AQUATIC INVASIVE SPECIES UNIT

Washington State Department of Fish and Wildlife

Photo courtesy: Jesse Schultz

https://flatheadlakers.org/programissues/thwarting-aquatic-invaders/zebra-mussels-other-invaders/

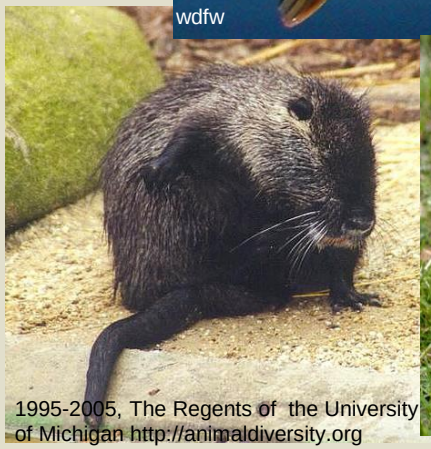
Photo courtesy: Chelsey Buffington

What is a successful Aquatic Invasive Species (AIS)?

- Introduced organism, nonnative to ecosystem
- Ex. European green crab in Maine
- Highly adaptive
- Rapid reproduction
- Must find niche
- Outcompetes native species
- Alters ecosystems
- Reduces recreation
- Negatively impacts human and pet health
- Aesthetic value of nature
- $$$$$$$$$$$$$$$$$$$$$$


Newport Bay Conservancy


wdfw


1995-2005, The Regents of the University of Michigan http://animaldiversity.org


Gary M. Stolz USFWS

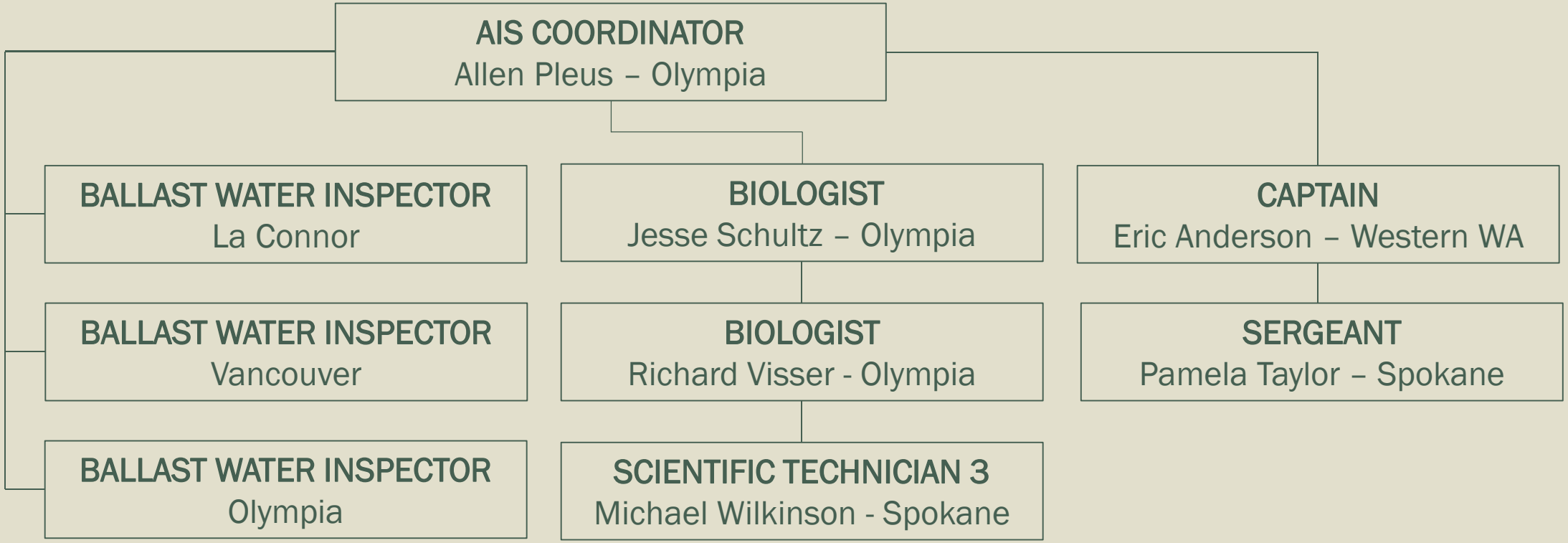
Beneficial Nonnatives

- They’re not all bad!
- Most common harvests
- Manila Clams
- Pacific Oysters

www.asnailsodyssey.com/LEARNABOUT/CLAM/clamType.php

https://www.finecooking.com

WDFW AIS Unit Permanent Staff

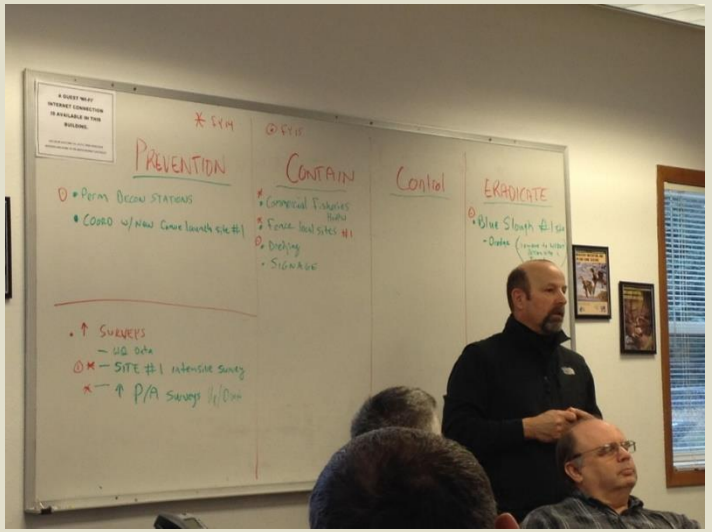


Ballast Water

- Established in 2000
- Minimize AIS risk
- Funded through Aquatic Lands Enhancement Account (ALEA)

Everything else, besides ballast water

- Established mid 1990s
  - *Zebra/Quagga mussels*
  - *European green crab*
  - *Atlantic Salmon*
- To prevent spread and establishment of AIS
- Prevention Account 2005
  - *Watercraft registration*



Why is WDFW managing AIS?

Revised Code of Washington 77.135

- RCW 77.135.020
  - *The department is lead agency for managing invasive species of the animal kingdom statewide.*

- Washington State Legislature
  - *http://app.leg.wa.gov/rcw/default.aspx?cite=77.135*

Revised AIS Laws Code of Washington 77.135

- RCW 77.135.040
  - *Prohibited and regulated species, NZMS and zebra/quagga mussels are listed as prohibited.*
- RCW 77.135.100
  - *Aquatic conveyance certificate of inspection.*
- RCW 77.135.110
  - *Aquatic conveyance clean and drain requirements.*
- RCW 77.135.120
  - *Conduct mandatory aquatic conveyance check stations.*

How does WDFW prevent and monitor for AIS?

