

# Describing Invertebrate Diversity Across Wetland Habitat Types

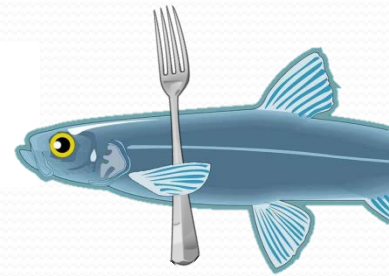
Development of recommendations for monitoring fish food  
resources in tidal wetland restoration sites



Rosemary Hartman, Alison Furler, and Bonnie Wang,  
California Department of Fish and Wildlife  
Fish Restoration Program

# Restoring wetland for listed fish

- Fish Restoration Program to restore 8,000 acres
- Produce fish food
- Zooplankton and macroinvertebrates
- But how do you prove it?



# Research Questions

- How do you quantify fish food production in vegetated wetlands?
- Is food different in different habitats?
- Is food different in different regions?



# Sampler types

## Leaf Pack



- Dried *Schoenoplectus* stems in a mesh bag
- Left tethered in wetland 4-6 weeks

## Sweep net/ Dip net



- 5, one-meter sweeps with 500 micron mesh net
- Scraped sides of tules
- Collected any SAV and FAV broken off in net

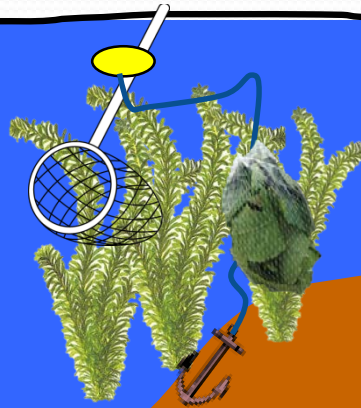
# Habitat types

## Rip-rapped channel bank



- Sweep net
- Leaf pack

## Submerged Vegetation (SAV) (*Egeria densa*)



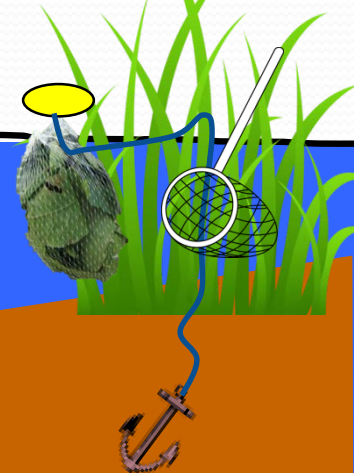
- Sweep net
- Leaf pack

## Floating vegetation (FAV) (*Eichhornia crassipes*)



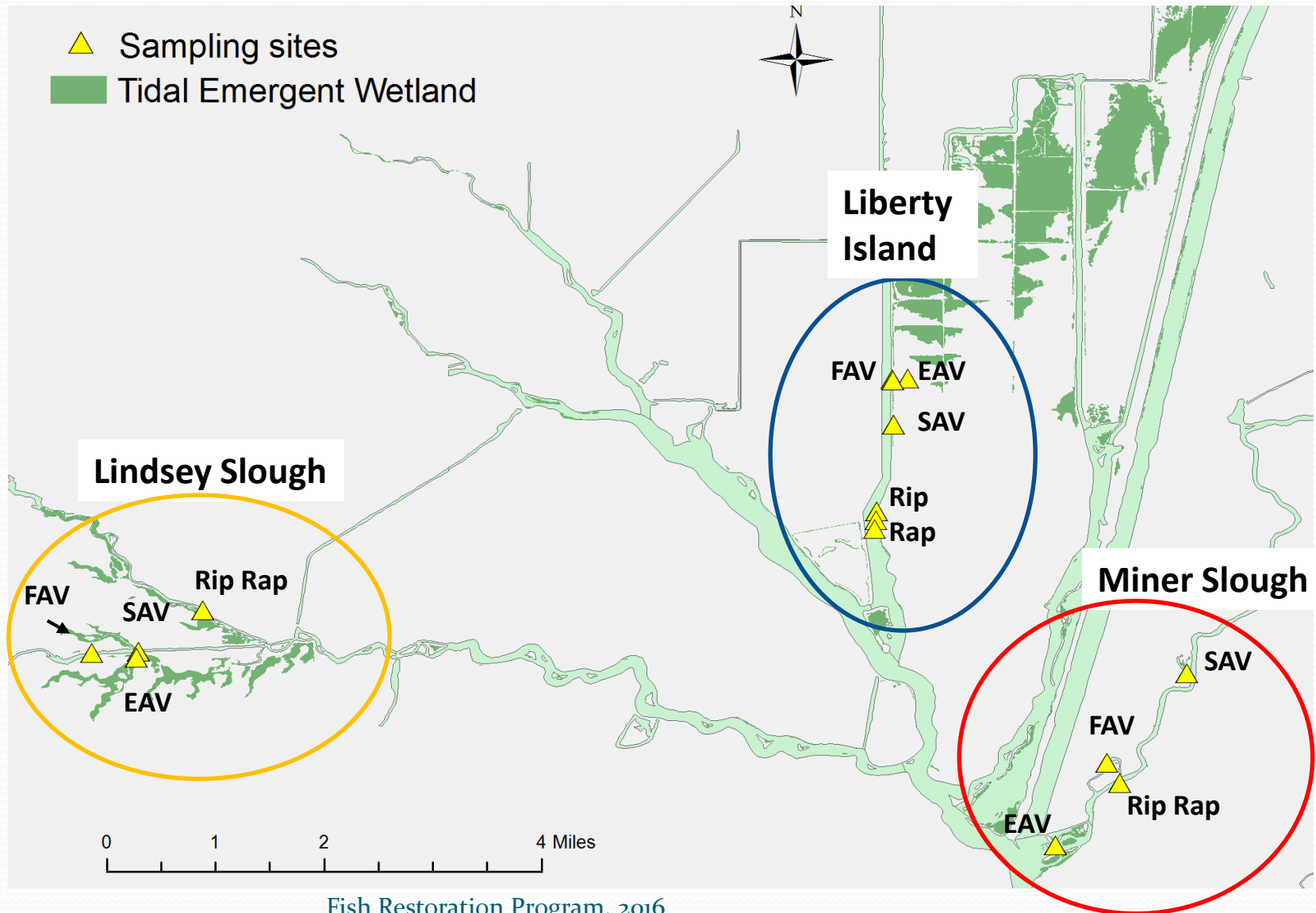
- Sweep net
- Leaf pack

## Emergent vegetation (EAV) (*Schoenoplectus* spp)



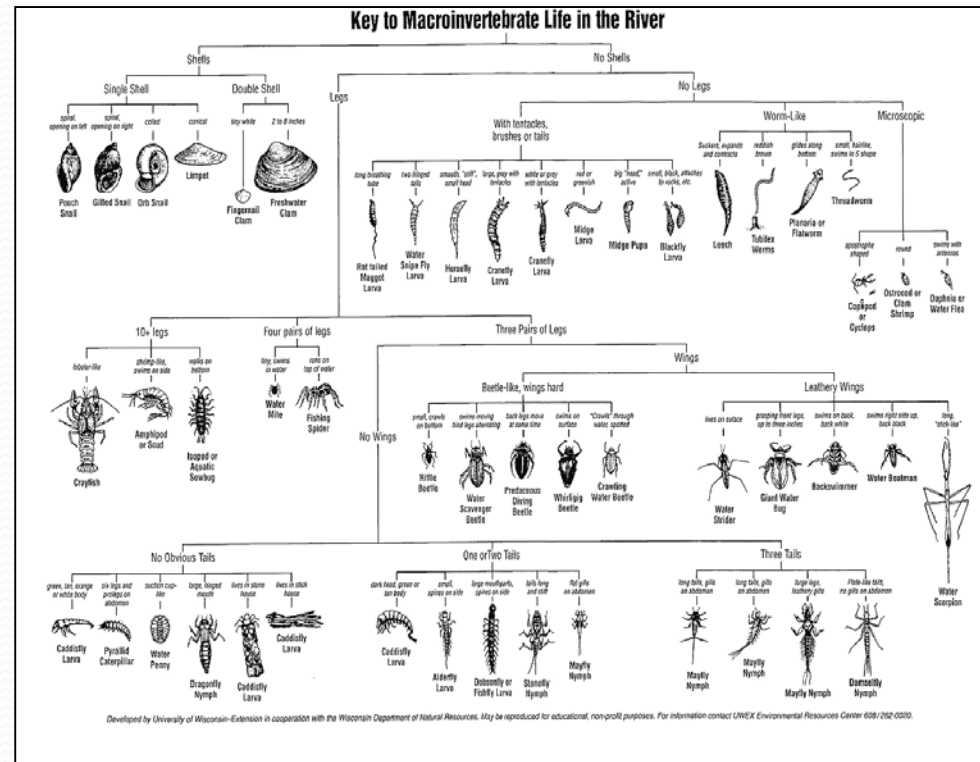
- Sweep net
- Leaf packs

# Sampling areas



# Analysis

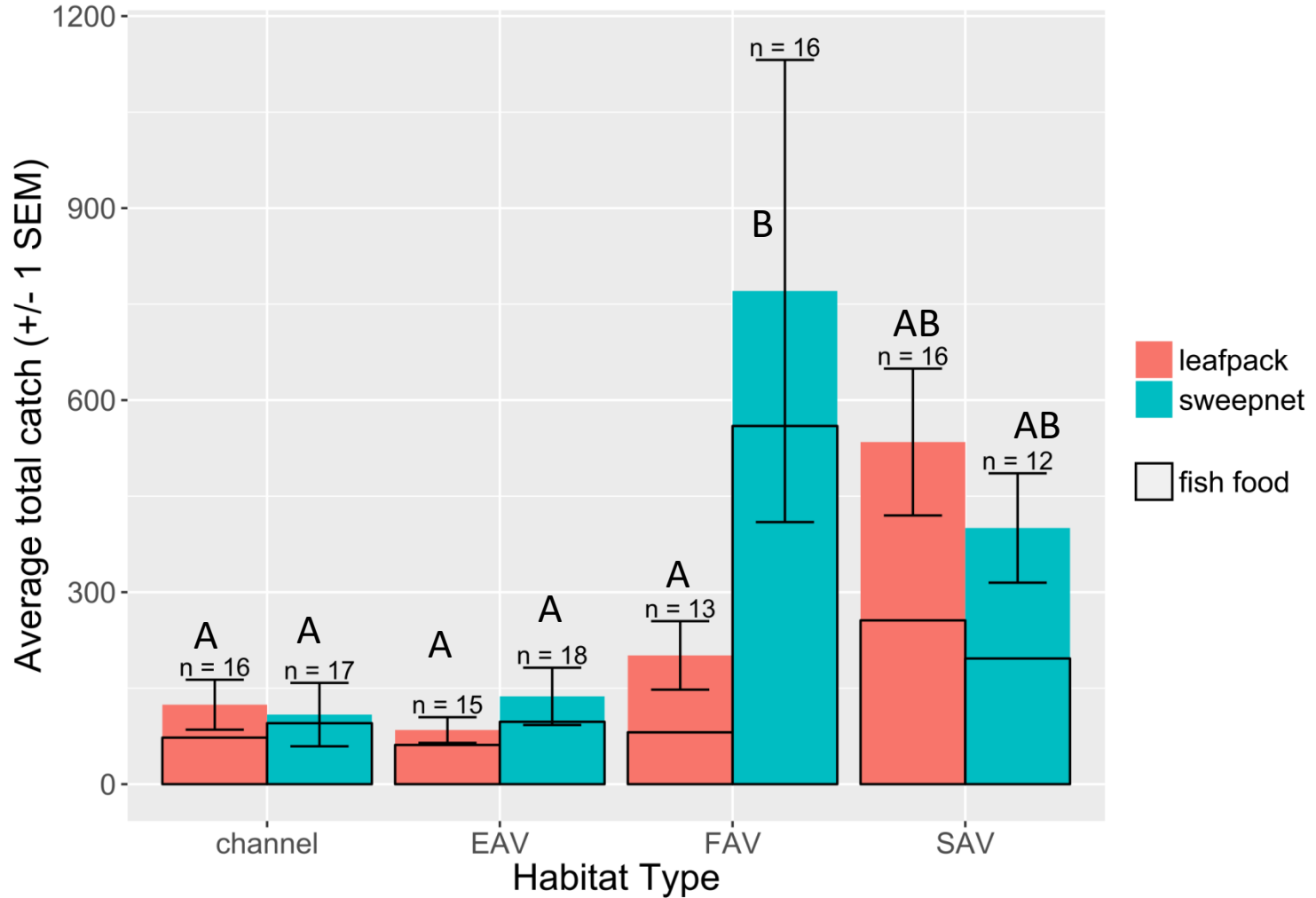
- Sort to lowest appropriate taxonomic level
- Compare total catch and richness with GLMM
- Compare community composition with PERMANOVA



