



# Aquatic Ecology: the Role of Organic Matter and Invertebrates

Theodore A. Kennedy & Steven P. Gloss

# Outline

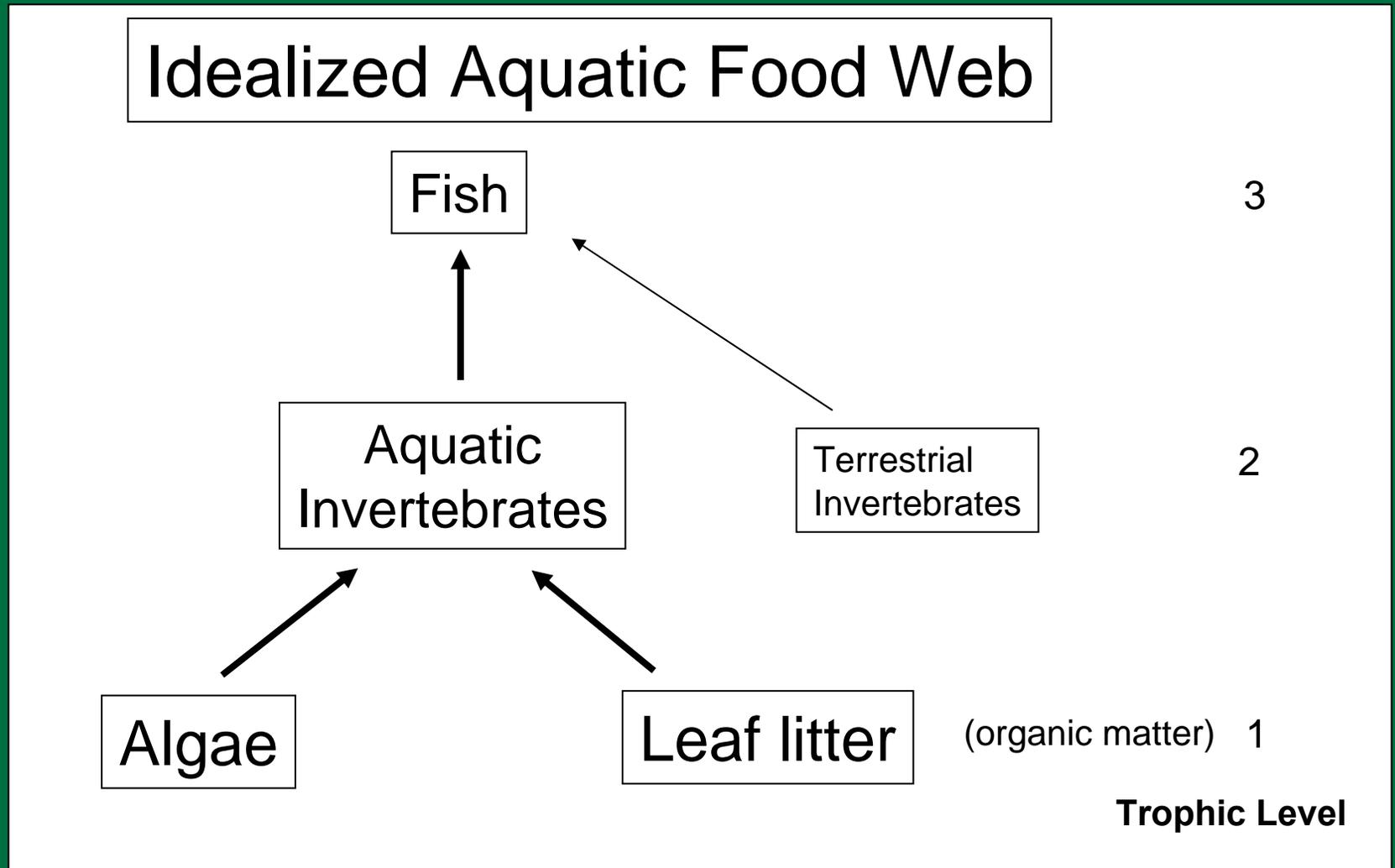
- Background on aquatic food webs
- Why conduct research/monitoring of organic matter and invertebrates?
- What food items are important to fish?
- Spatial and temporal patterns of organic matter and invertebrates
- Influence of dam releases on organic matter and invertebrates
- Recent findings
- Future directions

