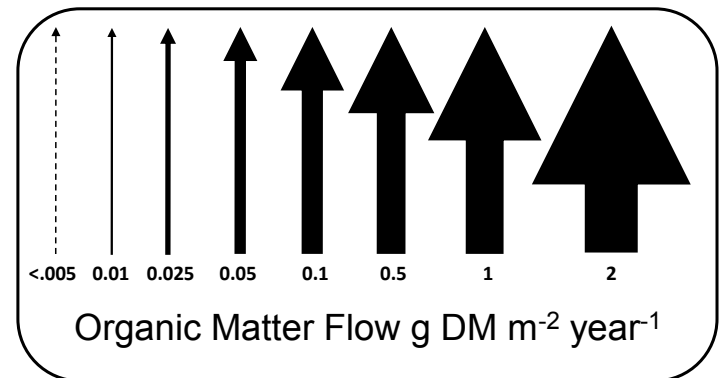
**Demand for each
prey item by each
fish species**

**• Fish Production
• Assimilation & Production
Efficiencies**

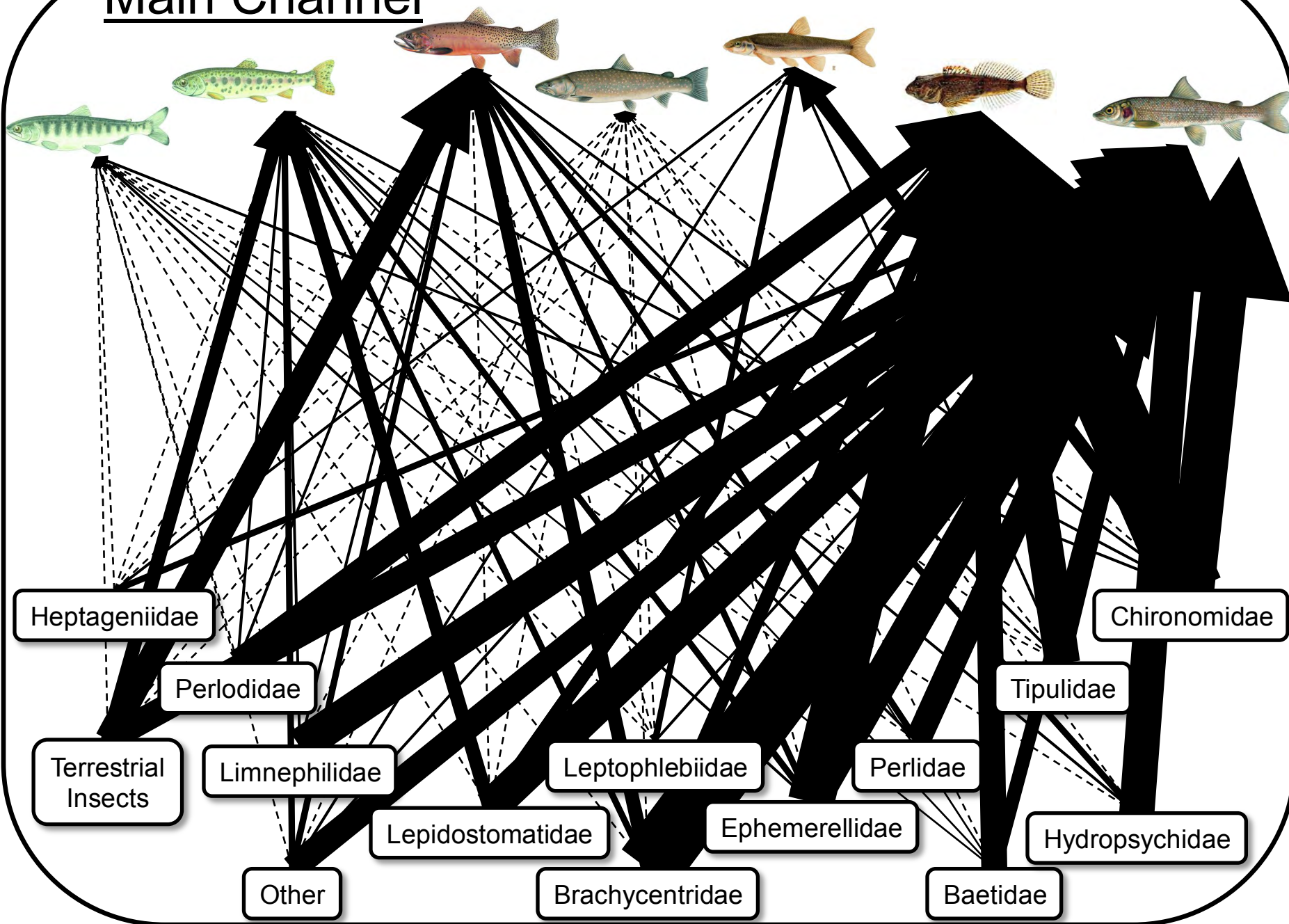
Methods: *Flow Food Webs*



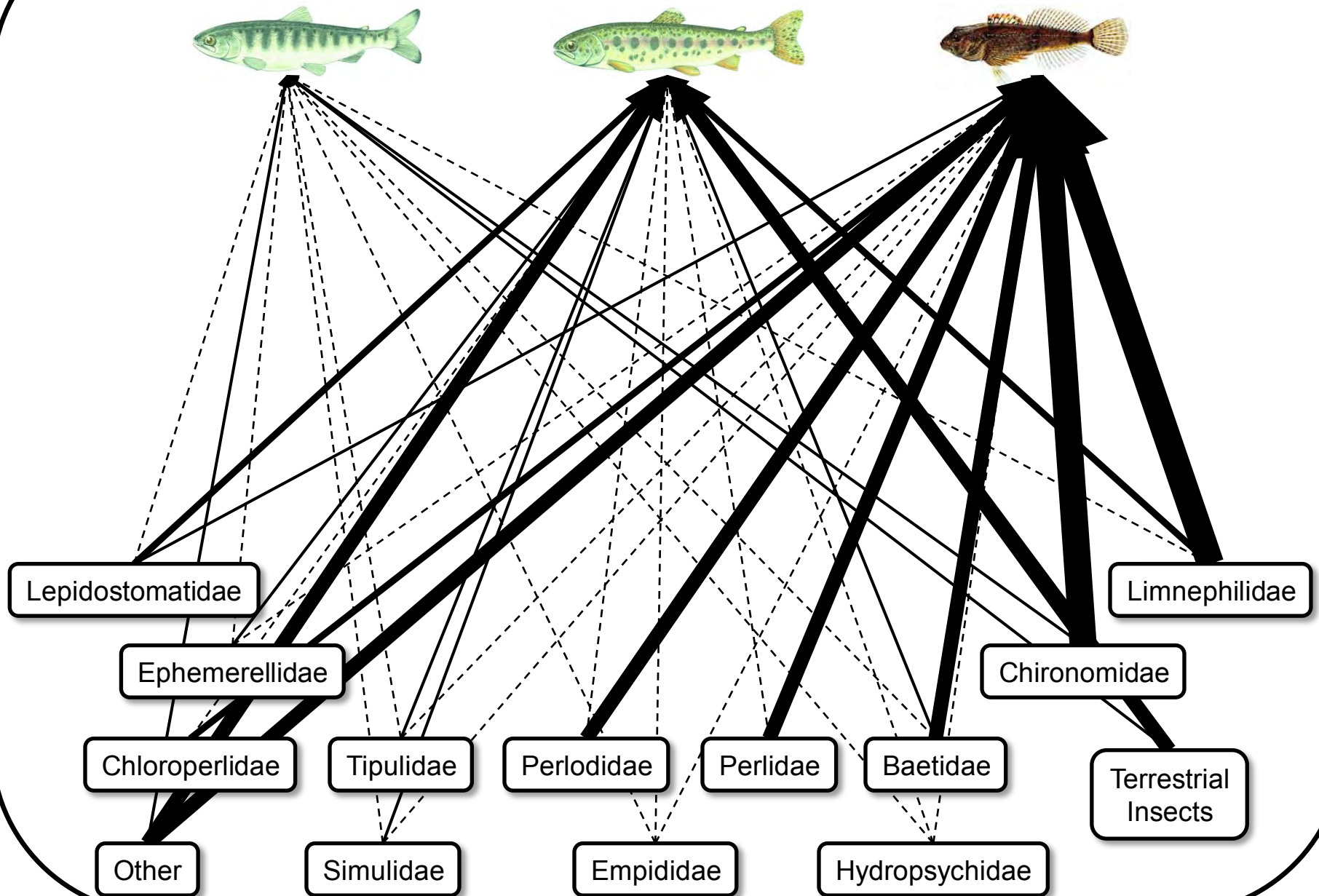
Quantitative flow web: links are weighted by organic



