Invasive Species: Implications for Habitat Restoration and Effects on Salmonids

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Columbia River Estuary Science-Policy Exchange
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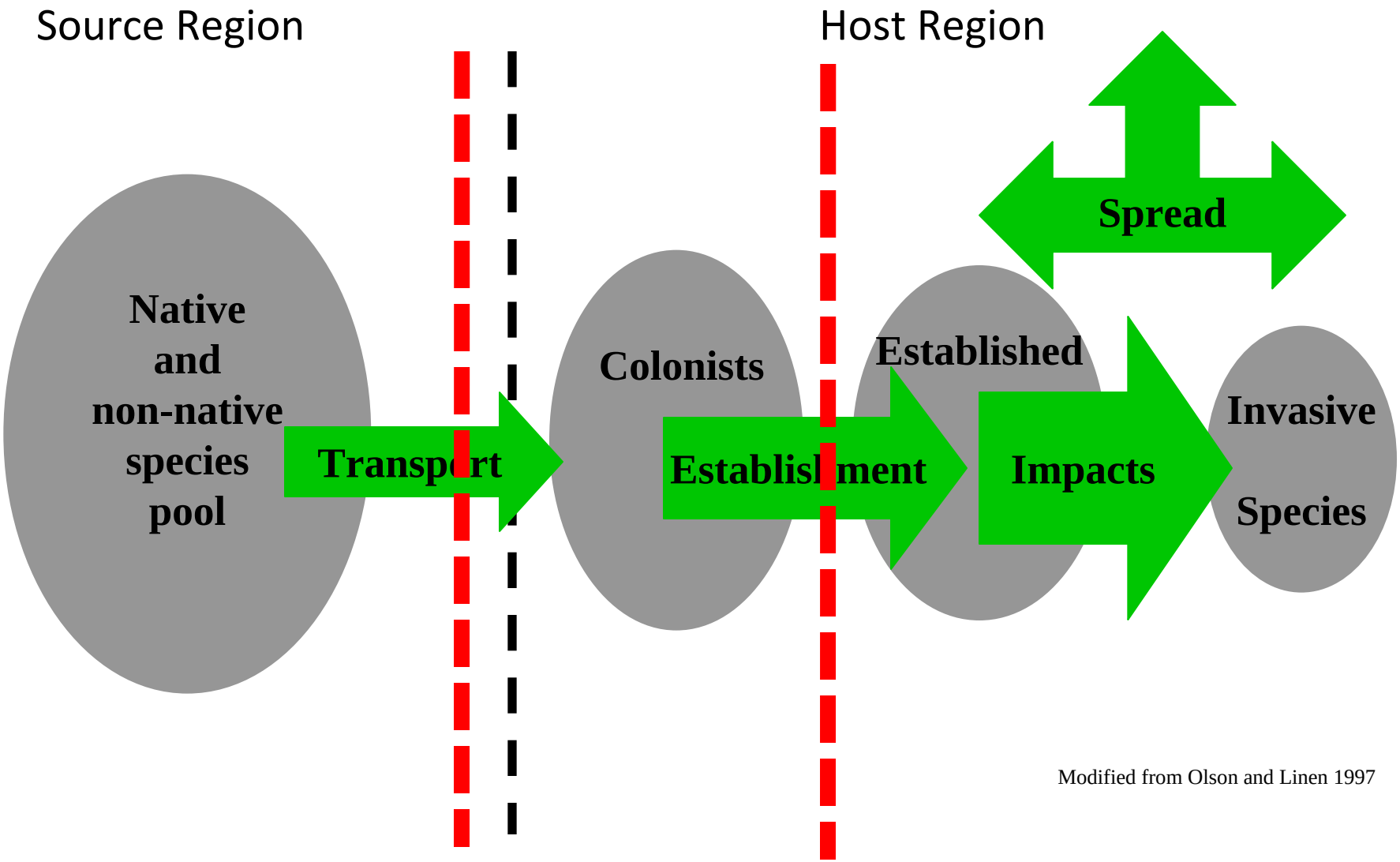
Overview

- Invasion Process
- Vectors
- Impacts
- Threats to the Pacific Northwest
- Management

Invasion Process



Modified from Olson and Linen 1997

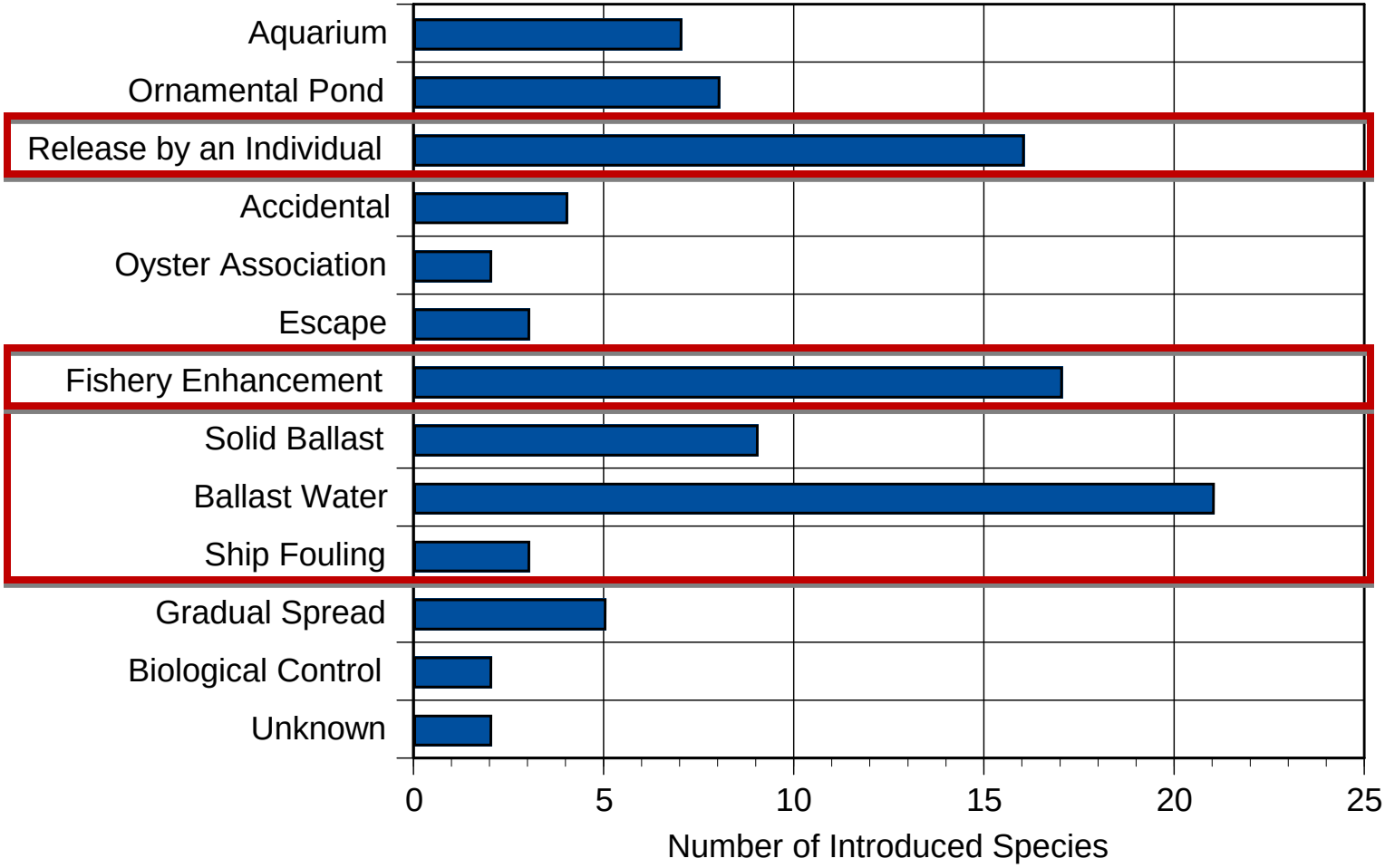
Vectors

- Ballast Water
- Hull Fouling
- Live Seafood
- Live Bait
- Aquaculture
- Aquarium and Pet Trade

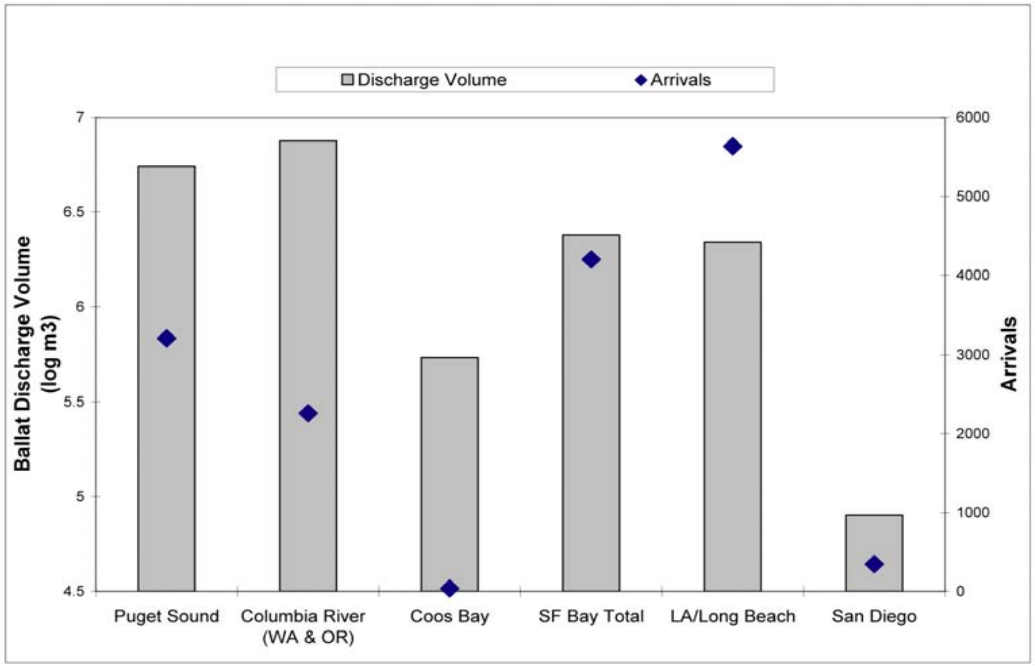
- Recreational Boating
- Hunting and Angling
- Intentional Release
- Gardening
- Ornamental Ponds
- Wildlife Restoration