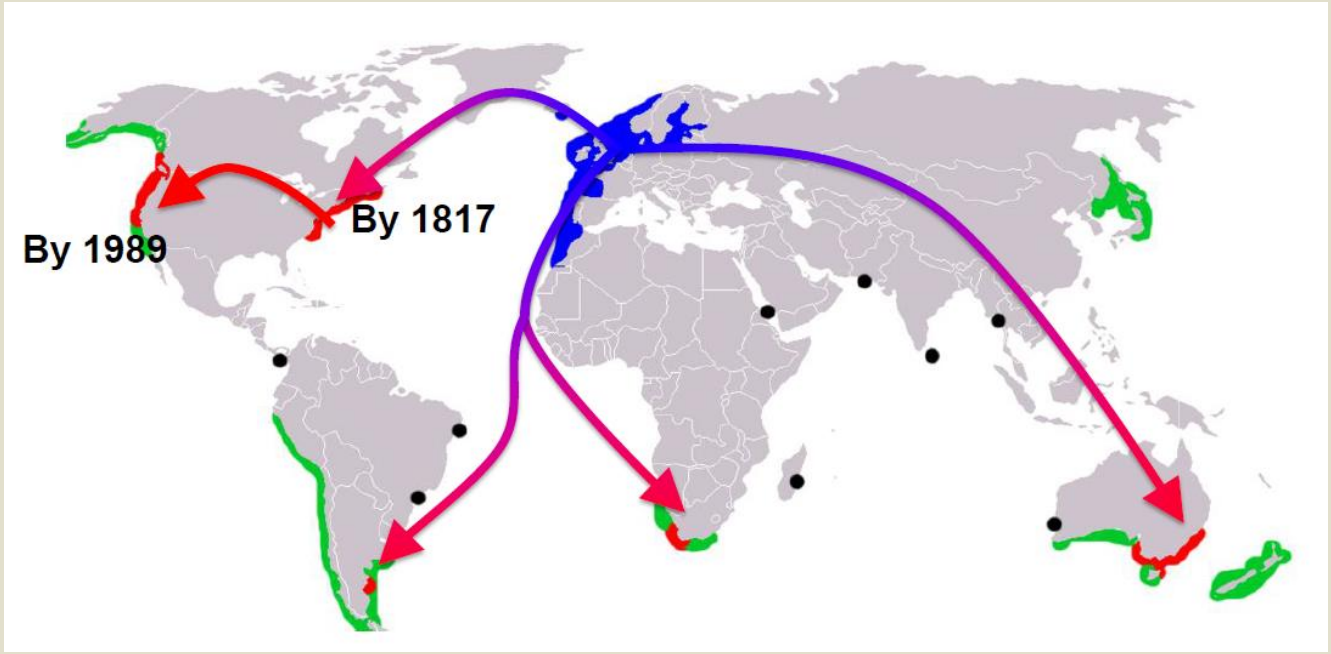
- Internal policy
- Regional coordination
- Outreach and education
- Revised AIS laws
- Early detection monitoring
- Incident response
- AIS identification
- Watercraft inspection check stations

EUROPEAN GREEN CRAB

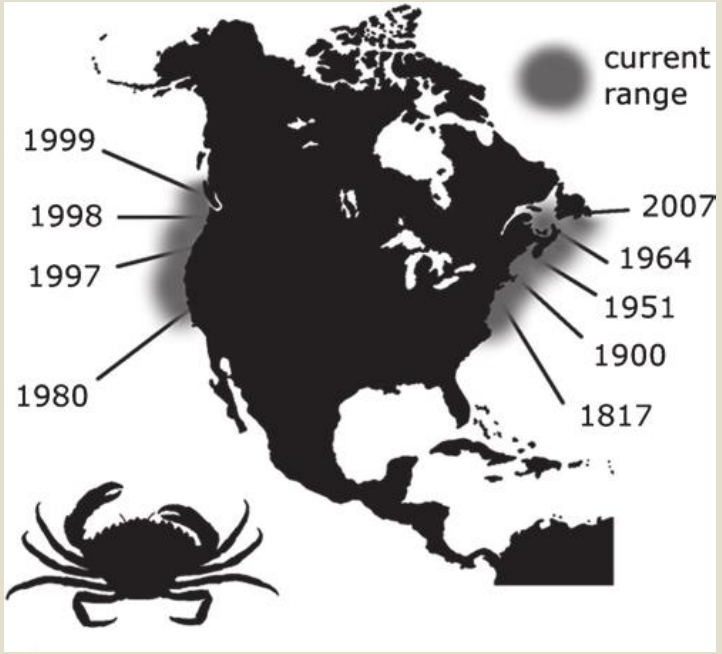
Carcinus maenas

Chelsey Buffington WDFW

Where did they come from?



European green crab distribution extent (Jeff Adams WSG)

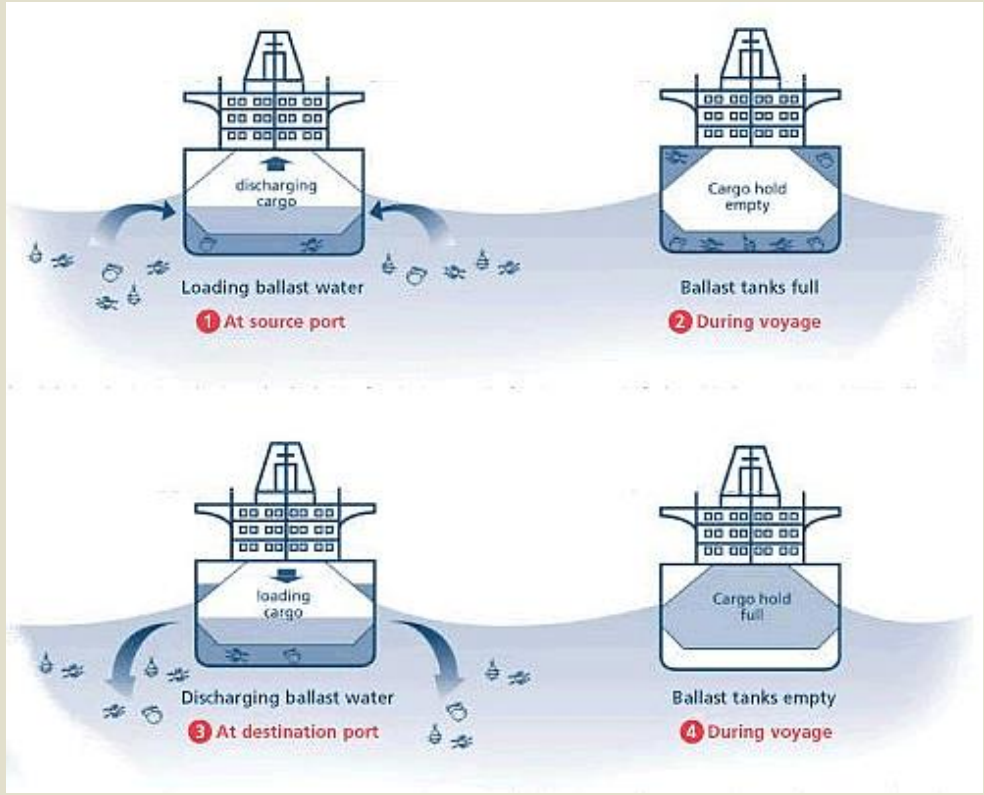


Timeline of invasion (Edgell and Hollander 2011)

- Native to NE Atlantic Ocean and Baltic Sea, ranging from Northern Africa to Norway and Iceland
- 19th century introduction to the eastern part of US, NY or NJ.
- 1989-90 California, colonized San Francisco Bay.
- 1997 Oregon, Coos Bay, Tillamook, Yaquina, Netarts…
- 1998 Washington, Grays Harbor and Willapa Bay, Makah and Dungeness Spit (2017)…
- 2013 Sooke Basin, BC.

How did they get here?

- Not 100% known.
  - *Most likely arrived via ballast water to the US.*
- Northward distribution from CA also unknown.
  - *Transport of larvae by ocean currents*
  - *Ballast water exchange*
  - *Transfer of live shellfish, bait, or aquaculture equipment*
- Uniform distribution likely suggest planktonic dispersal of larval stages (ANSTF).



Ballast water – hitch-hiking invasive species. Source: http://globallast.imo.org/

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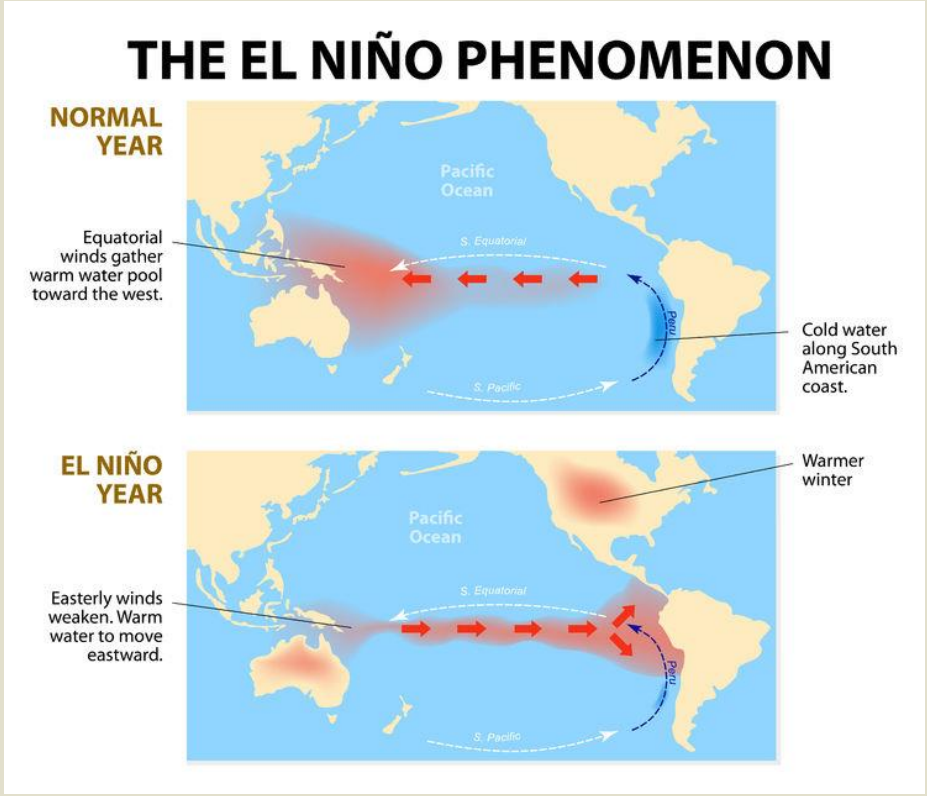


El nino vs La nina http://www.socialstudiesforkids.com/articles/geography/elnino-lanina.htm

What makes them a dangerous invasive?