# Total Catch

Best model:

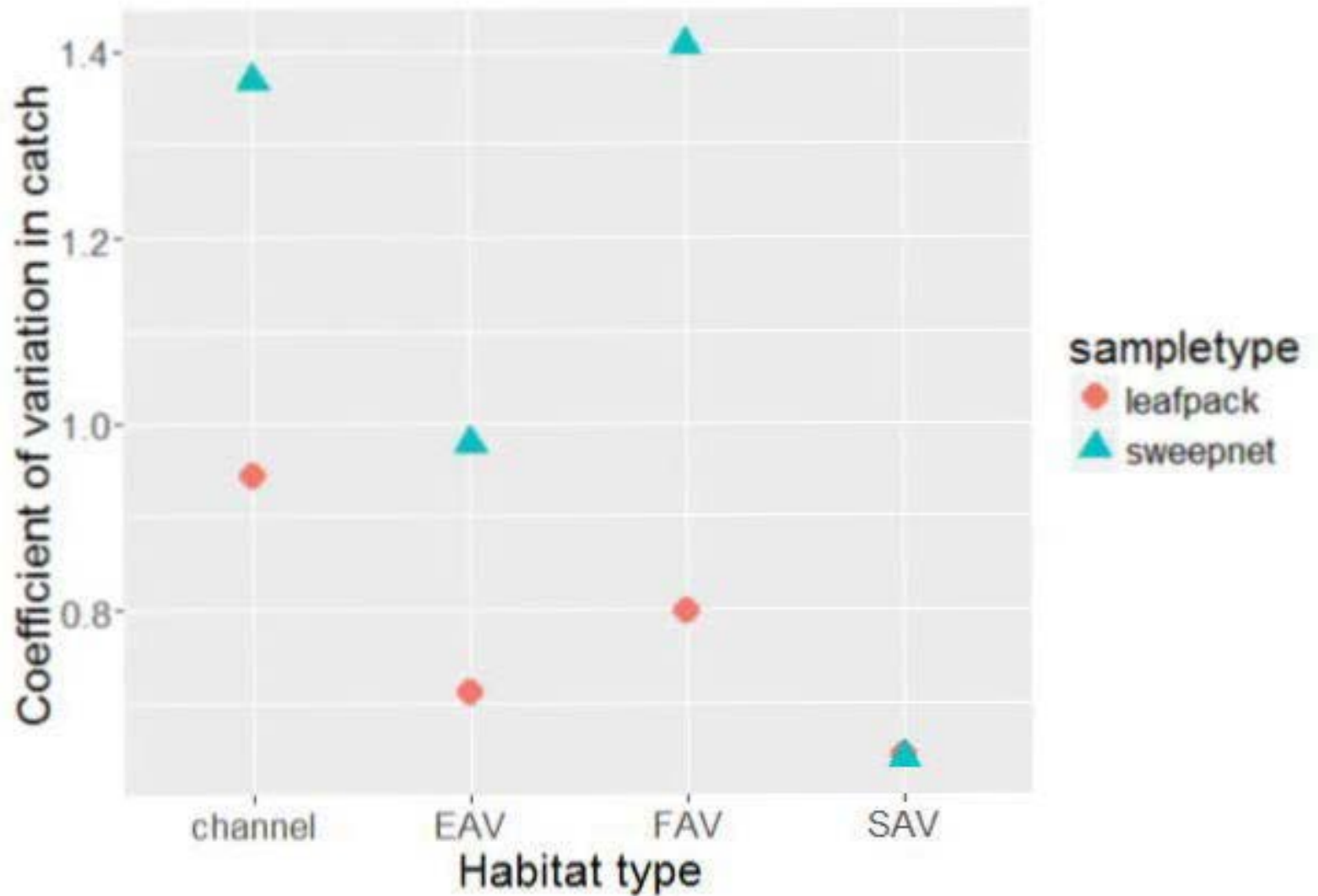
Catch  $\sim$  Sampletype\*Habitat + Region + E(station)



Letters denote groups that are significantly different at the  $p < 0.05$  level.