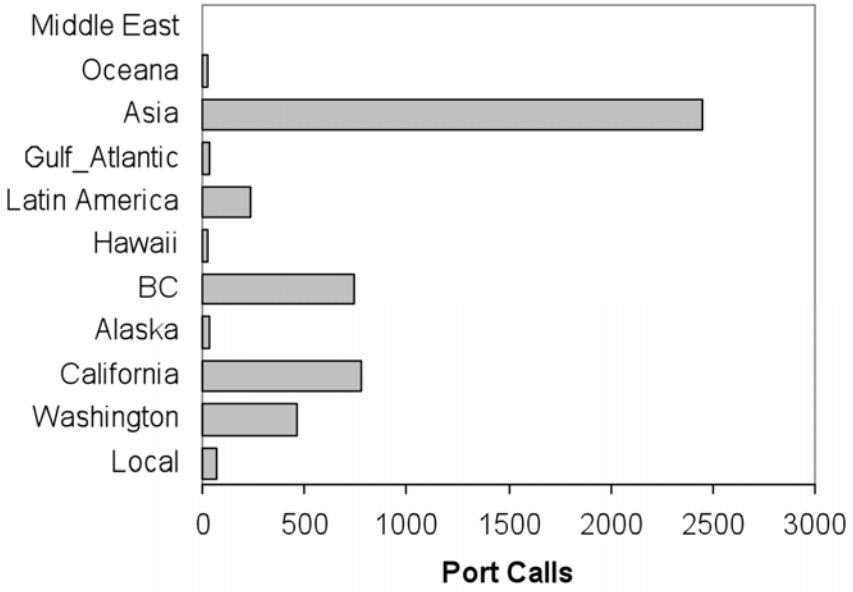


Vector Strength for Lower Columbia River Aquatic Invertebrates



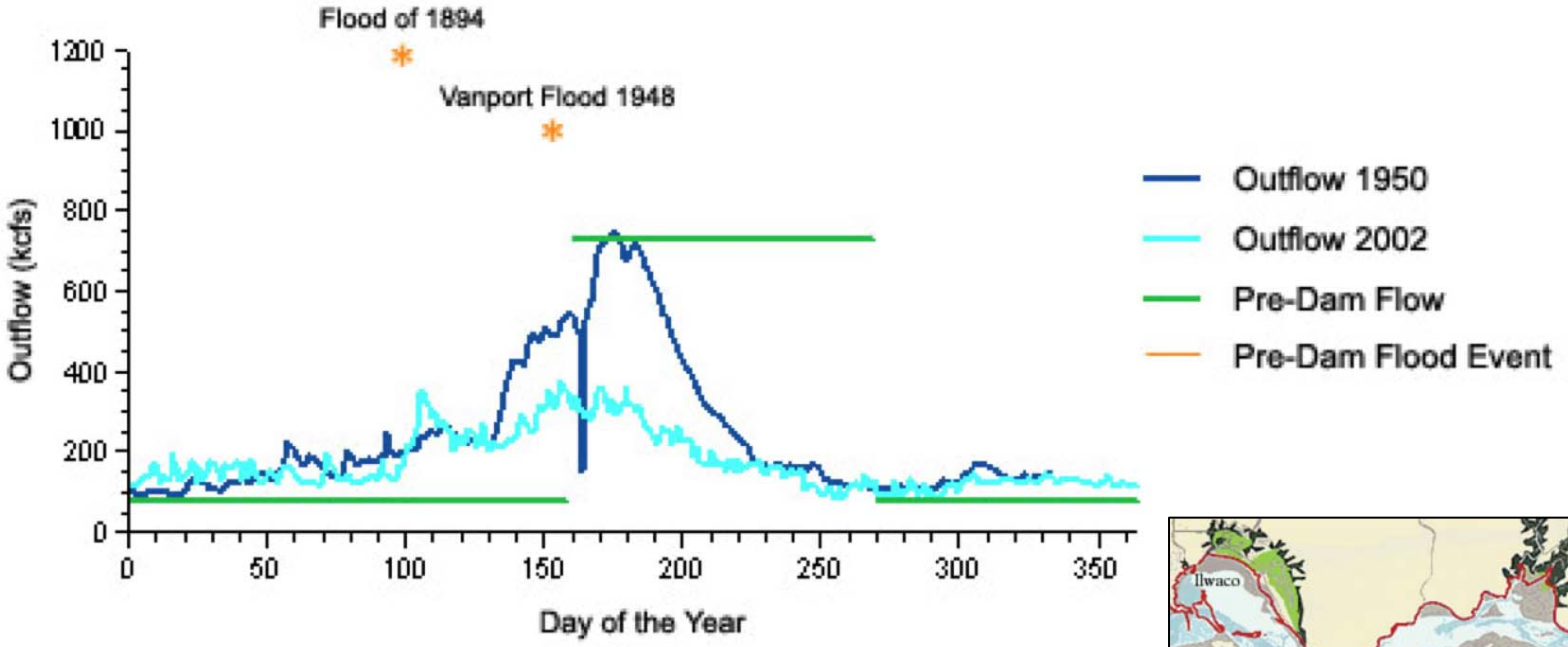
Source and Volume of Ballast Water Discharge into the Columbia River

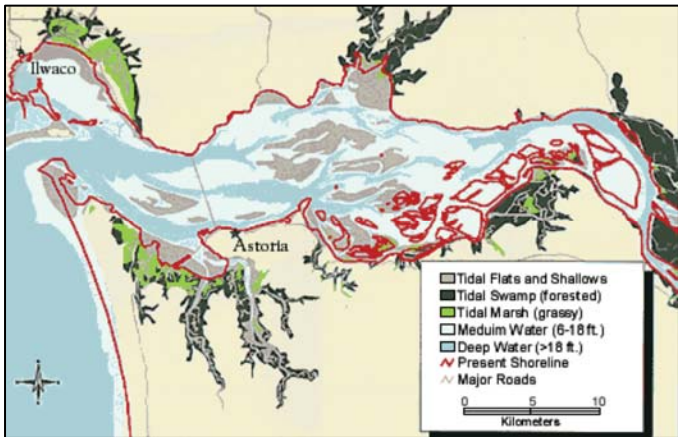




Source: 2009 Oregon Task Force on Shipping Transport of Aquatic Invasive Species Report to the Legislature