# Background

- What sources of energy drive aquatic food webs?
  - Terrestrial
  - Aquatic



# Background



# Why Conduct Research/Monitoring of Organic Matter and Invertebrates?

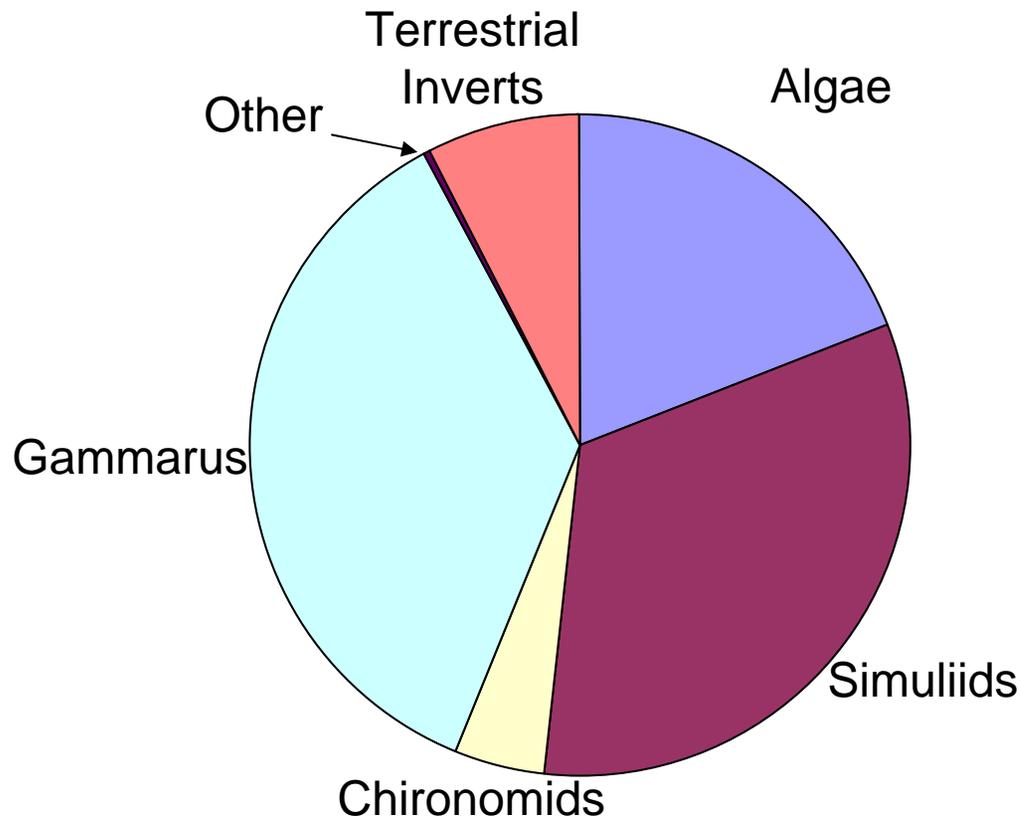
- **Recent trends for fish in the Colorado River may be due in part to changes in food availability and/or quality**
  - **Decline in population size and condition of humpback chub (Meretsky and others 2000, Johnstone and Lauretta 2004)**
  - **Decline in condition of LF rainbow trout (McKinney and others 2001)**

# Why Conduct Research/Monitoring of Organic Matter and Invertebrates?

- Critical to determining what controls the density of native and non-native fish in the Colorado River