- Potential to alter any ecosystem where they become established.
- Threat to our native Dungeness crab.
  - *UW study found that EGC can out compete Dungeness for food and habitat*
  - *They can improve prey-handling skills while foraging*
- Prey on bivalves and other crustaceans (clams, oysters, mussels, small crustaceans).
  - *Humbolt Bay, CA: manila clam harvest has dropped 40% since establishment*
- Compete with native fish and shore birds for food.

EGC eating a clam
https://ferrebeekeeper.files.wordpress.com/2013/12/shore-crab-eating-clam_paul-naylor_fre.jpg

What is their preferred crabitat?

- Habitat
  - *Protected rocky shores*
  - *Cobble beaches*
  - *Sandflats*
  - *Tidal marshes*
  - *Pocket estuaries*
- Salinities 4-54 ppt
- Temperatures 0-33°C (32-92°F)
- Keep in mind they have wide tolerances and can be found in areas you wouldn't expect to see them.

Tidal channels at Walan Point (left) and Foulweather Bluff (right)

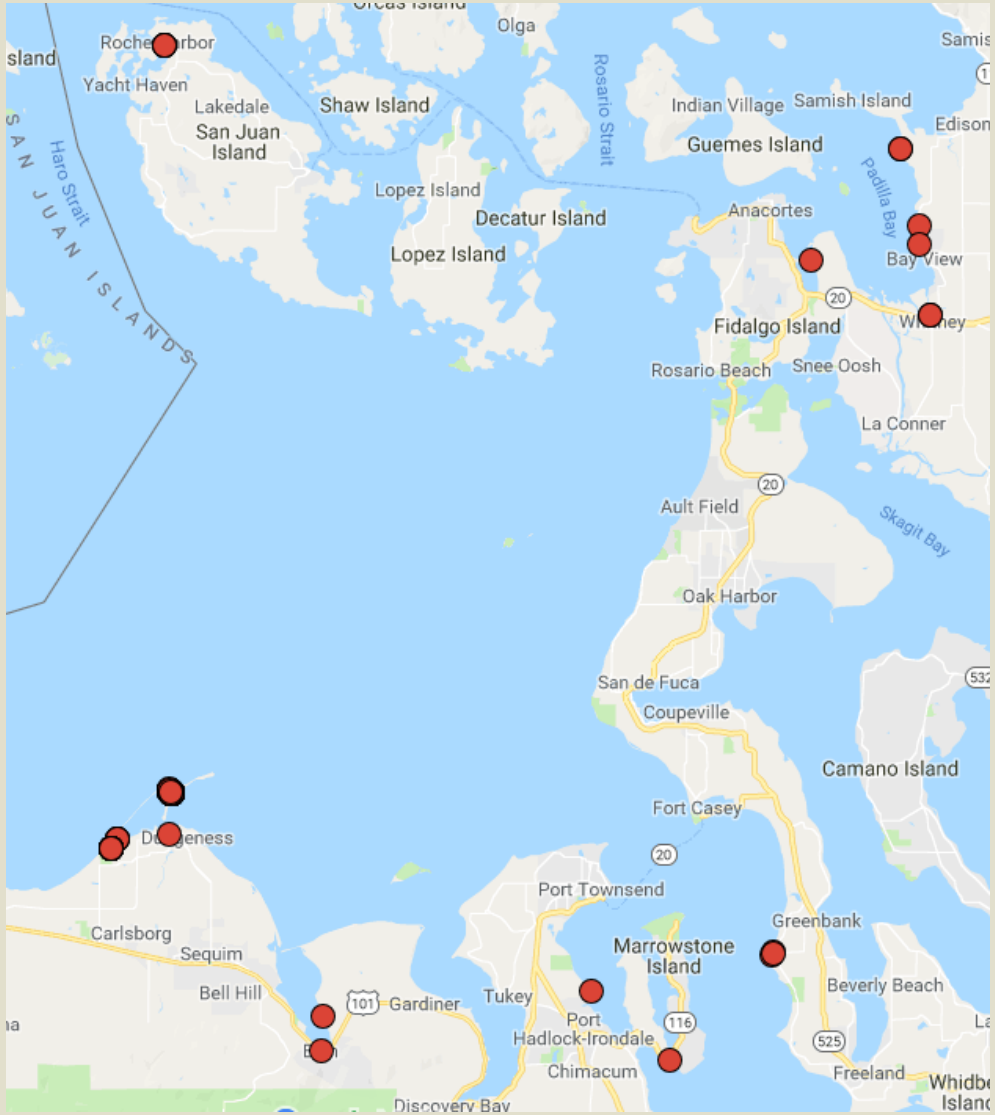
Classification

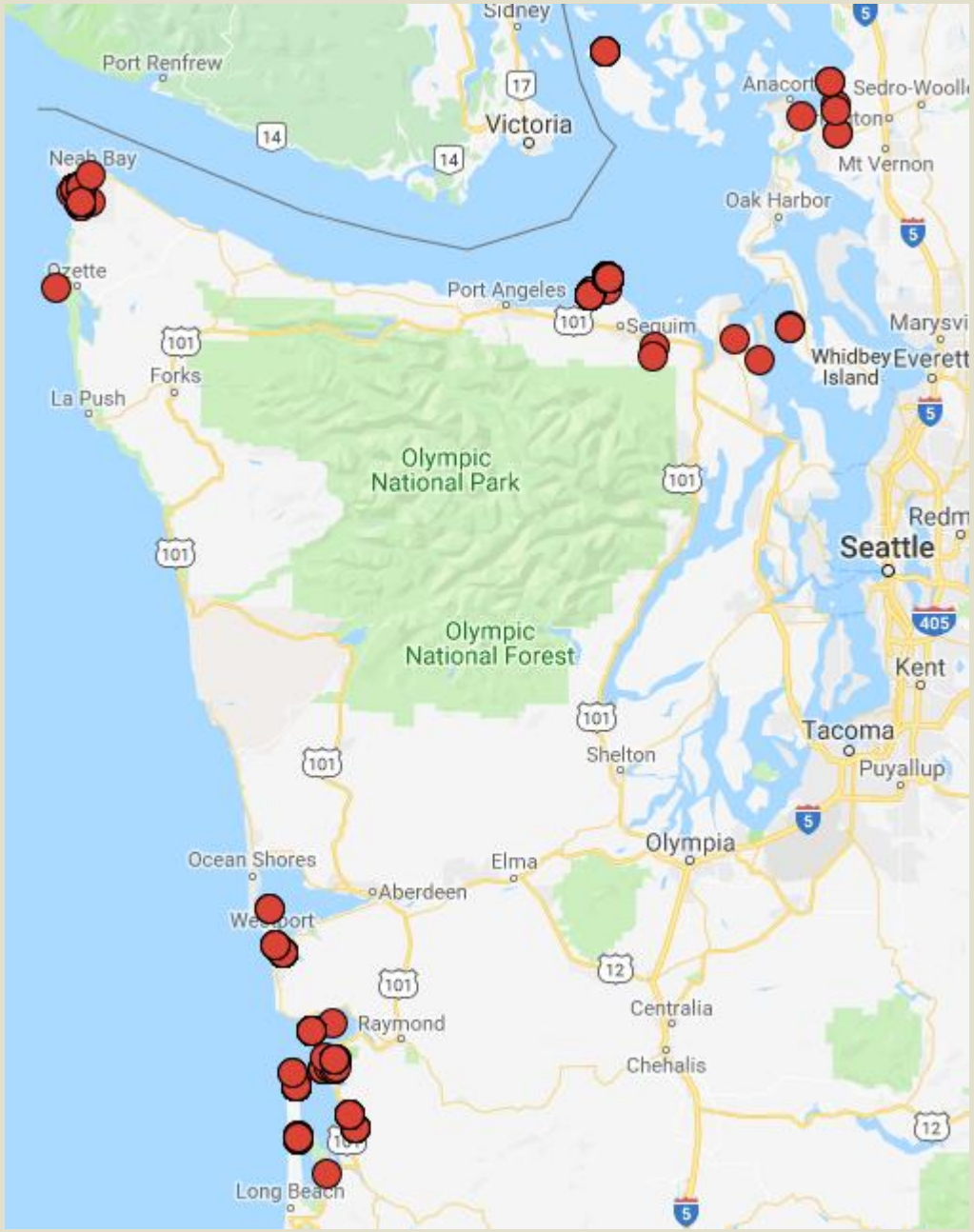
- Prohibited Level 1 Species
  - *(1)(a) Species classified as prohibited level 1 pose a high invasive risk and are a priority for prevention and expedited rapid response management actions.*
  - *Early Detection Monitoring*
    - Time to rally resources
    - Less expensive management
    - Higher management success rate
  - *Rapid Response*
    - Best chance at control/eradication

