

Fish, Amphipods and Leaves: How are they all related?

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- Saerom Park (2003) found that high numbers of fish (all cyprinids) were found in streams around Lake Matoaka after storm events as a result of the overflow of BMPs.
- The most abundant species found was *Clinostomus funduloides* (Rosyside dace).
- Other species:
  - *Gambusia holbrooki*(Mosquito fish)
  - *Semolitus atromaculatus* (Creek chub)
  - *Lepomis macrochirus* (Bluegill)

What effects do these fish have on stream community structures?

Hypothesis:

(1) fish reduce the total number of amphipods,
(2) fish cause a decrease in smaller sized amphipods,
(3) the presence of fish causes leaf litter to break down more slowly.

Top-down control of stream ecosystem??

What do these fish eat?

- Most studies have found that microcarnivorous fish preferentially eat large invertebrate prey (Brooks 1968, Bartell 1982).
- Mosquitofish have been found to eat a diet of mixed prey size, regardless of the abundance of prey available (Bence and Murdoch 1986).

Rosyside Dace

- ***__RARELY__ occurs in small impoundments and natural ponds
- Found to influence invertebrate abundance, but the effect was variable among habitats.
- Pool-dwelling invertebrates decreased more in the presence of cyprinid predation than riffle-dwelling ones.
- Larger species were less susceptible to predation than smaller species (Schlosser and Ebel, 1989)

Creek Chubs

Semolitus atromaculatus

- Live in creeks that are 2-7m wide.
- Rarely inhibits ponds or lakes—restricted to small streams
- Found in BMP's?
  - Yes! Several Creek Chubs were captured from the detention pond

- Gilliam, et al. (1989) found that Creek chubs decrease invertebrate populations significantly in streams

Do fish feed on amphipods?

