

Regional Approach to Aquatic Weed Management

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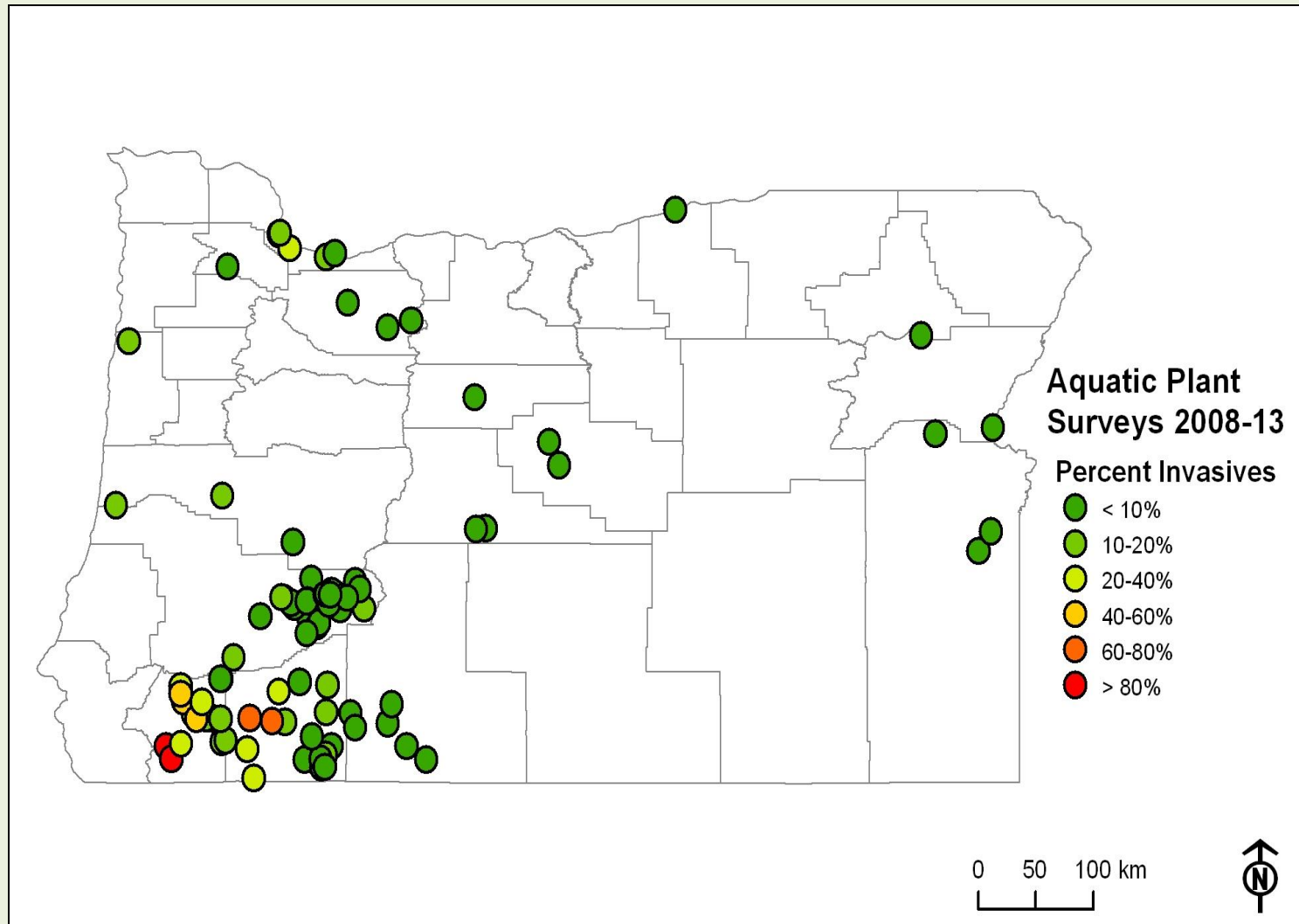
25 August 2015



Ecosystem Services Provided or Derived from FW Aquatic Systems

- Provisioning
 - Food
 - Freshwater
 - Fiber and fuel
 - Biochemical
 - Genetic materials
 - Biodiversity
- Regulating
 - Climate regulation
 - Hydrologic flows
 - Pollution control and detoxification
 - Erosion
 - Natural hazards
- Cultural
 - Spiritual and inspirational
 - Recreational
 - Aesthetic
 - Educational
- Supporting
 - Nutrient cycling
 - Pollination

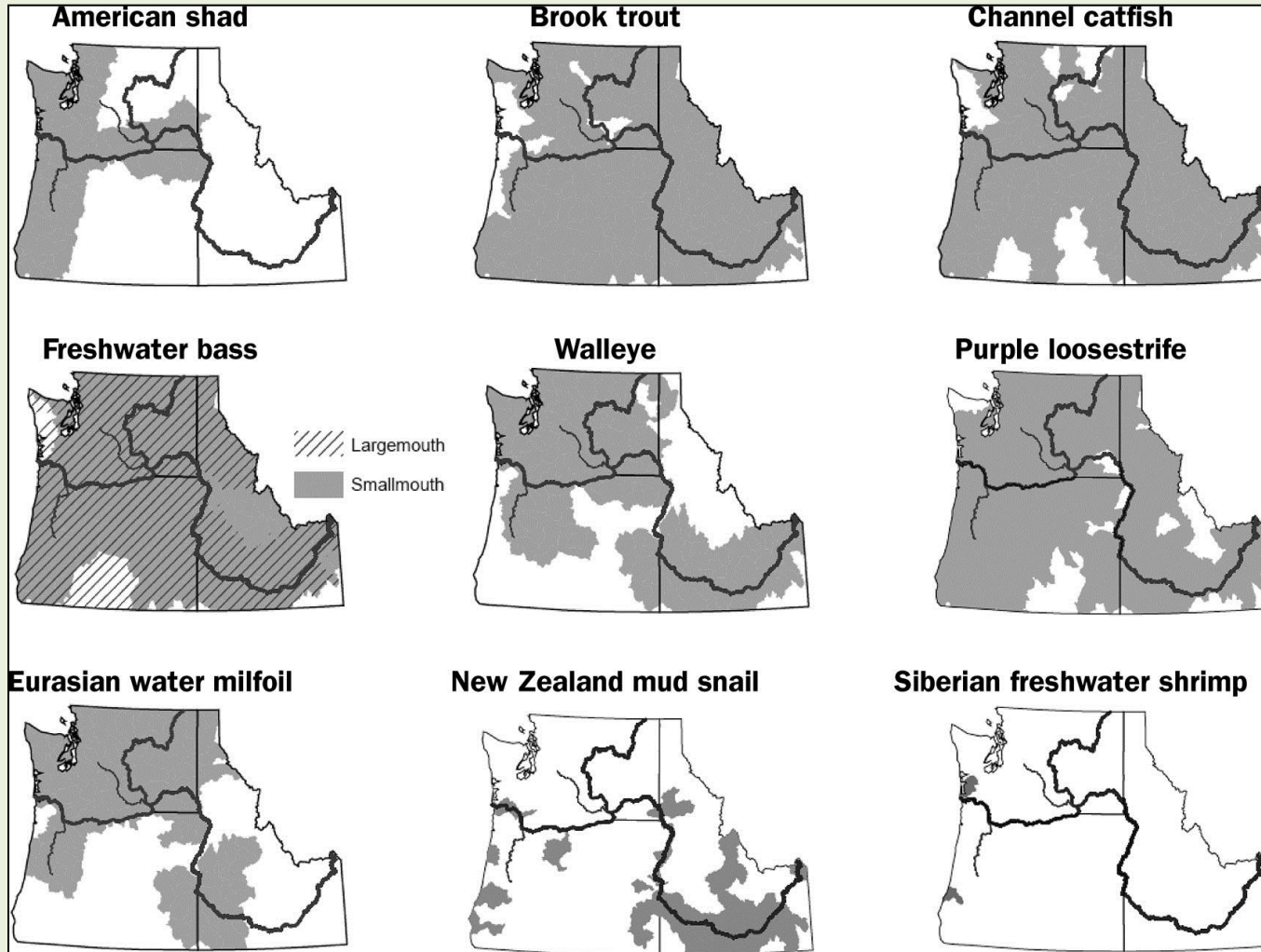
There is much to protect – Oregon example