Minnow trap at Fidalgo Bay (Photo: Chelsey Buffington)

EGC captured at Westcott Bay Marsh, San Juan Island (photo: Chelsey Buffington)

EGC detections in WA





What is being done about EGC in WA?

- San Juan/Padilla Bay
  - *Late summer 2016 EGC detected*
    - WSG, WDFW, PBNERR early detection and rapid response
  - *Scattered detections at Padilla Bay and few captures at Westcott Bay show little concern for viable population growth*
  - *2018: WDFW follow-up assessment*
  - *Ongoing WSG early detection monthly monitoring stations and trapping efforts by PBNERR*
- Dungeness Spit National Wildlife Reserve
  - *2017*
    - April 12: 4 EGC captured during early detection monthly monitoring
    - Rapid response: USFWS, WSG, WDFW conducted intense trapping and removal efforts
    - Total of 96 for the season
  - *2018*
    - Ongoing efforts from USFWS and volunteers with aide from WDFW
    - WSG monthly monitoring
    - Total of 69 for the season

European green crab at Dungeness Spit (photo: Allen Pleus WDFW)

Lorenz Sollmann USFWS (photo: Allen Pleus WDFW)

What is being done about EGC in WA?

European green crab at Makah Bay (photo: Zach Moore USFWS)

- Makah Bay/Neah Bay
  - *2017*
    - August: 1st EGC detection reported to WSG tipline (w/photo) at Hobuck Beach
    - October: rapid response by Makah Tribe, WDFW, USFWS, w/support from WSG, around Wa'atch and Tsoo-Yess river systems
    - Total of 34 EGC, plans underway for next year trapping season
  - *2018*
    - Makah Tribe intense trapping efforts
      - *Makah staff, NWIFC, WDFW, USFWS, WSG, volunteers!*
    - Total of 1029 for the trapping season!
    - Adrianne Akmajian, Makah ecologist, will conduct winter trapping

What is being done about EGC in WA

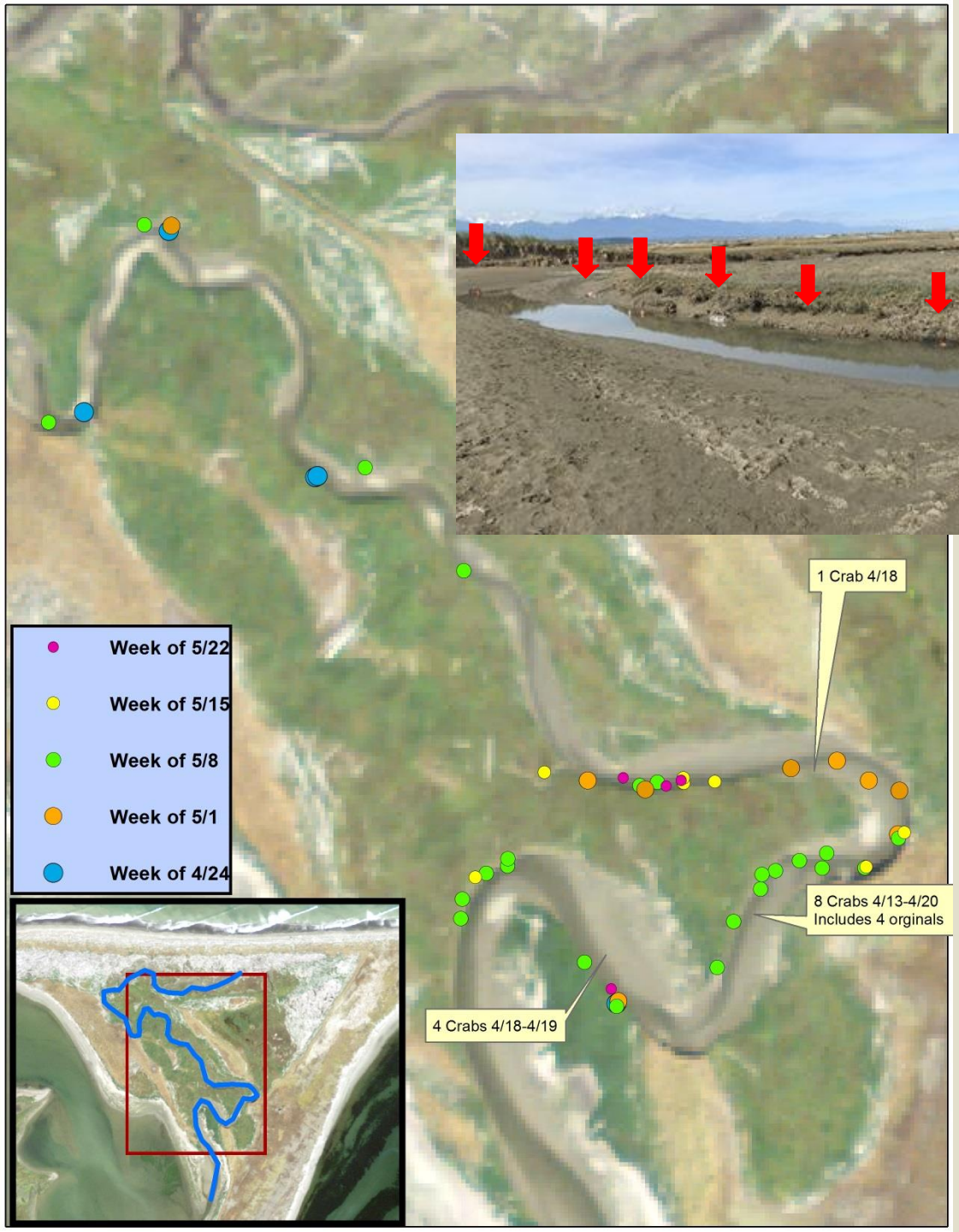
- Washington Sea Grant's Crab Team
  - *Launched in 2015 by WDFW in response to a mandate to monitor for EGC along inland WA shorelines*
  - *Primarily citizen science to achieve monitoring goals of salt marshes and pocket estuaries*
  - *Goals:*
    - Detect EGC at the earliest possible stage to control and reduce population and impacts
    - Build datasets to understand WA's estuaries to track green crab impacts
  - *Over 50 monthly monitoring sites and 200 volunteers!*
- WDFW
  - *1998 Detection at Willapa Bay and Grays Harbor*
    - WDFW further regulations on all shellfish, aquaculture and other aquatic imports and movements within the state
    - Funding from the Governor to establish a monitoring program and initiate control actions
      - *A program for the outer coast*
      - *A program for the Puget Sound, San Juan Islands, and Strait of Juan de Fuca*
  - *1999-2002 over 1,100 EGC removed from Willapa Bay and Grays Harbor*
  - *2002 coastal program was eliminated due to low juvenile recruitment levels that could not sustain a population…*
  - *2015 WSG Crab Team established to monitor EGC*
  - *2018 Pacific States Marine Fisheries Commission funding to employ a seasonal EGC dedicated employee*
    - Early detection at new sites, follow-up assessments of past detection sites, rapid response to Salish Sea detections