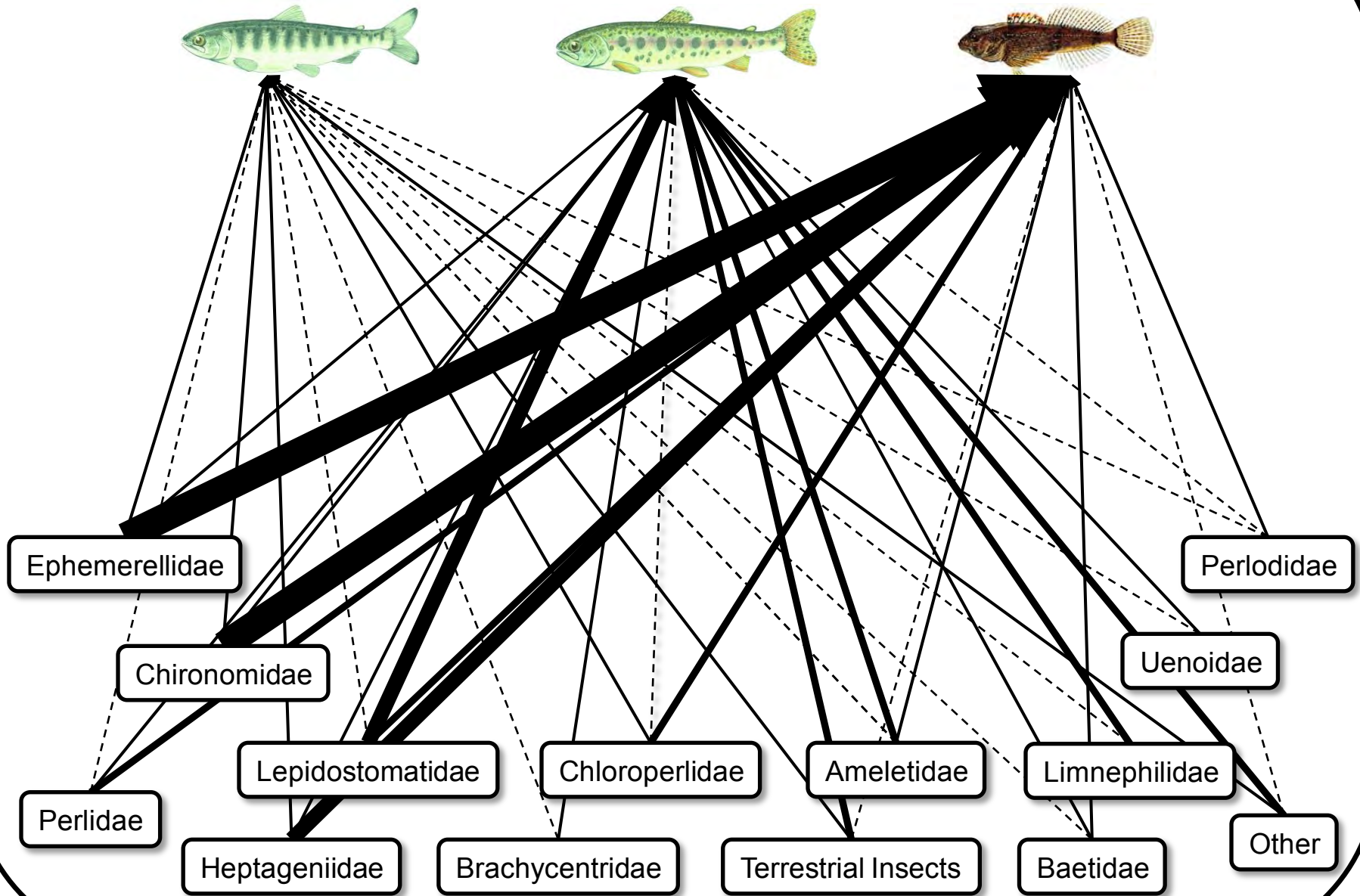
Main Channel



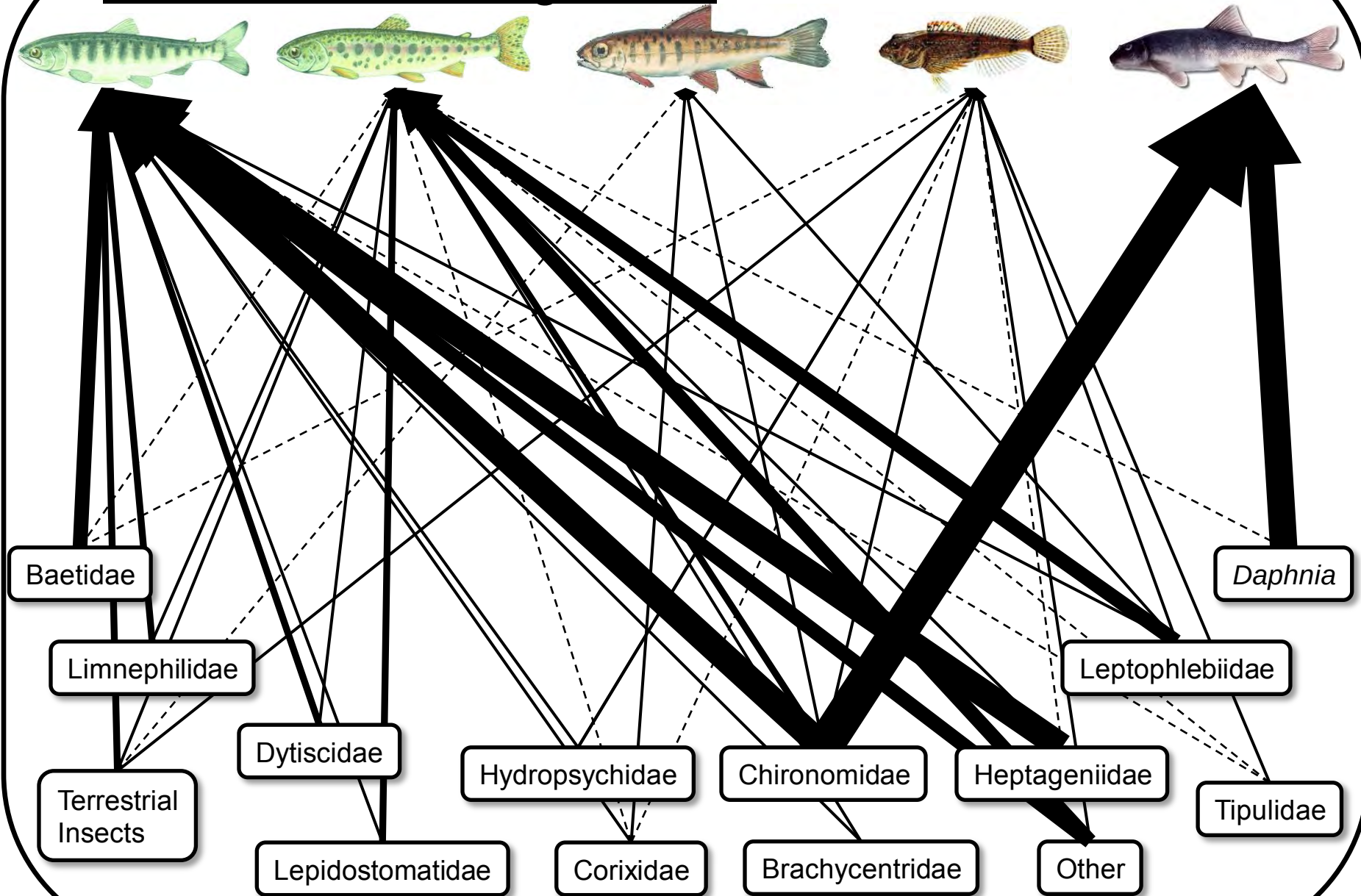
Connected Up & Downstream



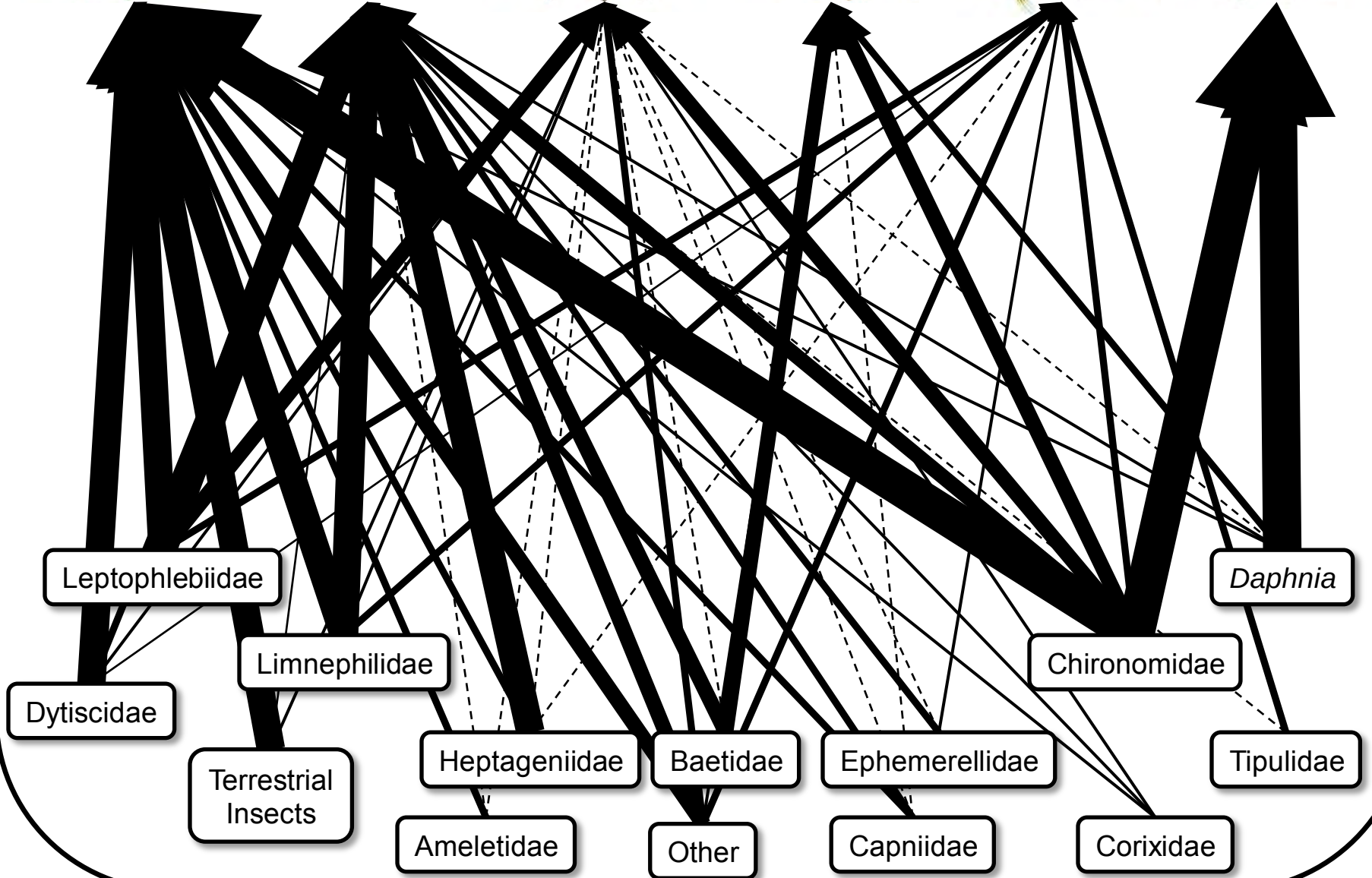
Connected Downstream



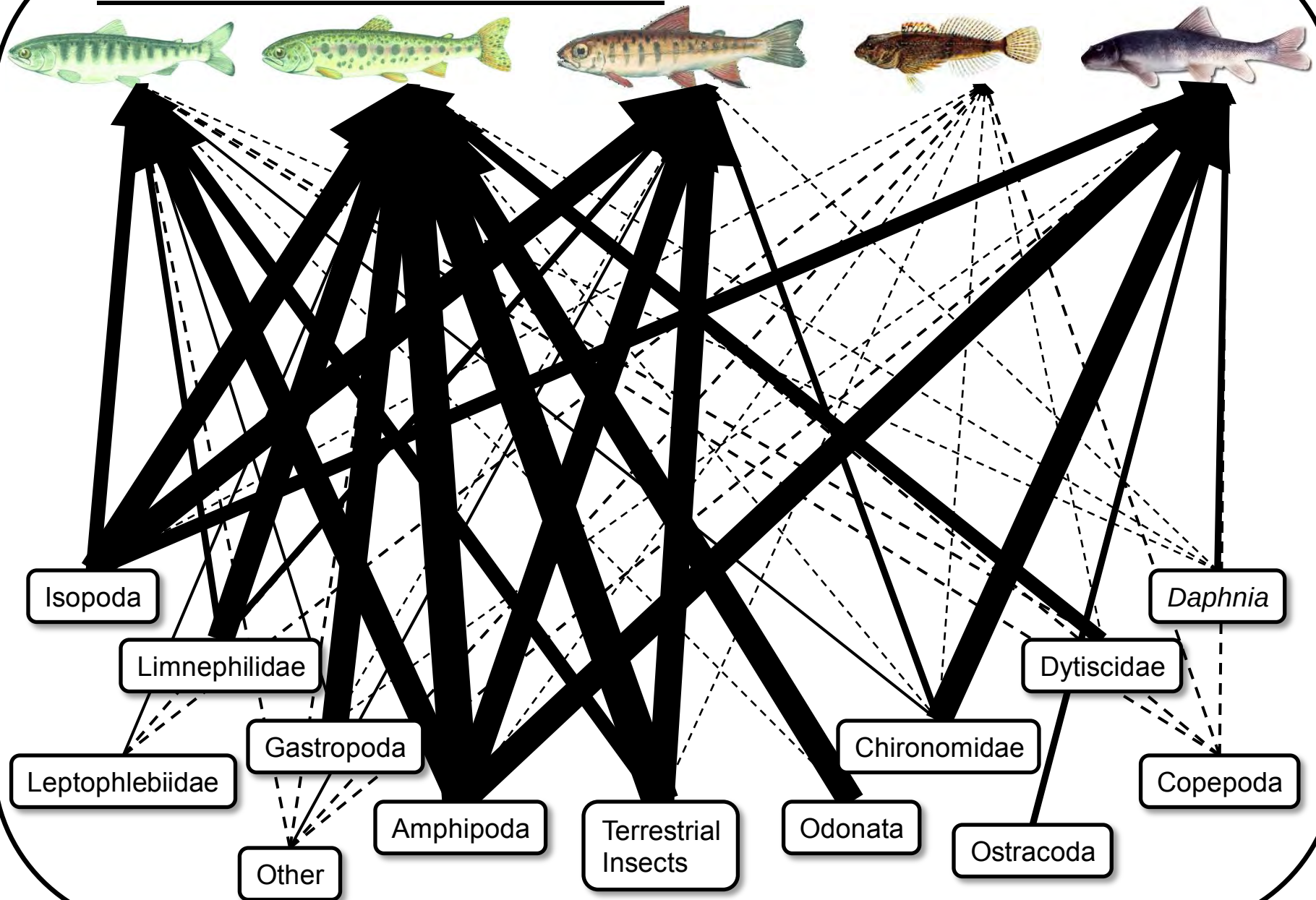
Disconnected Large Pool



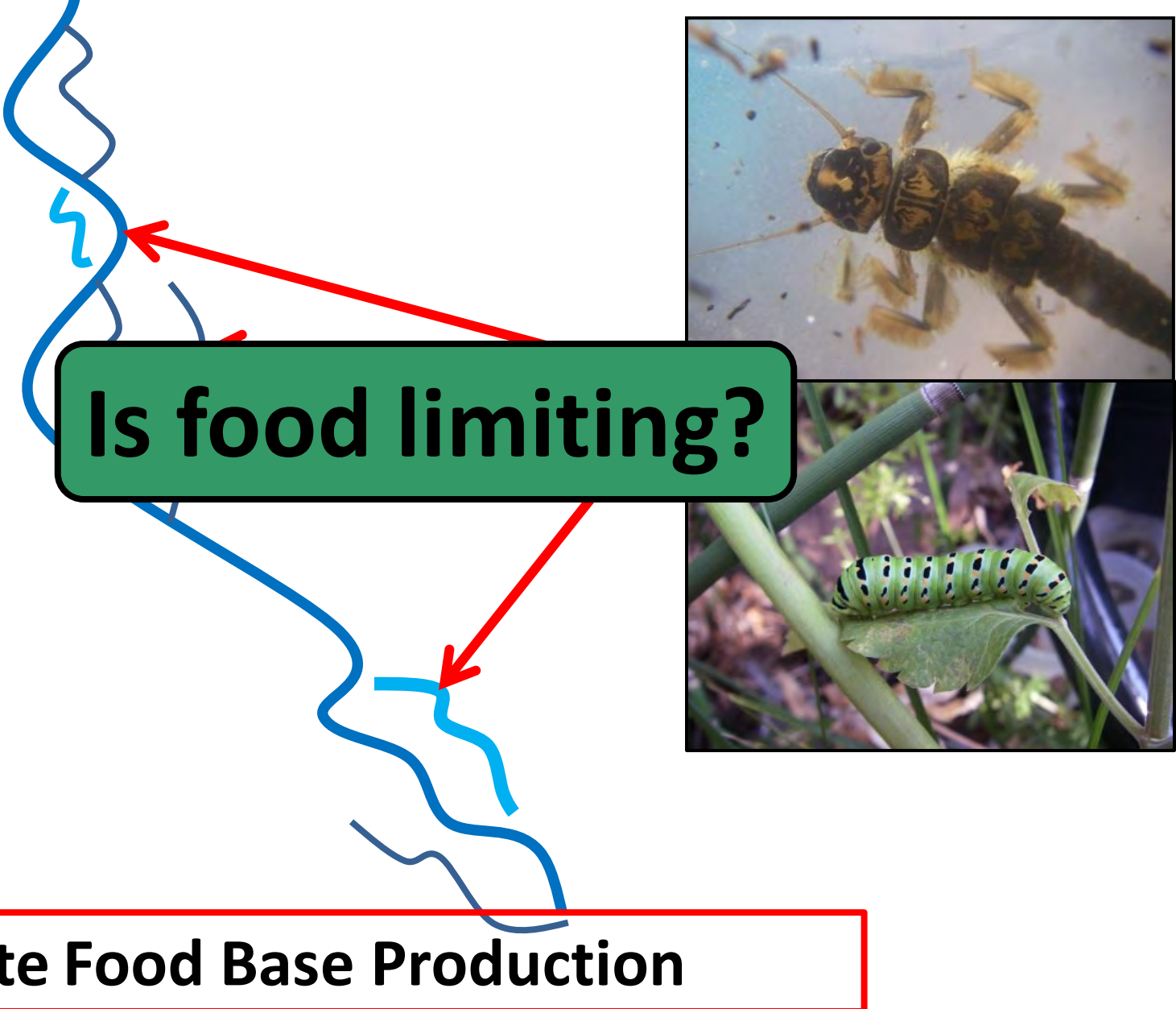
Disconnected Small Pool



Disconnected No Scour



