



Aquatic Insects and Environmental Flows

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Outline

1. Characteristics of Aquatic Insects
2. Aquatic Insects in Puerto Rico
3. Importance of Aquatic Insects on stream ecosystems
4. Influence of flow on Aquatic Insects:
 1. Adaptations to flow
 2. Impacts of flow regulation



Characteristics of Aquatic Insects

Terrestrial Origin

Invaded streams and
developed adaptations

Mostly Benthic

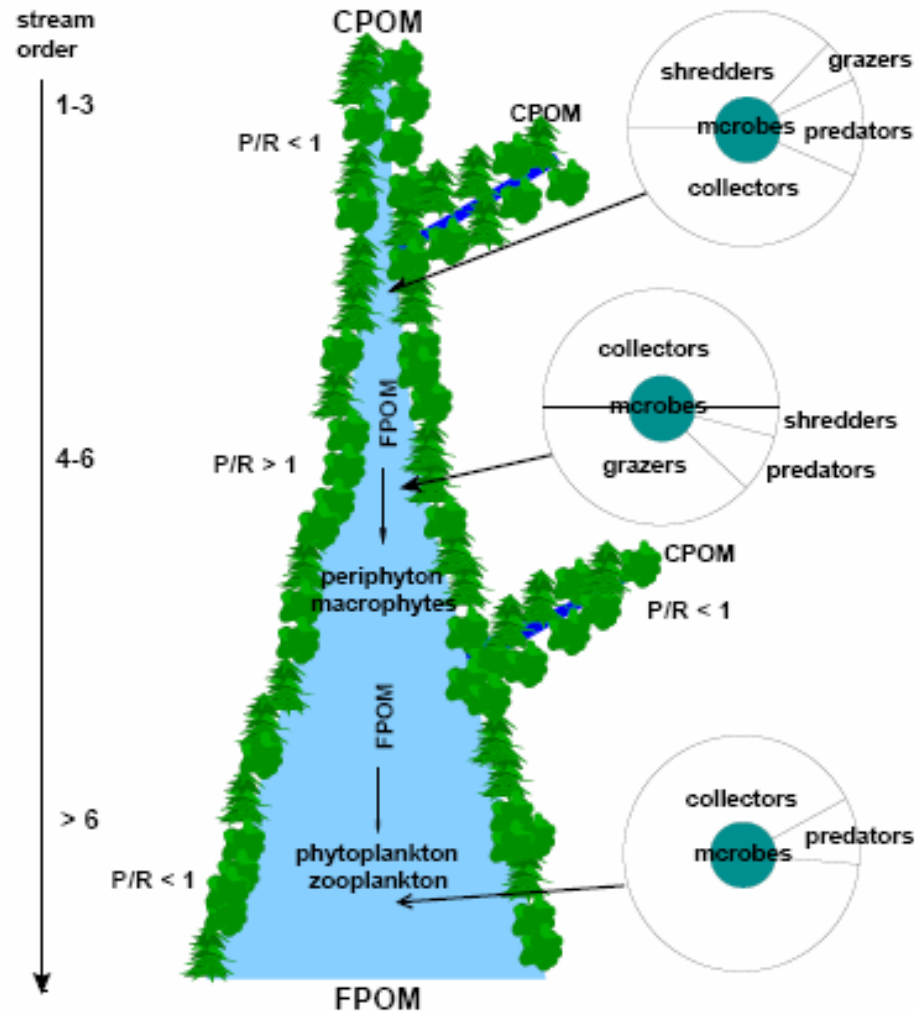
Associated to stable surfaces

Ubiquitous

They are everywhere

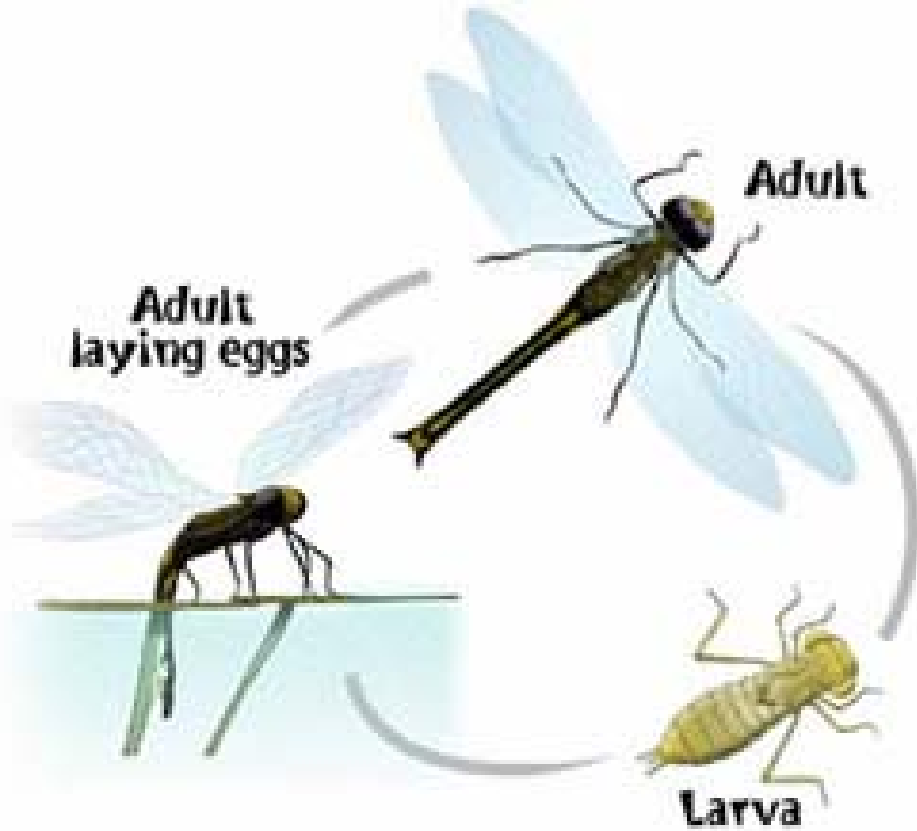


Characteristics of Aquatic Insects

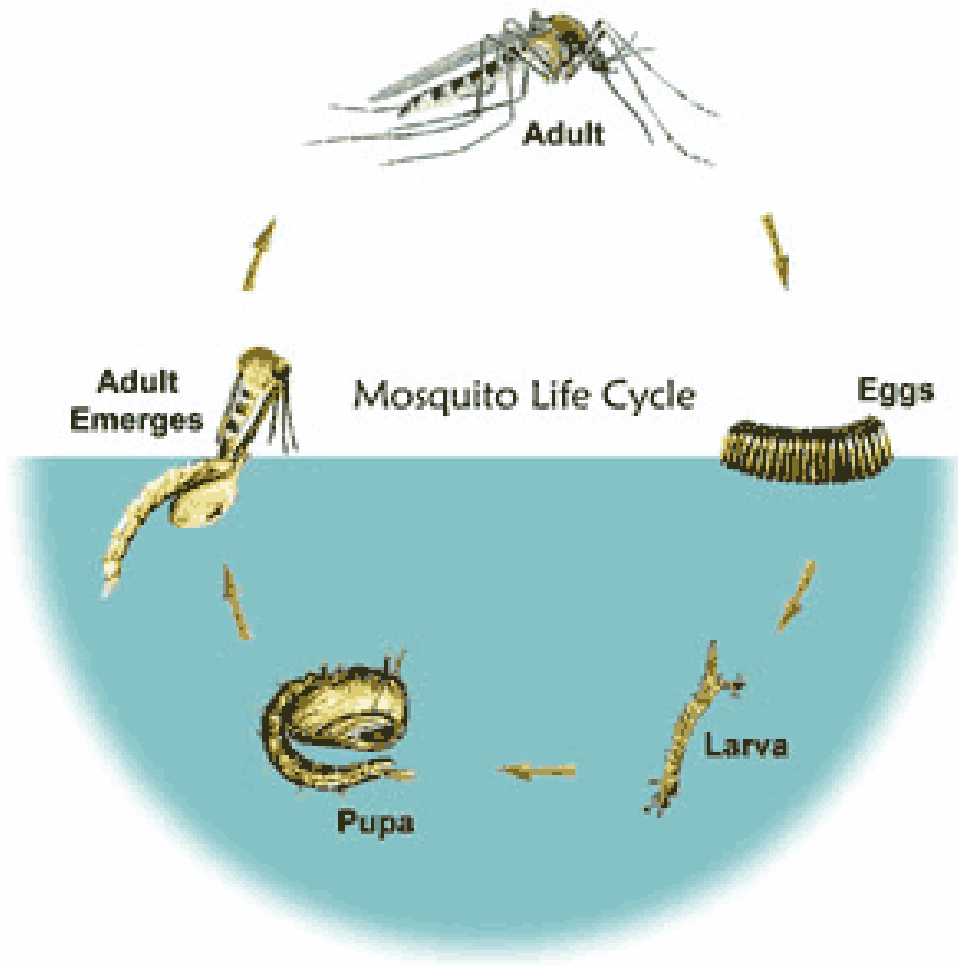


River Continuum Concept
Vannote, 1980

Aquatic Insects may be Hemimetabolous



...or
Holometabolous



Aquatic Insects in Puerto Rico



6 Orders

- Ephemeroptera
 - Odonata
 - Diptera