Habitat Alternation in the Columbia River Creates Environmental Match for AIS

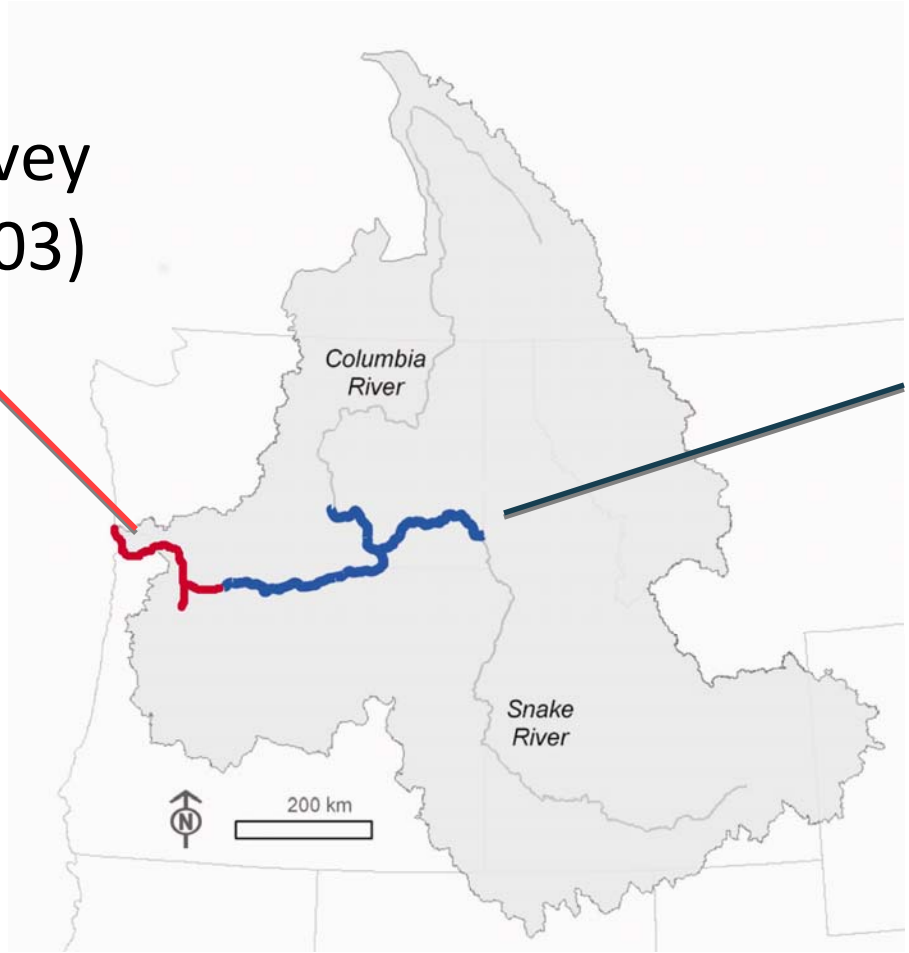




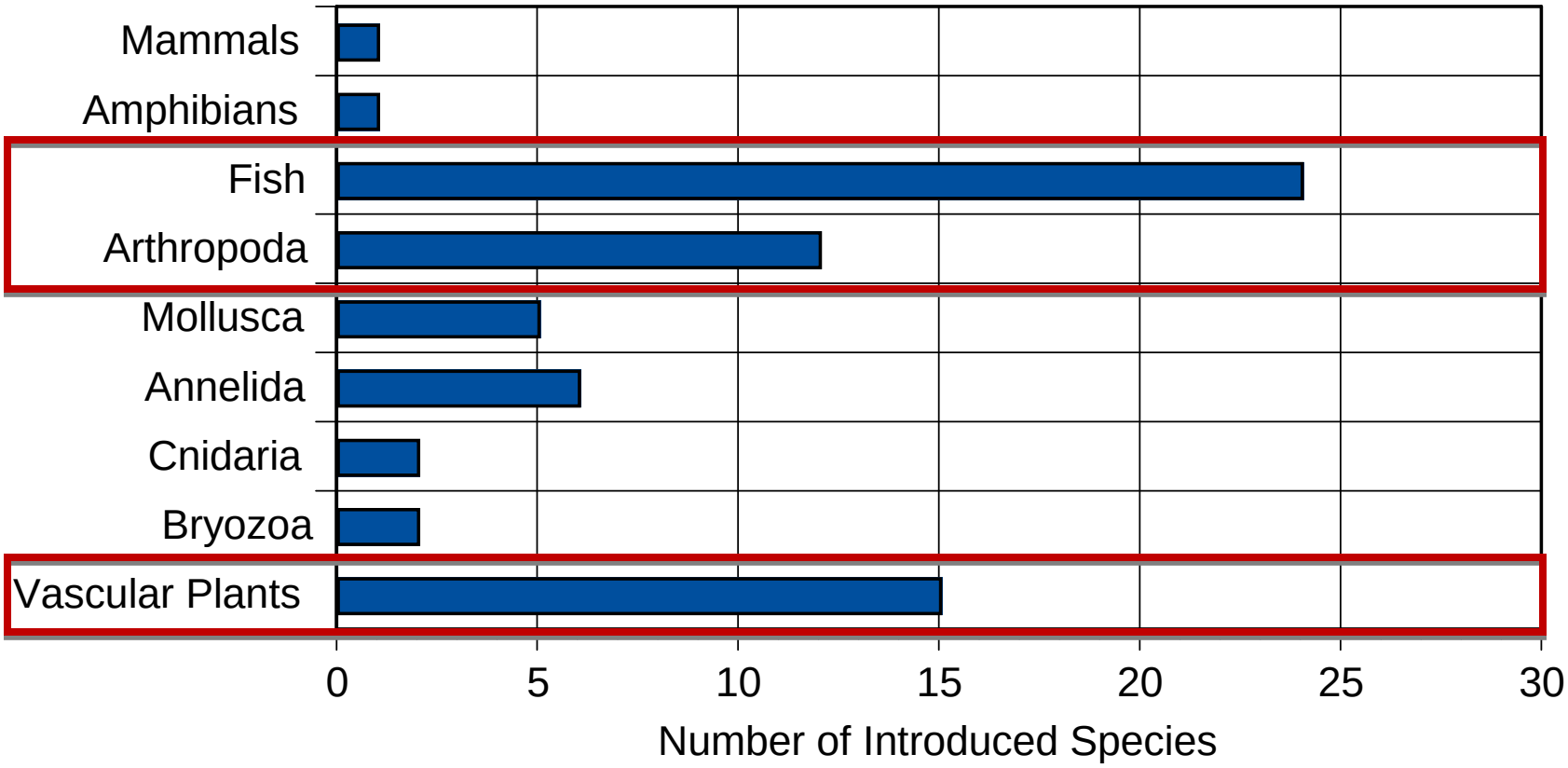
Habitat alteration along the Columbia River estuary contrasting the shoreline position in 1868-1875 with the present shoreline shown in outline. (Source: Lower Columbia River Bi-State Water Quality program http://www.ecotrust.org)

Columbia River AIS Surveys

- Lower Columbia River Survey (2001-2003)
  - 82 AIS
- Middle Columbia River Survey (2006)
  - 17 AIS

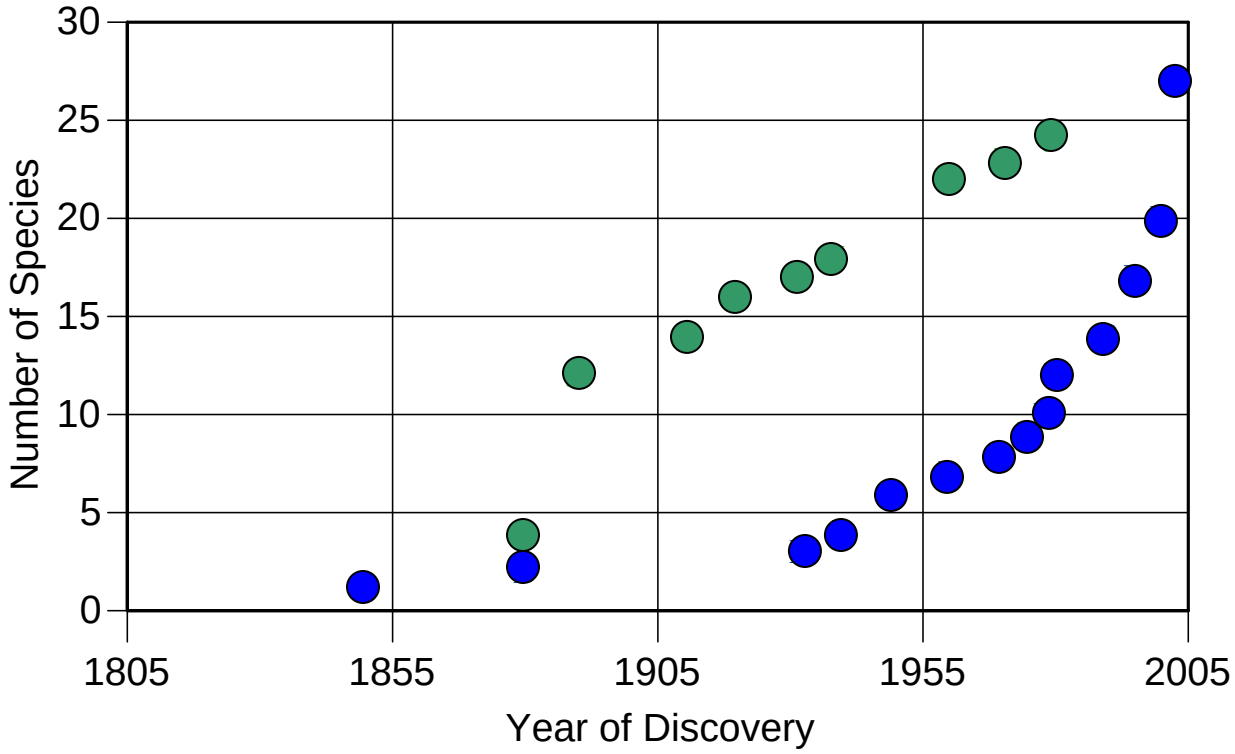


Lower Columbia AIS



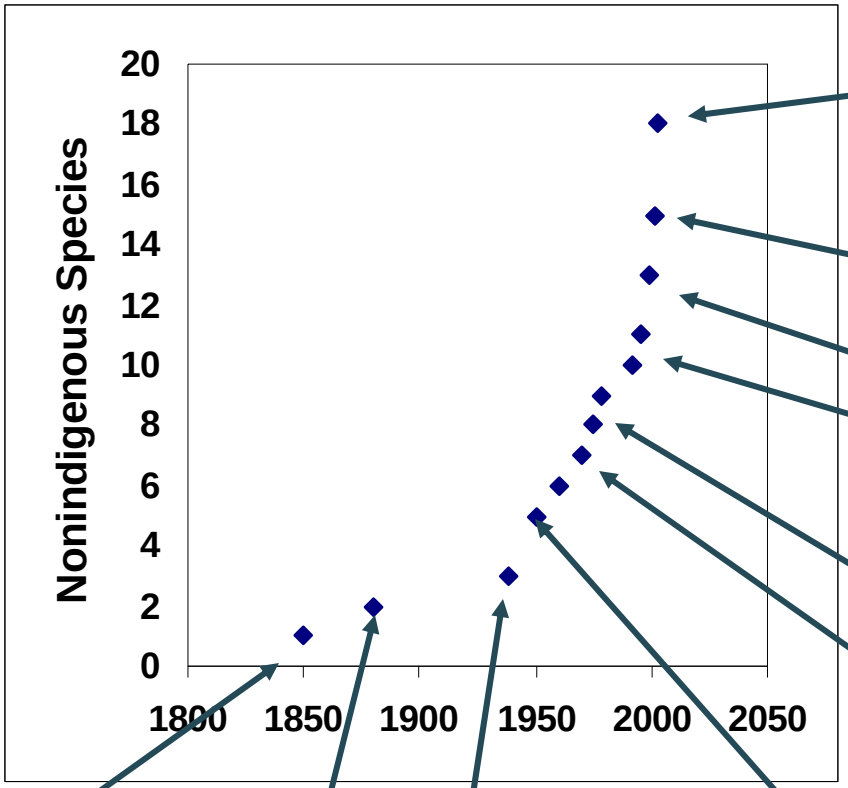
Lower Columbia River Invasion Rates

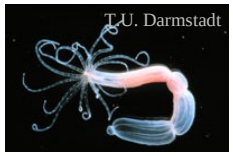
- Fish
  - High rate of introduction in 1800s, lower rate in 1900s
- Invertebrates
  - New species every 5 years from 1880-1975
  - New species every 5 months since 1995