Methods

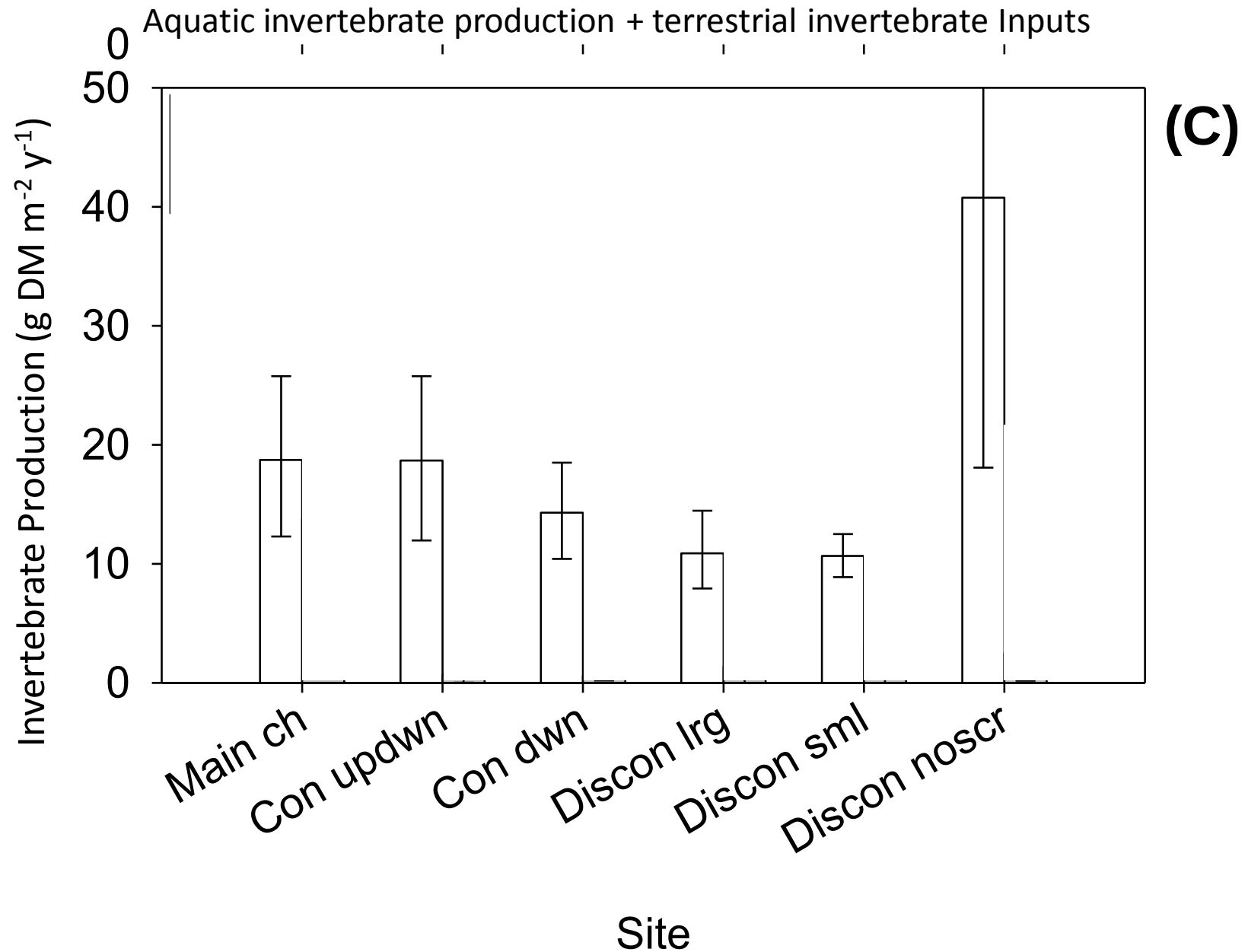


The diagram features a blue line representing a river, with a lighter blue section in the middle. A green box with the text "Is food limiting?" is positioned over the river. Two red arrows point from this box to the river: one points to the upper part of the lighter blue section, and