- Trichoptera
- Coleoptera
- Hemiptera

Ephemeroptera (hemimetabolous)



Habitat: rocky substrates of shallow streams

Feeding Habit: shredders, collectors and scrapers

Distinctive features: 3 tails at the end of abdomen, lateral gills on abdomen

Families in Puerto Rico:

Baetidae, Leptophlebiae and Caenidae

Odonata (hemimetabolous)



Habitat: mostly vegetated littoral areas

Feeding Habit: predators

Distinctive features: spoon shaped
lower lip

Families in Puerto Rico:

- (Sub-Order Anisoptera) Libellulidae
and Aeshnidae
- (Sub- Order Zygoptera)
Coenagrionidae, Lestidae,
Protoneuridae



Hemiptera (hemimetabolous)

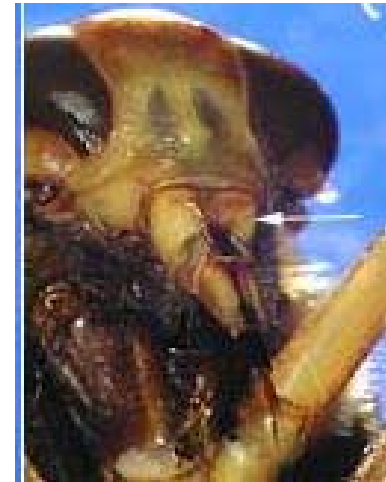
Habitat: various including littoral area and water surface

Feeding Habit: mostly predators

Distinctive features: mouth in the shape of a cone, hemi-elytra

Families in Puerto Rico:

- Mesoveliidae
- Veliidae
- Gerridae
- Pleidae
- Belostomatidae
- Corixidae
- Notonectidae



Diptera (holometabolous)

Habitat: substrate, water column,
littoral zone

Feeding Habit: collectors, scrapers, predators
and shredders

Distinctive features: lack of jointed
thoracic legs

Families in Puerto Rico:

- (Sub-Order Nematocera):
- Chironomidae, Tipulidae,
Ceratopogonidae, Simuliidae,
Psychodidae, Culicidae
- (Sub-Order Brachycera):
- Empididae, Tabanidae, Sciomyzidae,
Stratiomidae



Coleoptera (holometabolous)



Habitat: various including littoral zone, substrate and water surface

Feeding Habit: various including predators, shredders and scrapers

Distinctive features: mouthparts visible without dissection, thorax and abdomen concealed with elytra

Families in Puerto Rico:

Gyrinidae

Elmidae

Staphilinidae

Dytiscidae



Trichoptera (holometabolous)