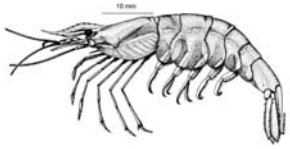


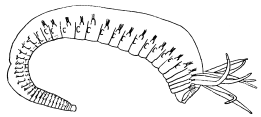
green = fishes blue= invertebrates

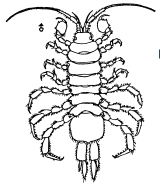
Lower Columbia Invertebrate Introductions

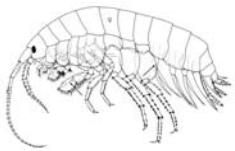




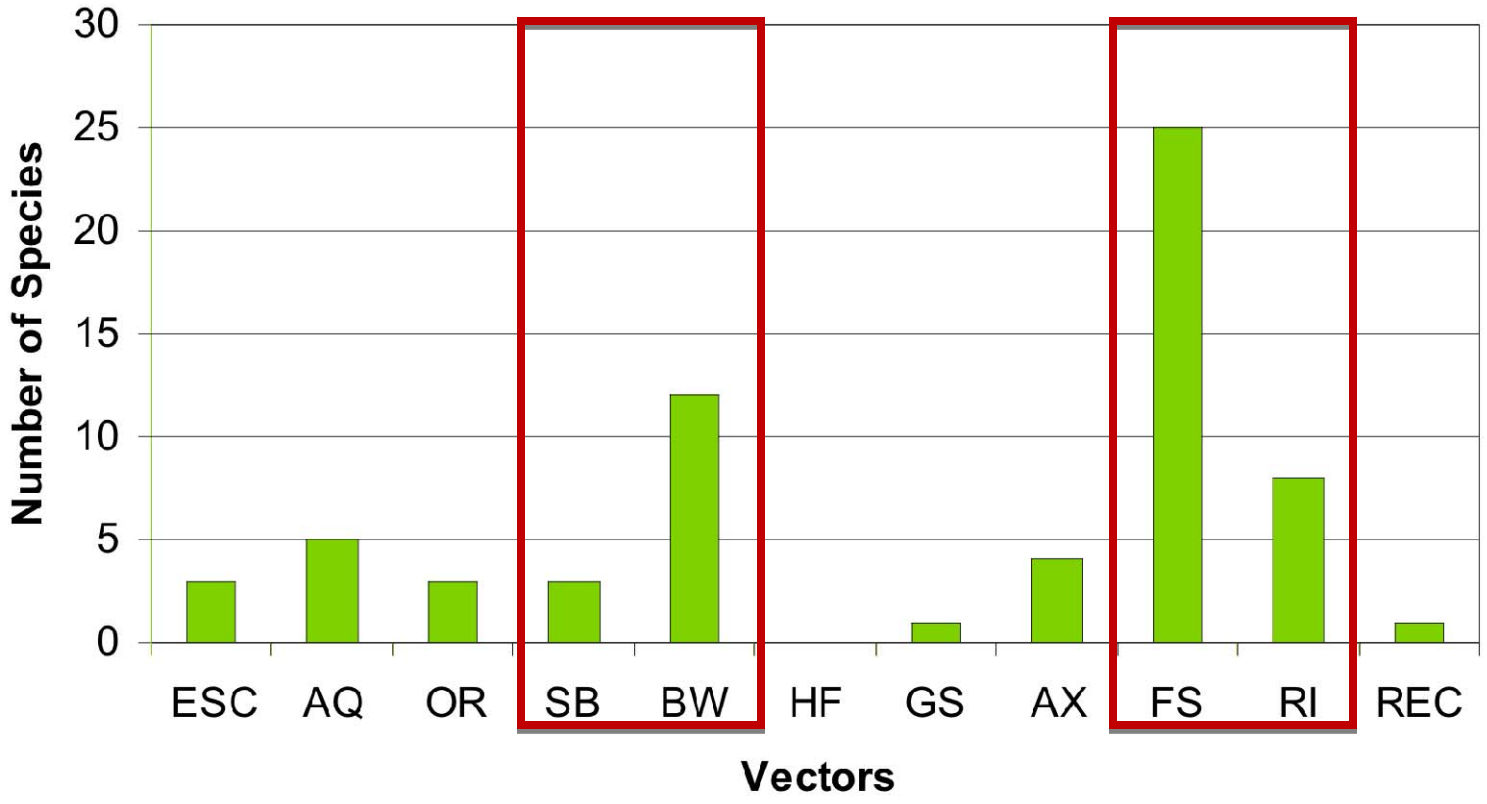






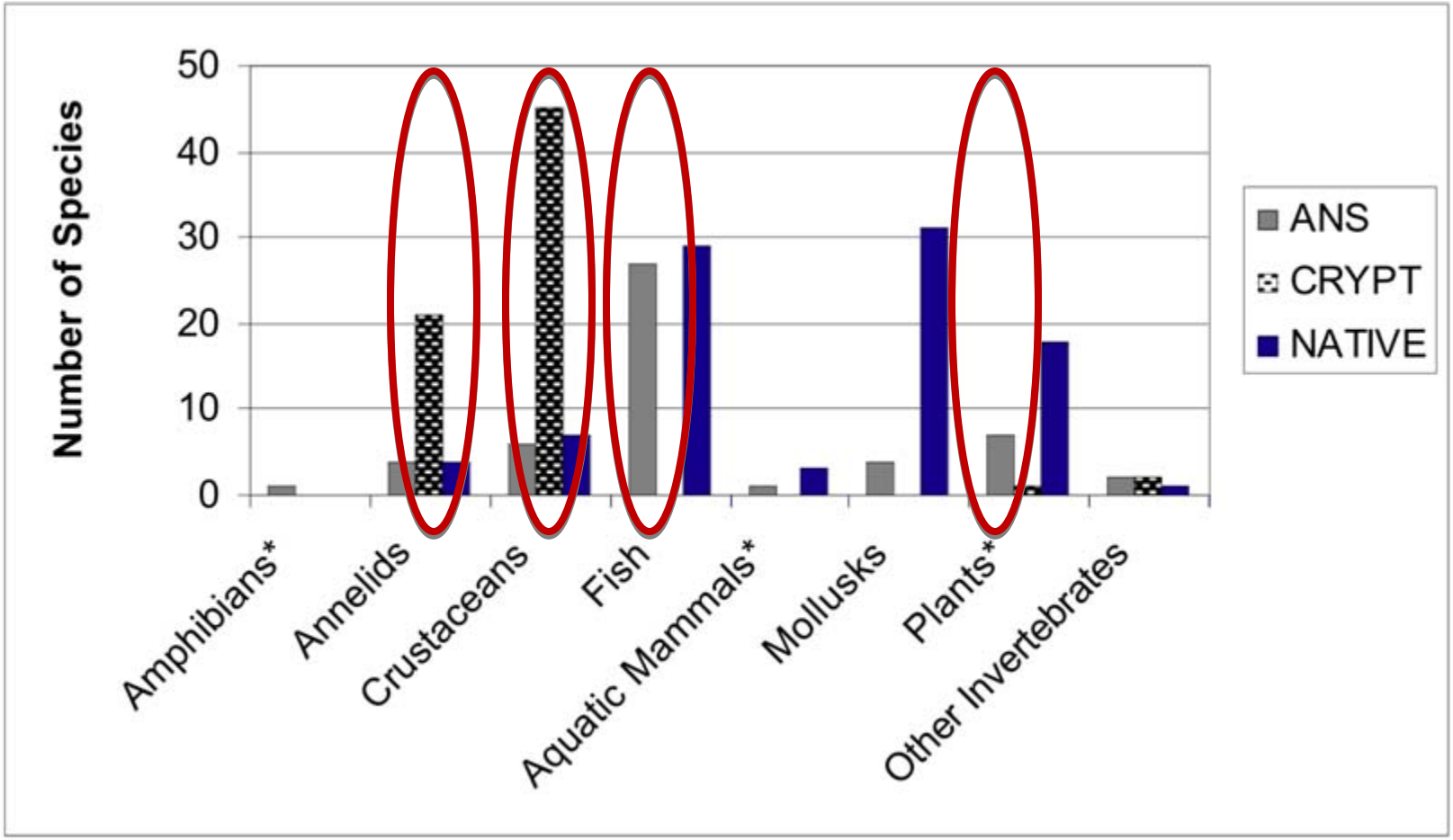


Middle Columbia River Vector Strength



ESC – escape from commercial cultivation, AQ – aquarium species, OR – ornamental species, SB – ships ballast, BW – ballast water, HF – hull fouling, GS – gradual spread from introduction outside basin, AX – accidental introduction (hitchhiking with an intentional release), FS – fisheries or wildlife enhancement by or approved by an agency, RI – release/stocking by an individual, not sanctioned by an agency, REC – recreational fishing/boating activity