Riparian weeds in the West

	% stream length containing at least one species	
Arizona	67.3	
California	44.6	Common burdock
Colorado	39.5	Canada thistle
N. Dakota	85.2	Cheatgrass
Nevada	56.4	English Ivy
S. Dakota	81.4	Giant reed
Utah	42.1	Himalaya blackberry
Wyoming	61.7	Leafy spurge
Washington	42.4	
Idaho	38.2	
Montana	42.0	
Oregon	37.9	

Invasive Species are a Regional Issue



Source: Sanderson et al. 2009. Bioscience .

Why do aquatic weeds matter?
What are the costs?

Total Economic Value of Ecosystem Services Provided by Wetlands

	\$/ha/yr
Provisioning services (Drinking water)	\$601
Cultural services (Recreation, aesthetics)	\$1373
Regulating services (Water purification)	\$1086
Supporting services (Hydrologic cycle, nutrient cycling, productivity)	\$214
Total value	\$3,274
	(\$1,321/acre/yr)



Photo: USEPA.2009. National Lakes Assessment

Economic Impacts of Selected Aquatic Weeds in Oregon

	Current Infestation		Susceptible Infestation	
	Acres	Economic Impact	Acres	Economic Impact
Purple Loosestrife	7,000	\$12,000	15,276,000	\$28,444,000
Spartina	<500	\$1,000	40,000	\$40,223,000
Knotweed	42,000	\$31,000	1,790,000	\$1,338,000
Egeria*			90,000	\$3,538,860

From: Economic Impact from Selected Noxious Weeds in Oregon (ODA 2014)

**Economic Analysis of Containment Programs, Damages, and Production Losses from Noxious Weeds in Oregon (ODA 2001)*

Loss of Ecosystem Services Due To Aquatic Weeds

Flood Control

\$1,000,000,000	11 counties in South FL	Rockwell 2003
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Recreation

\$1,300,000	3 lakes in IL	Singh et al. 1984
\$10,000,000	2 lakes in FL	Milon et al. 1986
\$100,000,000	Guntersville Reservoir, AL	Henderson 1995
\$45,000,000	4 lakes in Truckee watershed, CA	Eiswerth et al. 2000
\$84,000,000	BC (total FWM control program benefits = \$450M)	Newroth and Maxnuk 1993

Willingness to pay to prevent invasive species problems

\$/household

- Condition 1
 - Delay low impacts 1 year
- Condition 2
 - Delay high impacts 1 year
- Condition 3
 - Delay high impacts 10 years

Species group	Measures	Condition 1 (1 year)	Condition 2 (1 year)	Condition 3 (10 years)
Fishes	N	376	368	361
	Mean	\$57	\$53	\$122
	Median	\$10	\$20	\$25
	Mode	\$0	\$0	\$0
	St. dev.	\$276	\$118	\$357
Crustacean	N	415	410	392
	Mean	\$51	\$76	\$161
	Median	\$10	\$10	\$25
	Mode	\$0	\$0	\$0
	St. dev.	\$150	\$292	\$615
Mollusk	N	380	378	364
	Mean	\$41	\$59	\$170
	Median	\$10	\$20	\$25
	Mode	\$0	\$0	\$0
	St. dev.	\$164	\$142	\$375
Plant	N			
	Mean	\$54	\$74	\$189
	Median	\$10	\$20	\$25
	Mode	\$0	\$0	\$0
	St. dev.	\$188	\$279	\$812
All	N	355	355	351
	Mean	\$62	\$79	\$246
	Median	\$10	\$20	\$25
	Mode	\$0	\$0	\$0
	St. dev.	\$281	\$295	\$1024

There are 1.5 million households in Oregon

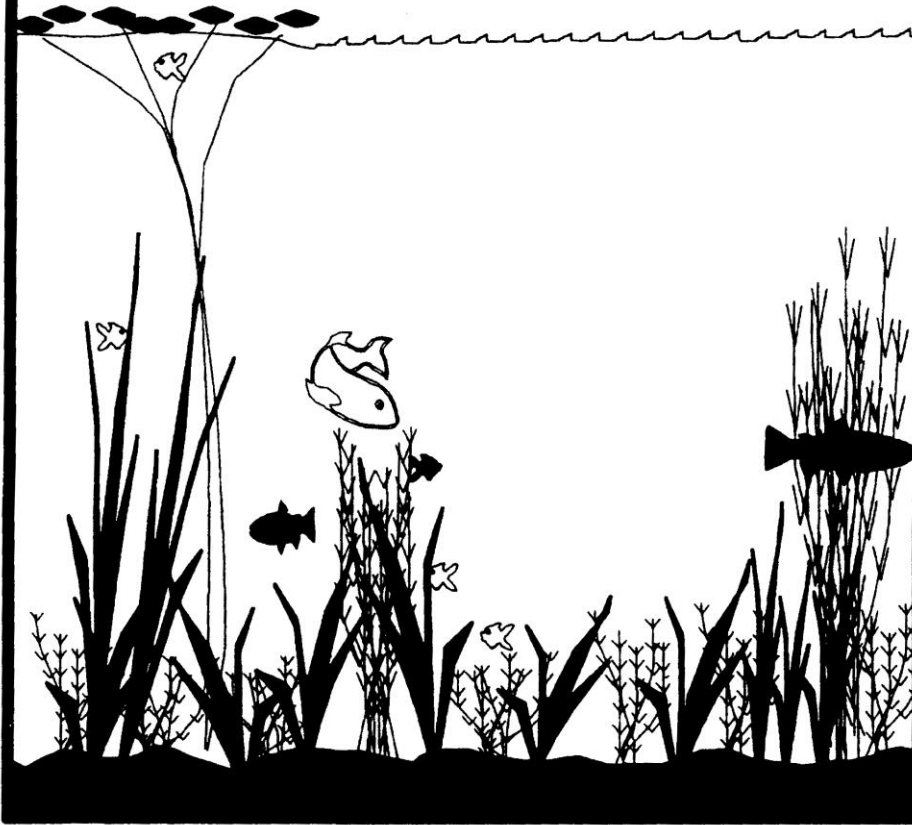
Alien Plants Have Large Impact on Threatened and Endangered Species

Causes of decline	All species [930]	Plants [602]	Birds [68]
Direct human habitat destruction and fragmentation, including logging, road building and diversion of water	497	233	48
Exploitation (hunting, fishing and collecting) and poisoning and/or trapping	90	19	11
Fire and changes in fire regime	102	92	1
Pollution (herbicides, pesticides, oil spills, etc.)	32	4	5
Invasive alien predators and herbivores	131	73	39
Alien plants: competition and indirect habitat effects	431	410	19
Competition with exotic animals (excluding feral and domestic animals) ^b	67	0	14
Feral pigs (herbivory, predation, competition and/or habitat effects)	268	257	8
Grazing and/or trampling by domestic and feral cattle, goats, sheep, horses and burros	327	295	13
Hybridization with alien species	22	5	0
Diseases (including alien and native species)	33	3	23
Parasites (physiological and behavioral)	3	0	2
Other or unknown	169	134	8

^aReclassification of data on all of the cases in which species were categorized as being imperiled by aliens by Wilcove *et al.* ([1], <http://www.natureserve.org>). Categories are nonexclusive and so numbers do not sum to total species numbers.