Rapid Response

- Equipment
  - *Traps*
  - *Bait*
  - *Transportation*
- Logistics
  - *Eradication/control strategy*
  - *Assess EGC population and scope*
  - *Coordination/communications/stakeholder outreach*
  - *Access*
- Staff
  - *Training*
  - *Safety*

- ~3.5 miles from USFWS HQ
- UTV Beach access + Hike
- 3-5 staff/day
- 25-125 traps/day

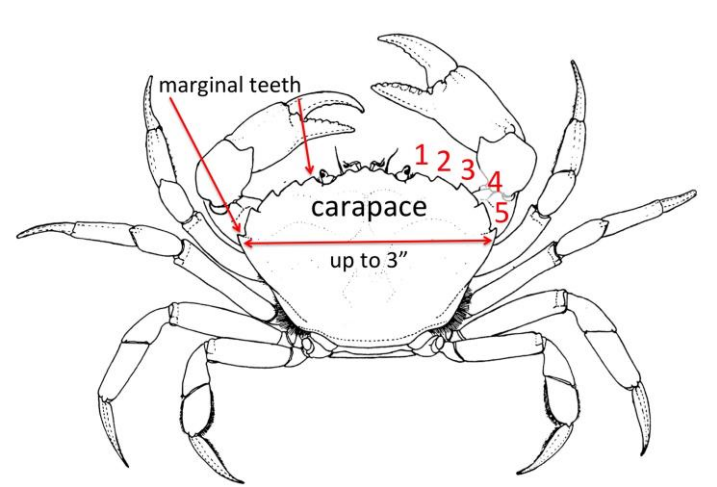
Intensive Trapping Efforts



- High ratio of natives to invasives

- As of June, 2017
- 69 EGC
  - 43 Males
  - 26 Females

How to identify an EGC



Identification Diagram of EGC
https://pugetsoundblogs.com/waterways/files/2016/09/diagram.jpg

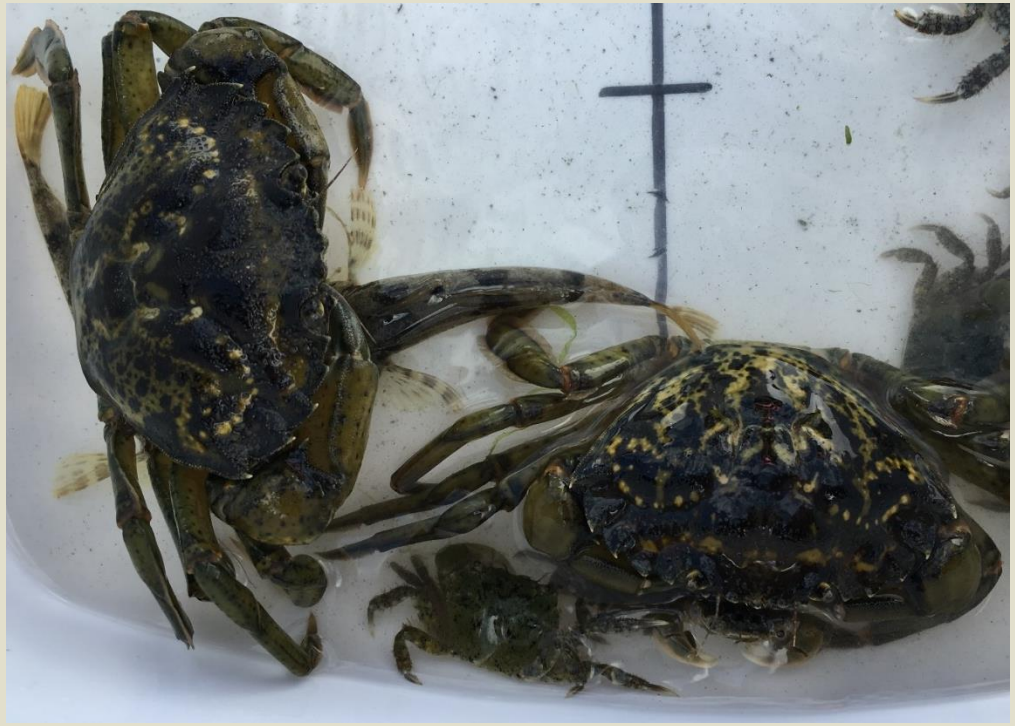
Pulled from Jeff Adams (WSG) Presentation (Stevens et al 2014)

- 5 spines!
- Not necessarily green…
- Can reach 4inches (100mm+)
- Keep an eye on the wrack line for molts

Male vs Female
http://www.flickriver.com/photos/tags/europeangreencrab/

Color Variation
http://www.asnailsodyssey.com/LEARNABOUT/CRAB/crabComp2.php


project WILD
You Can Make A Measurable Difference!



Native Shore Crabs

- Most common
  - *Hairy shore crabs*
  - *Purple shore crabs*

- Graceful
- Red Rock
- Hairy Helmet
- Spider
- Dungeness
- Hairy

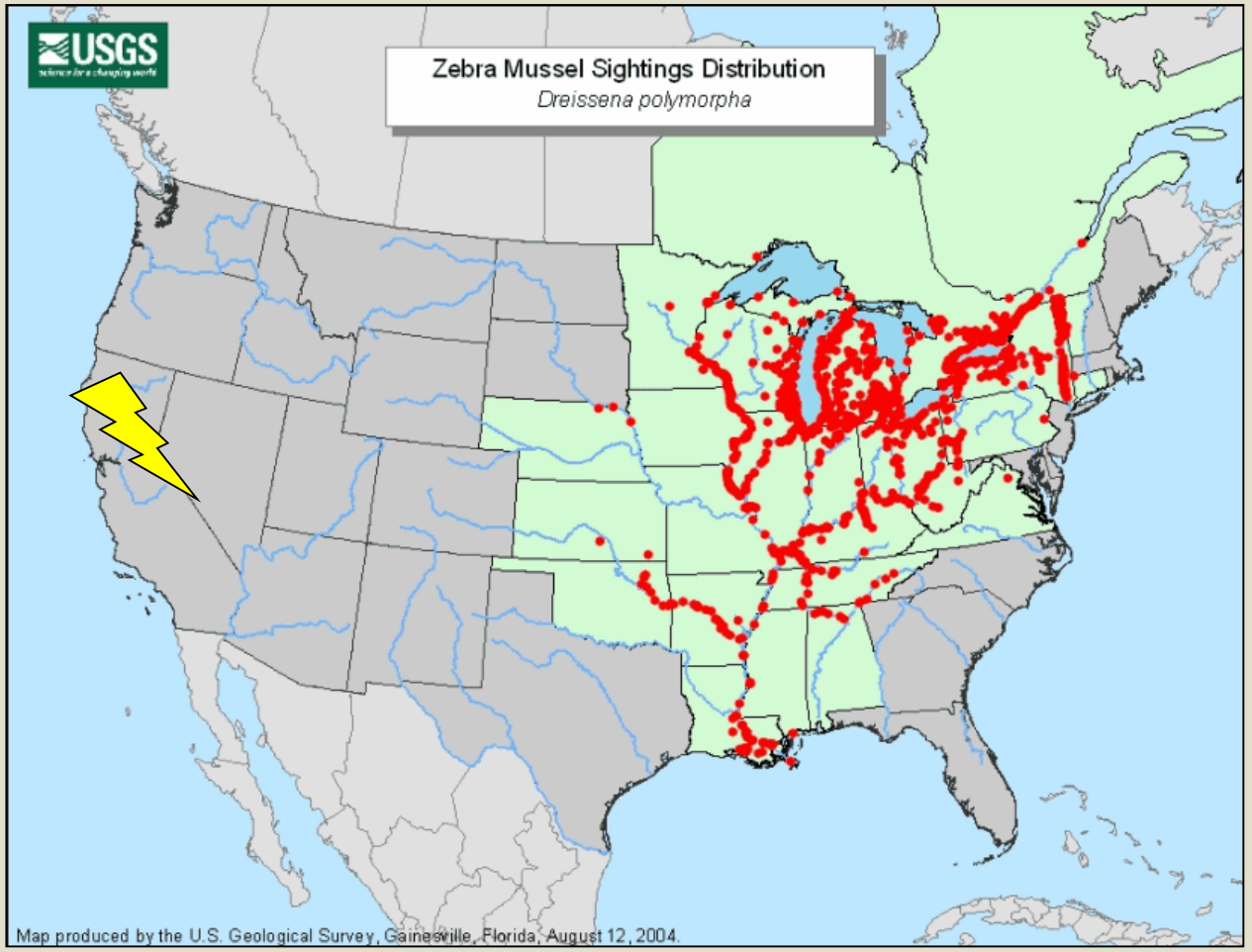
How to report a sighting

- Tell your supervisor.
- Take a photo and get a GPS and length if possible.
- You can text/email me directly!
  - *360.628.7754*
  - *Chelsey.Buffington@dfw.wa.gov*
- WDFW: ***http://wdfw.wa.gov/ais/reporting/***
- Washington State Recreation and Conservation Office: Washington Invasive Species Council
  - *Emergency Aquatic Invasive Species Hotline 1.888.WDFW.AIS*
  - *Download the mobile app: WA Invasives for iOS and Android*
  - ***http://www.invasivespecies.wa.gov/report.shtml***
- If you're interested in more information about green crab in particular check out:
  - *Washington Sea Grant's: Crab Team*