the other points to the lower part. To the right of the river, there are two inset photographs. The top photo shows a stonefly nymph (amphipod) in water. The bottom photo shows a green caterpillar with black spots on a leaf. The entire diagram is set against a white background.

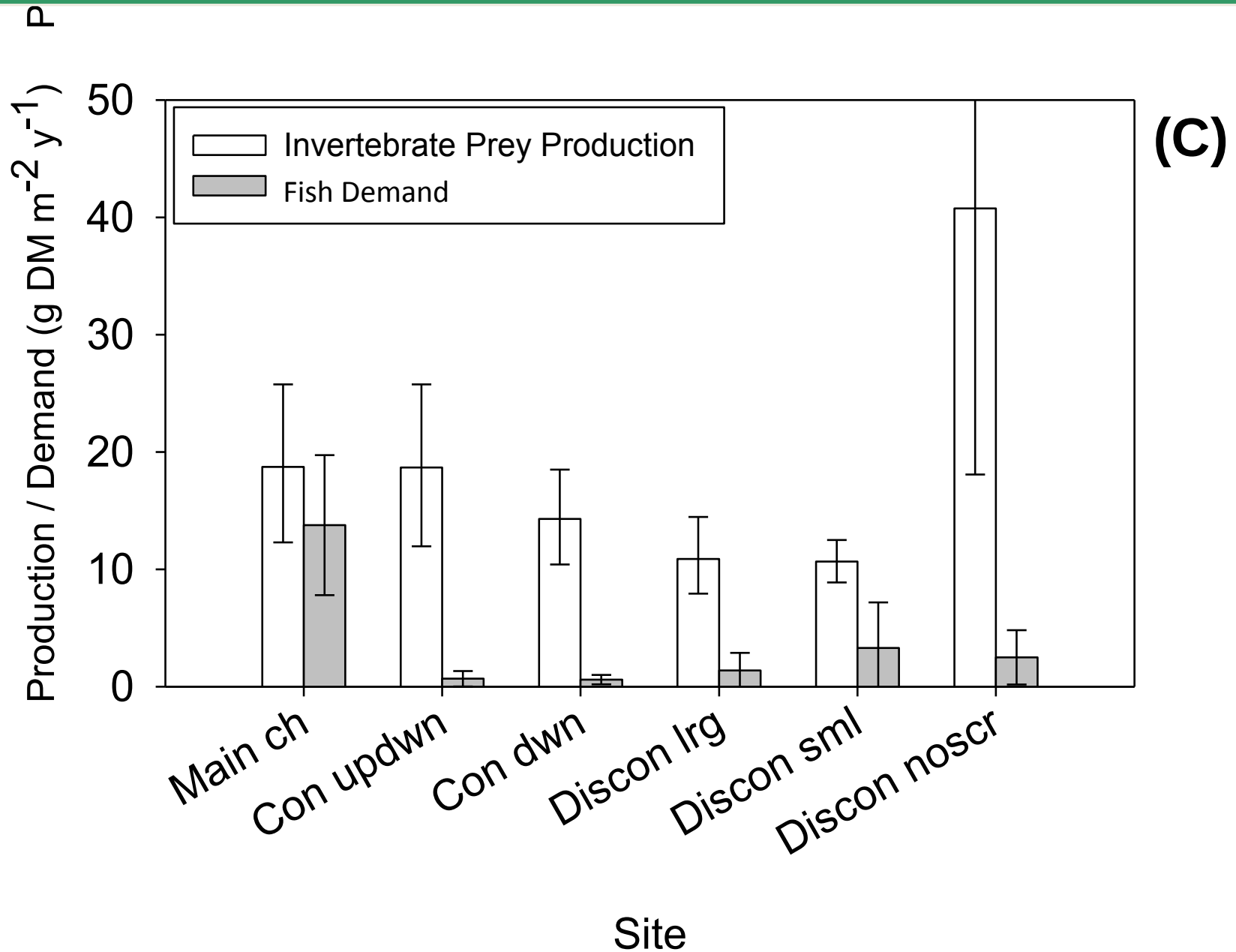
Is food limiting?

