

# PRELIMINARY RESULTS FROM THE LOWER COLUMBIA RIVER AQUATIC NONINDIGENOUS SPECIES SURVEY LCRANS 2001-2003



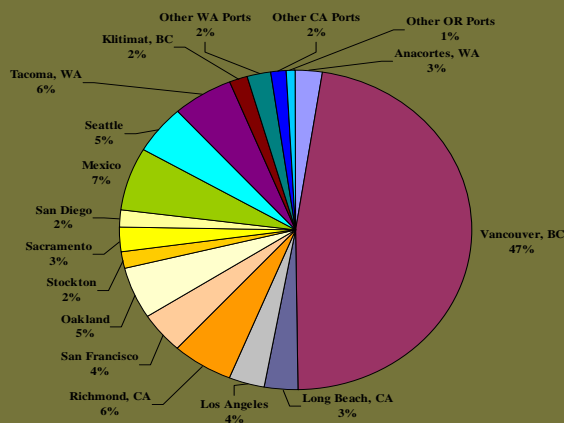
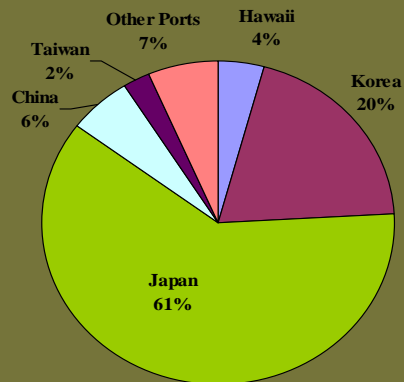
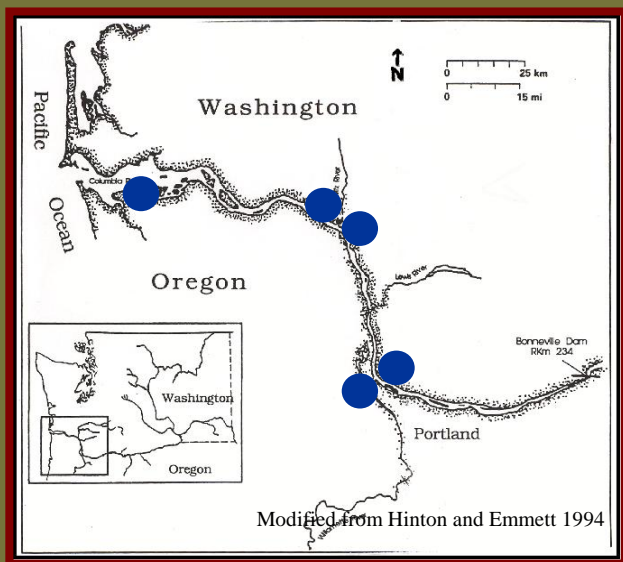
Robyn Draheim Waldeck – Portland State University

Mark Sytsma – Portland State University

Jeff Cordell – University of Washington

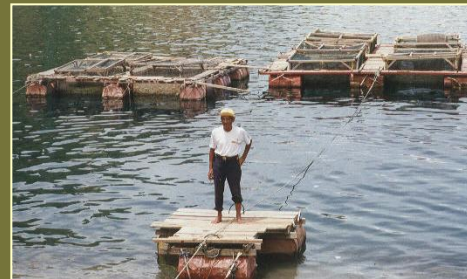
John Chapman – Oregon State University

# Shipping and Ballast Water in the Lower Columbia River



# Other Invasion Mechanisms

- Aquarium Trade
- Aquatic Plant/Pond Trade
- Live Seafood
- Aquaculture
- Fishing and Recreation
- Secondary Dispersal
- Shipping (non-ballast)



# LCRANS Objectives:

Characterizing non-native species in the lower Columbia River will provide a baseline for:

- Calculating the rates and types of species introductions to the river,
- Evaluating the efficacy of ballast water regulations,
- Contributing new information to ongoing regional ANS studies



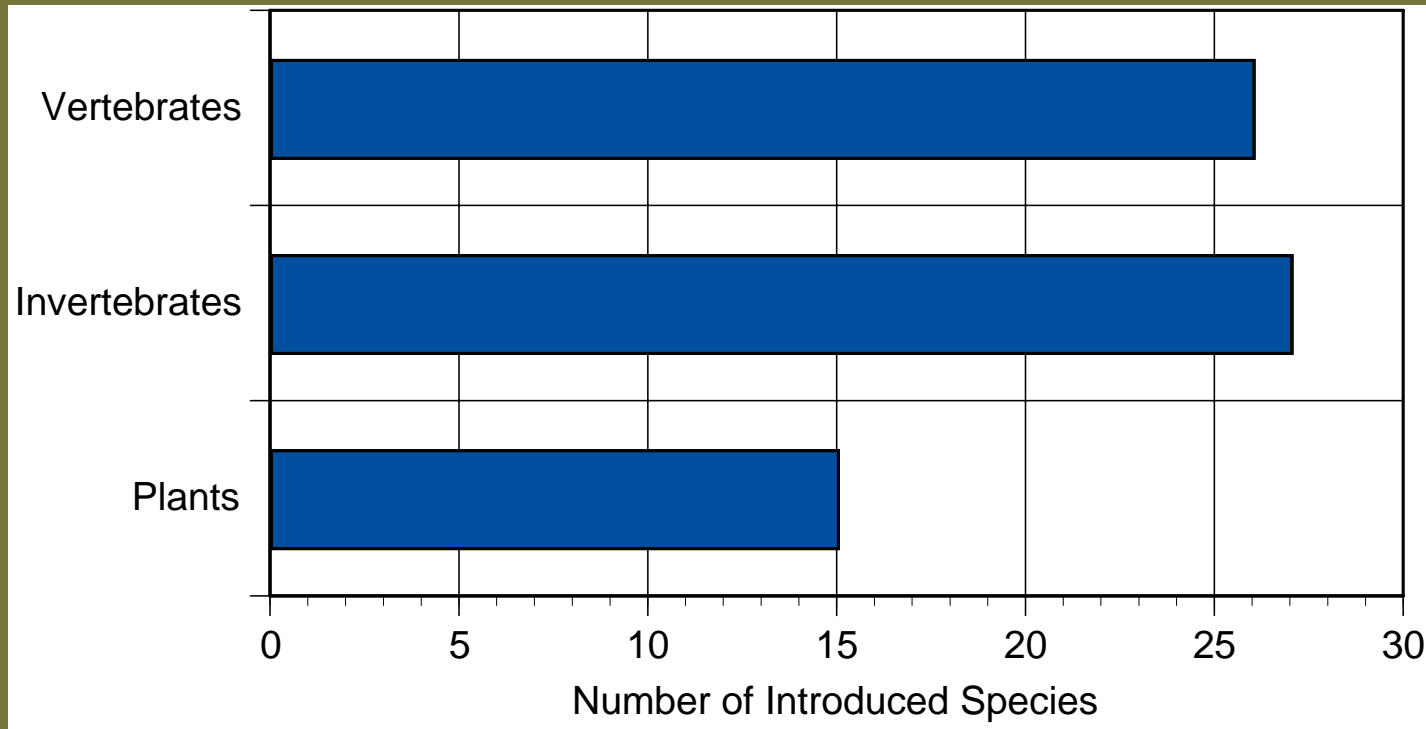
# LCRANS cont.