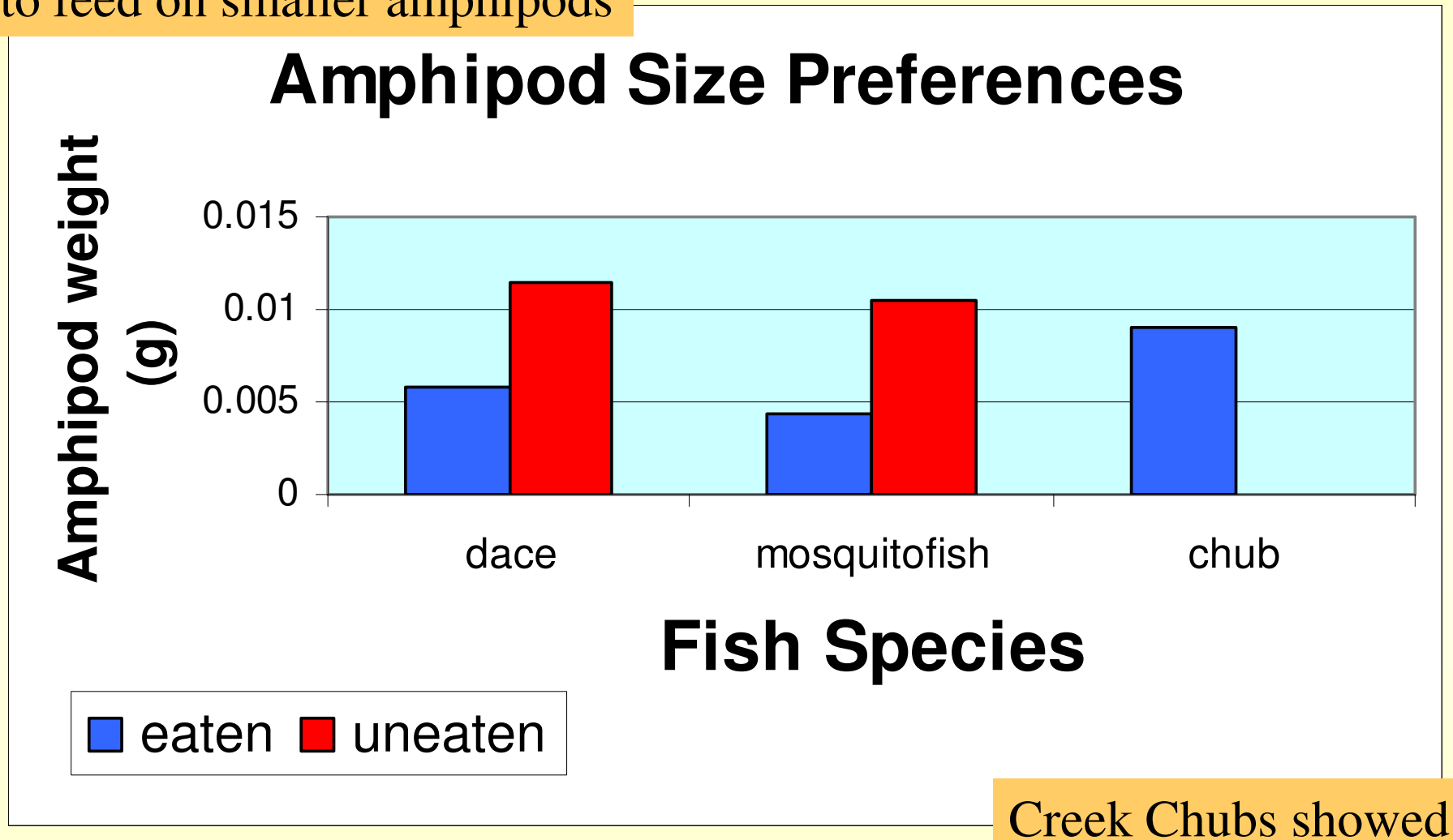
Fish Collection

- Rosyside Dace and Creek Chubs:
  - Retention pond at the headwaters of Strawberry Creek
- Mosquito fish
  - Dupont stream and Lake Matoaka
- Amphipods (*Gammarus pseudolimnaeus*)
  - Berkeley South and Strawberry Creek

Do fish feed on amphipods?

- A single fish was placed into a 600 ml beaker containing 10 amphipods of measured masses
- After 24 hours, the fish were removed and the remaining amphipods were weighed to determine which had been consumed by the fish
- A control beaker containing 10 amphipods and zero fish was set up to ensure that the amphipods were not simply crawling out of the beakers.

Dace and Mosquitofish prefer to feed on smaller amphipods



Creek Chubs showed no preference

Why do we care about amphipods?

•*Gammarus pseudolimnaeus* is a shredder, breaking down leaves that have fallen into the stream.

Shredders can account for about 25% of the loss of leaf mass (Peterson and Cummins 1974; Cuffney et al. 1990; Newman 1990).

The nutrients from terrestrial leaf litter form the base of the detritus-based food web. (Webster et al. 1995; Wallace et al. 1997).

Does the Presence of fish affect the rate of leaf litter decomposition?

Reutz, et al. (2001) found that the presence of fish lowered the abundance of total invertebrates and shredders inhabiting leaf packs.

Obendorfer et al. (1984) found that predation on shredders significantly reduced the breakdown of leaves in stream ecosystems