Invertebrate Food Base Production

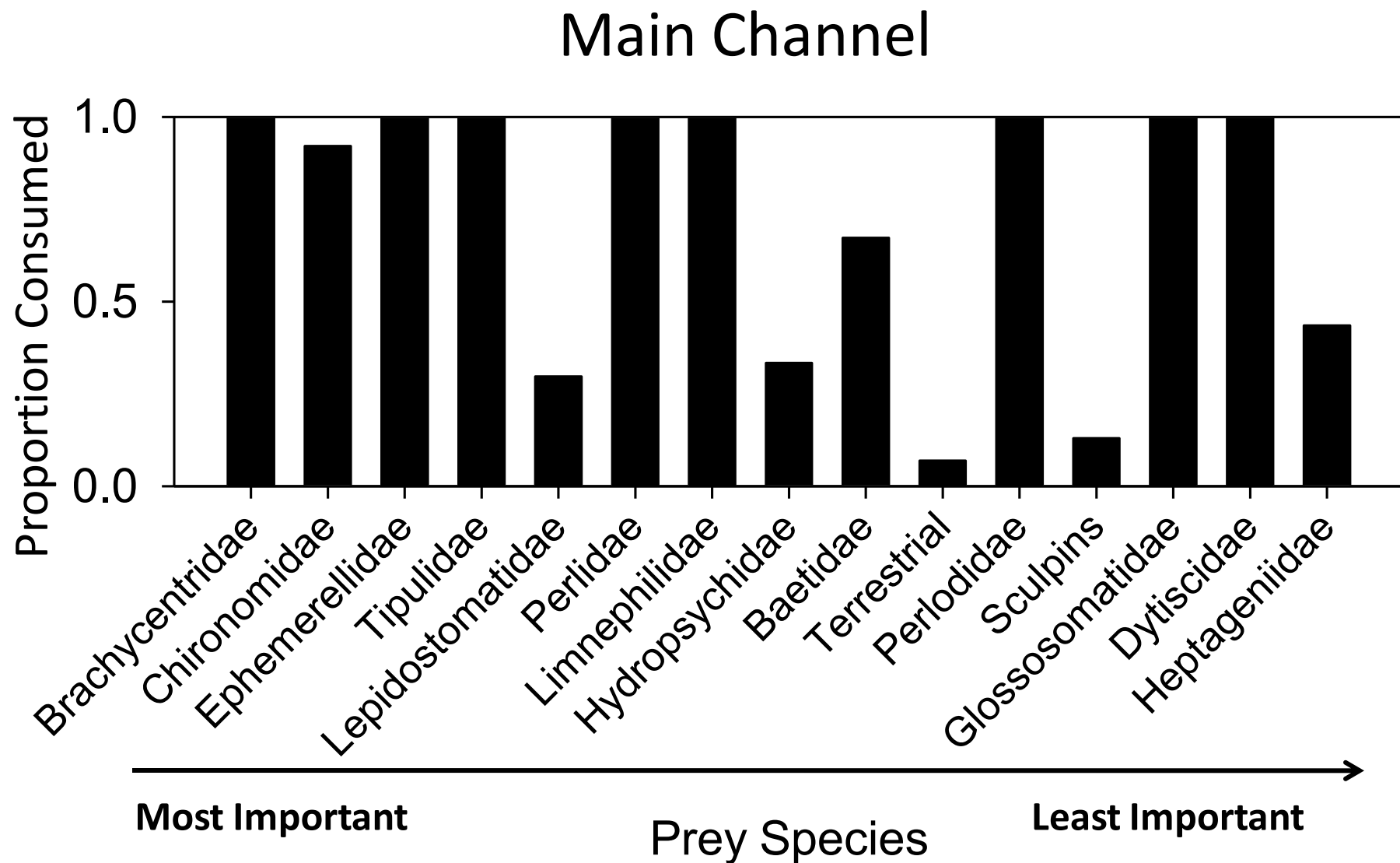
Results: *Invertebrate Production*



Results: *Food Production to Demand*



Results: *Total Interaction Strengths*



Main Channel

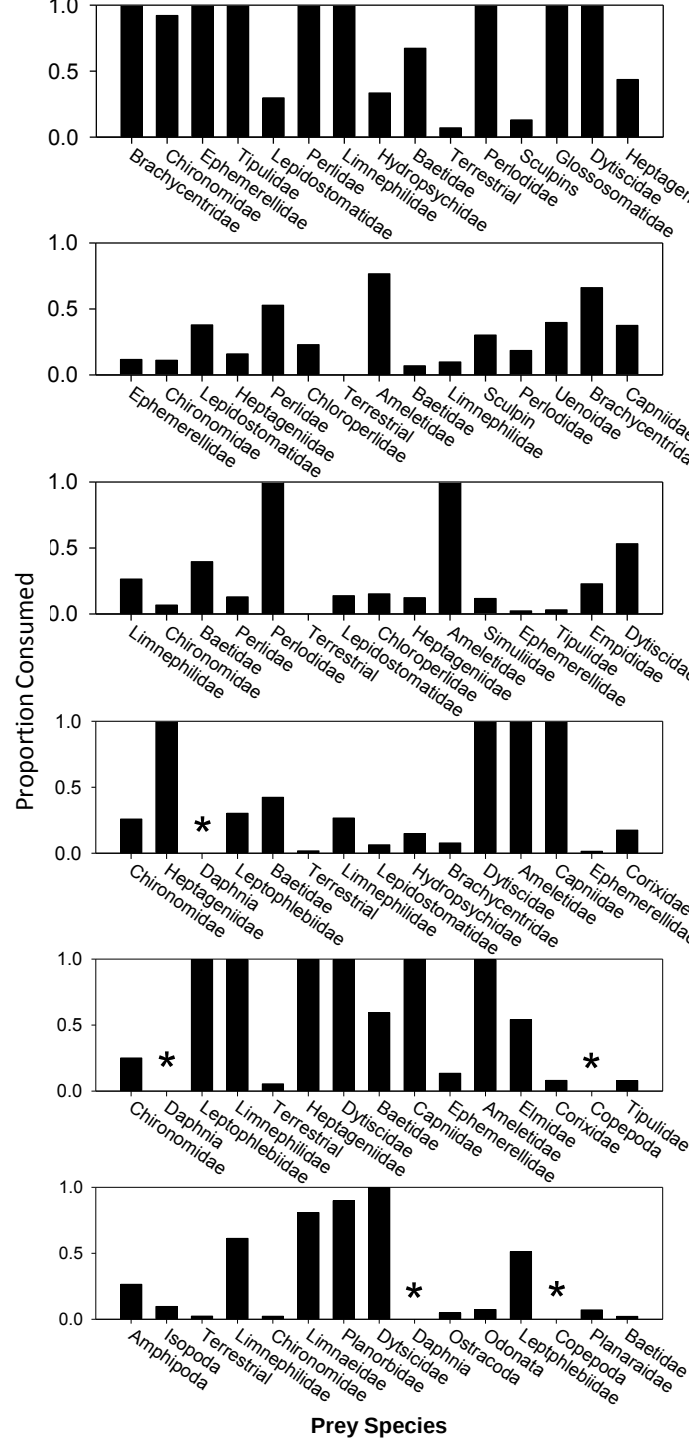
Connected up and downstream

Connected downstream

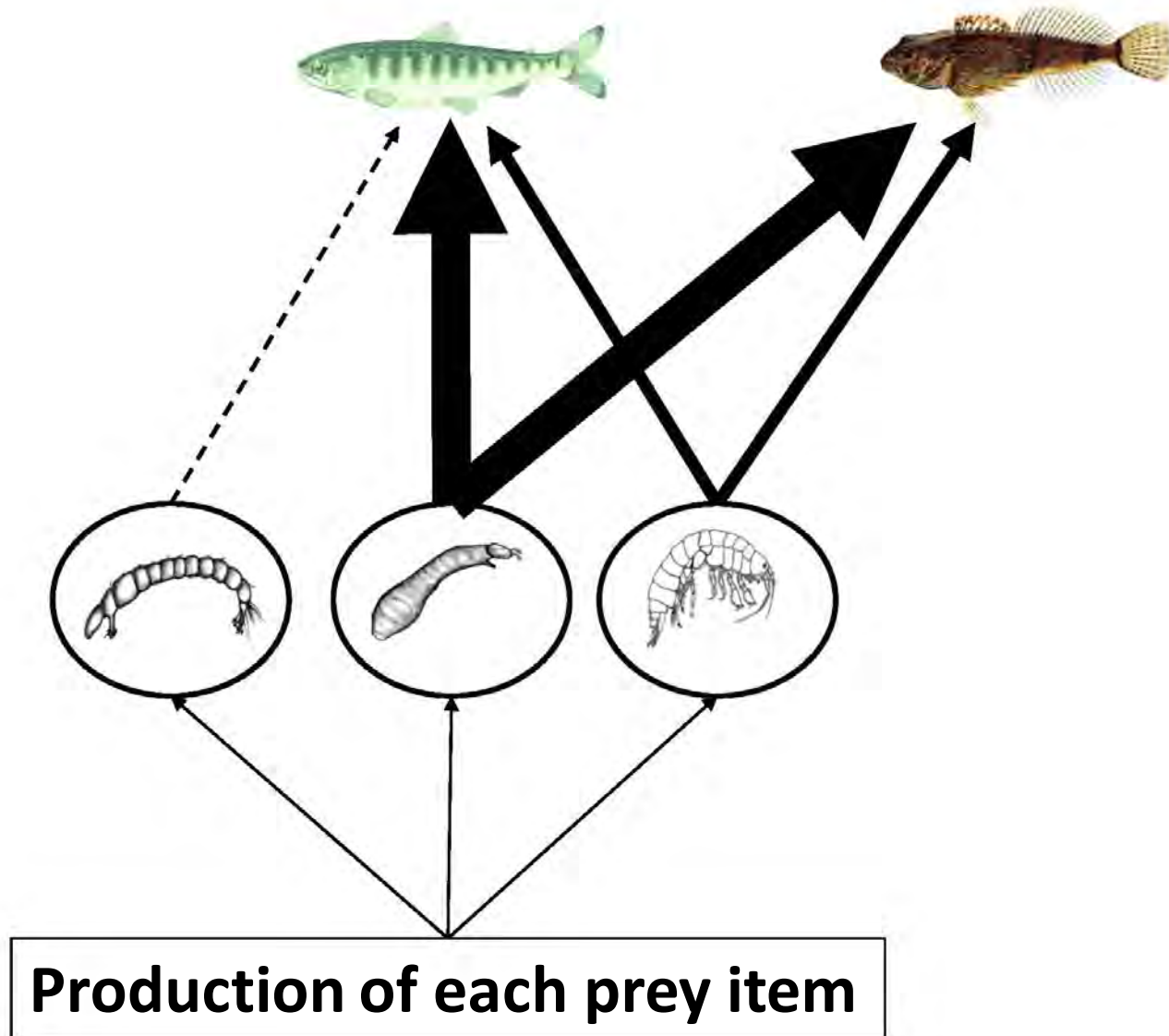
Disconnected large

Disconnected small

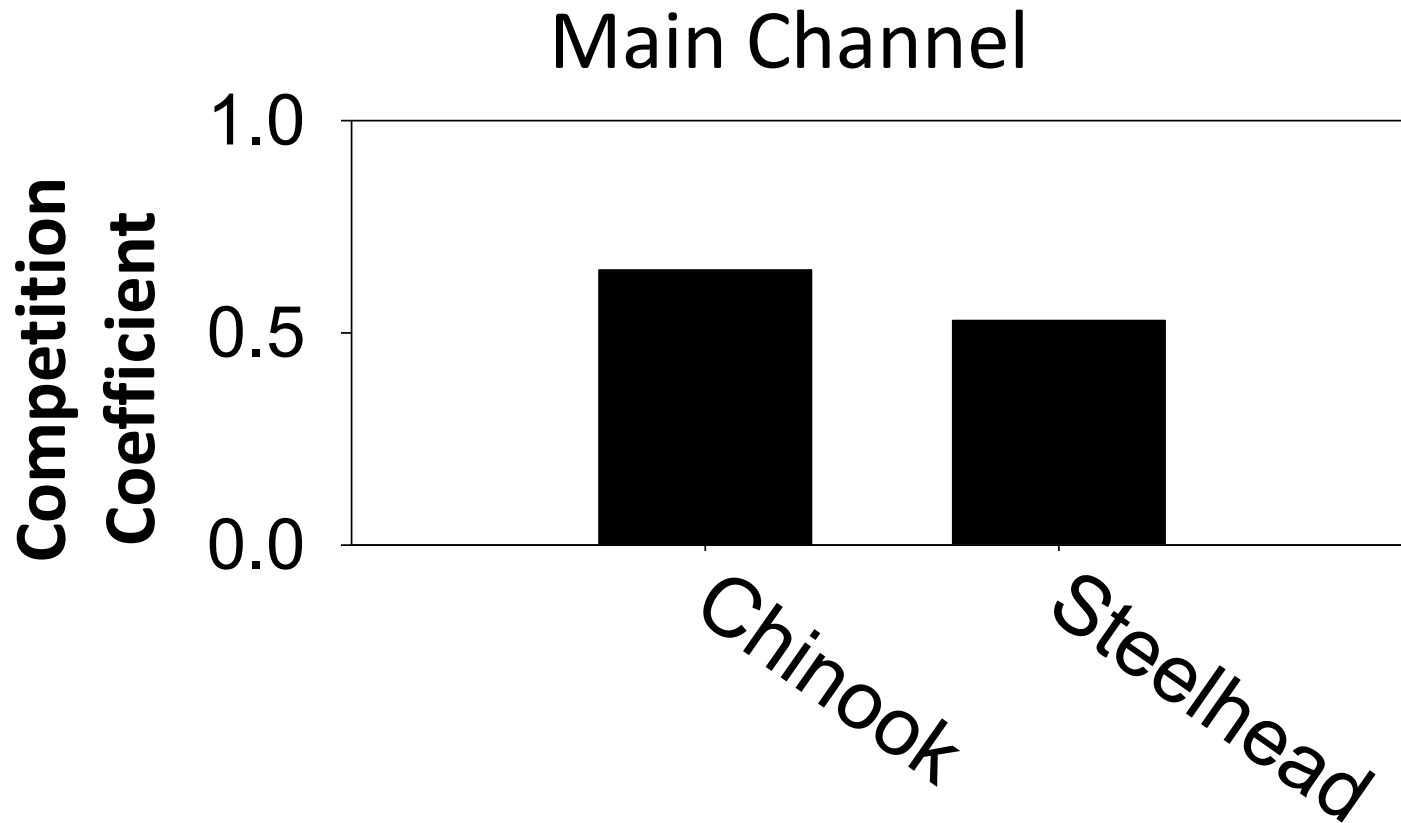
Disconnected no scour



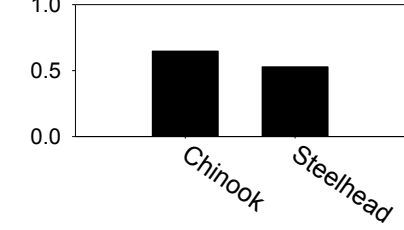
Methods: *Competition for Food*



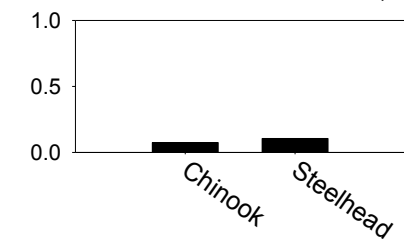
Results: *Competition*



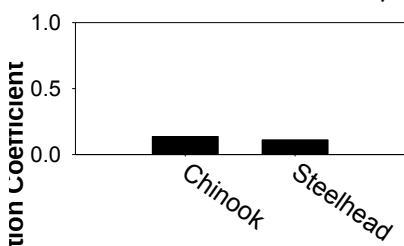
Main Channel



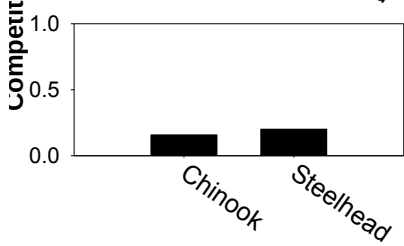
Connected up and downstream



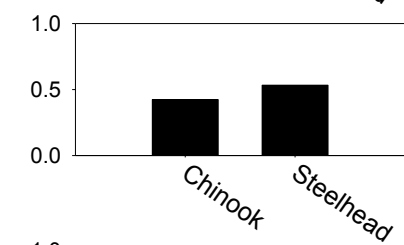