- Literature Review
- Technical Advisory Committee
- Field Surveys 2002, 2003
- Final Report
- Research Recommendations

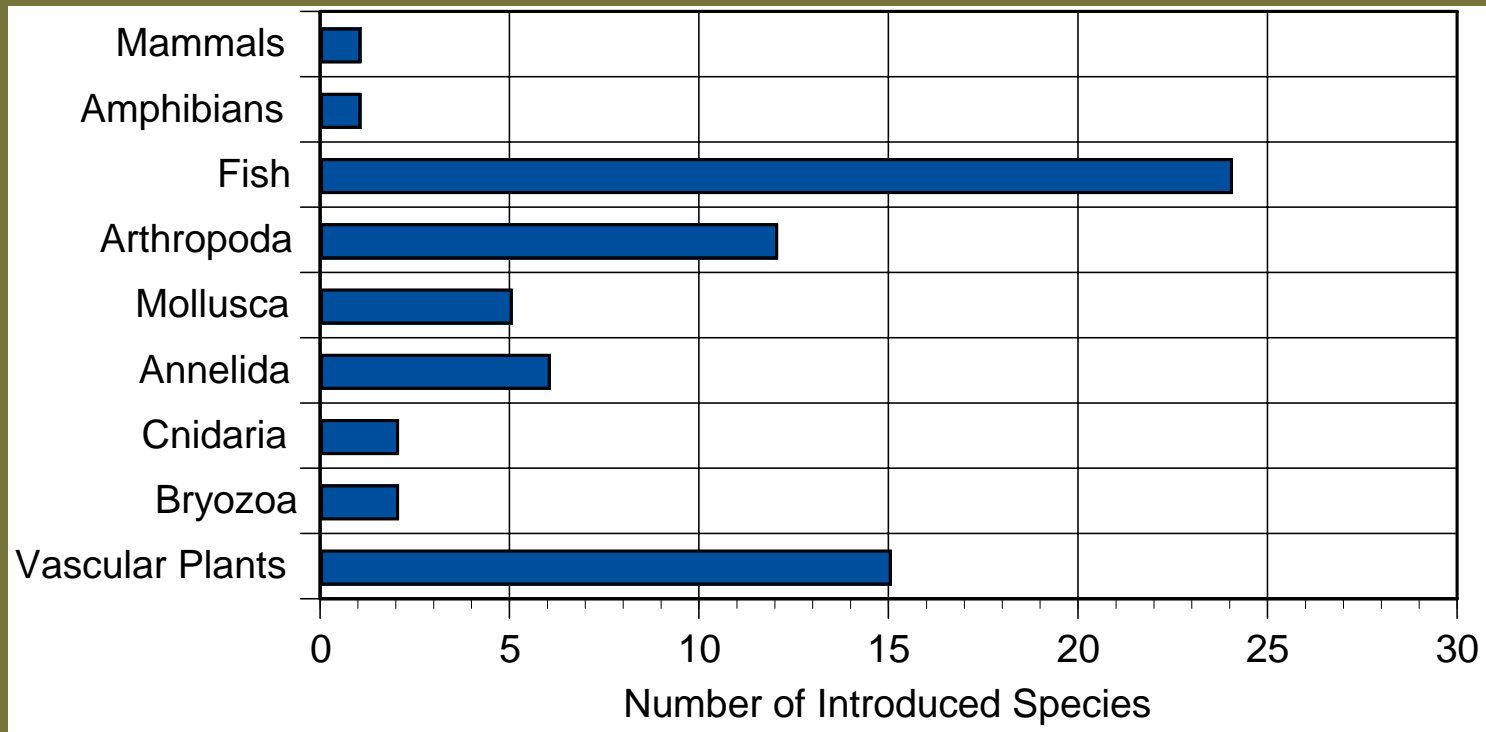
# LCRANS: Literature Review

- Nonnative fishes and plants are well documented
  - 27% of fishes are non-native
  - 15% of aquatic plants are non-native
- Little or no information on other taxa
- Impacts of ANS poorly documented
  - Ex: *Corbicula fluminea* – Asian clam