Middle Columbia River AIS

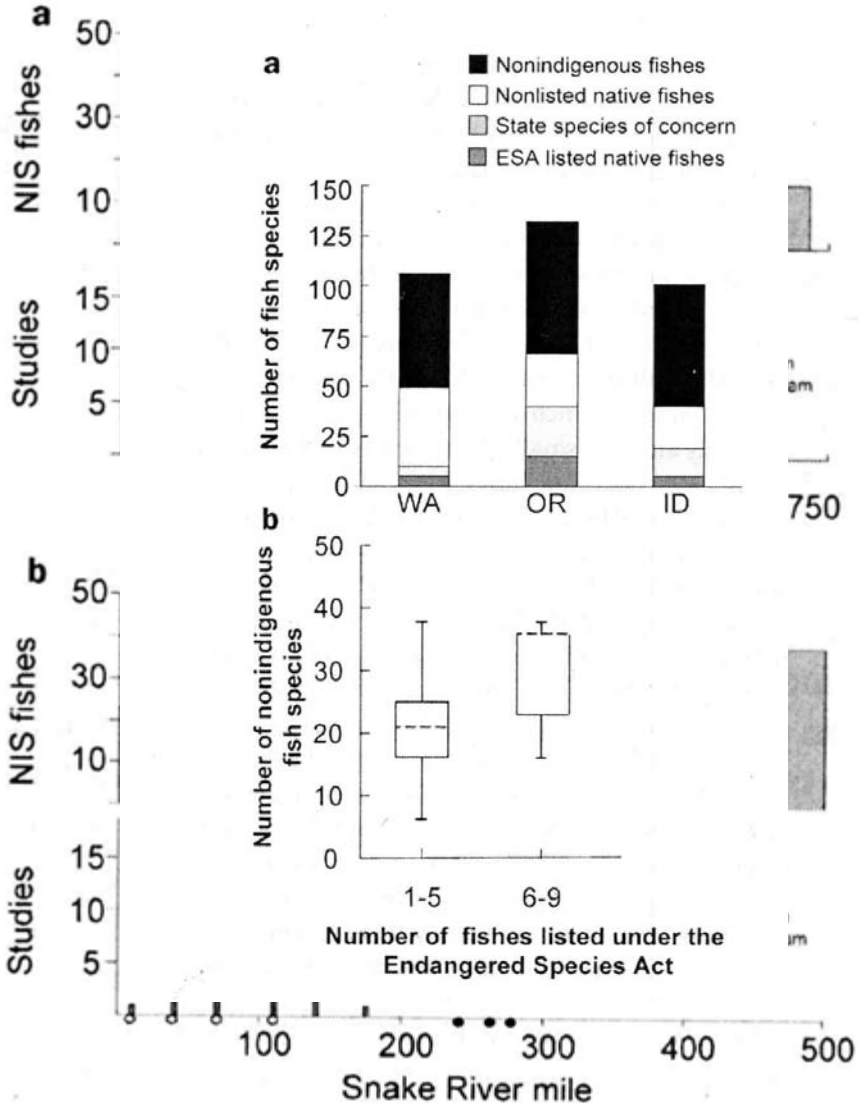


Consequences of Bioinvasion

- Direct effects
  - Predation

    Juvenile and adult salmon encounter 20-40 non-indigenous fish during migration

    High numbers of introduced fish species are found where there are high numbers of listed native species



(Sanderson et al. 2009. *Bioscience* 59: 245-256).

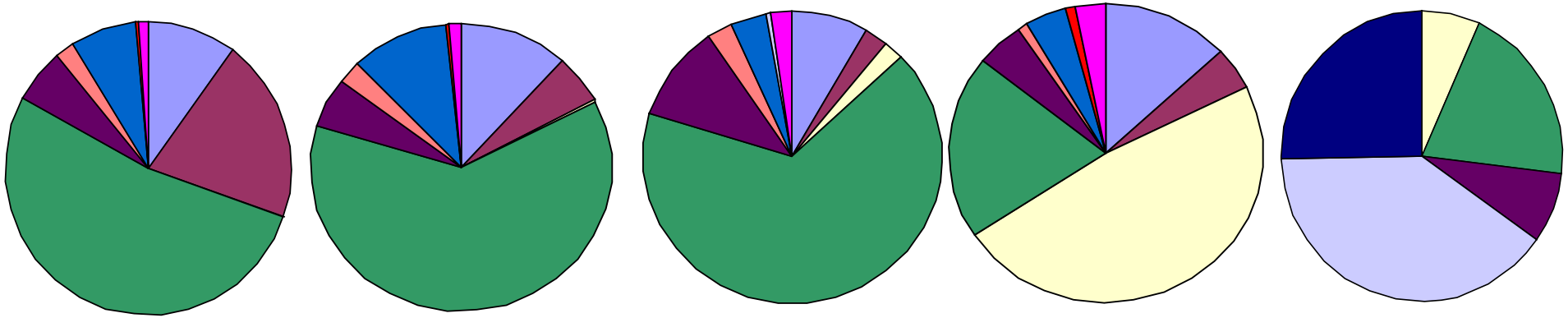
Consequences of Bioinvasion

- Indirect effects
  - Hybridization
  - Homogenization of biotic communities and loss of biodiversity and ecosystem resilience
  - Food web alteration

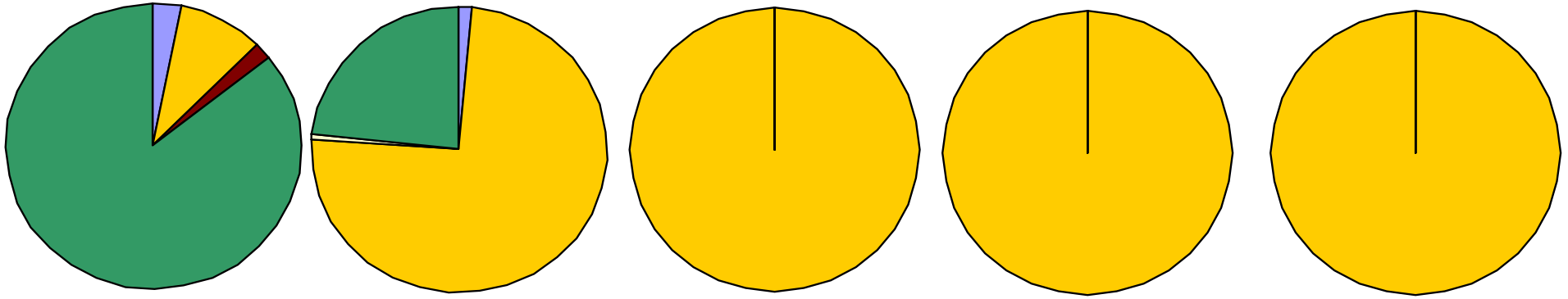
Spartina foliosa x *S. alterniflora* hybrid from SFB

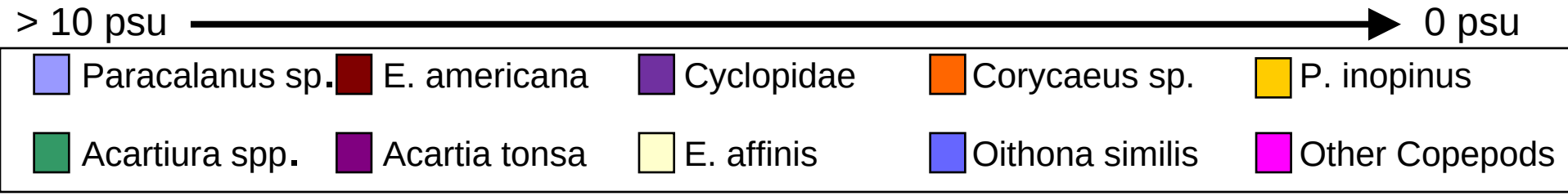
Psuedodiaptomus inopinus

Percent numerical composition of copepods across salinity gradient in 14 west coast estuaries without *P. inopinus*