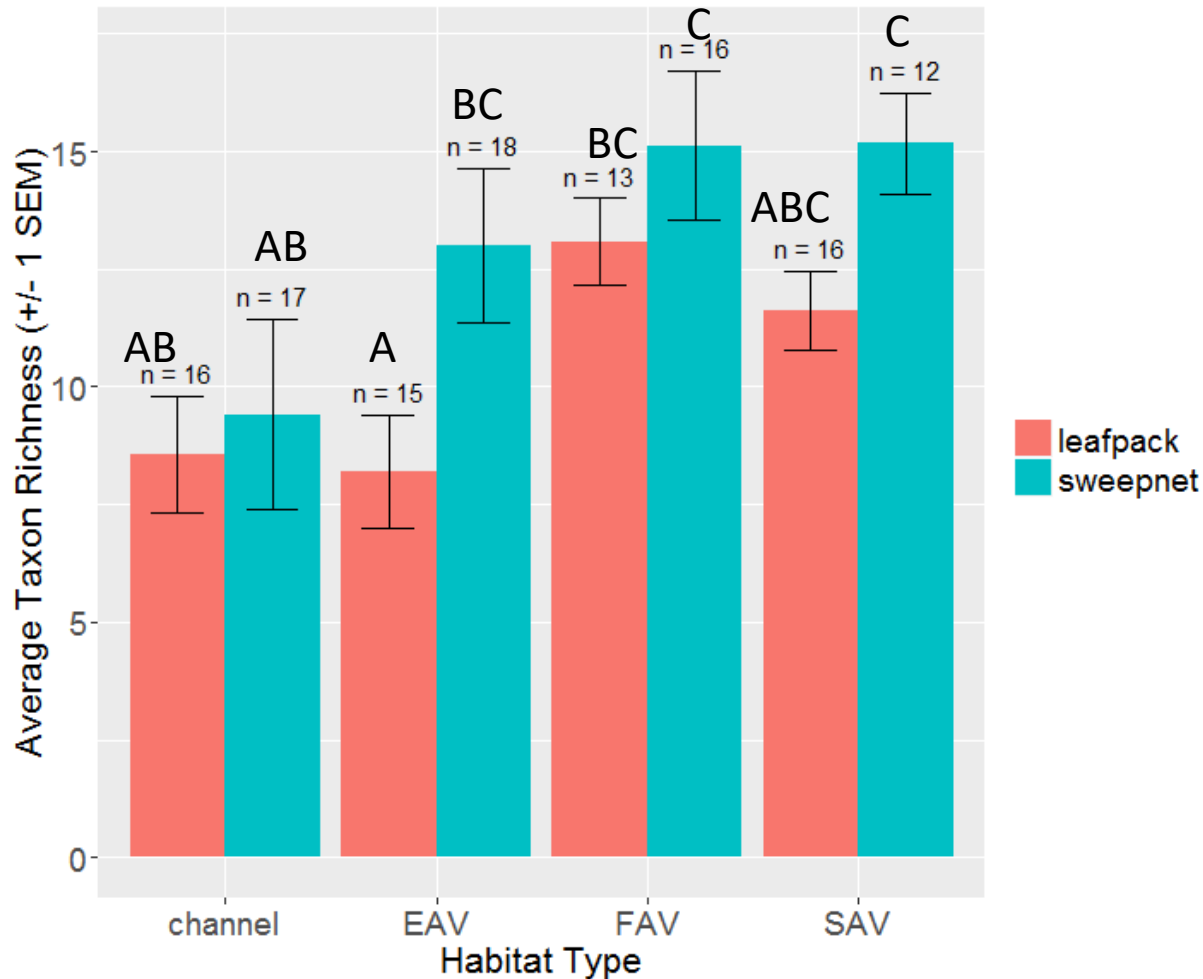
# Variability



# Taxon Richness

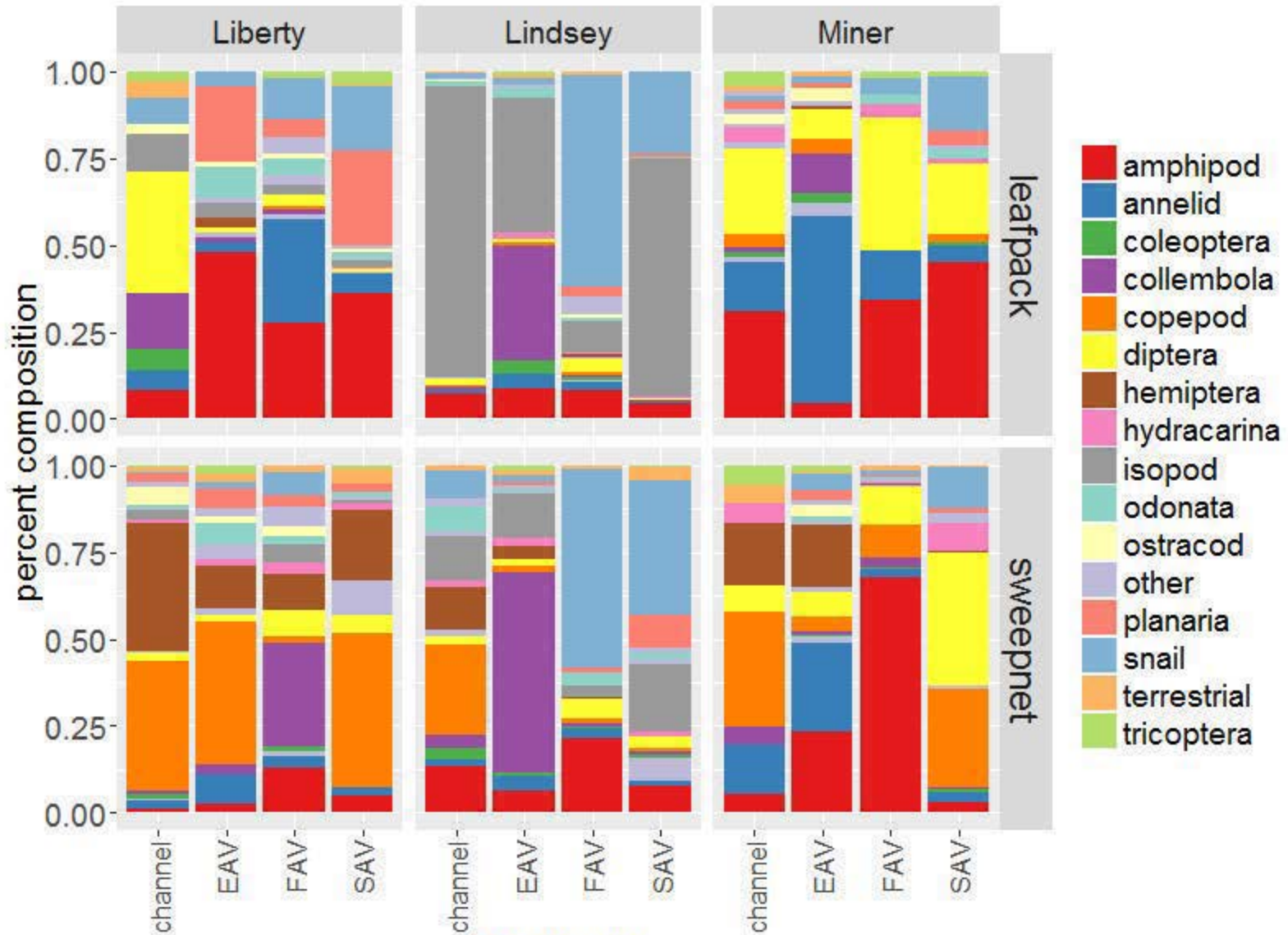
Best model:

Richness  $\sim$  Samplotype + Habitat + E(station)

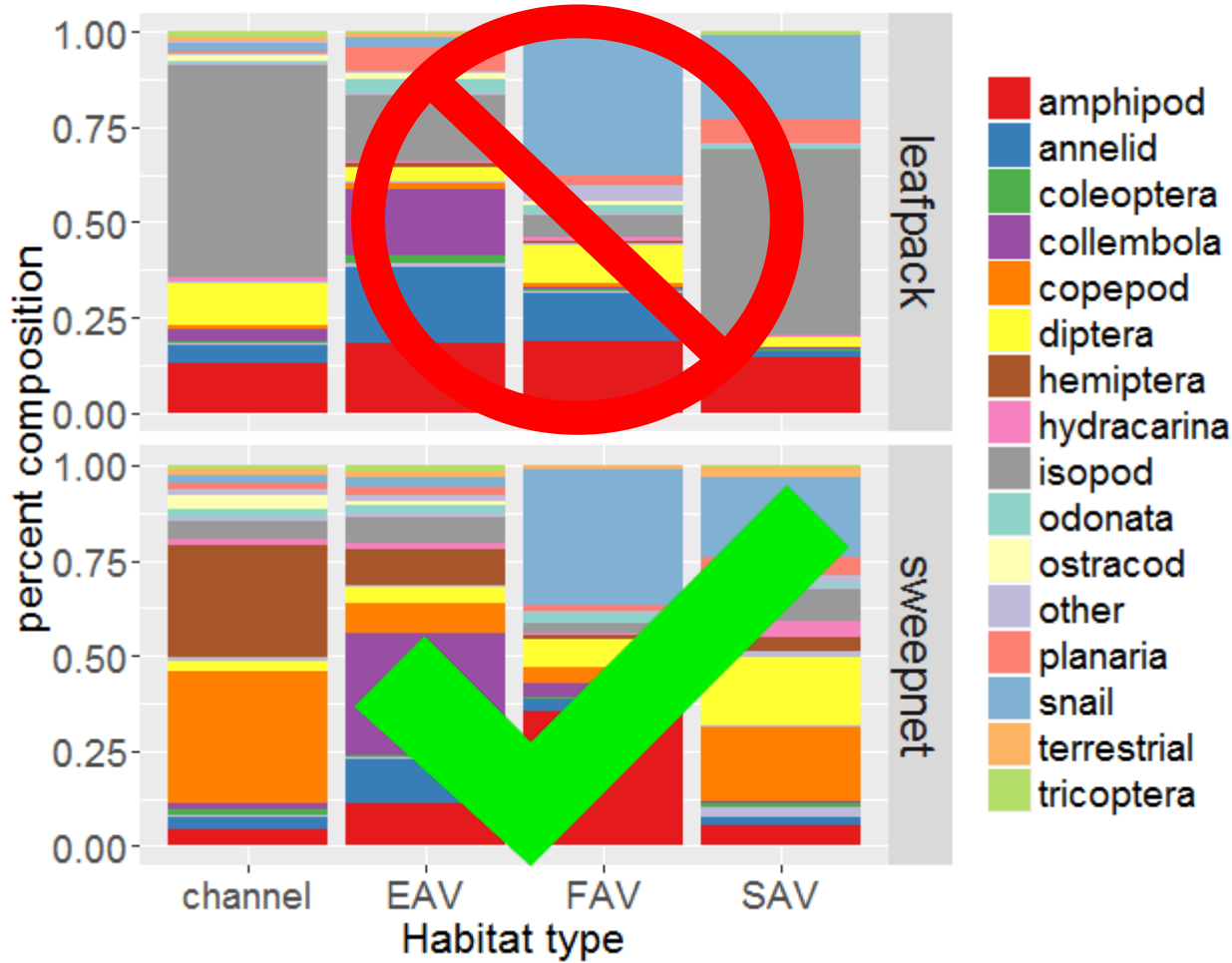


Letters denote groups that are significantly different at the p < 0.05 level.