# LCRANS: Invasions by Taxa

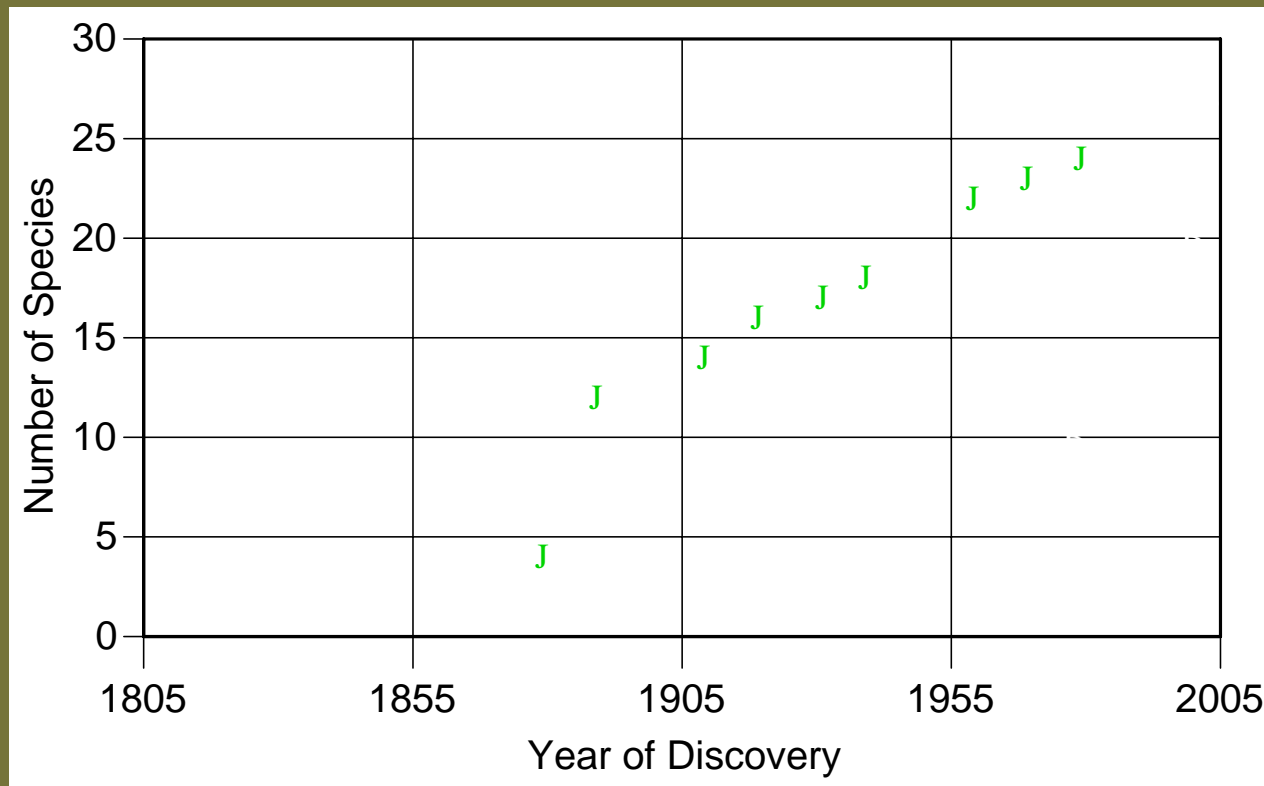


# LCRANS: Invasions by Taxa

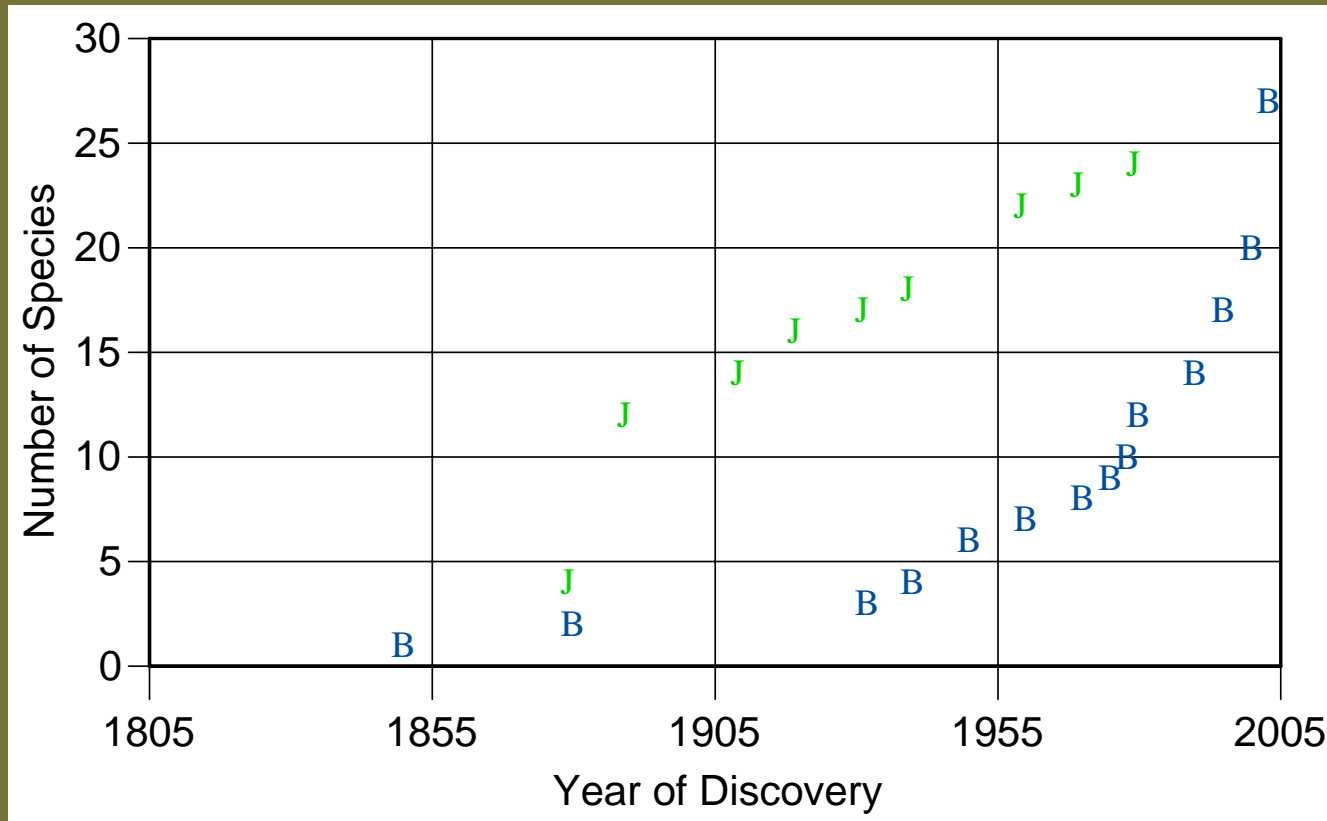


Invasions by minor taxonomic groups

# LCRANS: Fish Introductions

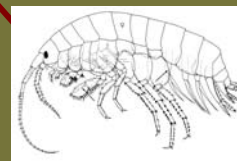
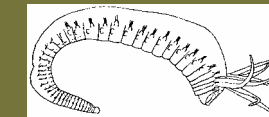
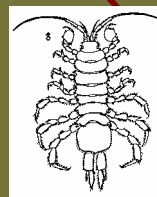
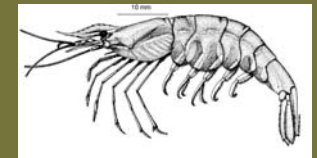
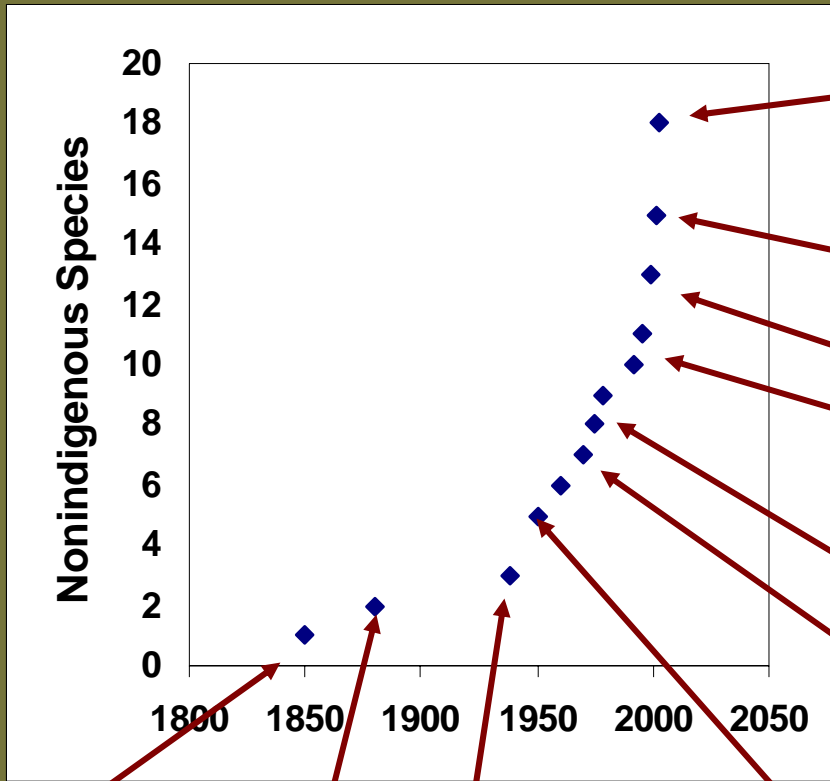