Habitat: various including rock faces, litoral areas and macrophytes

Feeding Habit: various including shredders, collectors, predators and scrapers

Distinctive features: abdomen may have modified prolegs that serve as hooks, they make cases, they lack wings and have thoracic legs

Families in Puerto Rico:

Hydroptilidae

Helicopsichidae

Leptoceridae

Phylopotamidae

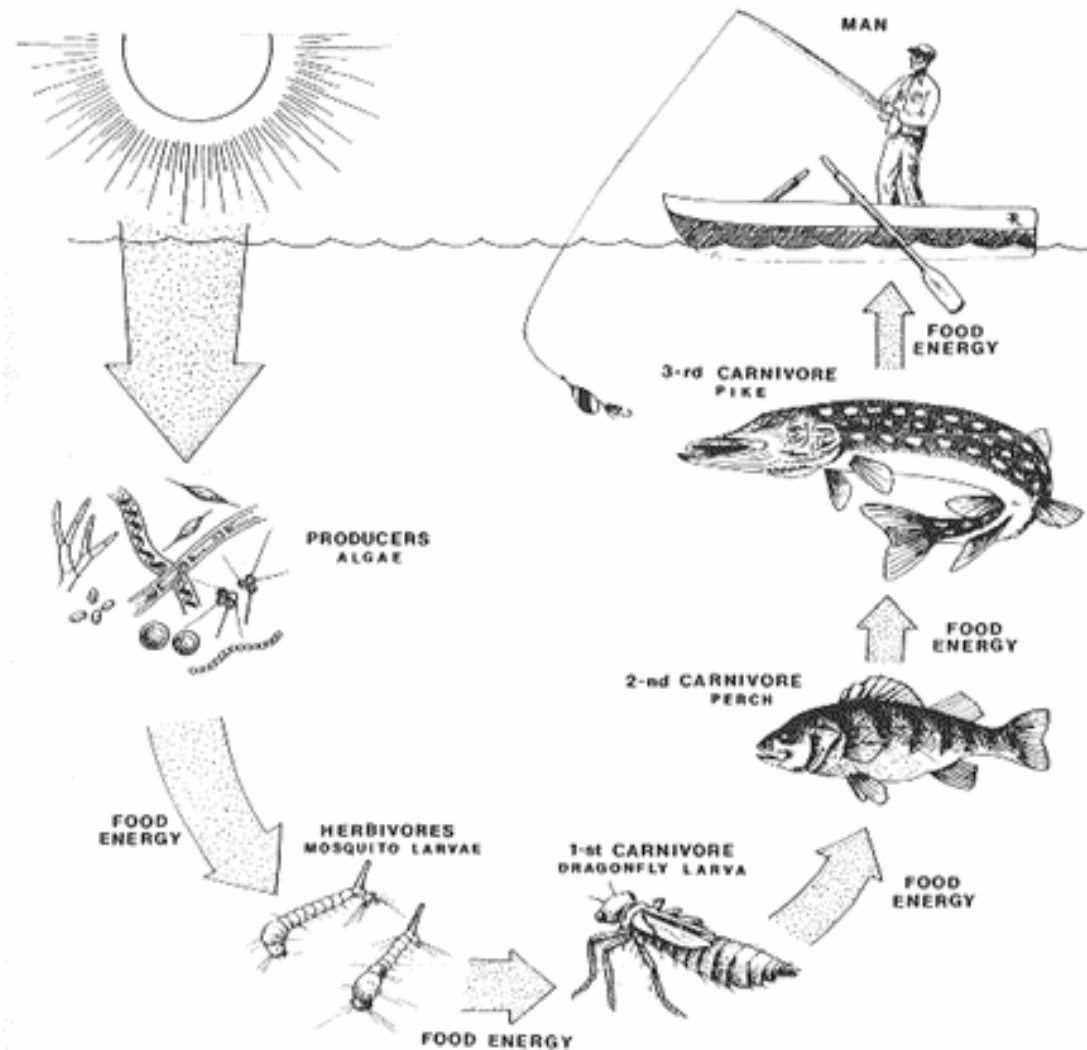
Hydropsichidae

Glossosomatidae