# What Food Items are Important to Fish in the Colorado River?

Humpback Chub gut contents (by volume)



(Valdez and Ryel 1995)

# What Food Items are Important to Fish in the Colorado River?



Simuliids  
Filter Feeder  
(larval black flies)



*Gammarus lacustris*  
Grazer of Algae  
(scud)

# What Food Items are Important to Fish in the Colorado River?

- Cannot just use gut content analysis of fish to determine important food items
  - Only reveals what has been eaten within past hours
  - Unlikely to detect rare events (e.g., predation)
  - Consumption  $\neq$  assimilation (e.g., algae)
  - Cannot determine relative contribution of terrestrial and aquatic organic matter to invertebrate and/or fish growth

# What Food Items are Important to Fish in the Colorado River?

- Combination of gut-content and stable isotope analysis required to:
  - Determine consumption *and* assimilation
  - Relative contribution of terrestrial and aquatic organic matter to fish growth/production
- Food items often have a unique chemical signature that gets conserved after assimilation by a consumer (you are what you eat)
- Stable isotope analysis uses this conserved signature to determine what has been *assimilated* by consumers

# What Food Items are Important to Fish in the Colorado River?

- Food web studies (Angradi 1994, McKinney and others 1999)
  - Gut content analysis of Lees Ferry trout indicated:
    - scuds, midges, and algae were the most common food items for trout

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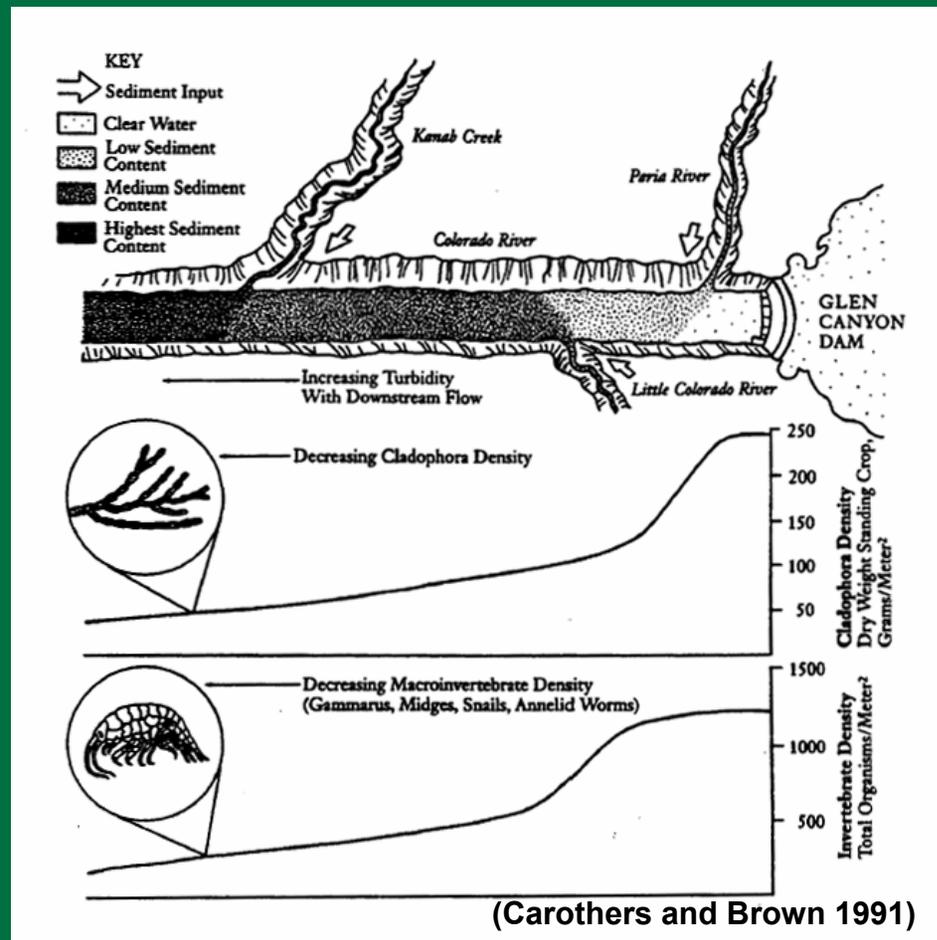
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  - Stable isotope analysis of Lees Ferry trout and invertebrates revealed:
    - Trout get energy/nutrients from invertebrates only
    - Invertebrates eat only algae
    - Lees Ferry food web driven entirely by algae