^bWe believe that domestic cattle should be categorized separately from alien invasive species, even though they are non-native in most areas in which they affect native species. Unlike invasive aliens, the population sizes and distribution of cattle are usually controlled by humans. Thus, cattle are not invasive in any of the usual meanings of the word, although they might have large effects on native populations, communities and ecosystems.

A. Diverse native community



Open water surface

Patchy vegetation = habitat for invertebrates
(fish food)

Good dissolved oxygen concentration and pH

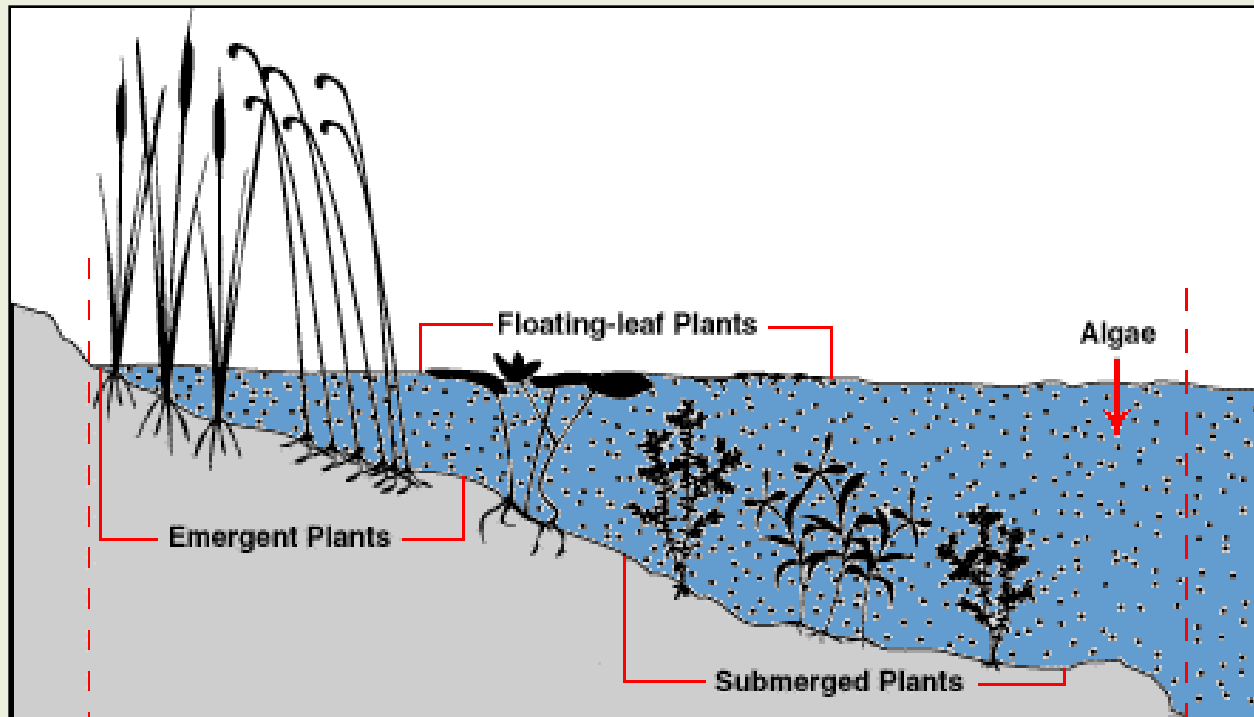


Surface mats impact recreation

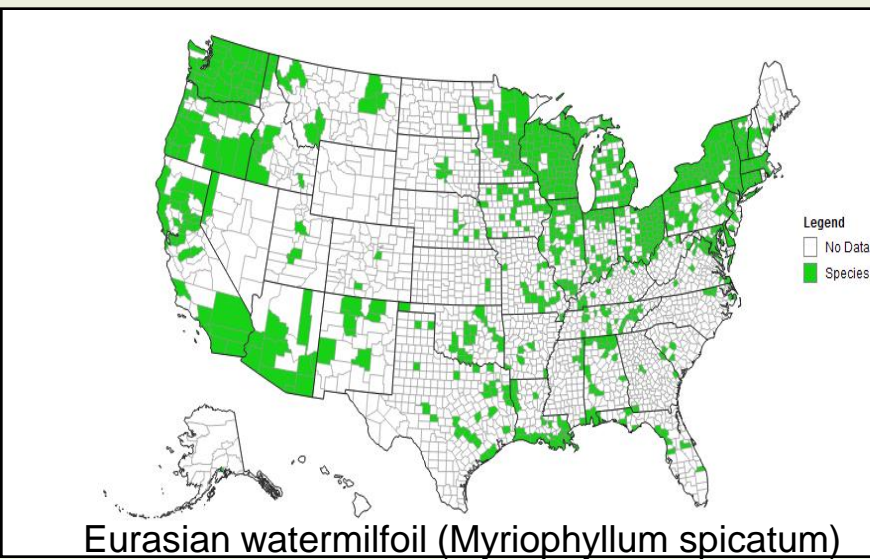
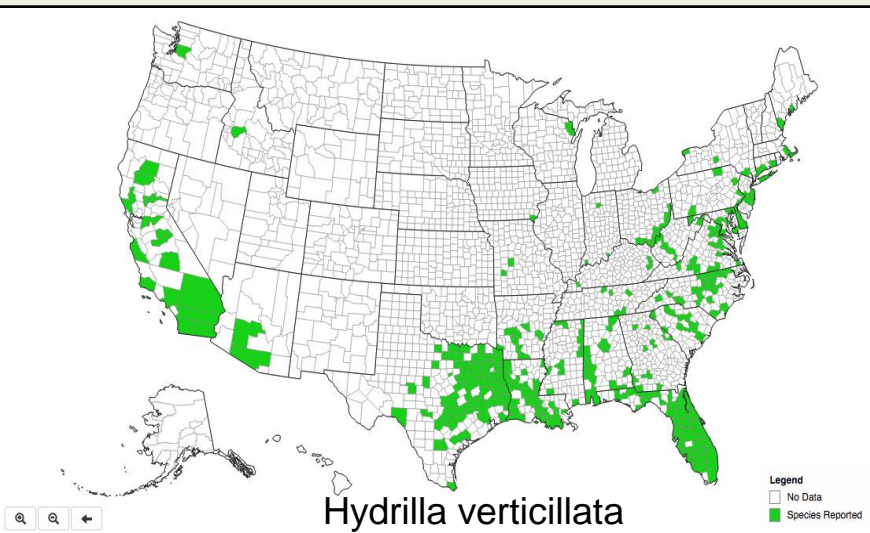
Large temperature, dissolved oxygen, and pH
fluctuations