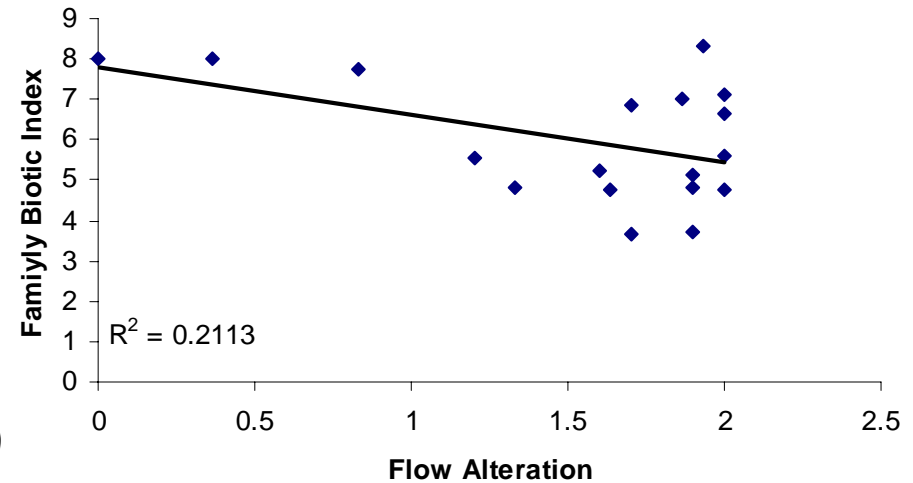
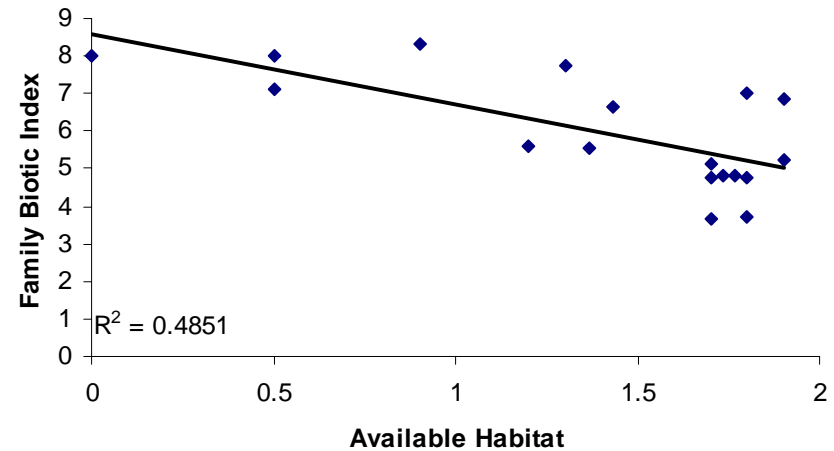
Importance of Aquatic Insects

They are a key part of the aquatic food web



Importance of Aquatic Insects

They may be used as indicators of stream health.



according to (Hilsenhoff 1987, Plafkin et al 1989)

Influence of Flow on Aquatic Insects

Flow should be viewed as the primary environmental factor determining the essential character of these ecosystems (Hart and Finelli 1999).