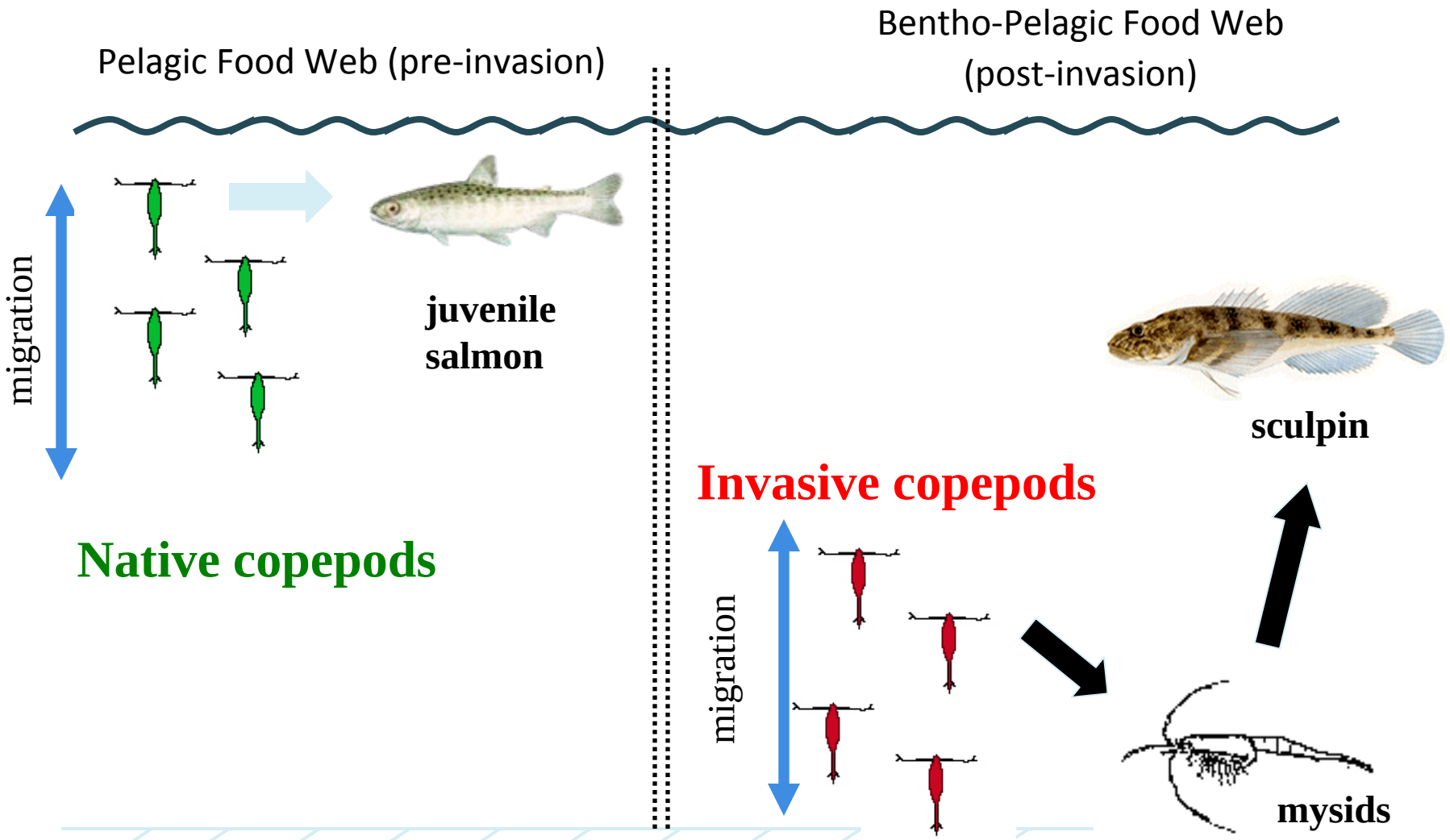
in 7 west coast estuaries with P.inopinus





Source: Bollens, et al. 2002. *Hydrobiologia* 480: 87-110

Hypothesized Changes in Estuarine Food Webs



Source: Steve Bollens, WSU-Vancouver

AIS That Impact Restoration Activities and With System-Changing Potential

Zebra/Quagga Mussels

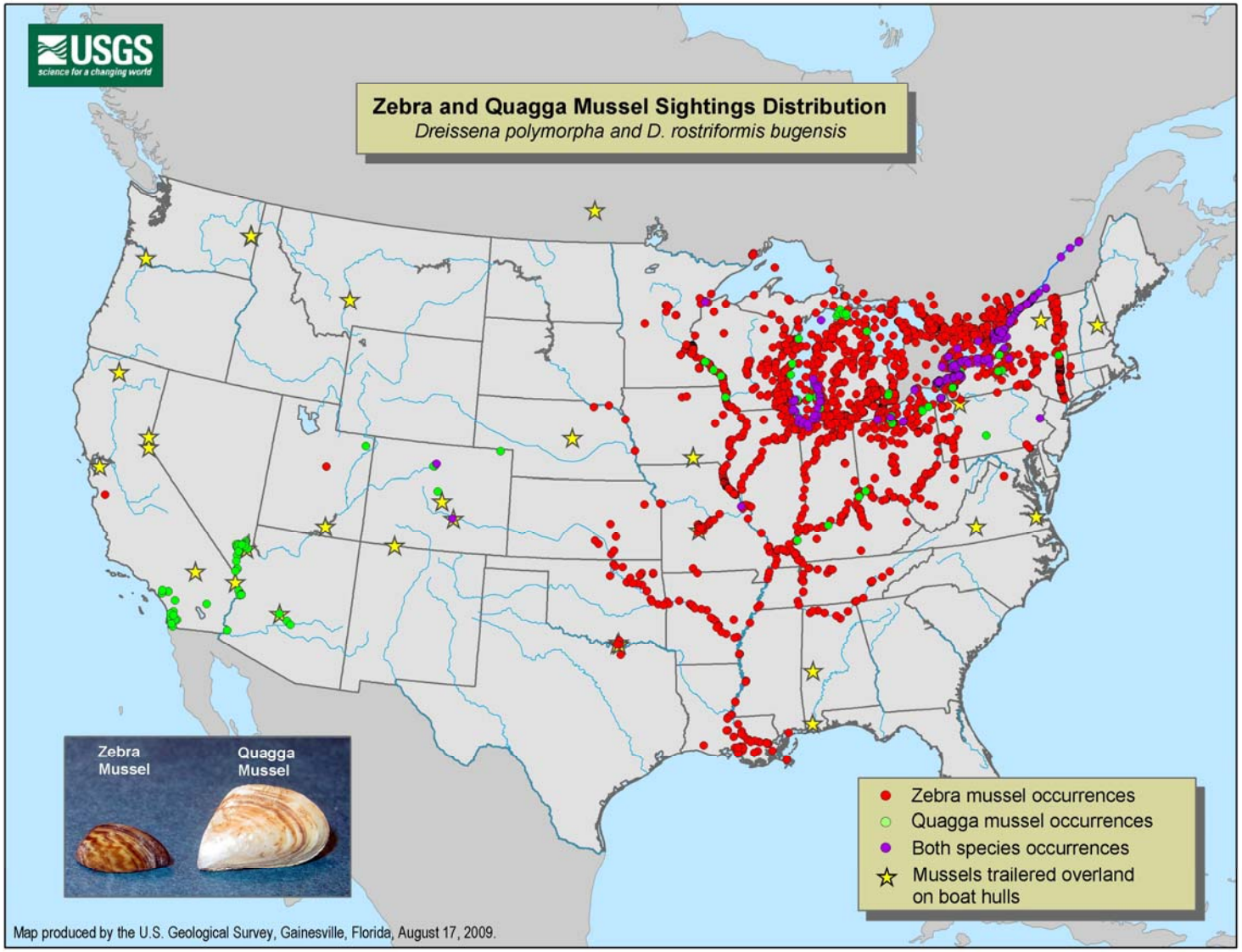
Common Reed Haplotypes 1 and M

Hydrilla

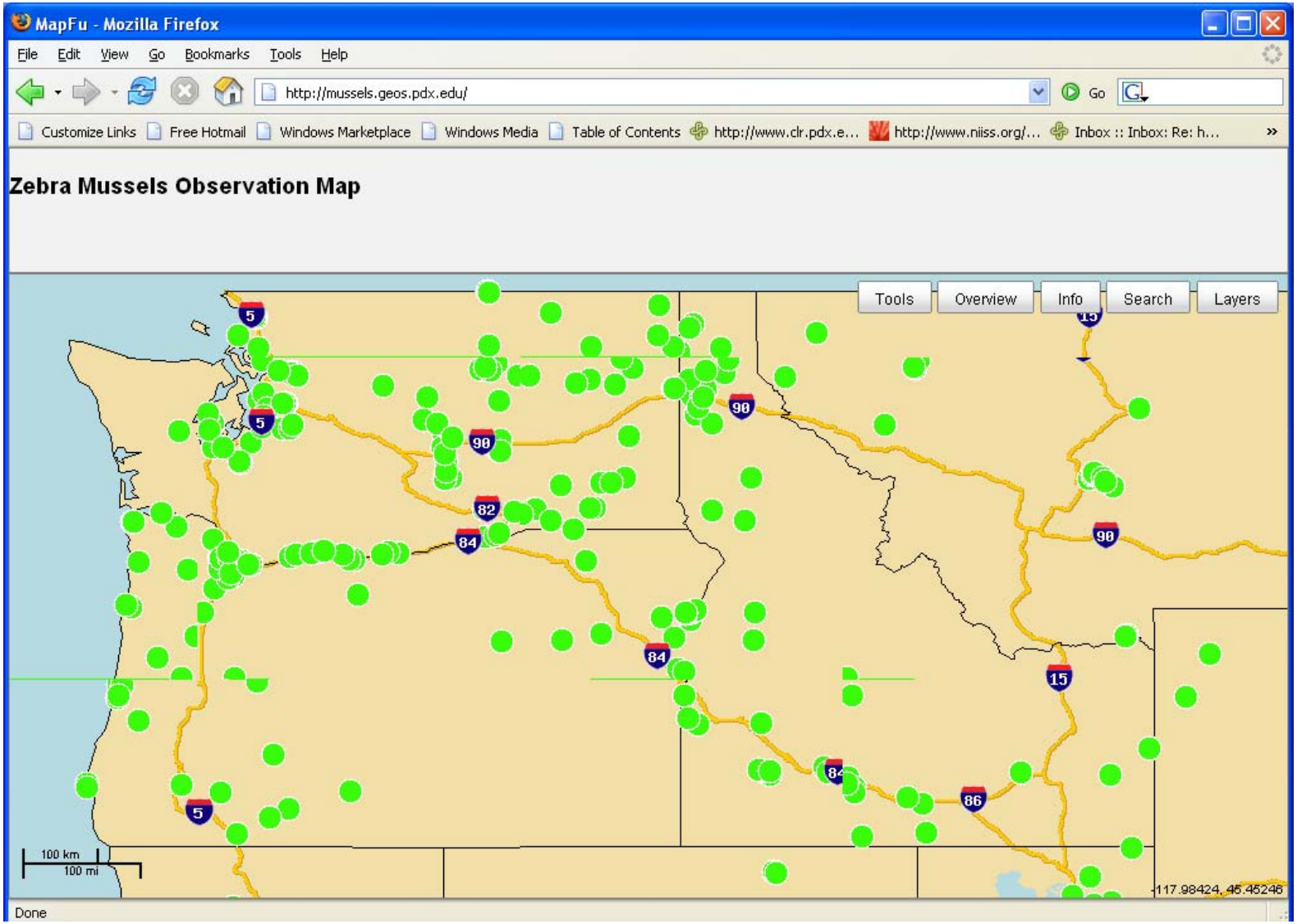
Zebra and Quagga Mussels

- Freshwater fouling organisms
  - Colonize underwater structures: submerged pumps, boats, nets, marine engines, navigation buoys, fish screens and ladders.
  - Disrupt natural food chains, and threaten native fish and mussel populations.
  - Clog intake and cooling pipes of large water users