# Community Composition



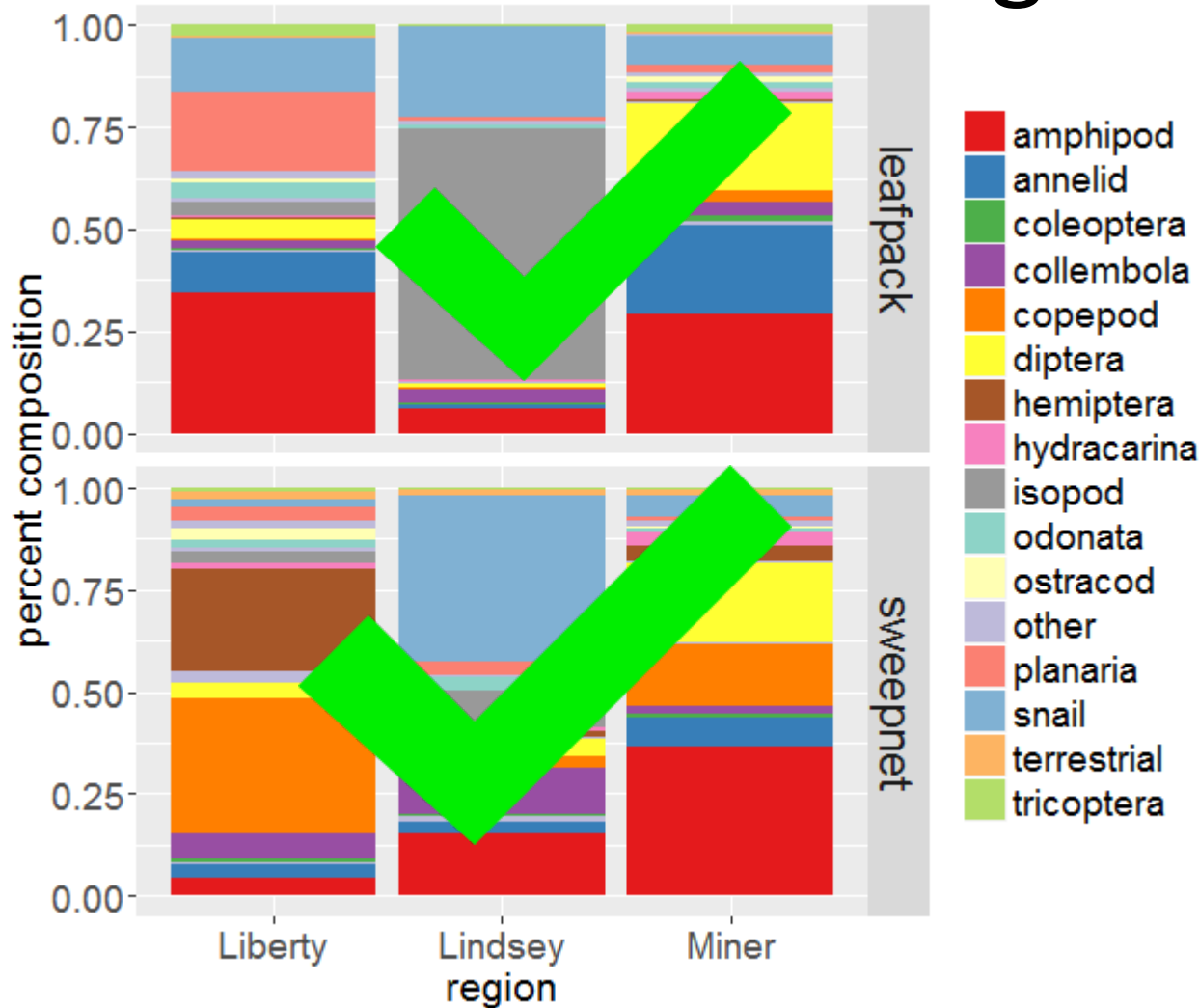
# Different Habitats



PERMANOVA results:  
 $F = 1.56$ ,  $P = 0.115$ ,  
 $R^2 = 0.153$

PERMANOVA results:  
 $F = 3.125$ ,  $P = 0.004$ ,  
 $R^2 = 280$

# Different Regions



PERMANOVA results:  
 $F = 4.47$ ,  $P = 0.001$ ,  
 $R^2 = 0.292$

PERMANOVA results:  
 $F = 3.532$ ,  $P = 0.002$ ,  
 $R^2 = 0.211$

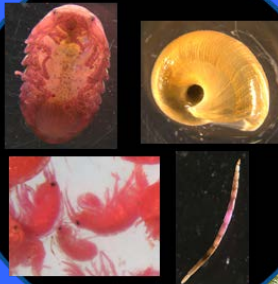
# What's for dinner?

## Rip-rapped channel bank



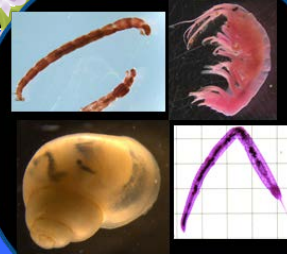
- Copepods
- Hemiptera
- Diptera
- Isopoda

## Submerged vegetation (*Egeria densa*)



- Snails
- Amphipods
- Isopods
- Diptera

## Floating vegetation (*Eichhornia crassipes*)



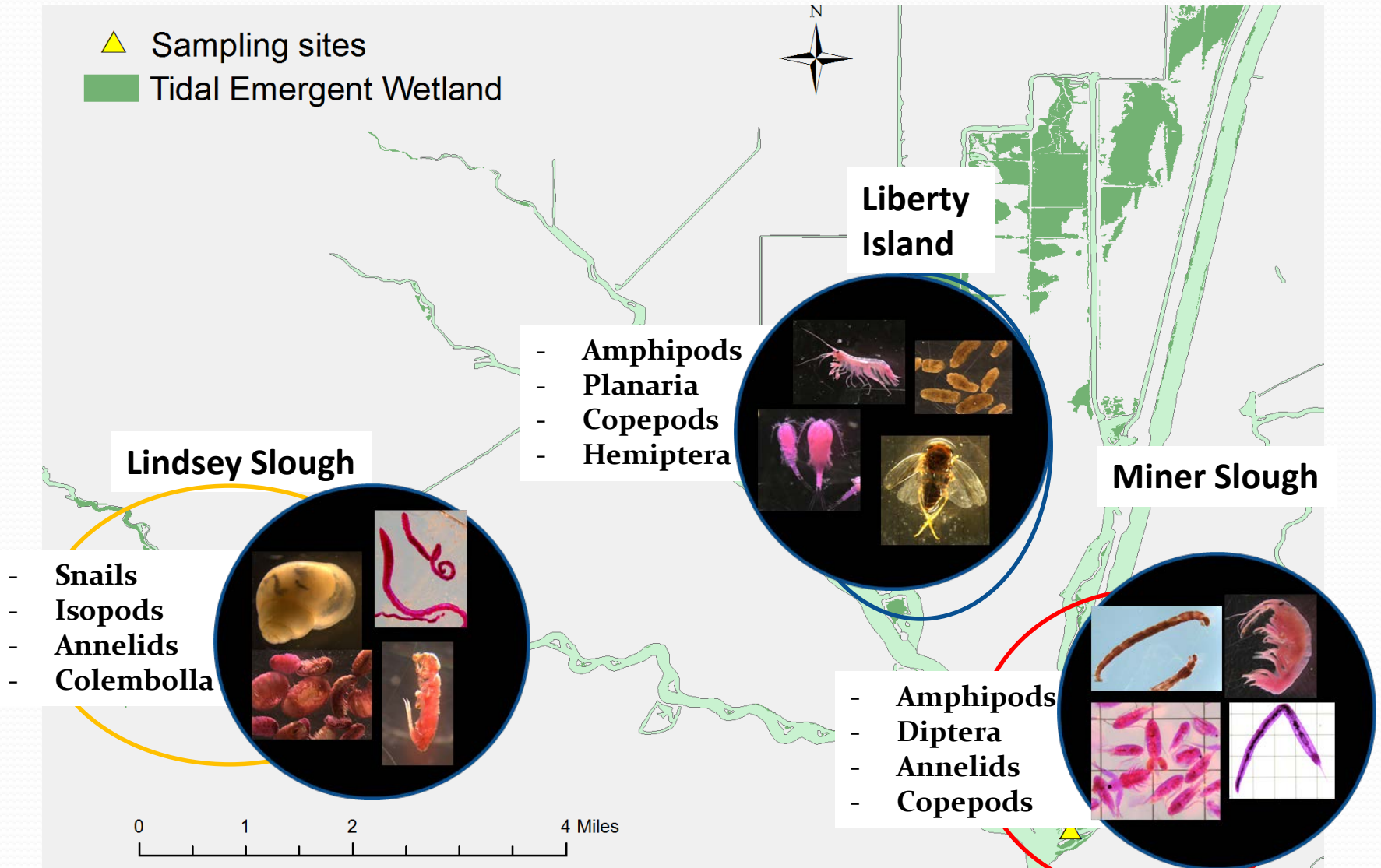
- Snails
- Amphipods
- Annelids
- Diptera