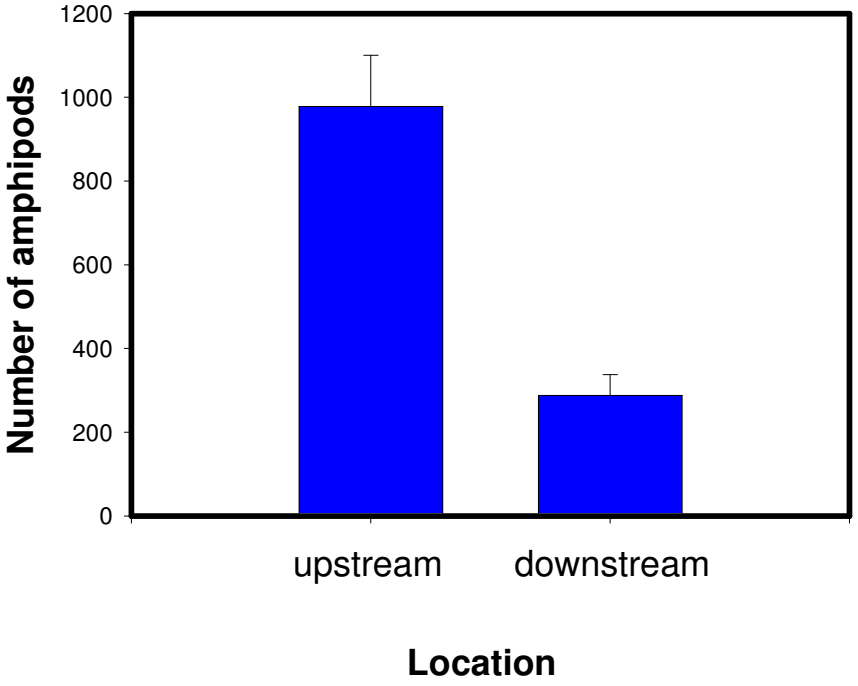
BUT, Rosenfeld (2000) predicted that trophic cascades in streams should be more likely in algal-based than detritus-based food webs

Polis and Strong (1996) found that fish had variable, indirect effects on leaf breakdown rates

How to measure decomposition?

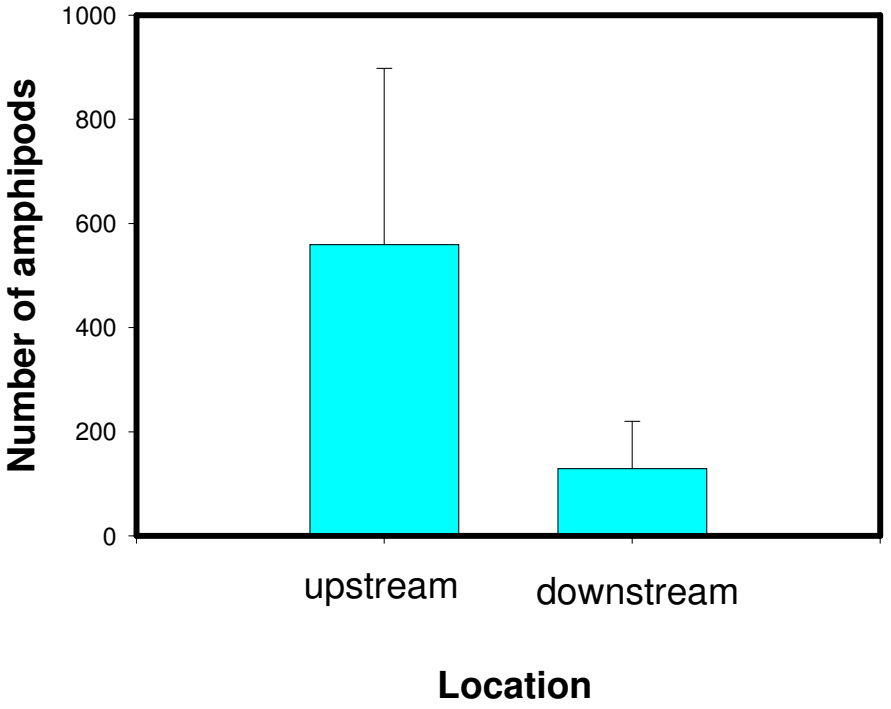
- Mesh bags filled with 50 grams of dry leaf litter
- Six bags were placed in an area containing fish and 6 bags in an area without fish in Strawberry, Berkeley and Pogonia Creek
- A control consisted of 5 bags placed in deionized water in the laboratory
- Half the bags were collected after 3 weeks and half after 5 weeks.
- Analyzed the number of amphipods, average amphipod size, the weight of the leaves and the C:N:P