Connected downstream



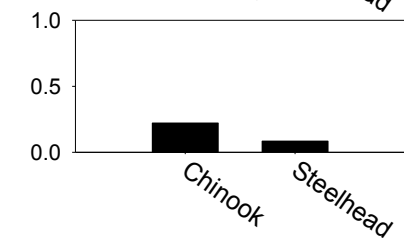
Disconnected large



Disconnected small



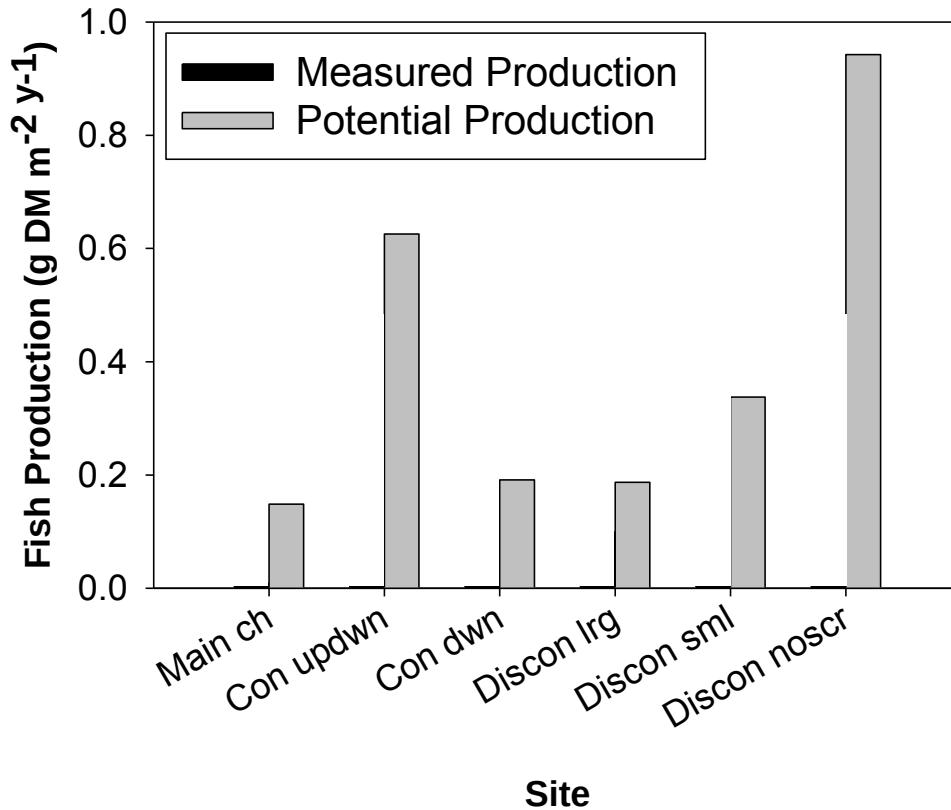
Disconnected no scour



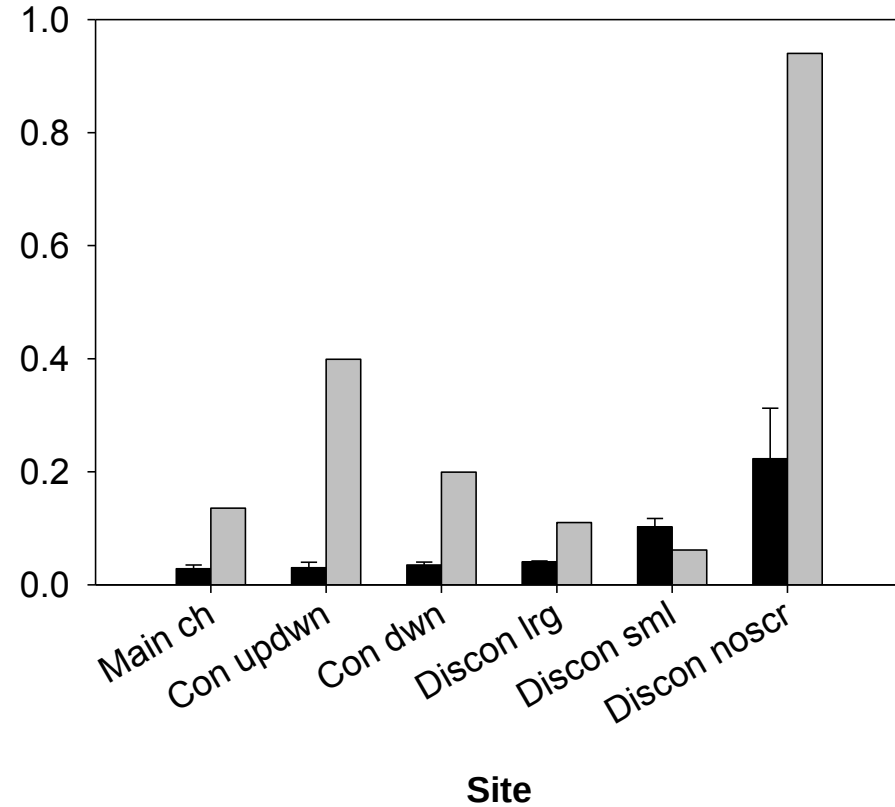
Fish Species

Results: *Potential Production*

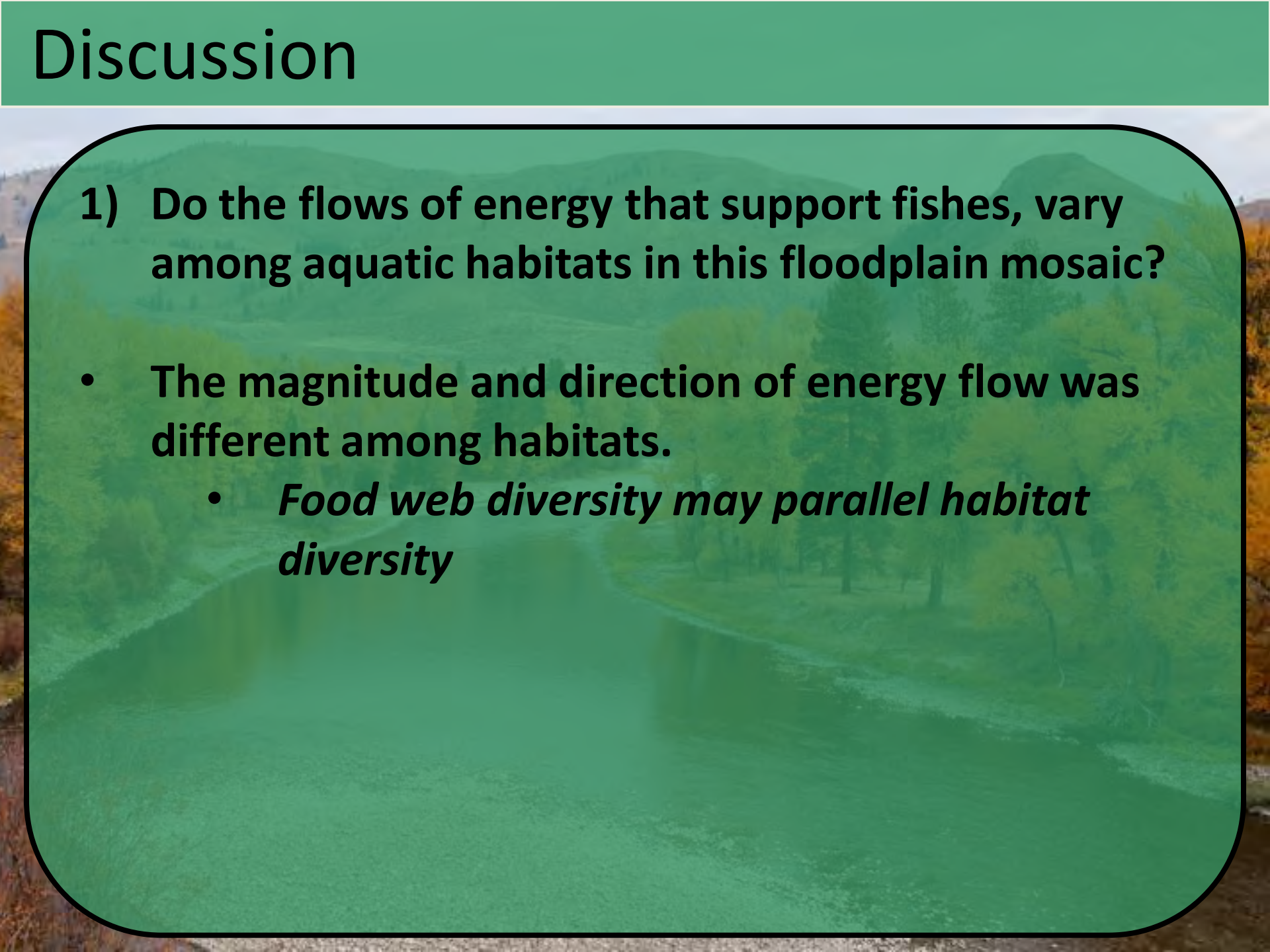
Chinook



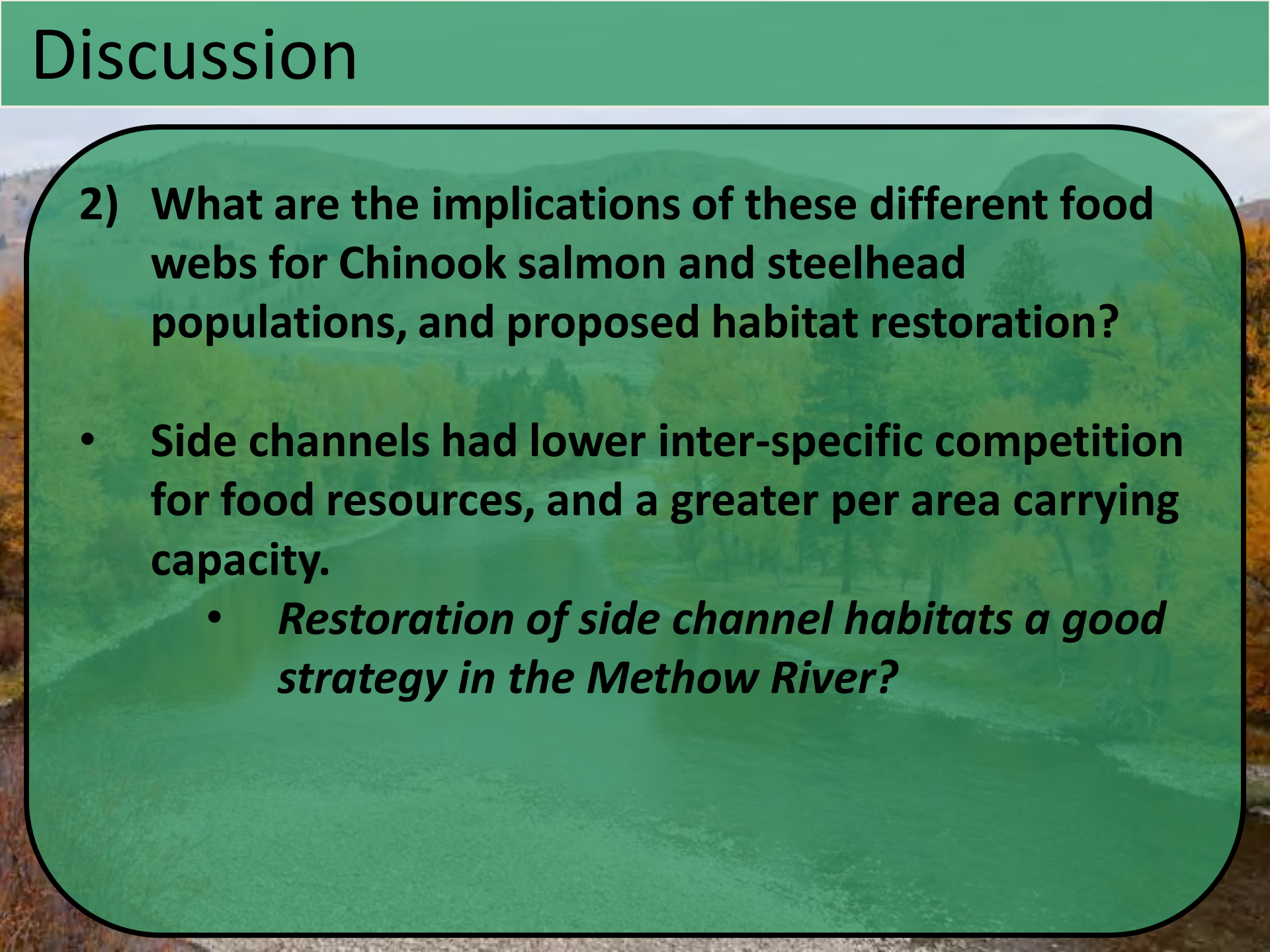
Steelhead



Discussion

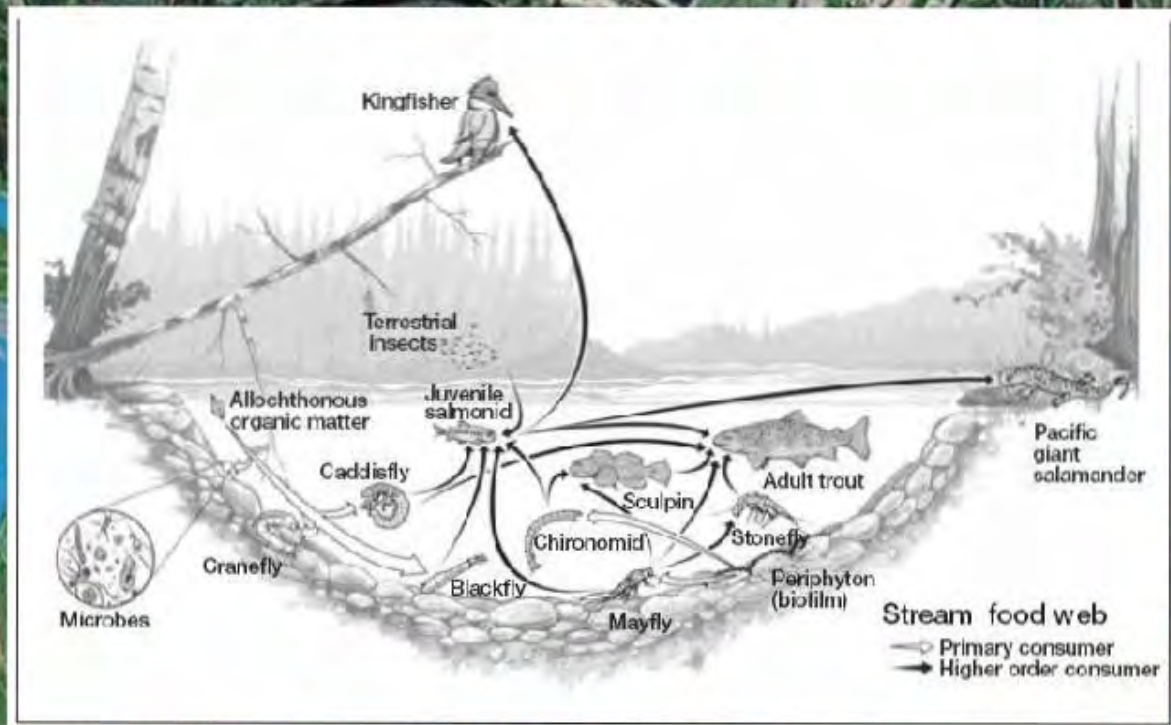
- 
- 1) Do the flows of energy that support fishes, vary among aquatic habitats in this floodplain mosaic?
 - The magnitude and direction of energy flow was different among habitats.
 - *Food web diversity may parallel habitat diversity*

Discussion

- 
- 2) What are the implications of these different food webs for Chinook salmon and steelhead populations, and proposed habitat restoration?
- Side channels had lower inter-specific competition for food resources, and a greater per area carrying capacity.
 - *Restoration of side channel habitats a good strategy in the Methow River?*

Discussion

- That said. . . floodplain habitats appear to be under-seeded with respect to food, indicating that additional salmon and steelhead production could be supported under current conditions.
 - *Not enough adult fish returning to fully seed habitats?*



Acknowledgements

Stream Ecology Center, Idaho State University

*Dave Ayers, Jessica Leuders-Dumont, Melinda Walker, Cameron Morris
Dr. John Davis, Dr. Amy Marcarelli, Kevin Donner, Scott Collins,
Jenny Cornell, Dr. G. Wayne Minshall, Dr. Madeleine Mineau,
Rebecca Martin