## Emergent vegetation (*Schoenoplectus* spp)



- Amphipods
- Annelids
- Colembolla
- Isopods

# What's for dinner?



# Something different for everyone!





# Which works better?

## Sweep net/ Dip net



- + Higher species richness
- + Differentiates habitats and regions
- + Fast
- + Captures mobile and sedentary invertebrates
- Higher variability
- May catch fish
- Difficult to use in tules

## Leaf Pack



- + Differentiates regions
- + Lower variability
- + No fish catch
- Does not differentiate between habitats
- Needs 4-6 weeks in the marsh
- May be lost
- Does not capture mobile invertebrates

Both have their uses.

Sweep net/ Dip net



Leaf Pack



# Acknowledgements

- Stacy Sherman, Dave Contreras, Jared Mauldin, and Matt Siepert for field help.
- Alison Furler, Bonnie Wang, Ryan Kok, Kyle Griffiths, and the Bay Study for help processing samples.
- Fish Restoration Program & our partners at DWR for funding.
- IEP Tidal Wetlands Monitoring Project Workteam for study advice.
- Wayne Fields, Erin Marineau, Sharon Lawler, and the Stockton CFDW lab for providing help with identifications

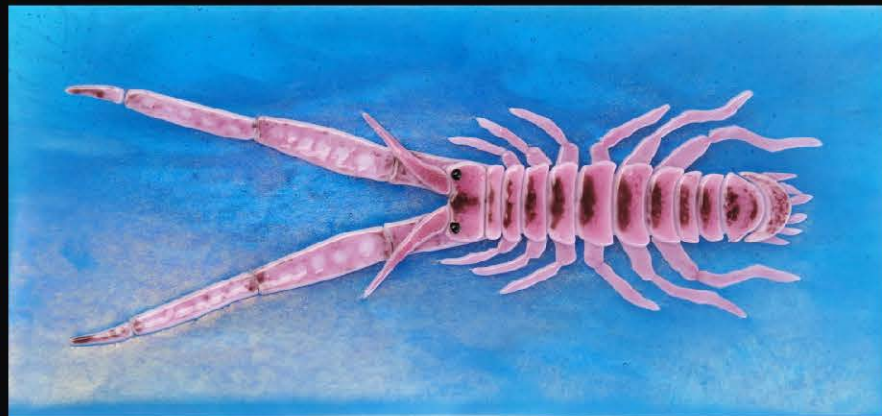
# Questions?



**Corophium**, by Rosemary Hartman  
Stained Glass



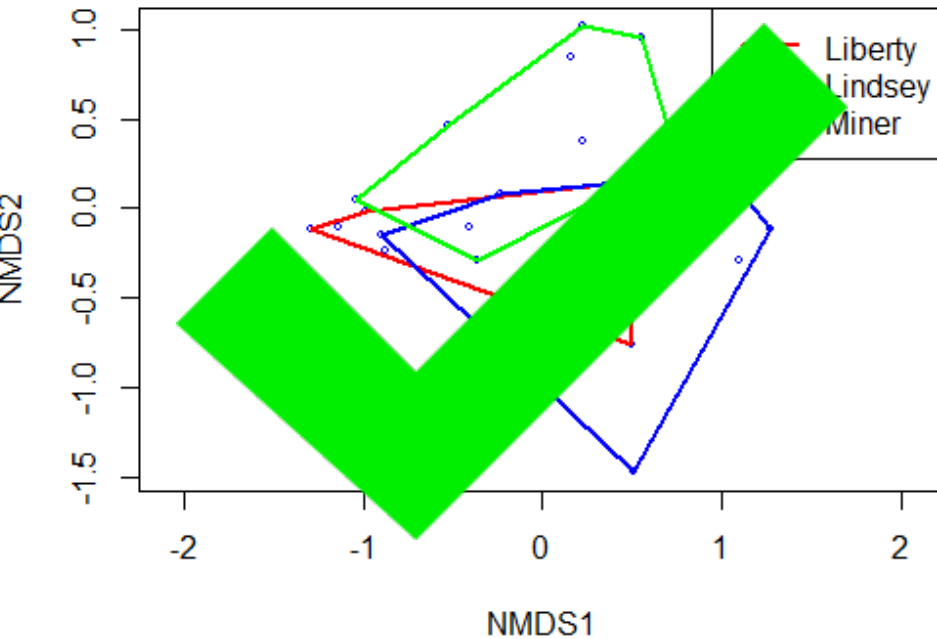
**Corophium**, by Alison Furler  
Photomicrograph



