# INTERTIDAL AQUACULTURE AS HABITAT IN PACIFIC NORTHWEST COASTAL ESTUARIES: CONSIDERING SCALE

Brett Dumbauld – USDA Agricultural Research Service

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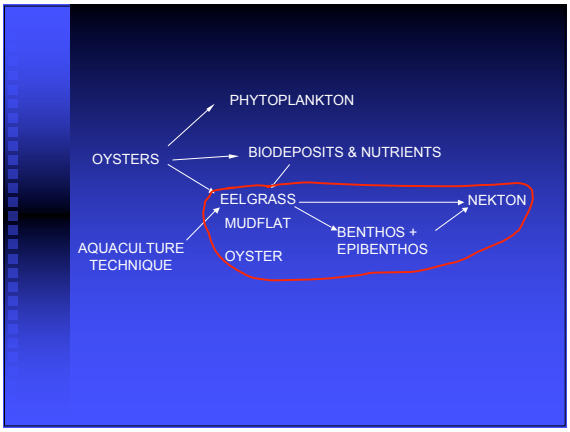
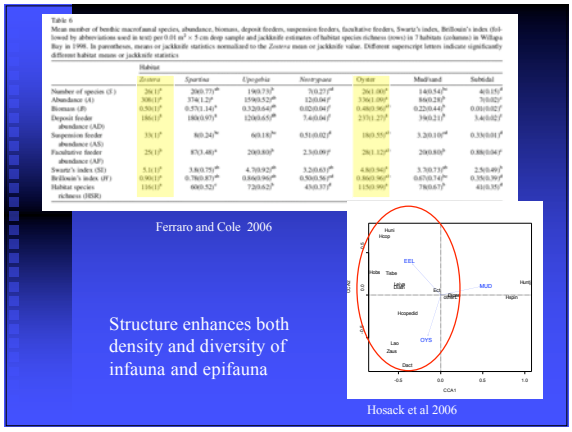
## Context

Most US West Coast open coast estuaries have:

- Broad intertidal flats
  - Willapa Bay 53% = 63.7 km$^2$
  - Yaquina Bay 35% = 6 km$^2$
  - Coos Bay = 48% = 18 km$^2$
  - Humboldt Bay 45% = 28 km$^2$
- Small area relative to the coastline, small riverine influx, large tidal influence, strong winds can influence a shallow and therefore well mixed water column and substrate
  - Biology greatly influenced by nearshore coastal ocean and strong winds over shallow tidal flats

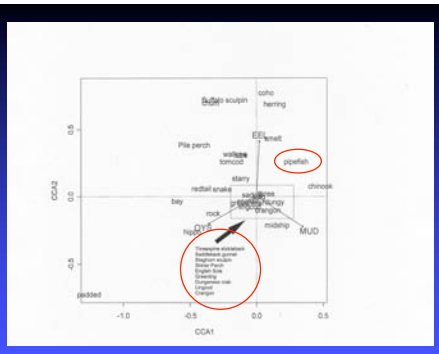


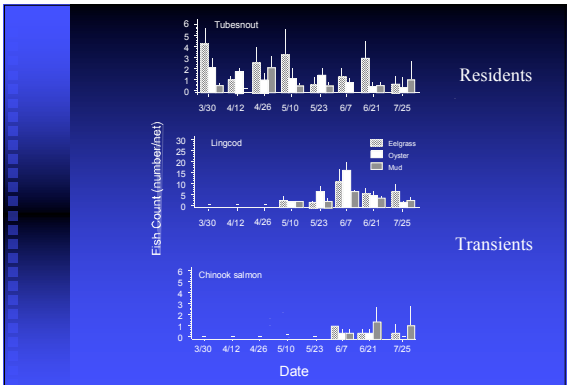



Ferraro and Cole 2006

Structure enhances both density and diversity of infauna and epifauna

Hosack et al 2006



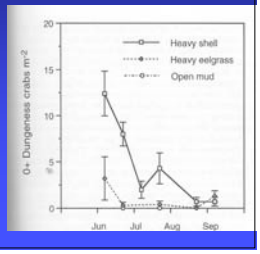




Dungeness crab

1+ crab

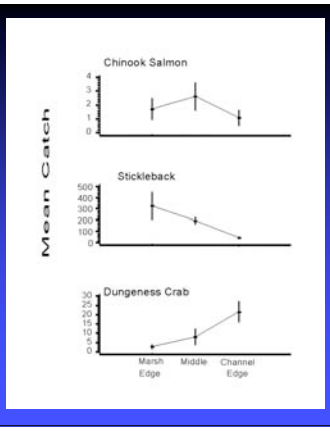
Life History Stage Important

0+ crab

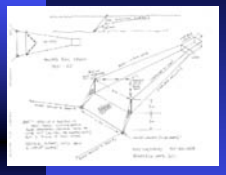


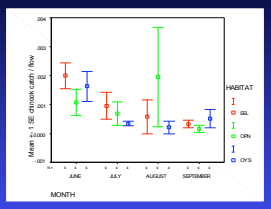

Doty et al. 1990

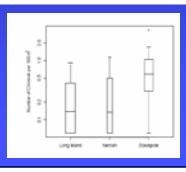
Spatial gradients due to tidal elevation and location in the estuary are important




## Juvenile Salmon





## EFFECTS OF OYSTERS AND EELGRASS ON BENTHOS, FISH AND INVERTEBRATES

- Both oysters and eelgrass provide structure and habitat, particularly for small benthic invertebrates
- Habitat use by large mobile invertebrates and fish depends on species and life history stage
- There are likely regional differences. West coast estuarine fish assemblages are less diverse than larger east coast counterparts. Coastal estuaries have broad intertidal flats and fish use of intertidal habitats with steeper gradients in fjord systems with nearby subtidal is also likely different.