# LCRANS: Species Accumulation

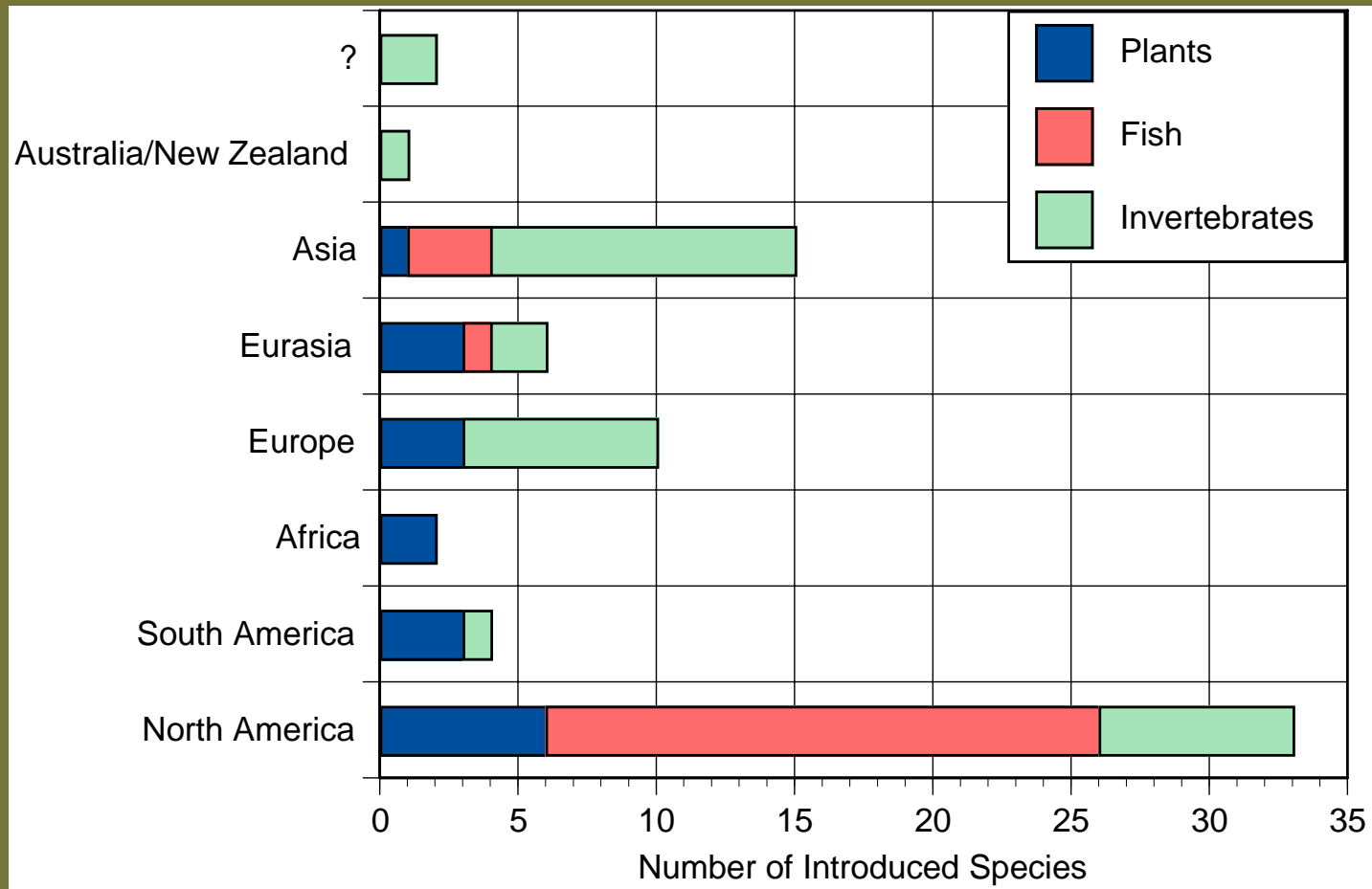


green = fishes    blue = invertebrates

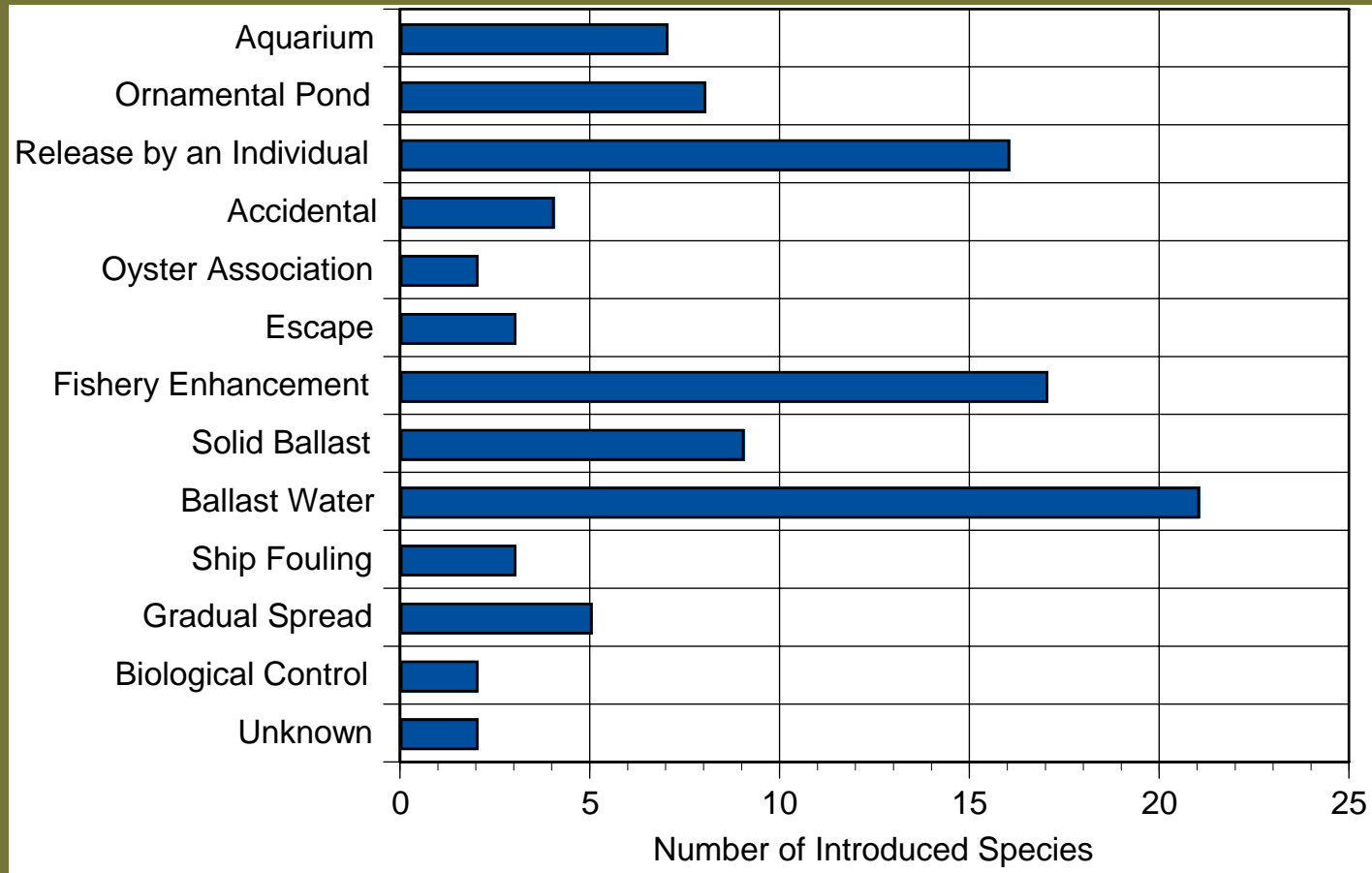
# Species Accumulation Over Time in the Lower Columbia River