AIS IDENTIFICATION WASHINGTON'S TOP PRIORITY

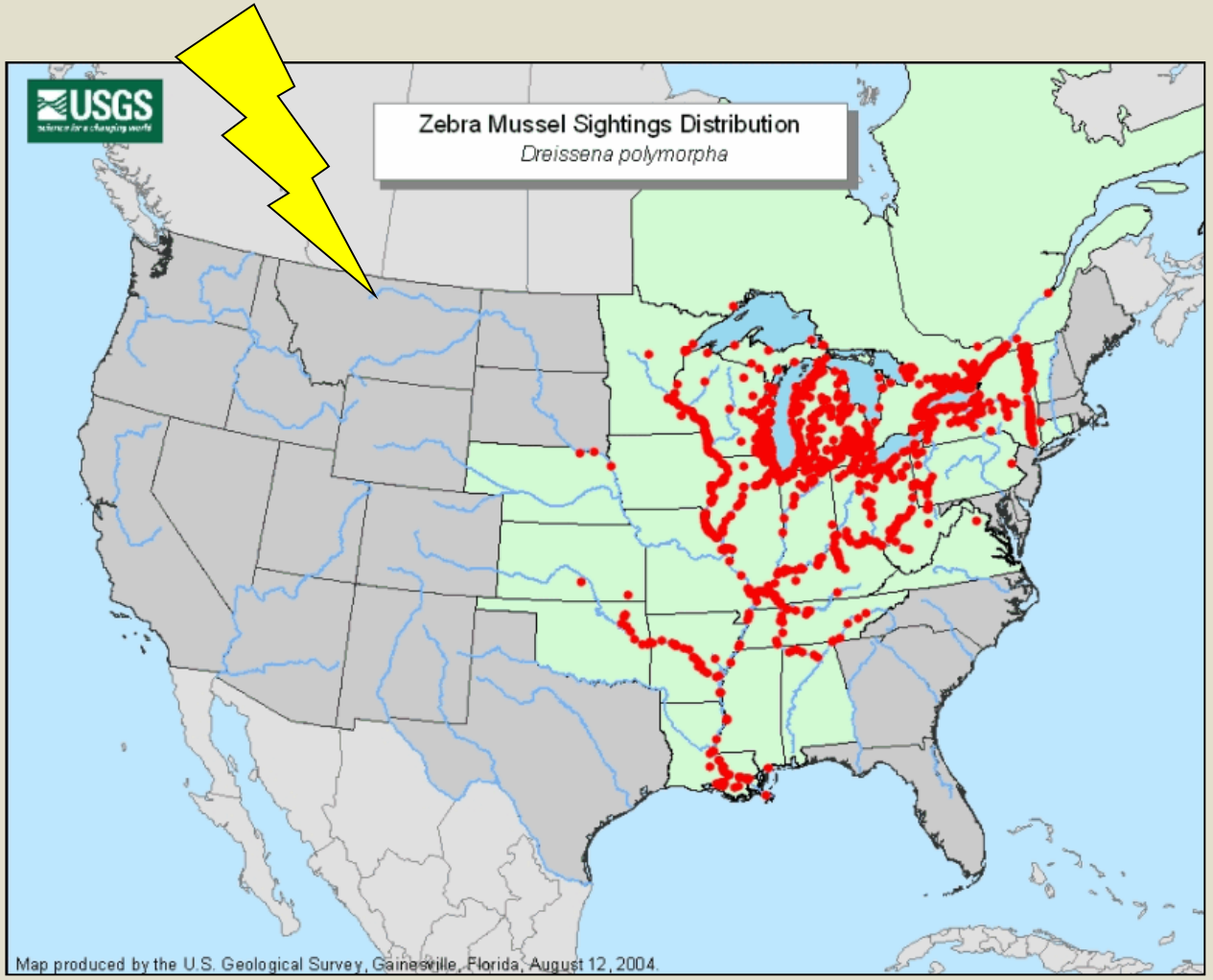
January 2007 “Lightning Strikes” A 1000 Mile Jump!

- Zebra/Quagga mussels are discovered at Lake Mead!
- Nevada, California & Arizona!

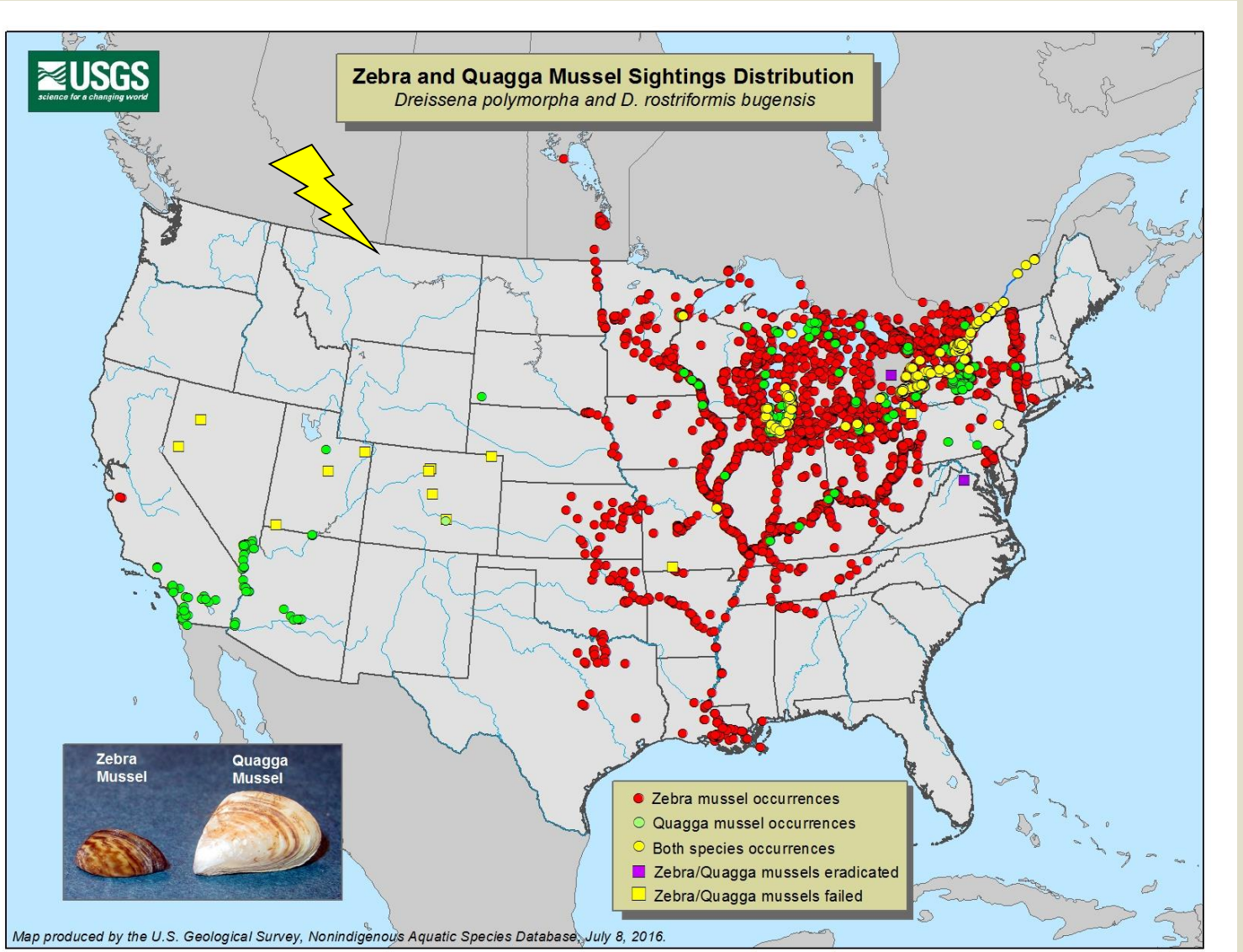


November 2016 "Atomic Bomb Drops" 75 Miles MT to WA

- Tiber Reservoir tested positive for veligers and Canyon Ferry Reservoir "**suspect**"