Stunted fish

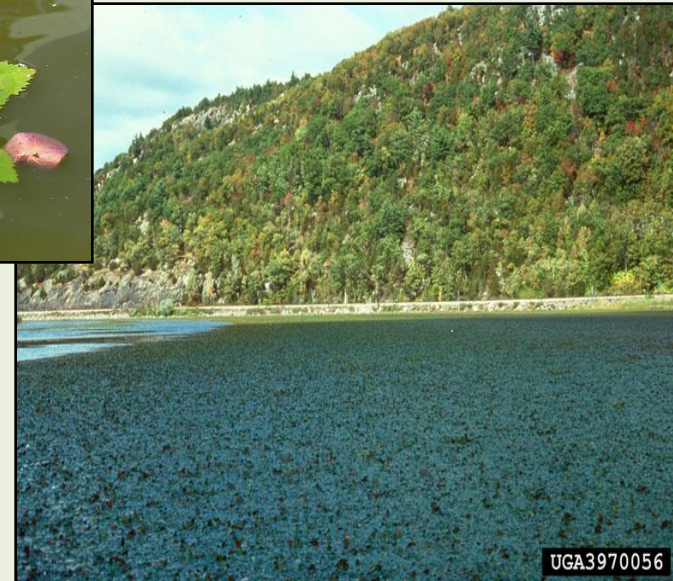
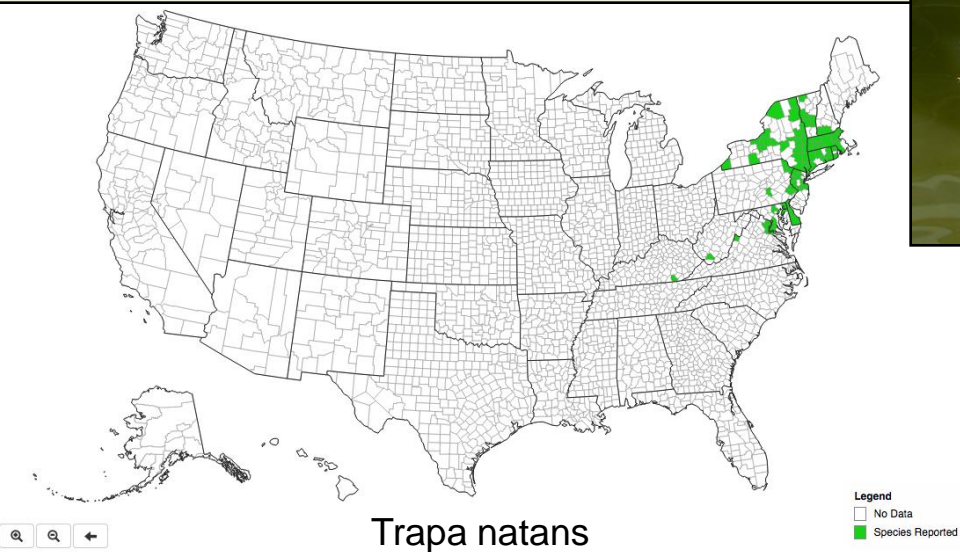
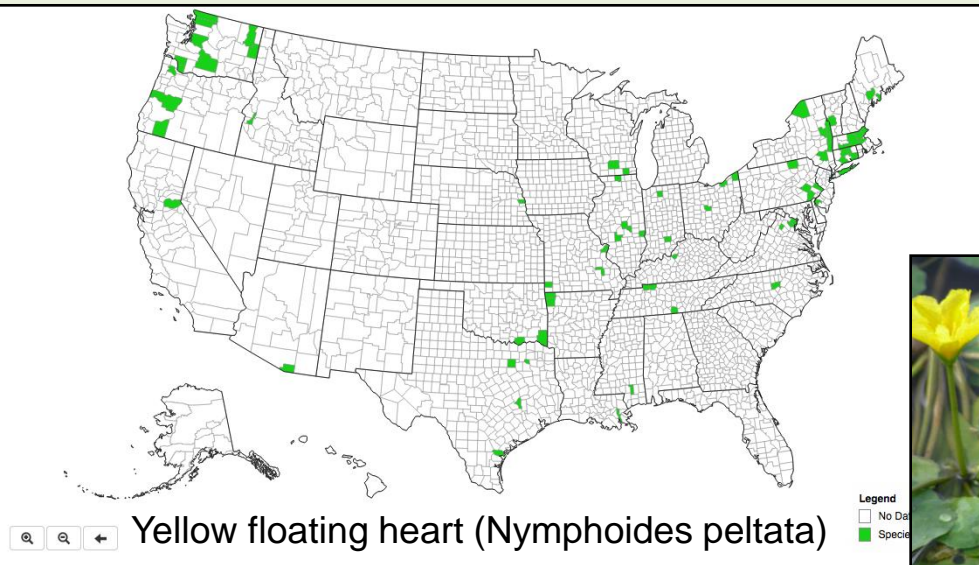
Species of concern



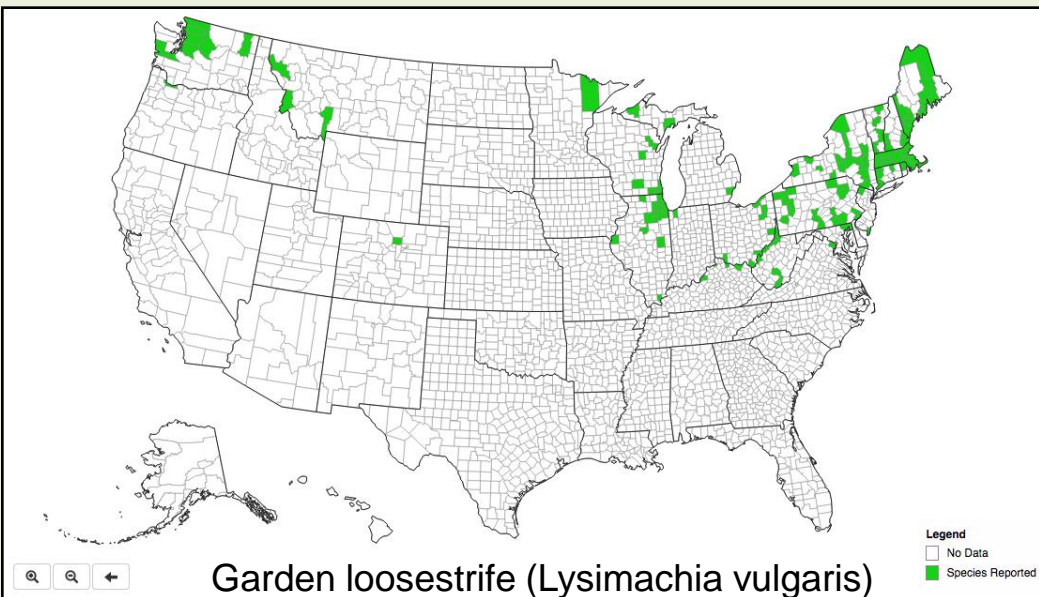
Submersed plants



Floating leaf plants



Emergent plants



Garden loosestrife infestation at Marymoor Park

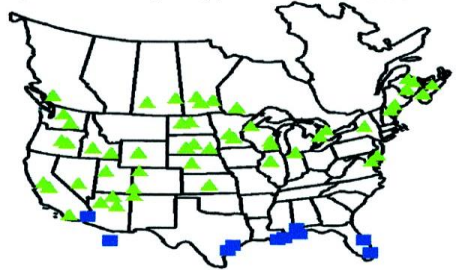
a) Native Haplotypes Before 1910



b) Invasive Haplotype Before 1910



c) Native Haplotypes After 1960



d) Invasive Haplotype After 1960



Reed (*Phragmites australis*)