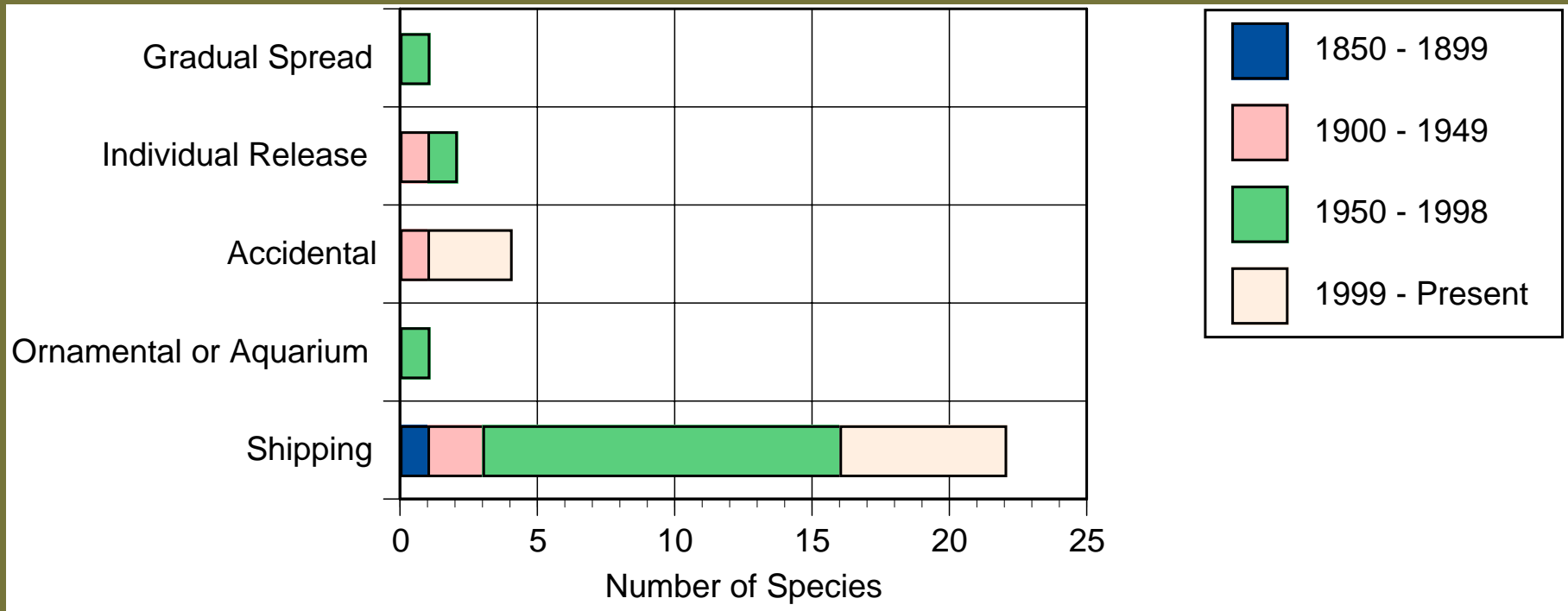
# LCRANS: Geographic Origins



# LCRANS: Invasion Mechanisms



# LCRANS: Invasion Mechanisms



[Data shown only for invertebrates]

# Distribution of Non-Native Invertebrates on the West Coast

Species	PWS	PS	WB	CR	CB	SFB	MB
<i>Nuttallia obscurata</i>		X	X	X	X		
<i>Mya arenaria</i>	X	X	X	X	X	X	X
<i>Corbicula fluminea</i>		X	X	X	X	X	
<i>Potamopyrgus antipodarum</i>				X			
<i>Cipangopaludina chinensis</i>				X		X	
<i>Hobsonia florida</i>		X	X	X		X	
<i>Pseudodiaptomus inopinus</i>		X	X	X	X		
<i>Pseudodiaptomus forbesi</i>				X		X	
<i>Sinocalanus doerri</i>				X		X	
<i>Crangonyx pseudogracilis</i>				X		X	
<i>Grandidierella japonica</i>		X	X	X	X	X	X
<i>Caecidotea racovitzai</i>				X		X	
<i>Corophium acherusicum</i>		X	X	X	X	X	X
<i>Nippoleucon hinumensis</i>			X	X	X	X	
<i>Exopalaemon modestus</i>				X		X	
<i>Balanus improvisus</i>			X	X	X	X	X



From: Ruiz et al. 2000, Mills et al., Carlton and Wonham unpub, Cohen et al. 2001, WEMAP unpublished, Cohen et al. 2001, Carlton unpub. (in Ruiz et al. 2000), Cohen and Carlton 1995 and numerous other sources

# Directional Patterns of Spread?

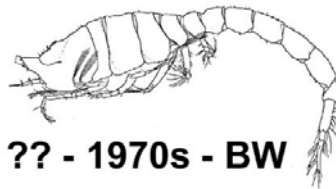


*Grandidierella japonica*



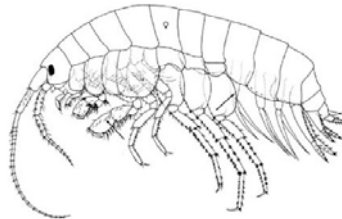
C >> O W - 1960s - AqC

*Nippoleucon hinumensis*



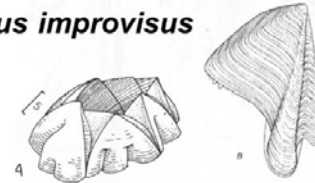
?? >> ?? - 1970s - BW

*Crangonyx pseudogracilis*



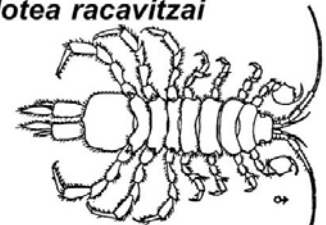
O W >> C - 1950s? - PT?

*Balanus improvisus*



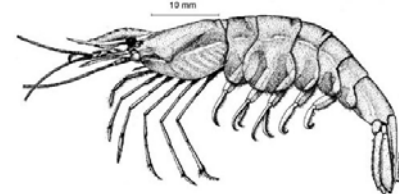
?? <> ?? - 1700s? - SF

*Caecidotea racavitzai*



O W >> C - 1950s? - PT?

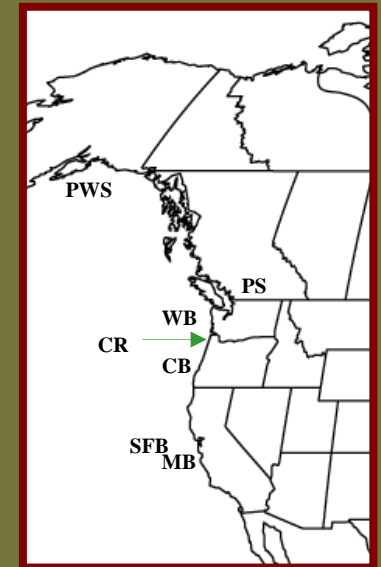
*Exopalaemon modestus*  
Emmett et al. 2003