USGS Columbia River Research Lab

*Wesley Tibbits, Grace Eger, Dr. Joe Benjamin

Stream Team, Oregon State University

*Richard Van Driesche, Dr. Judy Li

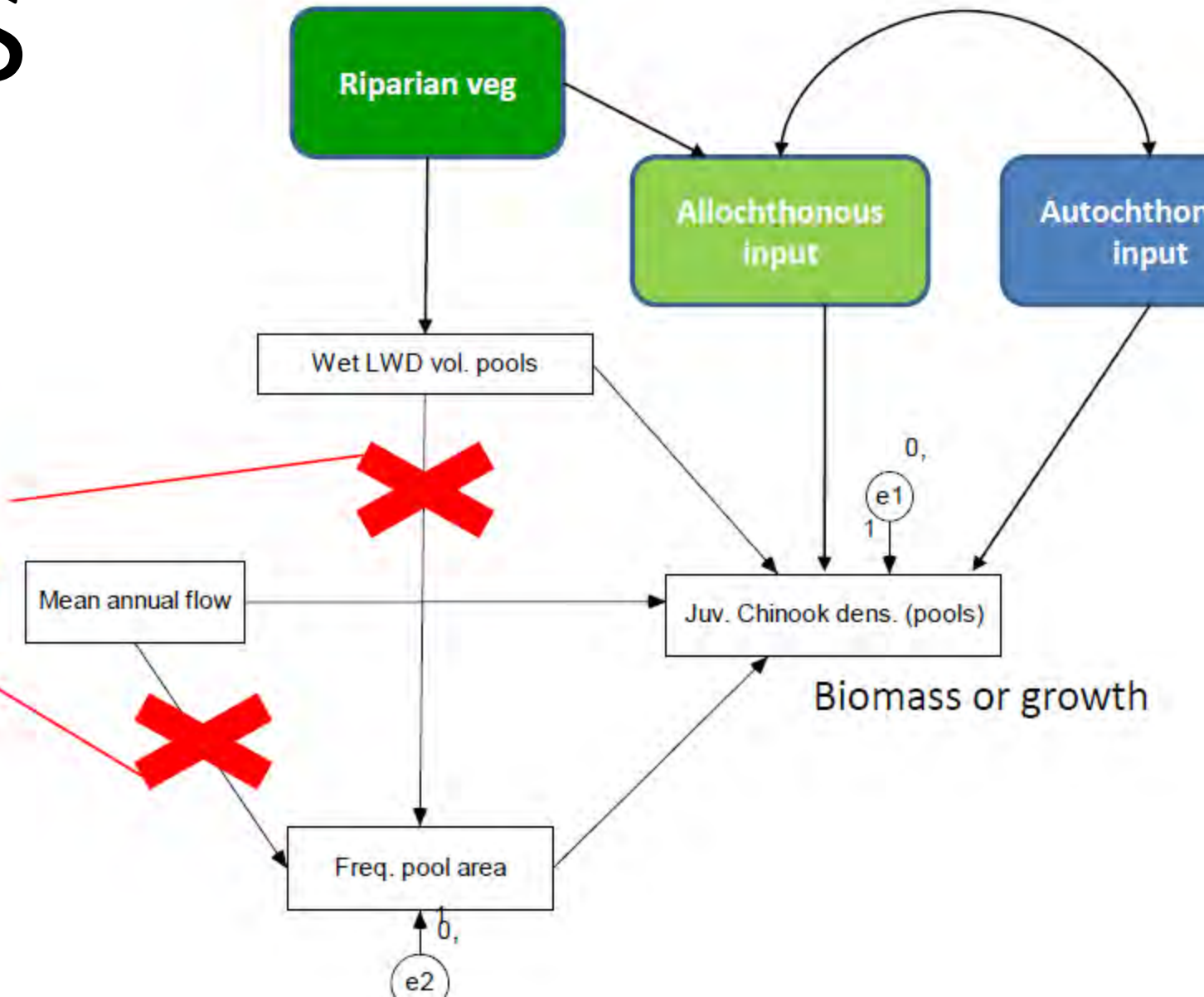
Funding and Support, Bureau of Reclamation

*Michael Newsom

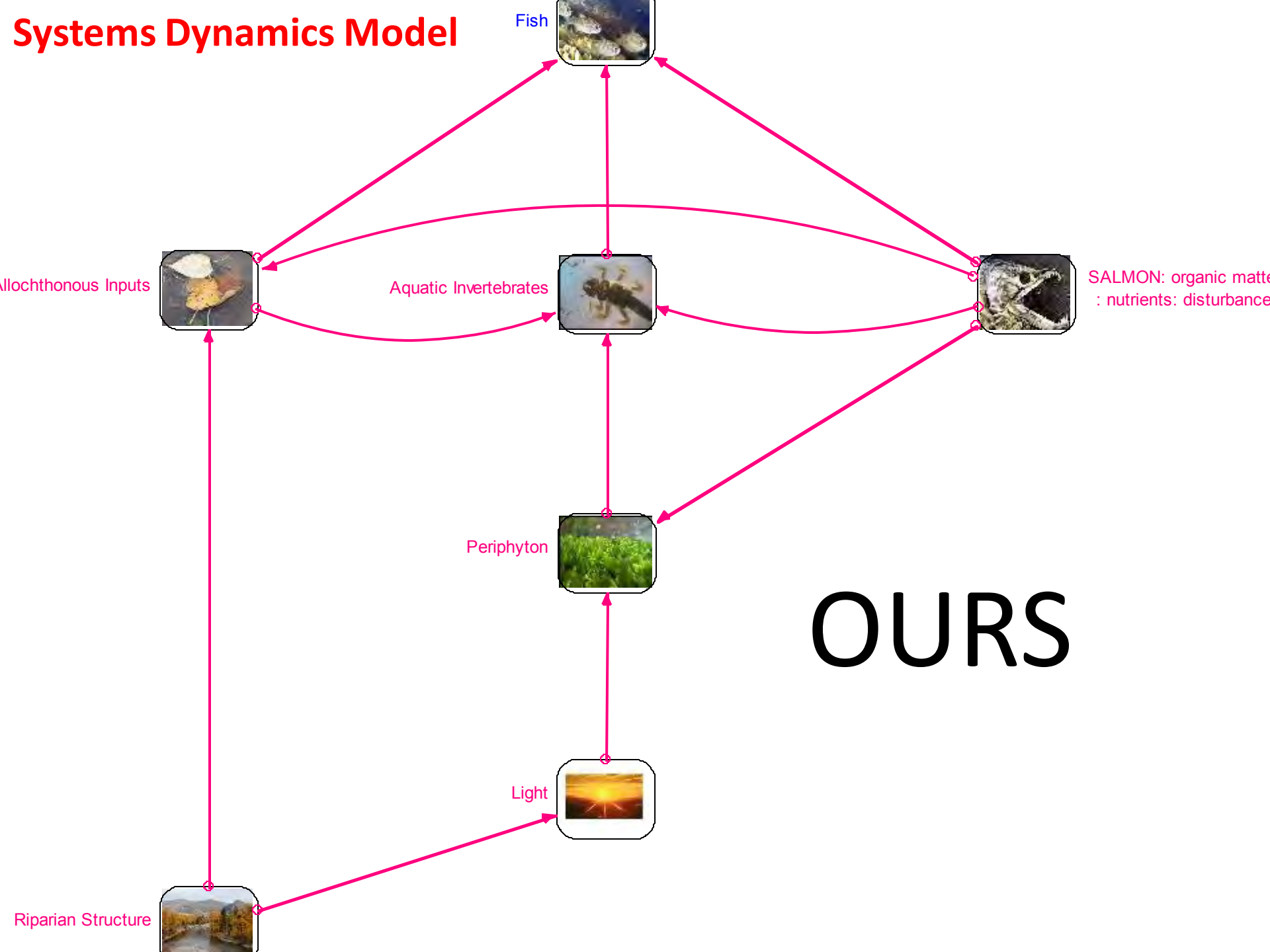
SEM – Food Web/Habitat Hypotheses

YOURS

For the food web model, these parameters don't need to be estimated



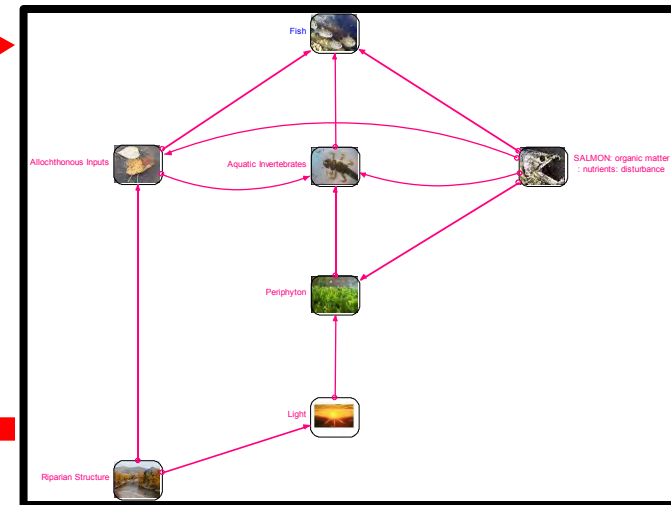
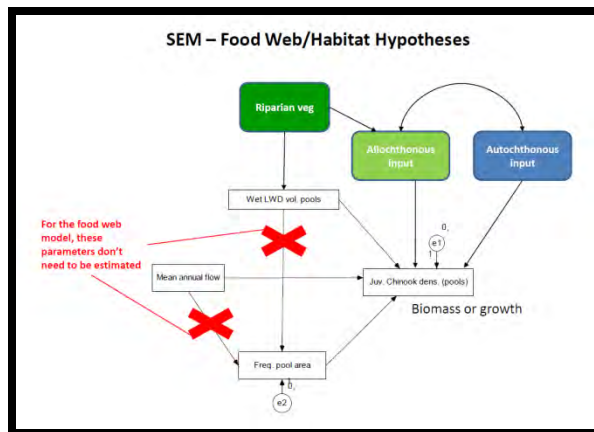
Systems Dynamics Model



YOURS

OURS

Tested Hypotheses
(i.e., model parameterization, validation, and restructuring)



Generated Hypotheses
(i.e., model structure generation)

Just one potential feed-back between our efforts. I am sure there are more. . .