Invasive Phragmites

Native Phragmites



Vectors

- Ballast Water
- Live Bait
- Aquaculture
- Aquarium and Pet Trade
- Recreational Boating
- Hunting and Angling
- Intentional Release
- Horticultural escapes
- Wildlife Restoration



Examples of Regional Management Success

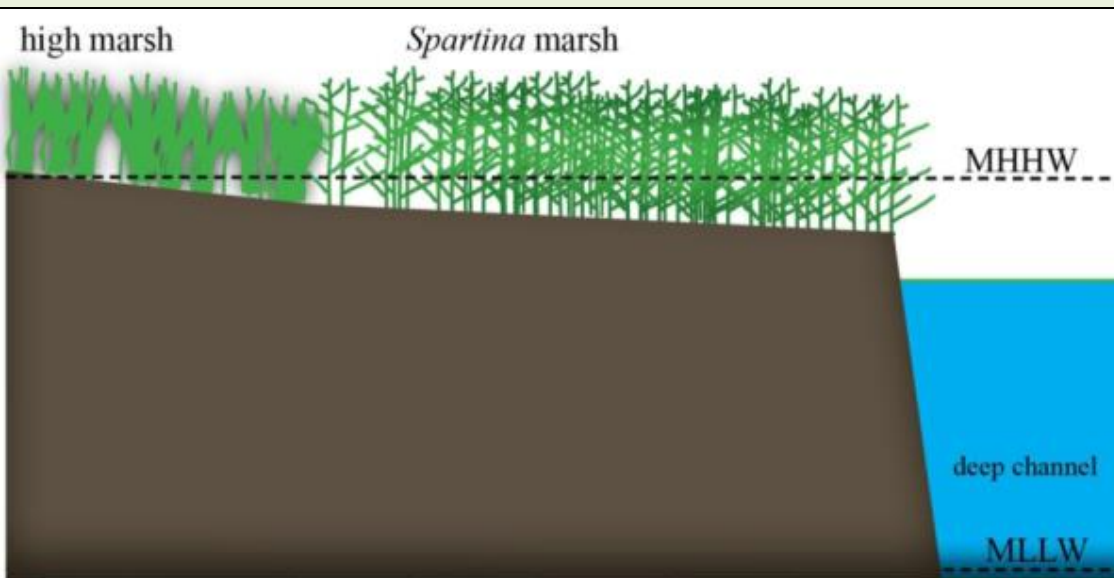
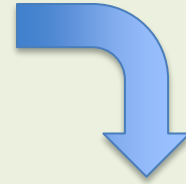
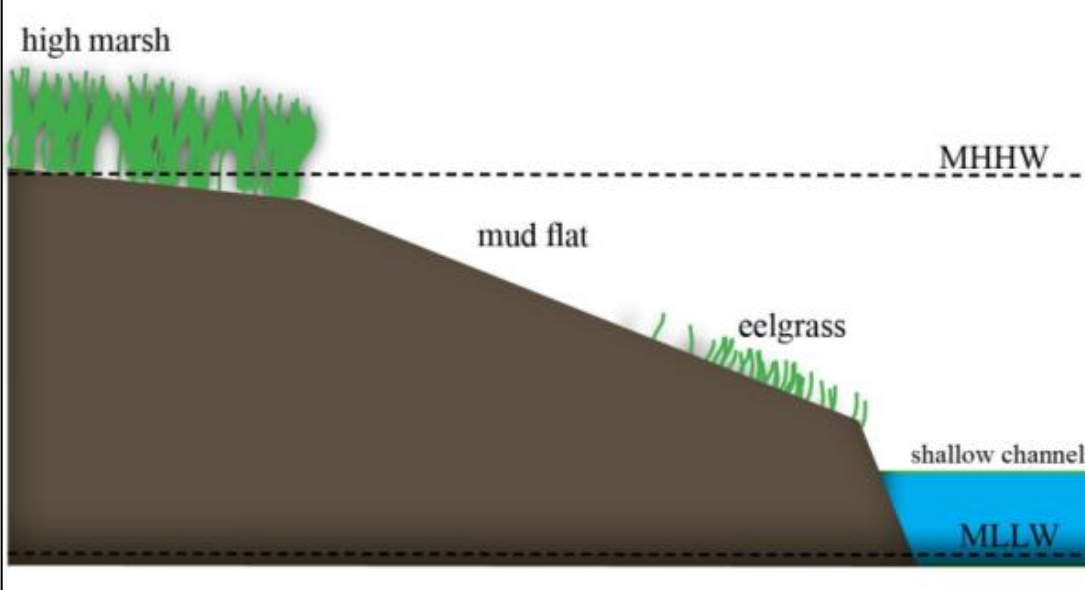
Saltmarsh cordgrass
(*Spartina spp*)

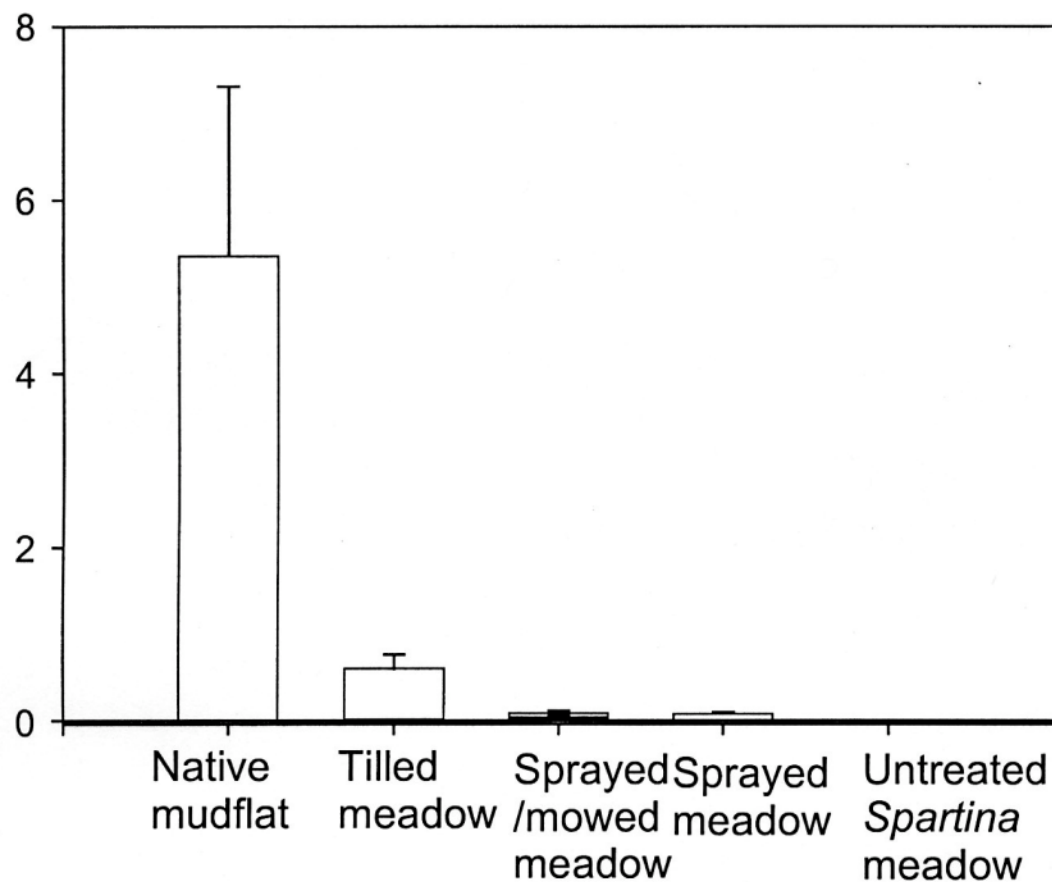
Flowering rush
(*Butomus umbellatus*)