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    - Lees Ferry food web driven entirely by algae
  - **Food web in downstream tributaries more complicated:**
    - Some driven by upland vegetation, others by riparian vegetation
  - **Mainstem food web at downstream locations remains unclear**

# Spatial and Temporal Patterns of Organic Matter and Invertebrates

- Density and biomass of algae and invertebrates decreases downstream due to tributary sediment inputs



# Spatial and Temporal Patterns of Organic Matter and Invertebrates

- Quantity of drifting organic matter increases downstream
- Composition of drifting organic matter shifts downstream, from algae to terrestrial material
- Invertebrate composition shifts downstream
  - Scuds and larval midges (grazers of algae) most common invertebrates upstream
  - Black flies (filter feeders) most common invertebrate downstream

# Spatial and Temporal Patterns of Organic Matter and Invertebrates

- Density/biomass of organic matter and invertebrates varies with season
  - Algae and invertebrates peak ~ summer
  - Detritus peaks ~ fall/winter

# Influence of Dam Releases on Organic Matter and Invertebrates

- Stage can vary by several meters per day
  - Creates a 'varial' zone of shoreline that is both exposed and inundated daily
  - Varial zone supports low density of algae and invertebrate



# Influence of Dam Releases on Organic Matter and Invertebrates

- **Modified Low Fluctuating Flow**
  - Reduced size of varial zone
  - Increased area of river bottom that is permanently submerged
  - Probably increased productivity and standing mass of important foodbase components

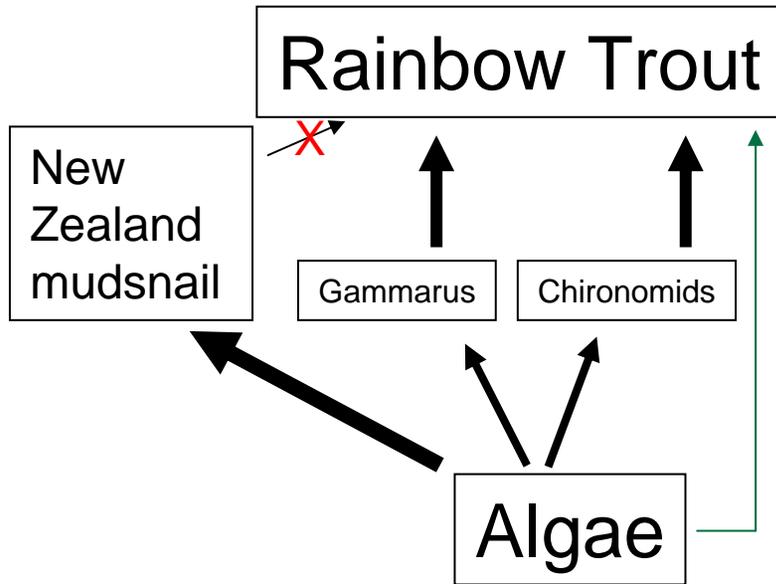
# Recent Findings

- **New Zealand Mudsnails**
  - **First noticed in 2002, but present as early as 1995**
  - **Extremely high densities, particularly in Glen Canyon (>40,000/m<sup>2</sup>)**
  - **Consume exclusively algae**
  - **Potential trophic 'dead end'**



# Future Directions

Lees Ferry



Colorado River at LCR confluence