Current distribution of zebra/quagga mussels



Zebra/Quagga Mussels Identification

- <u>NO NATIVE FRESHWATER MUSSEL HAS BYSSAL THREADS IN WASHINGTON</u>
- Color varies (may have stripes)
- Adults average ¾ inch length, however some as large as 2 inches
- Post-settled juveniles are the size of a BB and feel similar to sand paper

Native mussels →

Early detection ZQ mussel monitoring

- Conducted April-November
  - *Vertical and horizontal plankton tows*
  - *Artificial substrates/collection plates*
  - *Visual shoreline*
  - *Water quality including calcium*
  - *eDNA*

Co Partners →

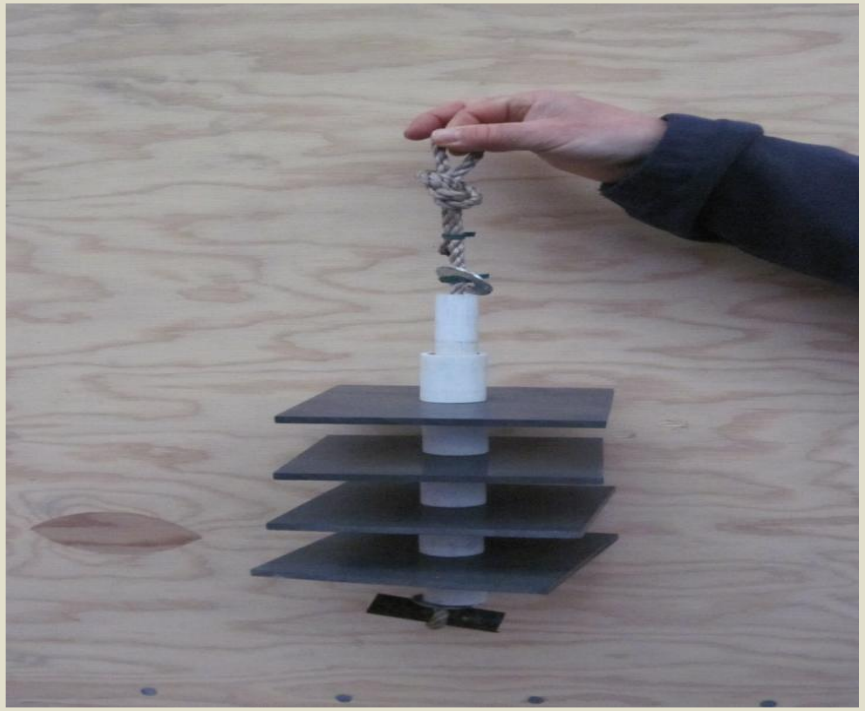
Sampler	Water Body	Reservoir
Chelan County PUD	Columbia River	Rocky Reach
City of Everett and Snohomish PUD	Sultan River	Spada
Douglas County PUD	Columbia River	Pateros
Grant County PUD	Columbia River	Priest Rapids and Wanapum
National Park Service	Columbia River	Roosevelt
National Park Service	Spokane River	Confluence of Roosevelt
Spokane Tribe	Columbia River	Roosevelt

Vertical and horizontal plankton net tows

- Water temperatures greater than 12°C (spawning) typically May-October
- For juveniles/veligers
- Horizontal and vertical tows for 1 composite sample per site

Artificial substrates/collection plates

- Can be monitored year around
- For post-settled juveniles and adults
- Typically 1 per site



Visual shoreline surveys

- Can be monitored year around
- For post-settled juveniles and adults
- Standardized by time – 10 minutes

Water quality

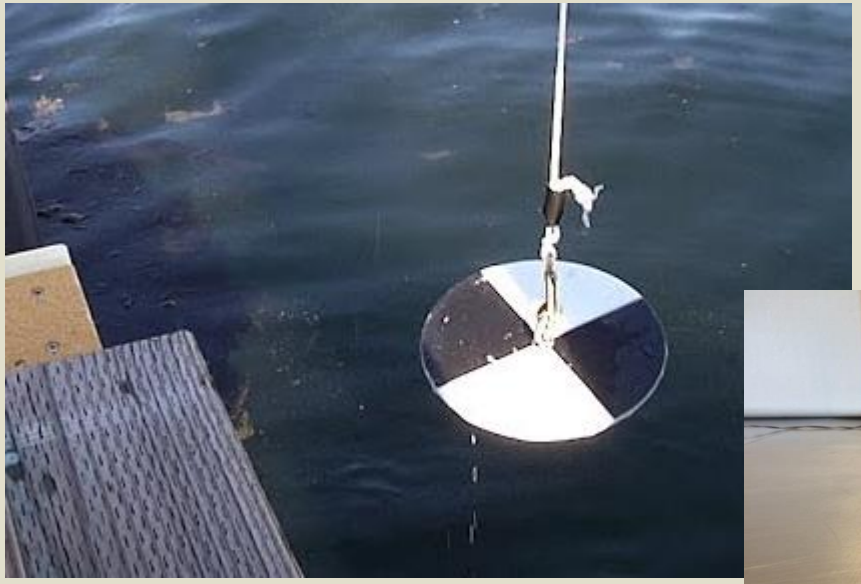
- Can be monitored year around
- For calcium 1 sample per site per year
- Other parameters measured every site visit