Spartina spp.

- 1 native in CA (*S. foliosa*)
- 4 non-native, invasive species
 - *S. alterniflora* (Eastern & Gulf coast of North America)
 - *S. patens* (Eastern & Gulf coast of North America)
 - *S. anglica* (hybrid of English *S. maritima* & *S. alterniflora*)
 - *S. densiflora* (South America)
 - *S. foliosa* x *S. alterniflora* hybrid



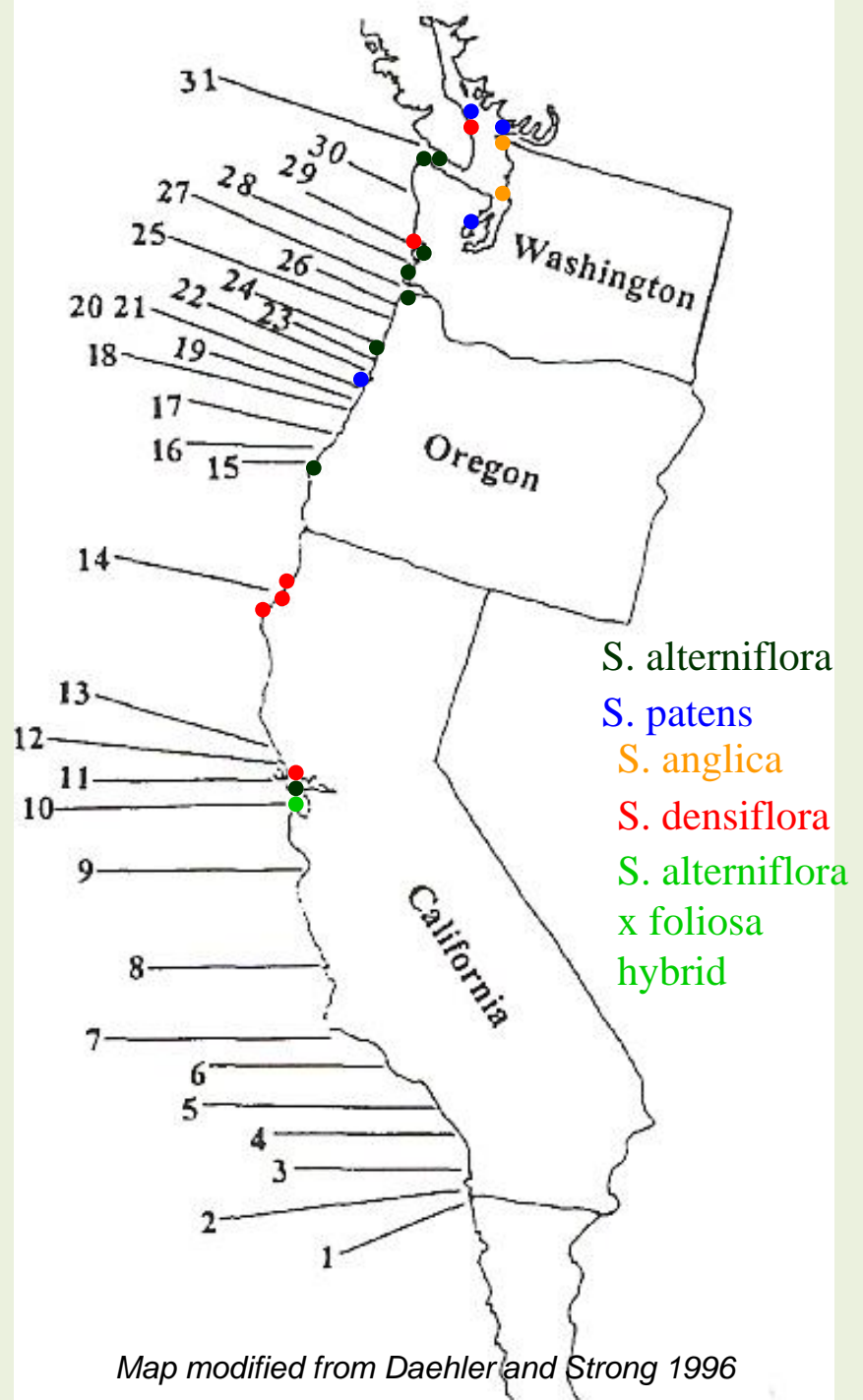




From: Patten, K. Shorebird, waterfowl, and birds of prey usage in Willapa Bay in response to *Spartina* control efforts. WSU Long Beach Extension Unit