O W >> C - 1990s - BW

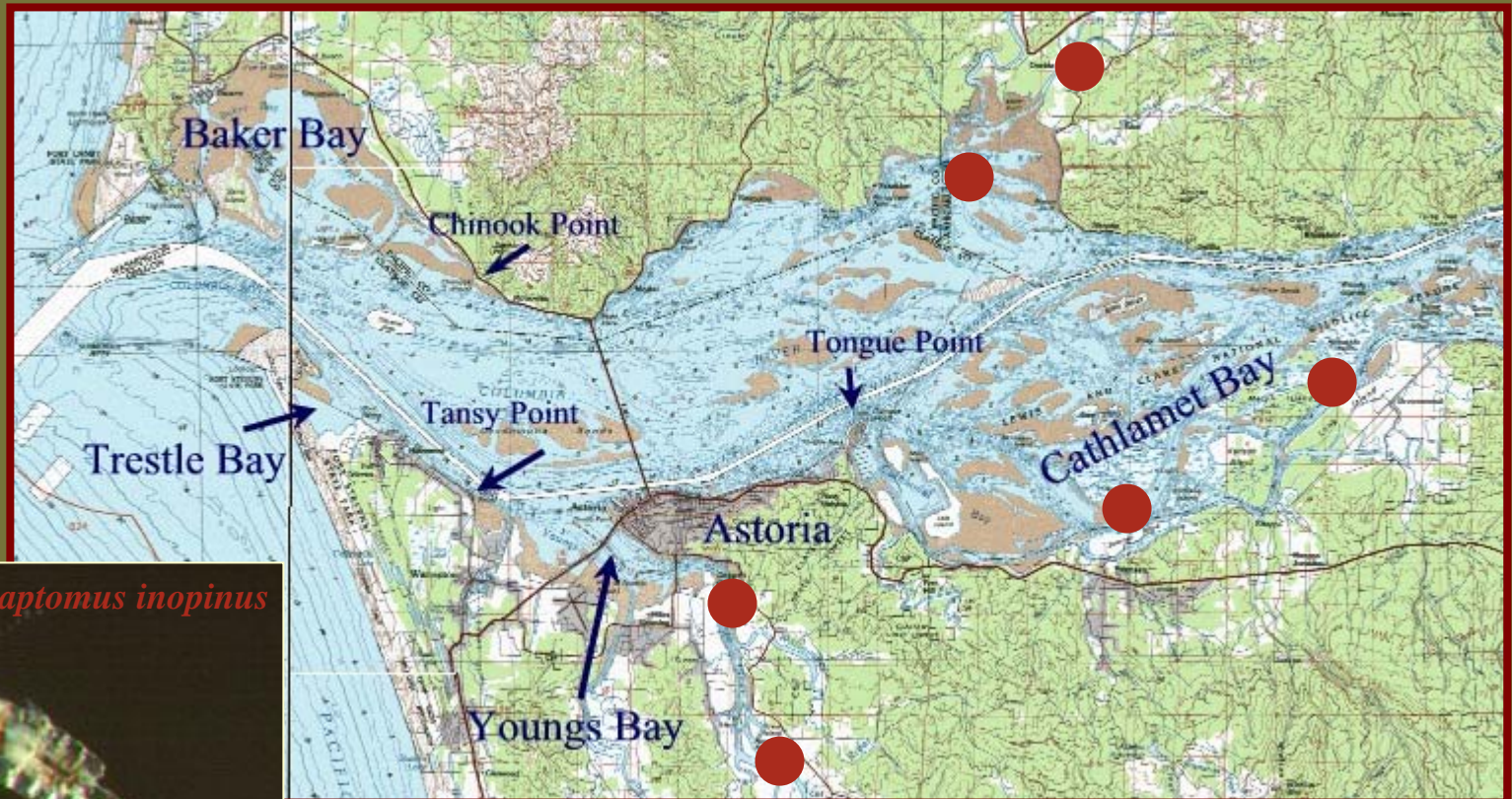
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<i>Mya arenaria</i>	X	X	X	X	X	X	X
<i>Corbicula fluminea</i>		X	X	X	X	X	
<i>Potamopyrgus antipodarum</i>				X			
<i>Cipangopaludina chinensis</i>				X		X	
<i>Hobsonia florida</i>		X	X	X		X	
<i>Pseudodiaptomus inopinus</i>		X	X	X	X		
<i>Pseudodiaptomus forbesi</i>				X		X	
<i>Sinocalanus doerri</i>				X		X	
<i>Crangonyx pseudogracilis</i>				X		X	
<i>Grandidierella japonica</i>		X	X	X	X	X	X
<i>Caecidotea racovitzai</i>				X		X	
<i>Corophium acherusicum</i>		X	X	X	X	X	X
<i>Nippoleucon hinumensis</i>			X	X	X	X	
<i>Exopalaemon modestus</i>				X		X	
<i>Balanus improvisus</i>			X	X	X	X	X



From: Ruiz et al. 2000, Mills et al., Carlton and Wonham unpub, Cohen et al. 2001, WEMAP unpublished, Cohen et al. 2001, Carlton unpub. (in Ruiz et al. 2000), Cohen and Carlton 1995 and numerous other sources