Current Distribution



Zebra/Quagga Mussel Monitoring



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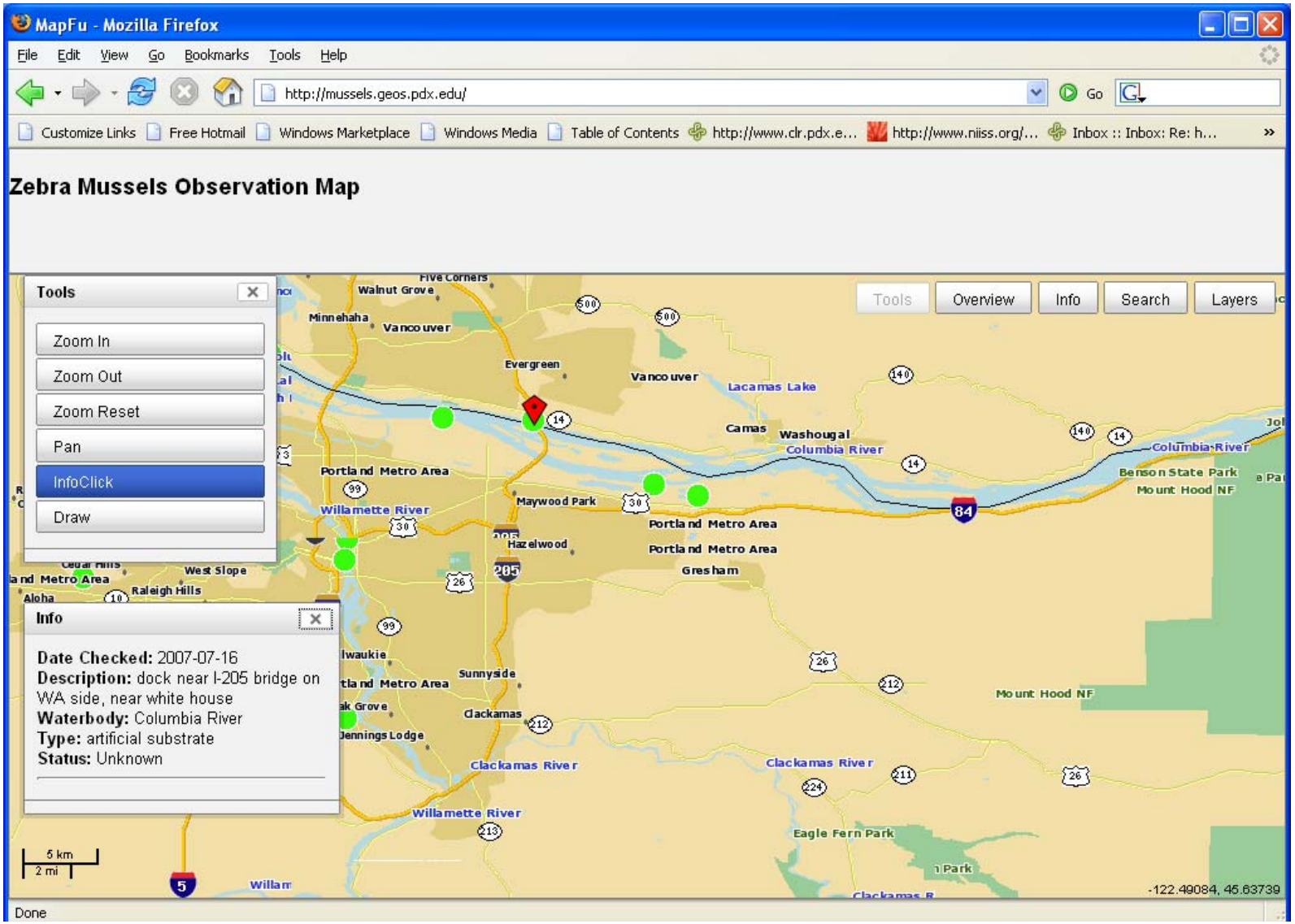
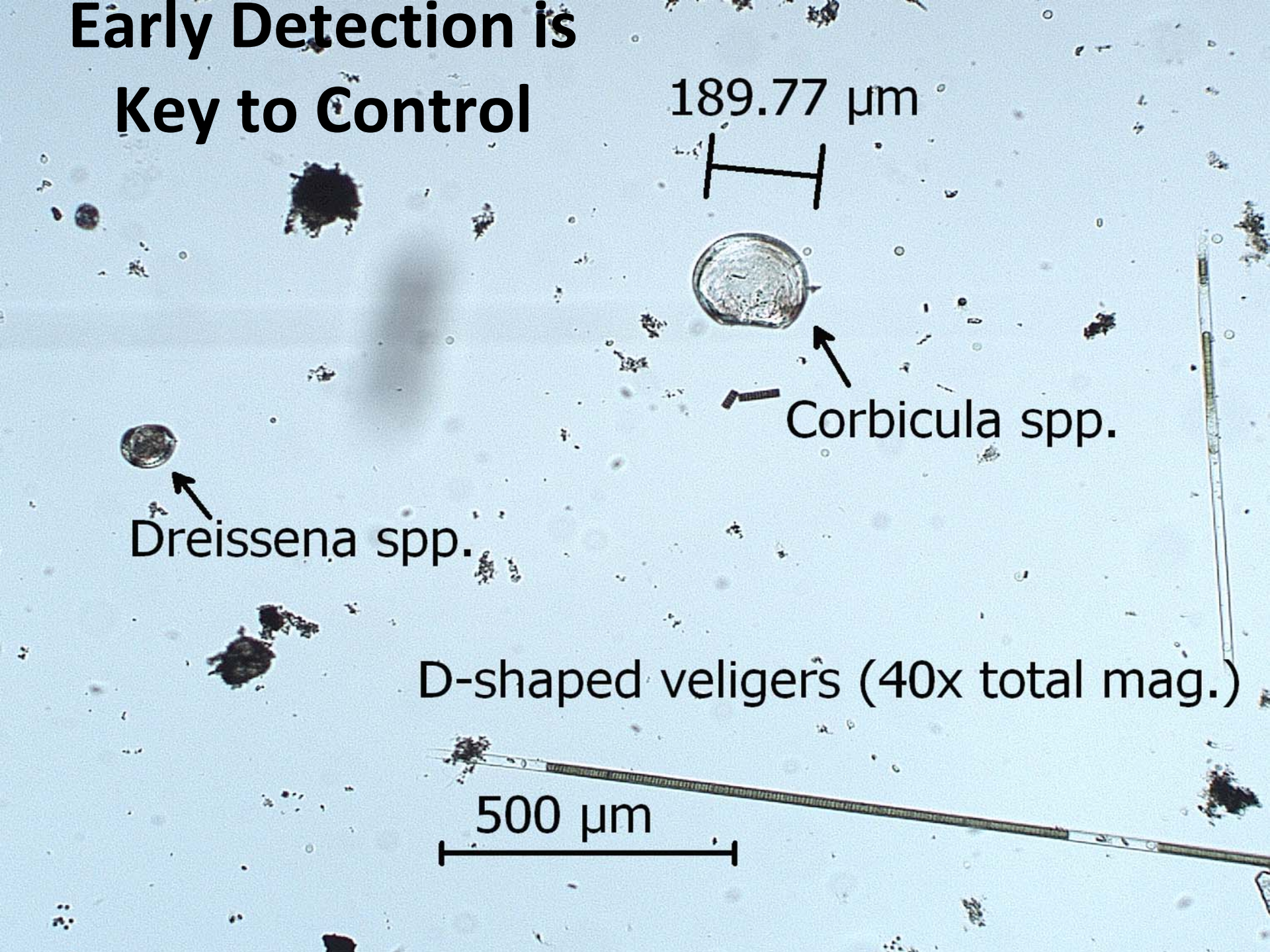
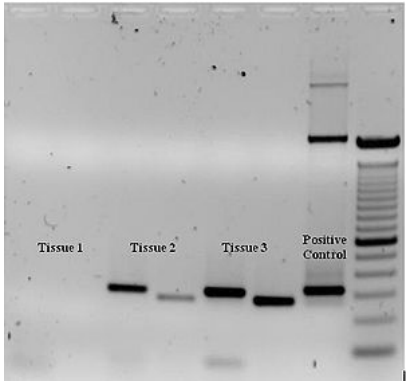