OK! Patterns at this local scale are apparent, but do they scale up and how should the information be used?

What's the goal?

- Policy goal is that eelgrass has been shown to provide estuarine habitat for numerous species and therefore is protected under federal statute (Clean Water Act Section 404, ACOE, and EFH-ESA, NMFS and USFWS) as well as individual state statutes and no-net loss policies. Preserve it! But what about oysters as habitat?
- Conservation goal – preserve biodiversity, ecological processes
- Managers goal – maintain individual species or stock abundance
- Aquaculture goal – sustainable shellfish harvest

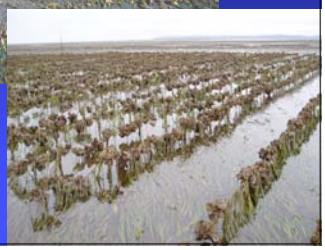
How are these goals applied?

Policy = No net loss of aquatic vegetation

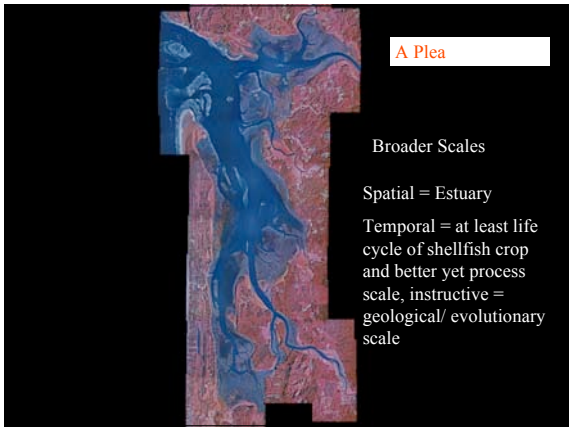
Applied case by case at a relatively small = bed scale. The new nationwide federal permit sets some conservative levels for case by case consideration (e.g. 10 acres of project area occupied by vegetation, no dredge harvest in areas where SAV is present)

No

Yes



Not that simple!

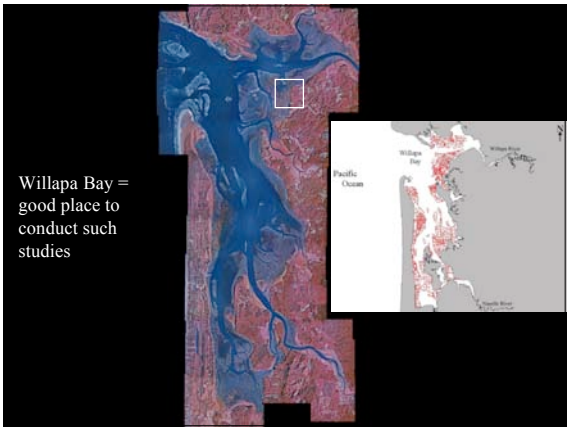


A Plea

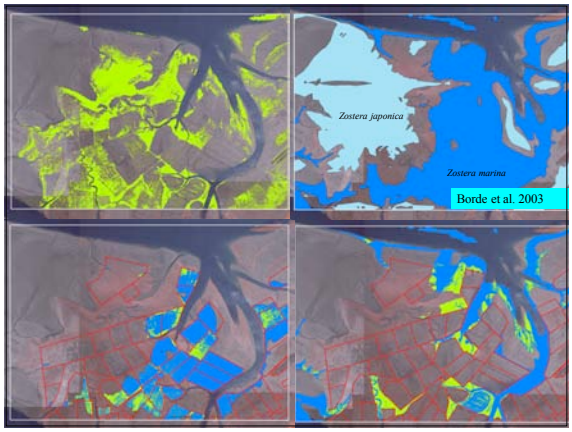
Broader Scales

Spatial = Estuary

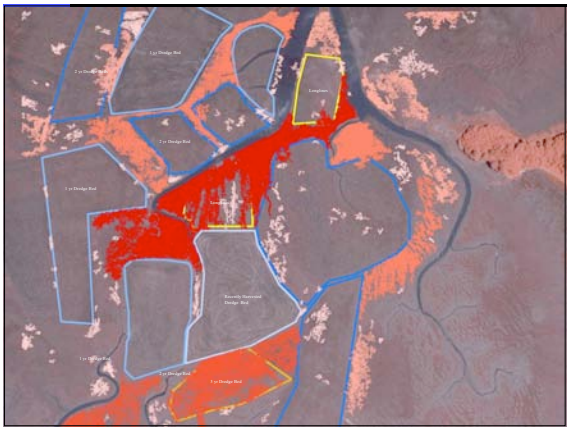
Temporal = at least life cycle of shellfish crop and better yet process scale, instructive = geological/ evolutionary scale



Willapa Bay = good place to conduct such studies


- 79.7 acres of *Zostera spp*. of 355 predicted acres within aquaculture = 24%
- 109 acres of *Zostera spp*. of 486 predicted acres outside aquaculture = 22%

## Landscape Ecology, Habitat Stucture and BMP's

- Are eelgrass corridors important? If so does fragmentation of these areas via aquaculture matter?
- Are eelgrass meadows important? If so does fragmentation of these areas via aquaculture matter?
- Are shrimp beds important? If so does fragmentation of these areas via aquaculture matter?
- If significant effects are demonstrated then buffers added and/or even spatial location of beds reconsidered, but temporal scaling might also suggest modifications to timing of farming practices