# Non-native Copepods in the Columbia River Estuary – 1990s



*Pseudodiaptomus inopinus*



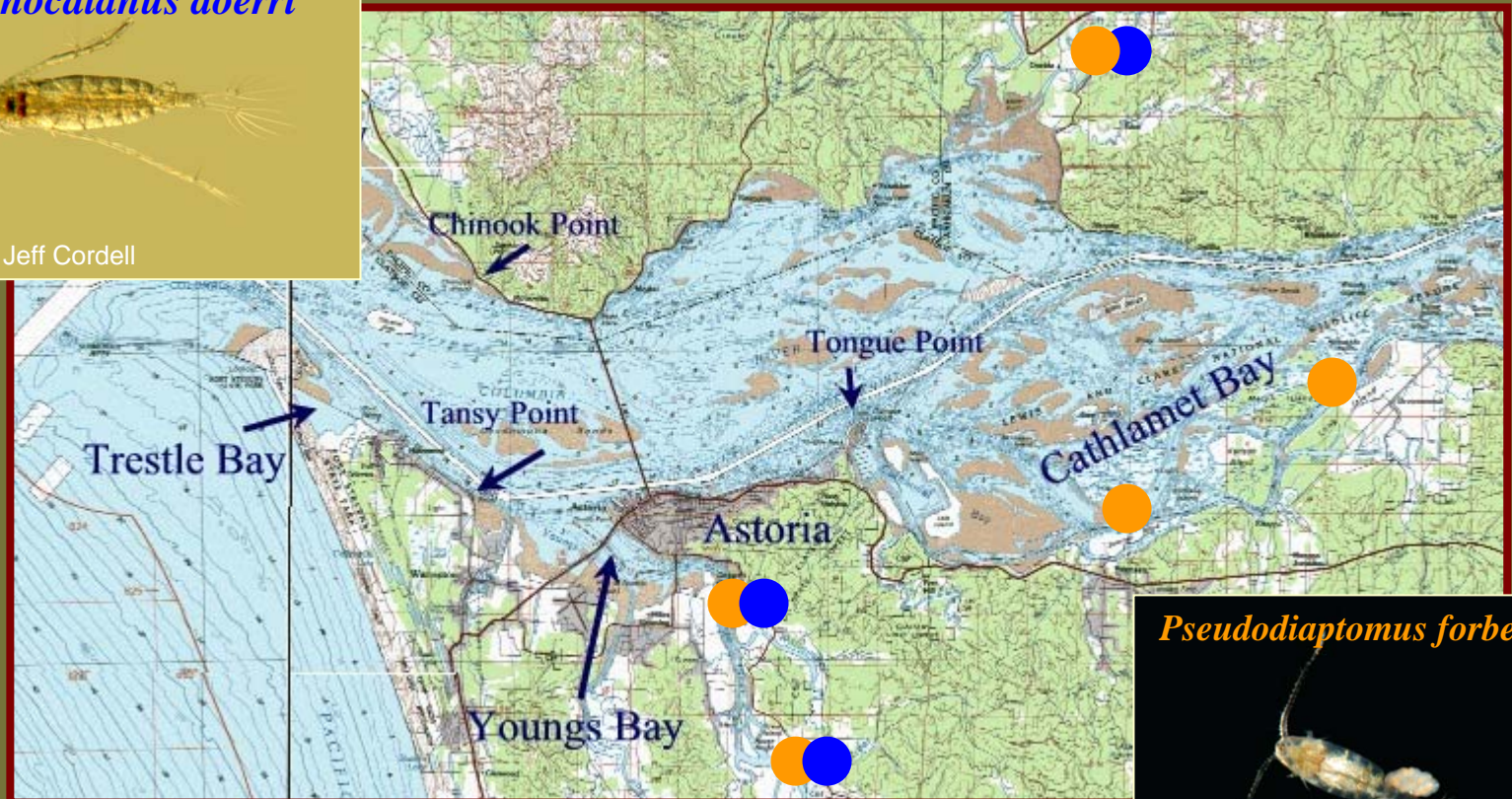
Photo: Jeff Cordell

# Non-native Copepods in the Columbia River Estuary - 2002

*Sinocalanus doerri*



Photo: Jeff Cordell



*Pseudodiaptomus forbesi*



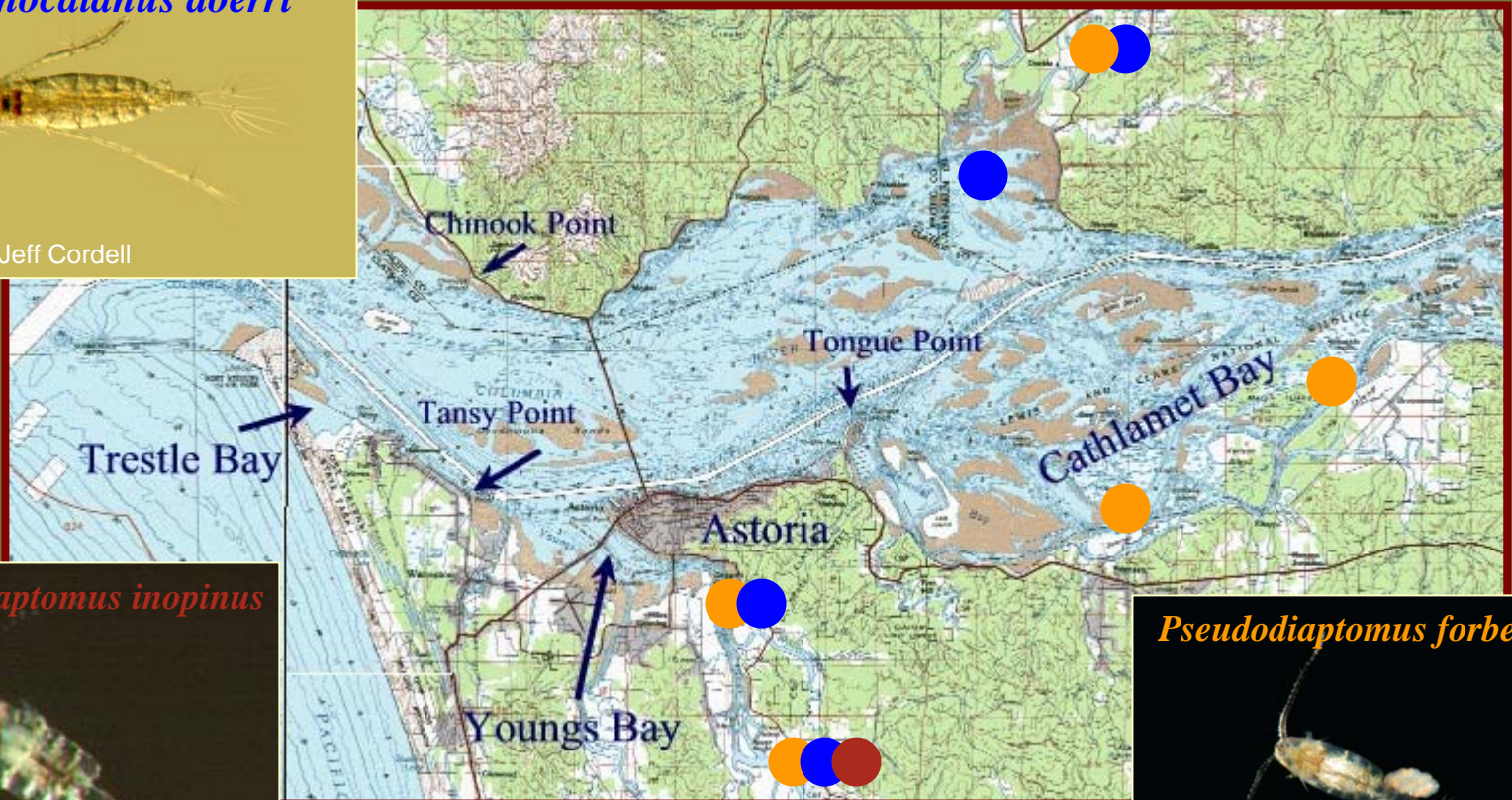
Photo: Jeff Cordell

# Non-native Copepods in the Columbia River Estuary - 2003

*Sinocalanus doerri*



Photo: Jeff Cordell



*Pseudodiaptomus inopinus*



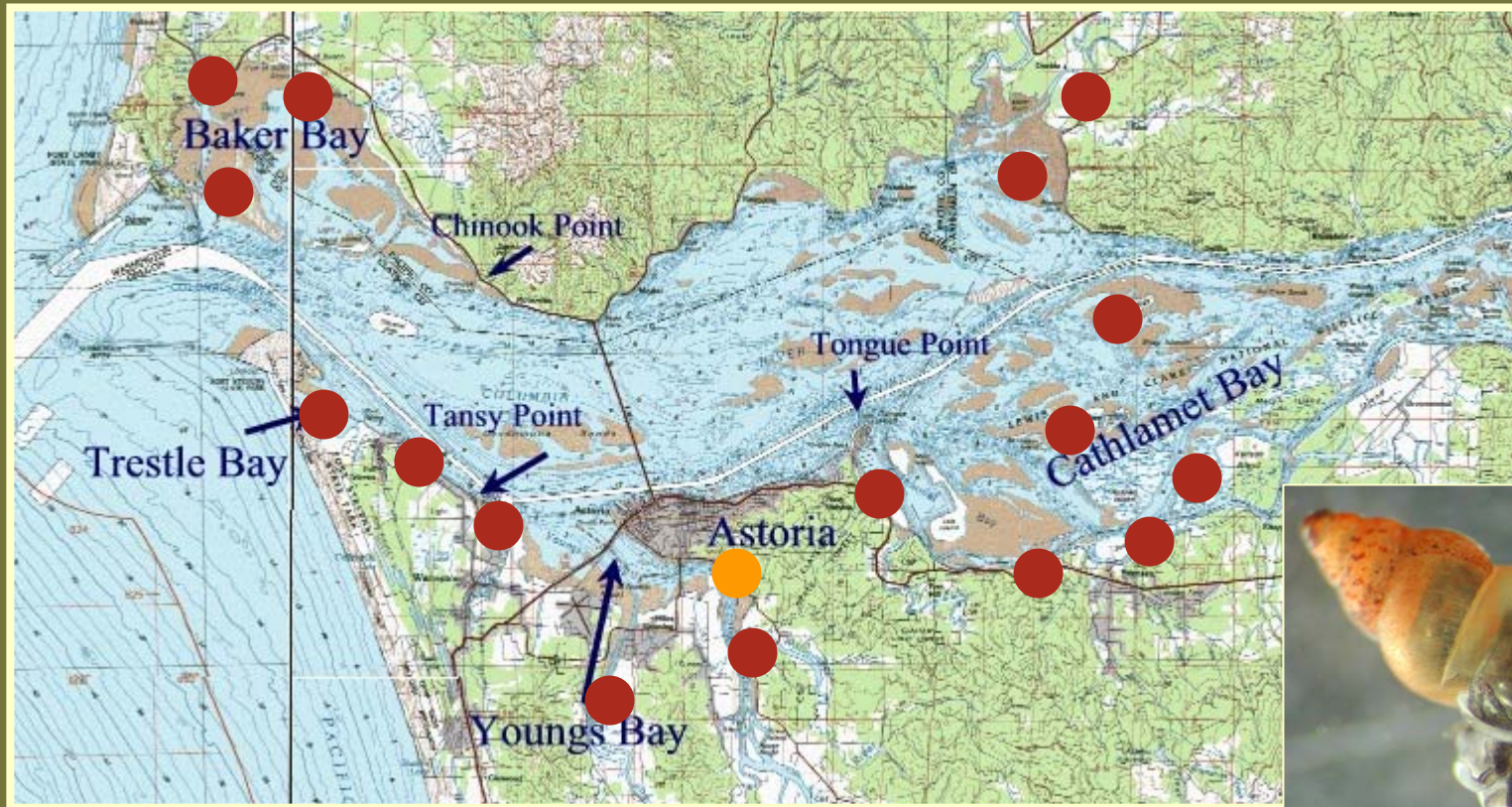
Photo: Jeff Cordell

*Pseudodiaptomus forbesi*



Photo: Jeff Cordell

# New Zealand Mudsnail Proliferation



Dan Gustafson

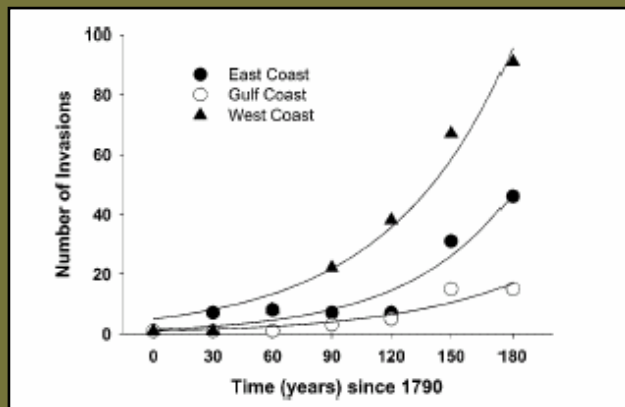
1992 ----- 2004

# What's Next For the Columbia River Estuary?

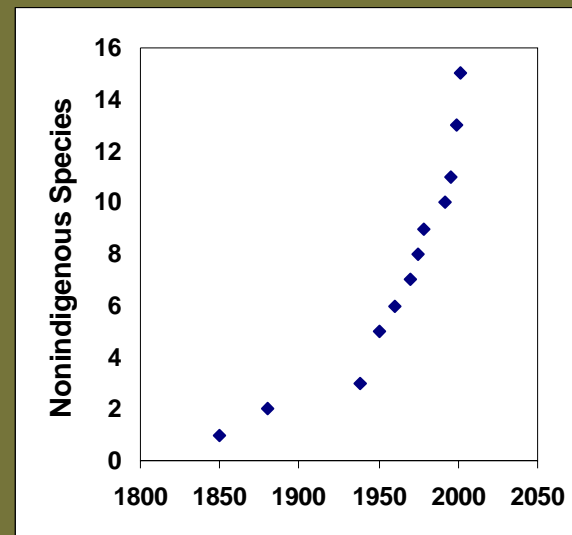


# What's Next For the Columbia River Estuary?

- Increasing rates of invasion?
  - Global and local rates on the rise



From Ruiz et al 2000





This project is made possible by a grant from the US Coast Guard and the US Fish and Wildlife Service with the cooperation of the Pacific States Marine Fisheries Commission.

We'd like to thank those people who have provided additional taxonomic expertise: Terry Frest, Ed Johannes, Leslie Harris, Jeff Adams, Kathy Hamel, Jennifer Parsons, Steve Fend, Dennis Erickson, and Mary Pfauth as well as the numerous volunteers who have accompanied us on our surveys.



# Future Research Needs

- Risk evaluation
- Vector identification
- Invasion impacts, interactions and facilitation
- Ballast water regulation evaluation
- Other taxonomic questions (ex: oligochaetes)
- Monitoring

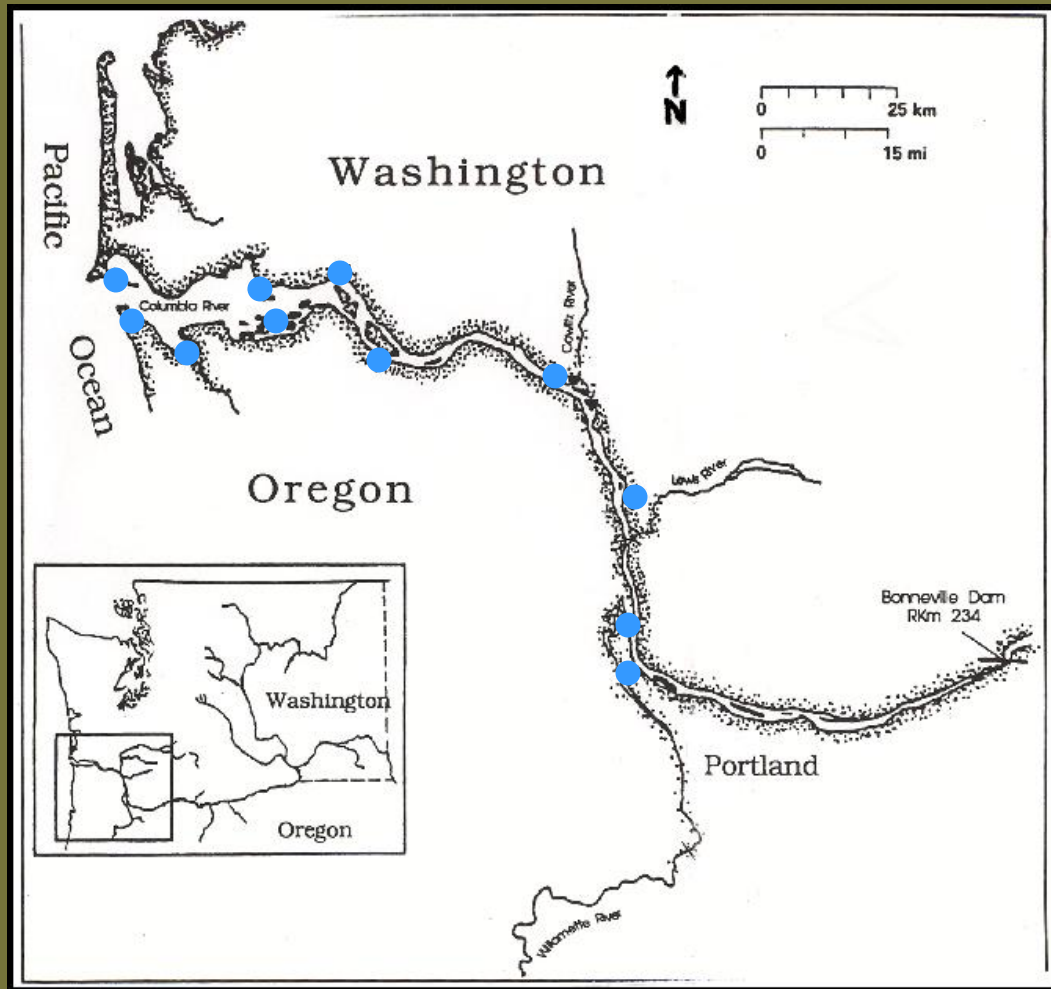