Amphipod abundance upstream vs. downstream Week 3



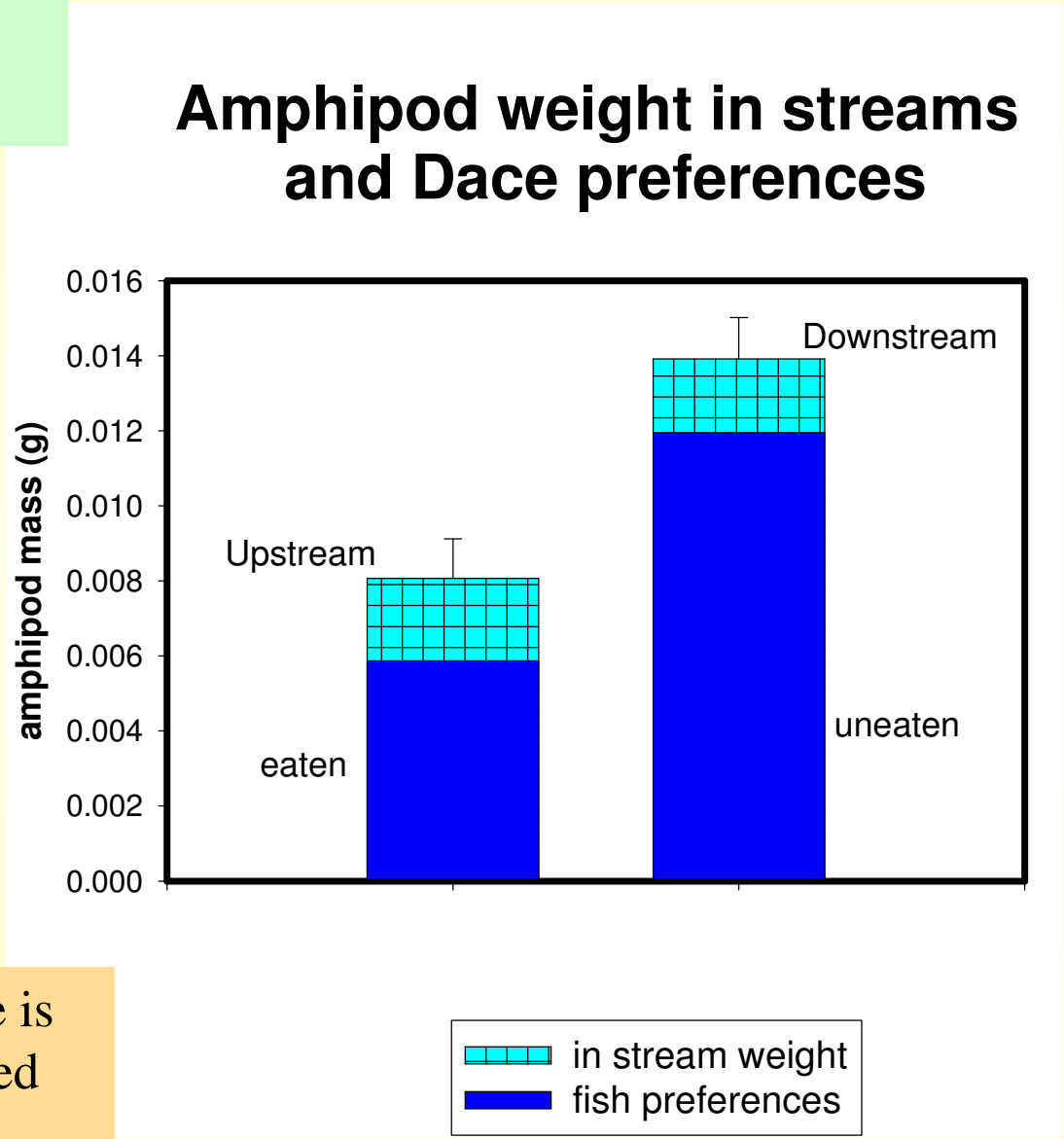
The abundance of amphipods in stream areas without fish was significantly greater than areas with fish.

Amphipod abundance upstream vs. downstream Week 5



Similar patterns of amphipod abundance upstream and downstream between weeks 3 and 5

Does the preference to feed on smaller amphipods affect the community structure?