**Corophium**, by Jane Hartman  
Fused Glass

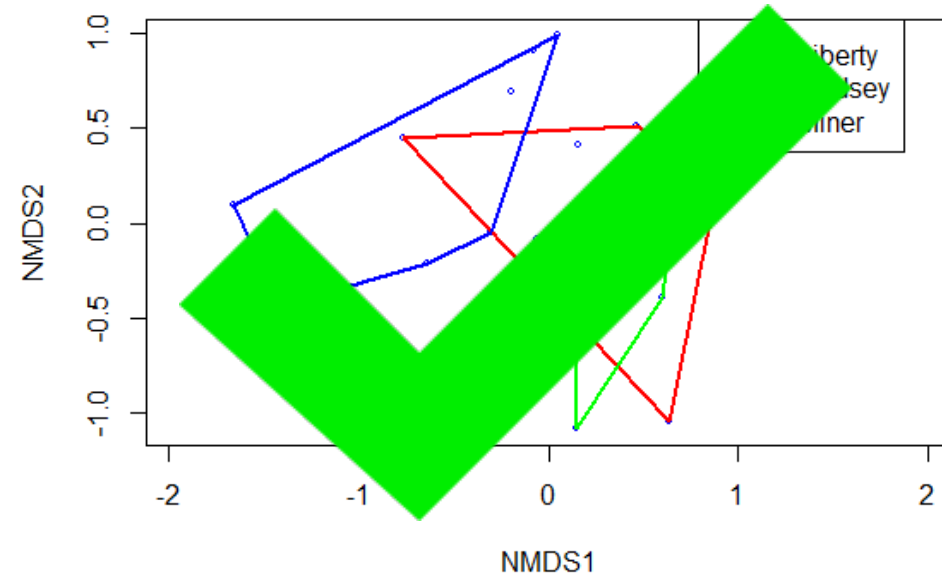
# Differences between regions

NMDS of sweepnet data by region



PERMANOVA results:  
F = 3.532, P = 0.002,  
R2 = 0.211

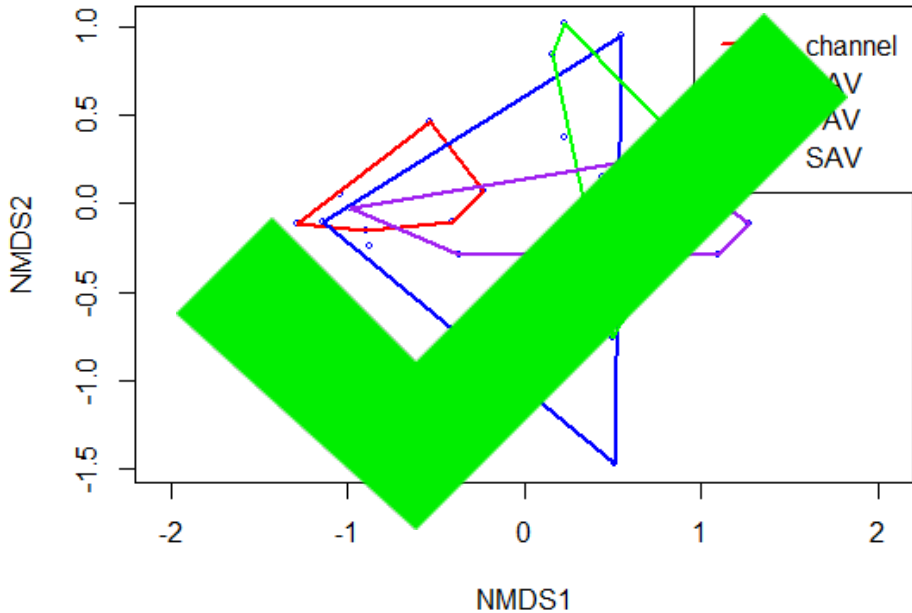
NMDS of leaf pack data by region



PERMANOVA results:  
F = 4.47, P = 0.001,  
R2 = 0.292

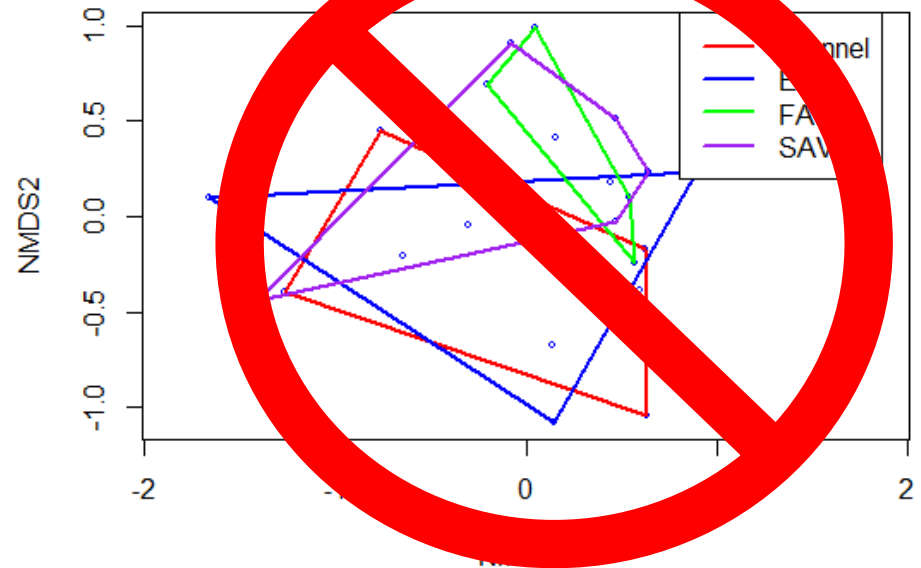
# Differences between habitat types

NMDS of sweepnet data by habitat type



PERMANOVA results:  
 $F = 3.125$ ,  $P = 0.004$ ,  
 $R^2 = 0.280$

NMDS of leaf data by habitat type



PERMANOVA results:  
 $F = 1.56$ ,  $P = 0.115$ ,  
 $R^2 = 0.153$

# Sampling areas