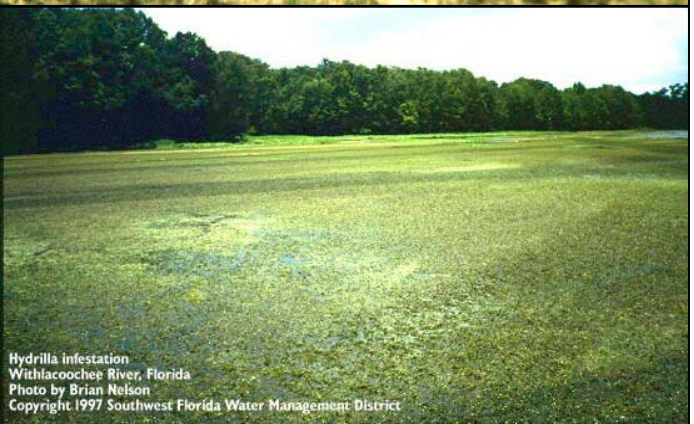

Early Detection is Key to Control
189.77 µm
Corbicula spp.
Dreissena spp.
D-shaped veligers (40x total mag.)
500 µm

Larvae Detection Bottleneck

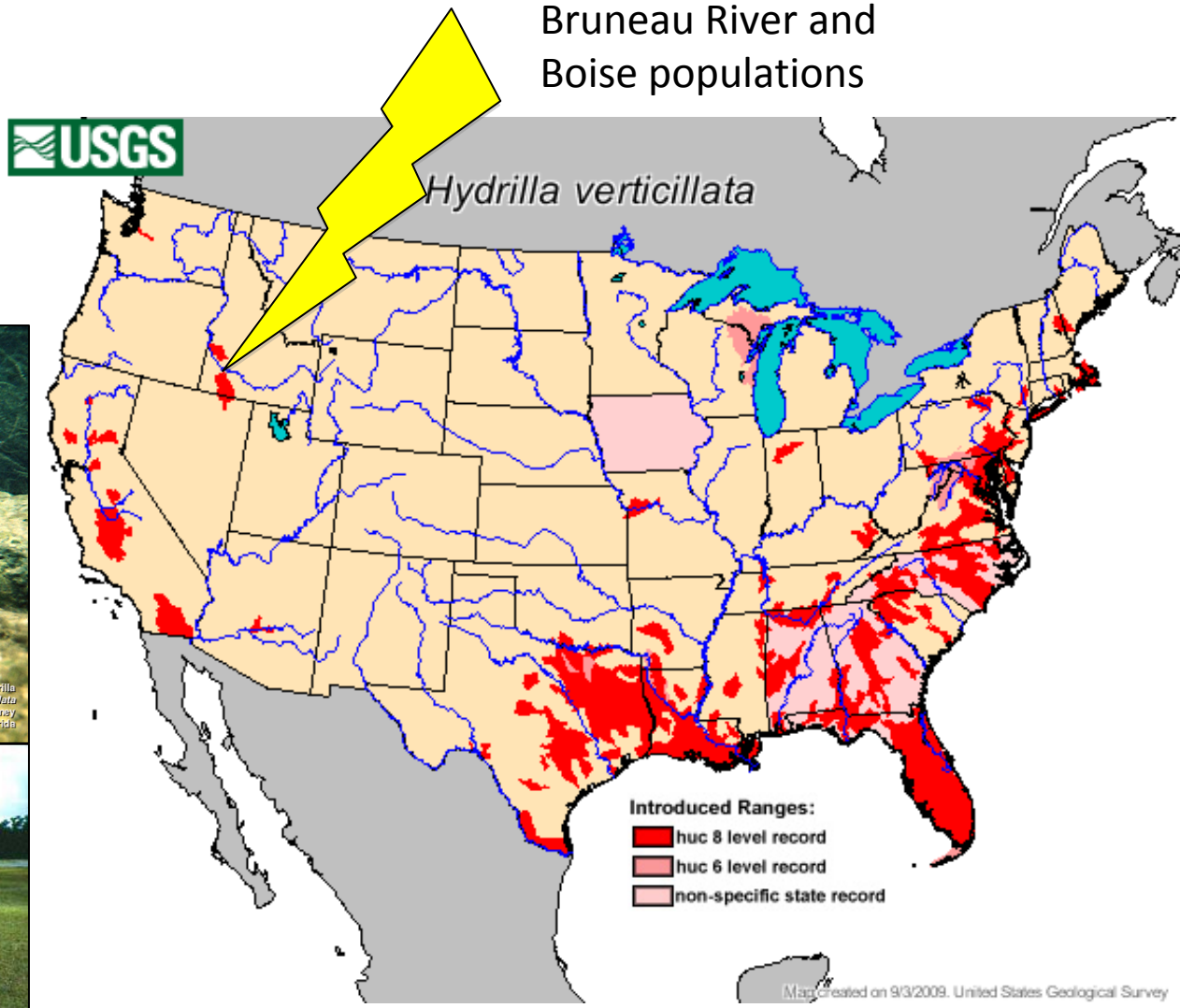
- Cross-polarized light microscopy
  - Slow but sure
- PCR
  - Potentially fast and accurate but needs standardization of procedures and testing on natural matrix samples
- FlowCam
  - Faster than human scope work. Accuracy?



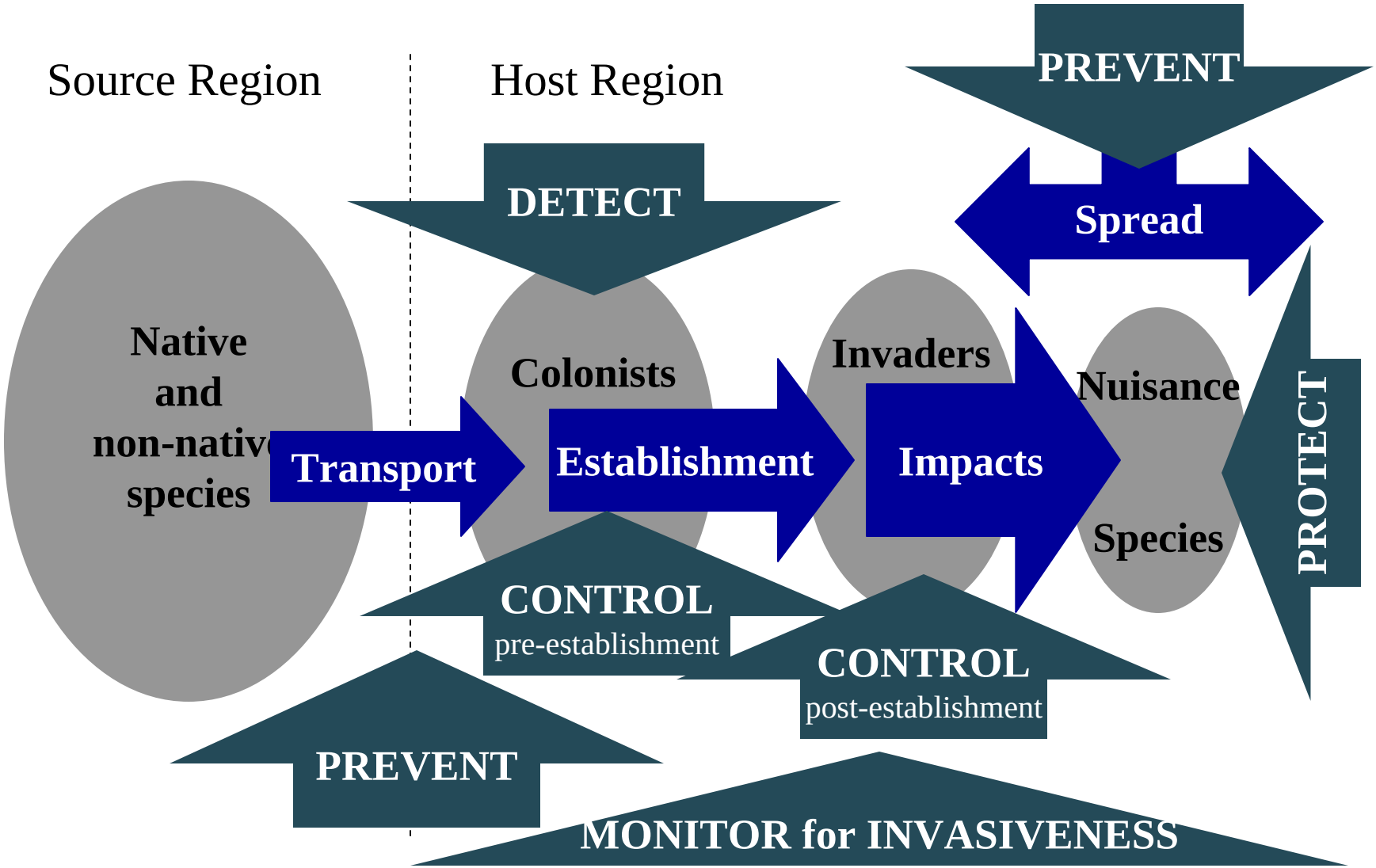
Hydrilla verticillata



Bruneau River and
Boise populations



Management


Source Region
Host Region
PREVENT
DETECT
Spread
Native and non-native species
Transport
Colonists
Establishment
Invaders
Impacts
Nuisance Species
PROTECT
CONTROL
pre-establishment
CONTROL
post-establishment
PREVENT
MONITOR for INVASIVENESS

Management Coordination

- National ANS Task Force
- Western Regional Panel of the ANSTF
- Columbia River Basin Team
- State Management Plans
- State Invasive Species Councils
- State Agency Activities

What's Needed?

- Enhanced early detection and rapid response capabilities
- Vulnerability assessments at federal hydro and fish passage facilities
- Research on management
- Permit issues need to be resolved


The End
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