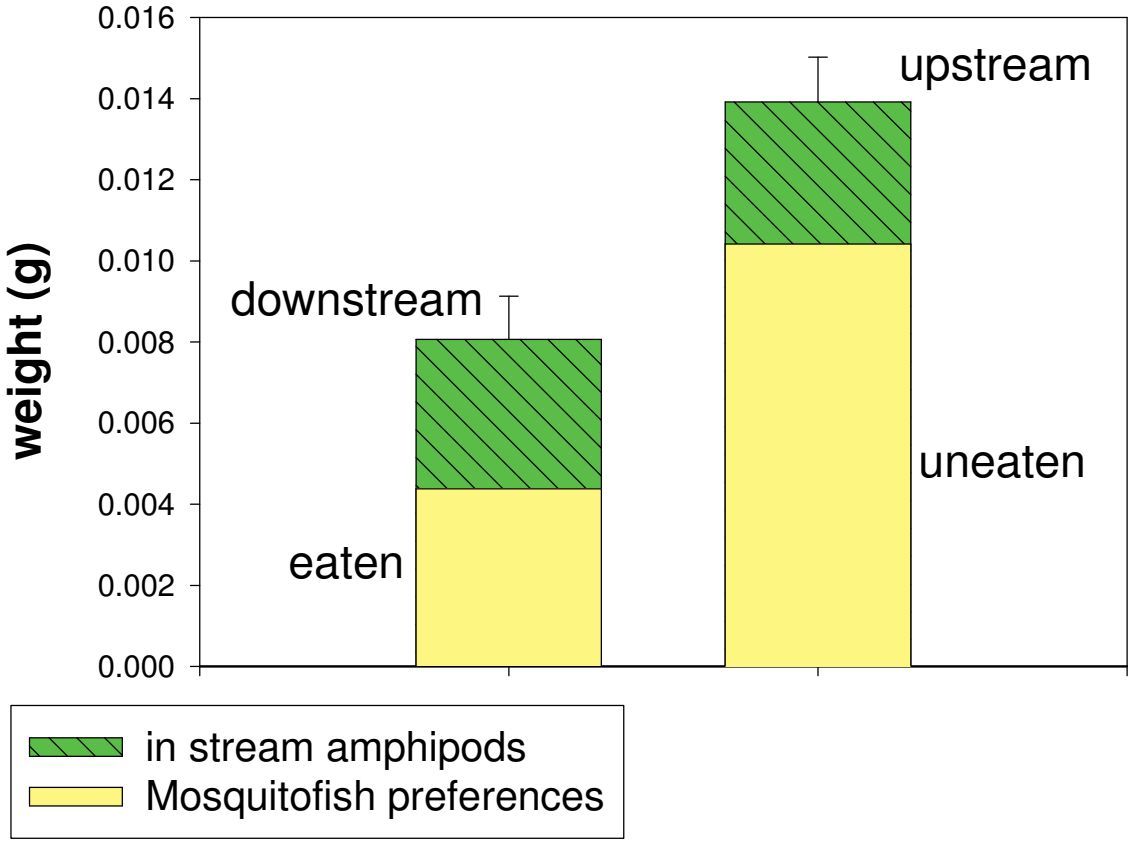


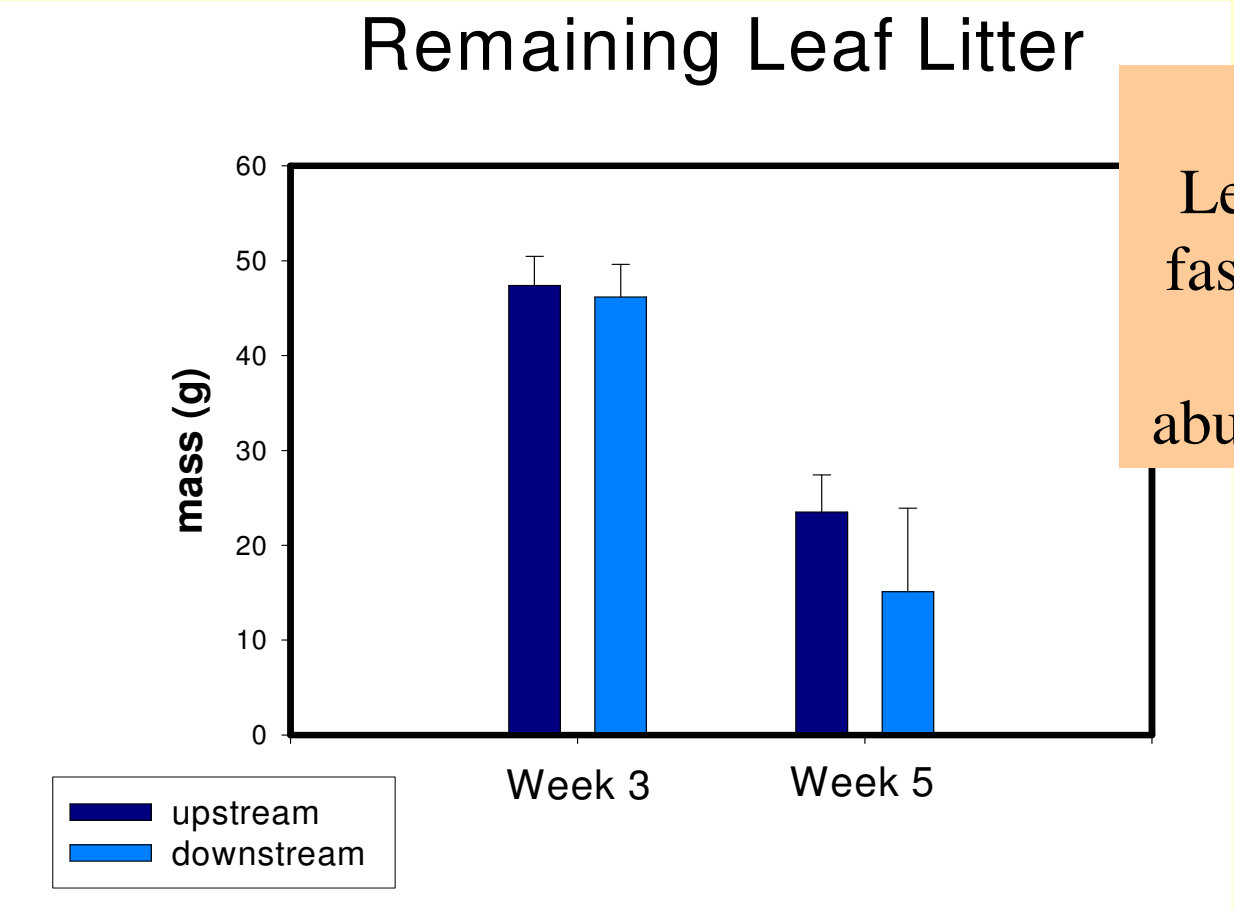
Dace prefer to eat smaller amphipods

Average amphipod size is larger in dace-populated areas

Mosquitofish also prefer smaller amphipods

Amphipod weight in streams and mosquitofish preferences





Hypothesis:
Leaf litter decomposes faster upstream because of the higher abundance of amphipods