- **Direct paths**

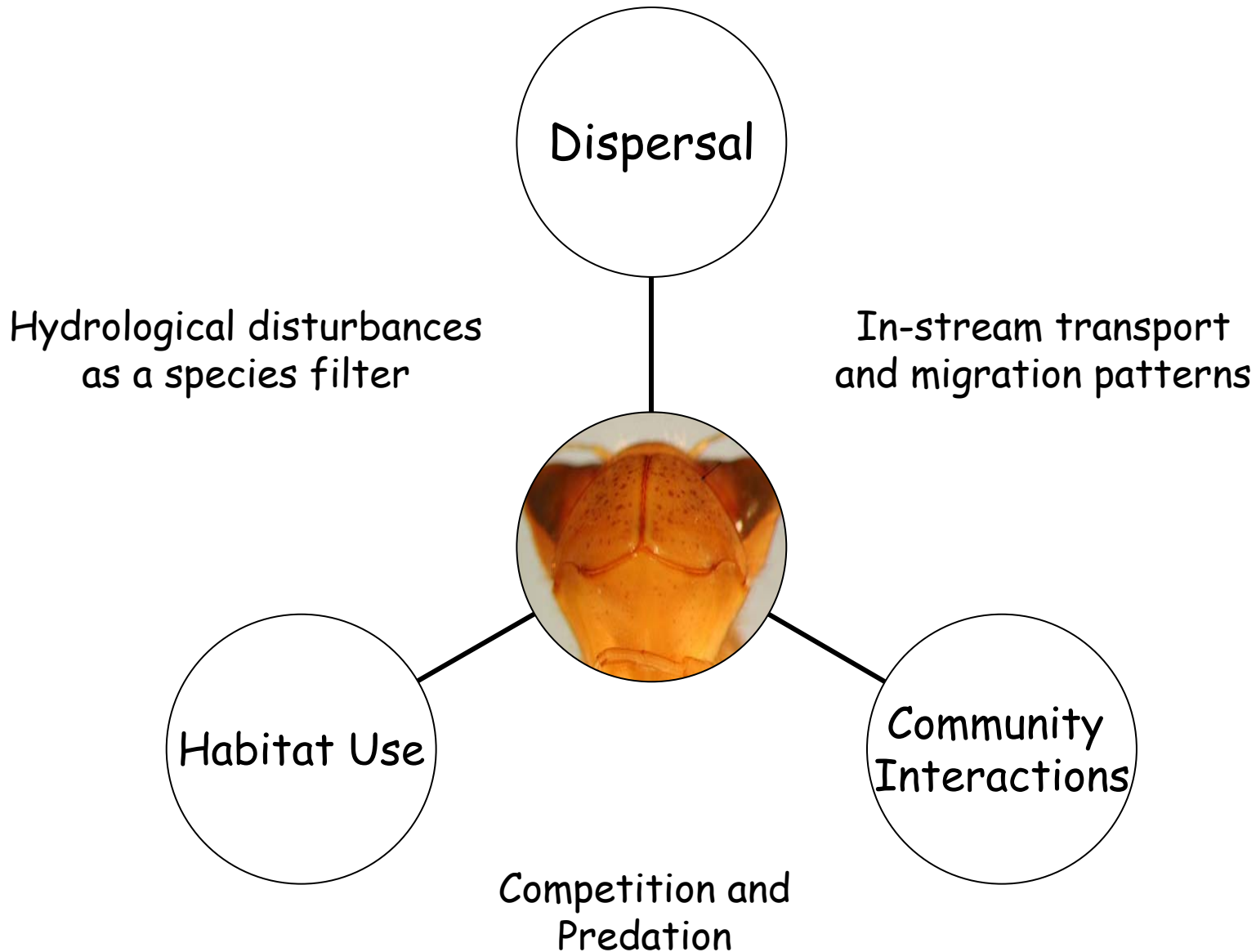
- Hydrodynamic forces act on the organism

- **Indirect paths**

- Altering an intermediate variable



Ecological processes affected by flow



Adaptations to flow



Impacts of flow regulation

An aerial photograph of a large concrete dam with multiple pillars, situated in a lush, green tropical forest. The dam is surrounded by dense vegetation, and a river flows through the forest below it. The water behind the dam is calm and reflects the sunlight. The foreground shows some tree branches and leaves, suggesting the photo was taken from an elevated position in the forest.

- Habitat Changes

- Changes in
community
interactions

- Reduced floodplain
inundation

- Life history changes

Challenges

Bunn and Arthington 2002

Determine which aspects of the altered flow regime are responsible for biological degradation.

Lag effect in the biological response to flow regulation (longer time scales for channel adjustments).

Separate the effects of altered flow regimes to the effects associated to altered land use.

Future Directions

Bunn and Arthington 2002

Research

Measurement of flow
experienced by organisms

Interdisciplinary approaches