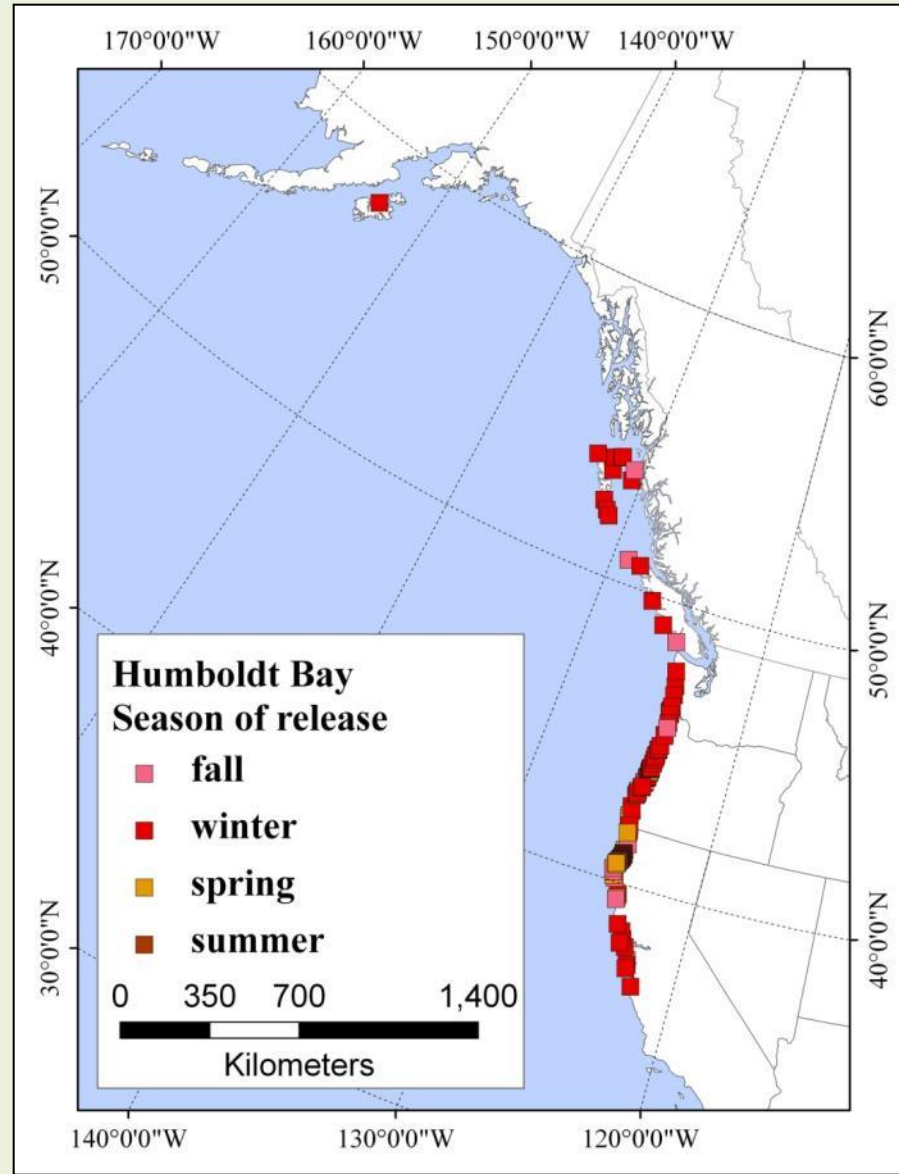
Spartina spp. Distribution

Comox Harbor, BC
Baynes Sound, BC
Fanny Bay, BC
Boundary Bay, BC
Puget Sound, WA
Gray's Harbor, WA
Willapa Bay, WA
Siuslaw River, OR
Coos Bay, OR
Sand Lake, OR
Humboldt Bay, CA
San Francisco Bay, CA