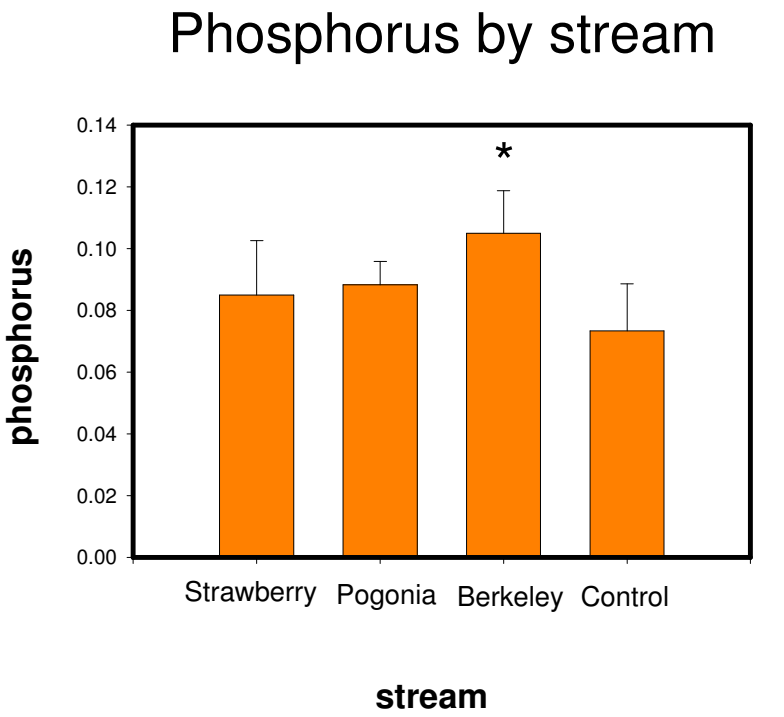
Leaf litter actually broke down Faster in the presence of fish.

However, these results have Insignificant P values.

Why such unexpected results?

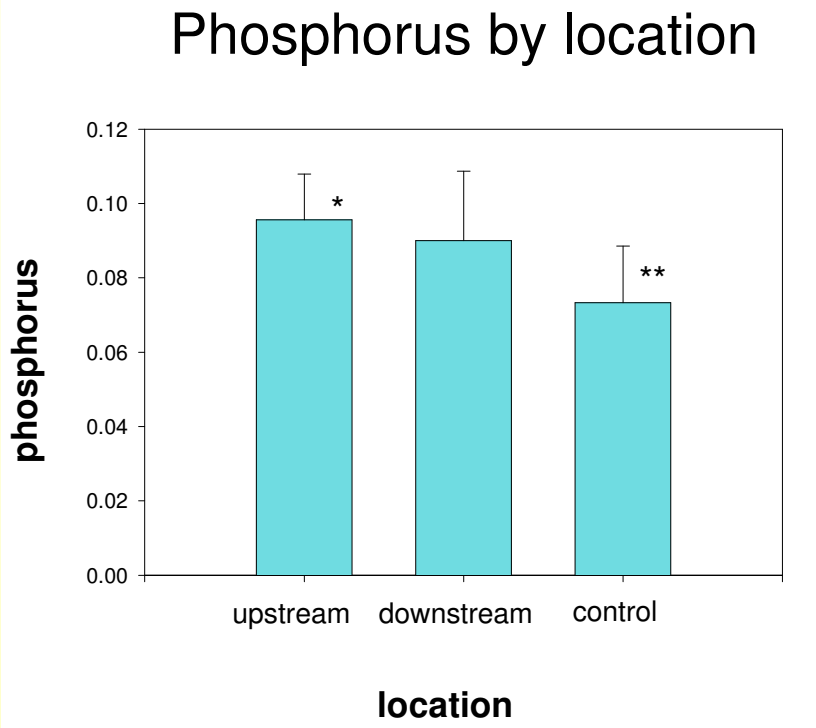
- Litter bags became turned around at Strawberry Creek, causing the contents of 2 of the bags to empty
- It is probable that other bags that weren't tied tightly enough also leaked
- Differences in turbidity
- Different ecosystems
- Leaf litter decomposition depends on dissolved oxygen, the availability of other food sources, etc. (Schlosser and Ebel 1989).

Elemental Analysis



Higher levels of phosphorus were found upstream compared to downstream

Higher levels of phosphorus were found in the Berkeley leaf litter



Future Studies

- Ensure that all leaf litter bags are securely closed!
- Reduce the number of variables in the stream
  - only variable should be the presence of fish
- Determine correlation between amphipods and leaf litter decomposition

Conclusions

- Dace and Mosquitofish preferentially feed on small amphipods
- The average amphipod size is larger in areas that contain fish
- Areas that contain fish contain a significantly lower number of amphipods
- Further studies need to be conducted with leaf litter decomposition