# Future Monitoring:

- Targeted sampling of habitats and taxa that are likely to contain new invaders every 3-5 years,
- A comprehensive survey of the study area every 10 years that would expand sampling beyond target groups, and
- Discrete sampling projects that target the data gaps and survey limitations of the LCRANS project.

# Monitoring: Targeted Sampling

- Sampling every 3-5 years
- Track changes in habitats that are highly invaded and are considered hot spots for detecting new arrivals.
- Target taxa include benthic crustaceans, mollusks, and polychaetes, hydroids, zooplankton and aquatic vascular plants.
- Replicate protocols followed by LCRANS.

# Proposed Monitoring Stations



# Monitoring: Comprehensive Survey

- Target and non-target habitats and taxa sampled in coordination with targeted sampling efforts.
- Comprehensive sampling every nine or ten years (depending on the pattern of targeted sampling).
- Rapid assessment project
- Include lesser taxa, as well as more coverage of habitats like smaller tributaries, slack water areas and areas such as crevices that are likely to not be sampled by other regional projects.
- Coordination of sites locations with the LCRANS sampling is recommended to evaluate changes and patterns of invasion.

# Monitoring: Discrete Projects

- Resolve the data gaps and sampling limitations encountered by LCRANS with intensive surveys.
- Focus on undersampled taxa and areas such as the mouth and main channel of the estuary where LCRANS was unable to sample.
- Targeted surveys will be amended to incorporate new information.
- Later research target specific questions (such as competitive interactions, etc) or species of immediate concern to the region.