Map modified from Daehler and Strong 1996

Drift card study demonstrates that *Spartina* is a regional problem



WEST COAST GOVERNORS' AGREEMENT on OCEAN HEALTH

WASHINGTON OREGON CALIFORNIA



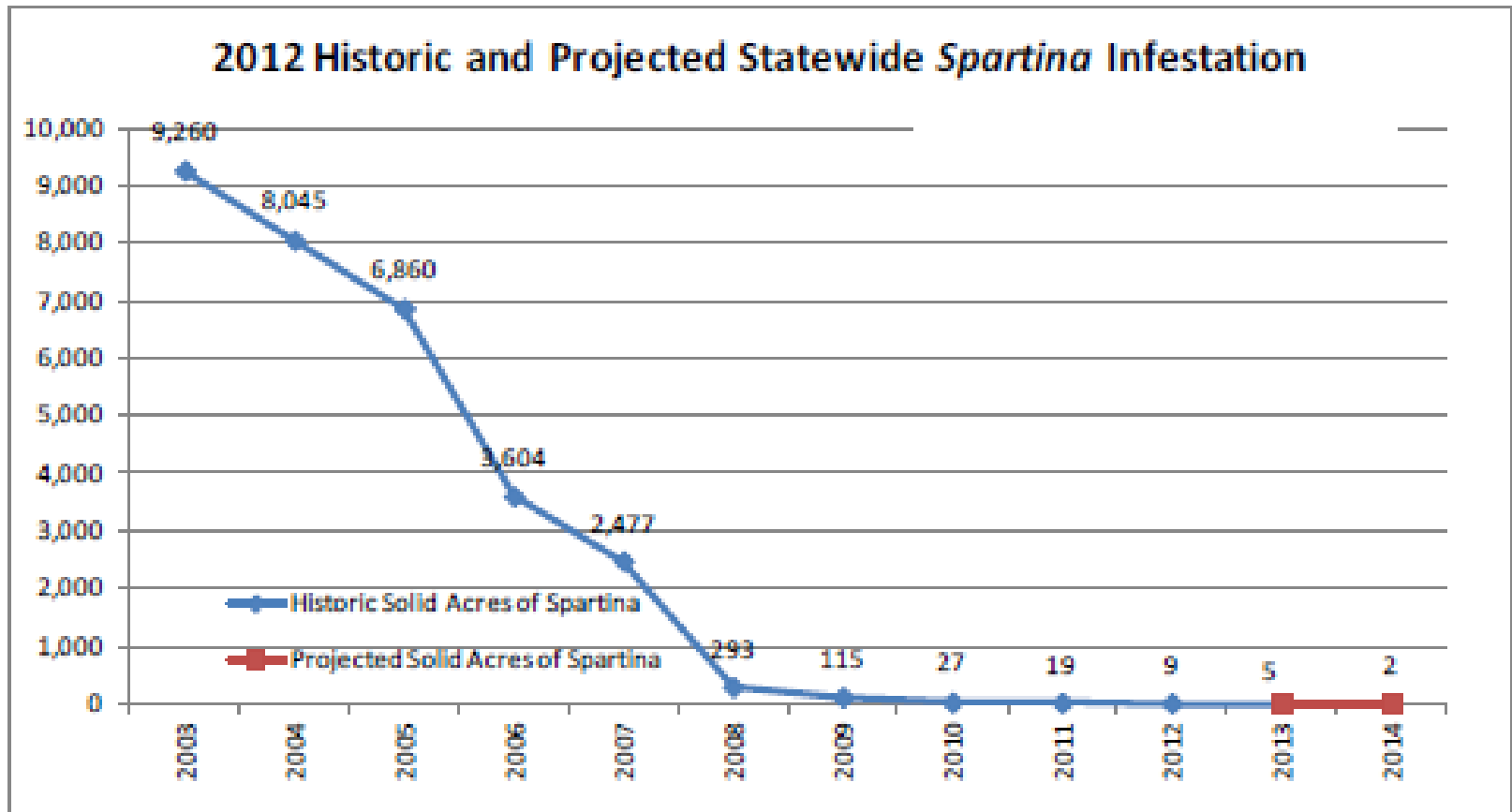
Action Plan

THE OFFICE OF THE GOVERNORS
WASHINGTON, OREGON, AND CALIFORNIA



2006

Willapa Bay



15,000 acres of Spartina in Willapa Bay in 2002

Nahcotta, Willapa Bay, WA
2005

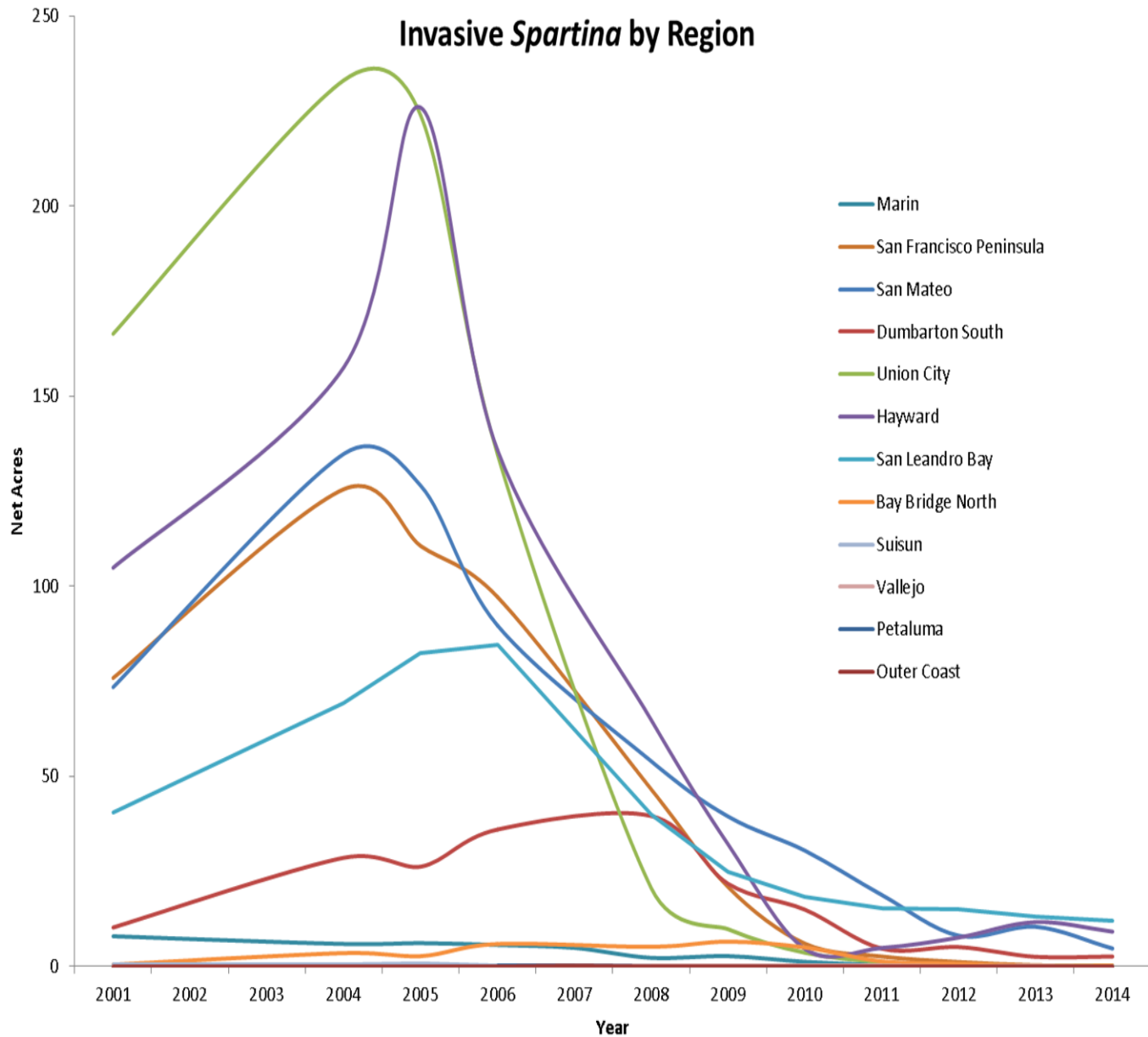


Photo WDFW

Nahcotta, Willapa Bay, WA
2008

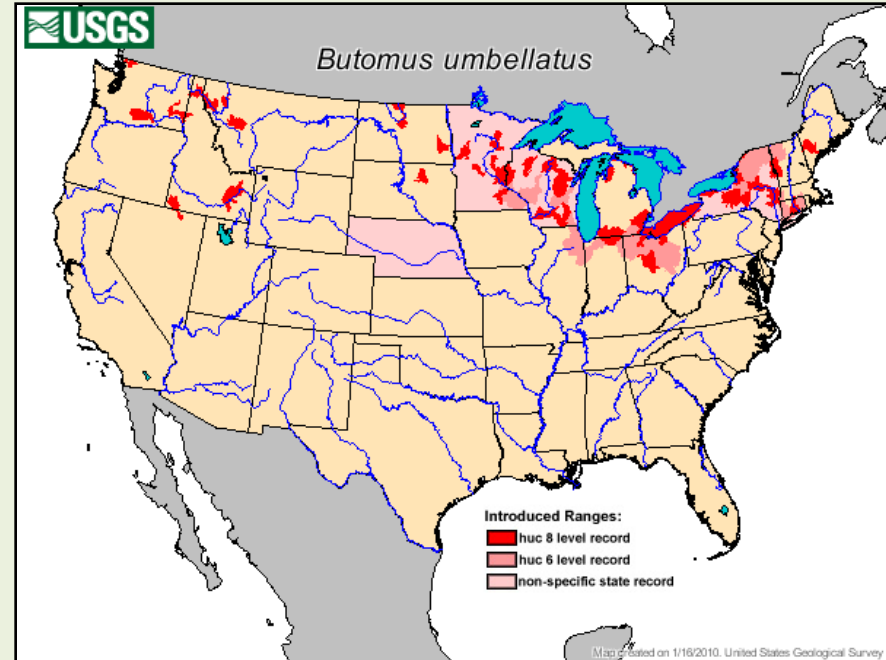


San Francisco Bay



Flowering rush (*Butomus umbellatus*)

East Bay, Flathead Lake, MT



circa 1895-1905 St. Lawrence River
1949 Snake River Idaho (Idaho Falls)
1964 Flathead Lake (north shore)

Flowering Rush Biocontrol Consortium

- Consortium formed in 2012
 - partnership between CABI Switzerland, WA, MT, ID, B.C., AB, MN, MS, OR
- Center for Agriculture and Biosciences International (CABI)
 - International (40 member countries) not-for-profit organization
 - experts in biocontrol research & development
- Widespread, established populations in upper Columbia Basin – spreading downstream
- Difficult to control with mechanical and chemical techniques
- Only species in Butomaceae family – increases likelihood for a host-specific biocontrol agent
- Biocontrol may provide long-term solution
 - rhizome-feeder needed for maximum impact
- Pursue funding

CABI Overseas Field Surveys

- sites visited in Germany, Czech Republic, Slovak Republic, Hungary, Serbia, Poland, Switzerland

<i>Bagous nodulosus</i> (a)	weevil	monophagous
<i>Bagous validus</i> (b)	weevil	monophagous
<i>Donacia tomentosa</i> (c)	leaf beetle	monophagous
<i>Phytoliriomyza ornata</i> (d)	agromyzid fly	monophagous
<i>Hydrellia concolor?</i> (e)	ephydrid fly	monophagous
<i>Glyptotendipes viridis?</i> (f)	chironomid fly	monophagous



Preliminary host-choice tests on *B. nodulus* (sequential adult feeding & oviposition tests) found no oviposition on nontarget species but a little adult feeding. So far looks promising

Recommendations

- Avoid parochialism – regional problems require regional solutions
- Prioritize species and develop effective management strategies – e.g., biocontrol for established species, new herbicide tools
- Develop better understanding of vectors and cooperate in vector management – as we are doing on mussels
- Develop a shared funding model to facilitate rapid response and research to protect the region from priority species – e.g., **Interstate Aquatic Pest Management Compact** modeled on existing Interstate Pest Management Compact targeting agricultural pest