Salinity

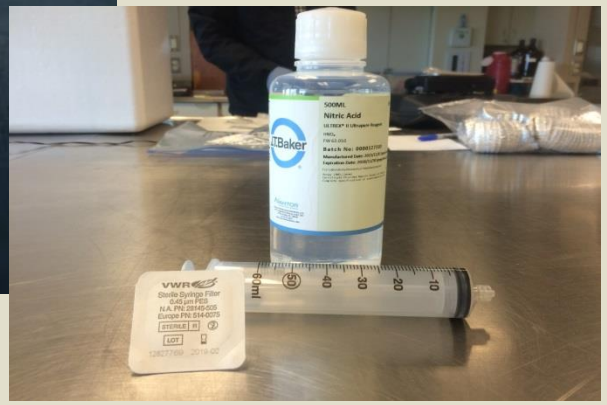
pH

Temperature

Dissolved Oxygen



Visibility



Calcium

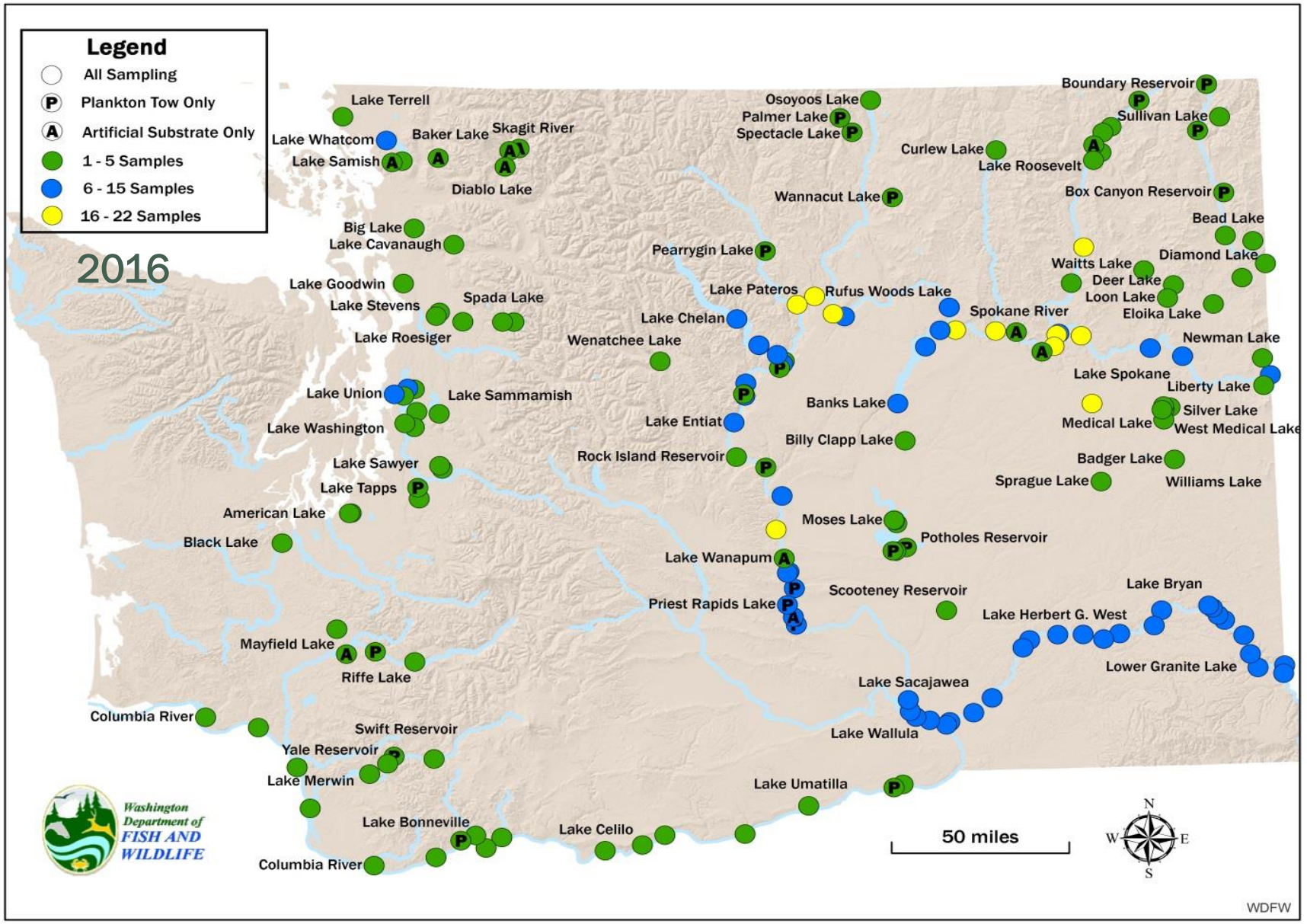
eDNA (environmental DNA)

- Can be conducted year around
- Started in 2017
- 1 sample per site per year

Risk assessment

- **Water bodies:** are determined by the potential for introduction through human activities and reproduction by water quality:
  - *Boatyards capable working on large commercially hauled watercraft*
  - *Private/public entities transporting equipment (docks, heavy equipment, etc.) that is not watercraft for hydro power facilities and agriculture*
  - *The "usual suspects" – all watercraft usage including water sports, wakeboarding tournaments, commercial, government, pleasure, recreational fishermen, and walleye and bass tournament anglers.*
  - *Calcium*
- **Sites within the water body**: are determined by where the most usage occurs (dams, boatyards, marinas, and launches) and veliger drifting patterns

Every high-risk water body is sampled



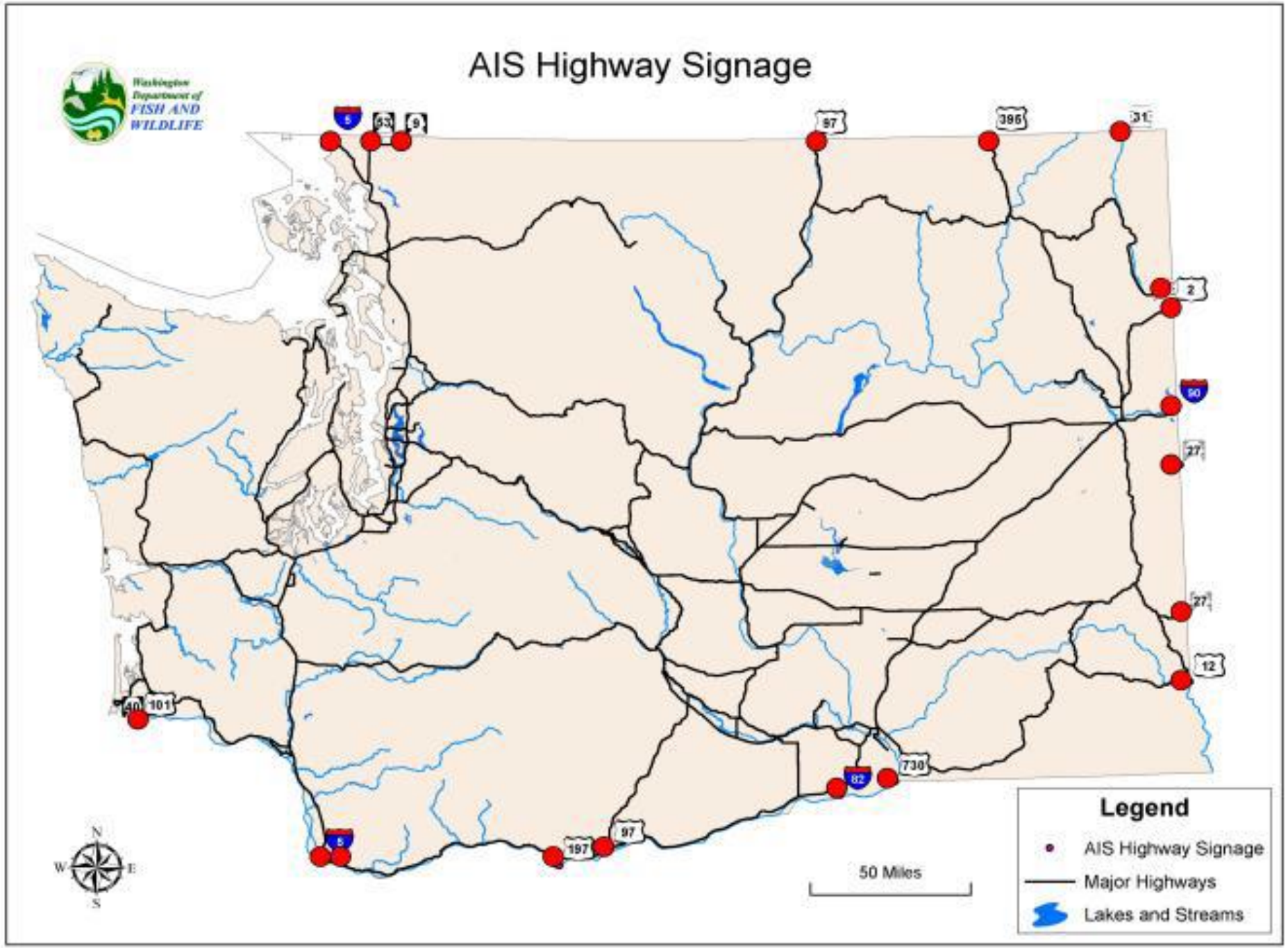
2017 results

227 sites at 95 water bodies

Sample Method	# of Samples
eDNA	118
Calcium	144
Artificial Substrates	303
Vertical and Horizontal Plankton Tows	560
Visual Shoreline	310

Sample Method	Laboratory Analysis
Vertical and horizontal plankton tows	Private consultant Cameron Lange
Artificial substrates	Field staff
Visual shoreline survey	Field staff
Water quality (temperature, pH, and D.O.)	Hanna HI9829 handheld multiparameter
Water quality (calcium)	Eastern Washington University Professor Carmen A. Nezat, Ph.D.
eDNA	WDFW Molecular Genetics Lab Scientist Sarah K. Brown, Ph.D.

WATERCRAFT CHECK STATIONS


AIS Highway Signage
Washington Department of FISH AND WILDLIFE
5
9
97
395
2
90
27
27
12
101
730
82
5
197
97
N
W
E
S
50 Miles
Legend
AIS Highway Signage
Major Highways
Lakes and Streams

Mandatory watercraft check stations

- Enforcement lead
- Only a couple of minutes
- Immune from AIS citations at check stations if all department directives are followed
- Designed to be outreach and education
- Randomly along roadways and water bodies


Mandatory watercraft check station at Plymouth Port of entry

Neighboring states watercraft check stations

Idaho

Photo Idaho Invasive Species Program

Oregon

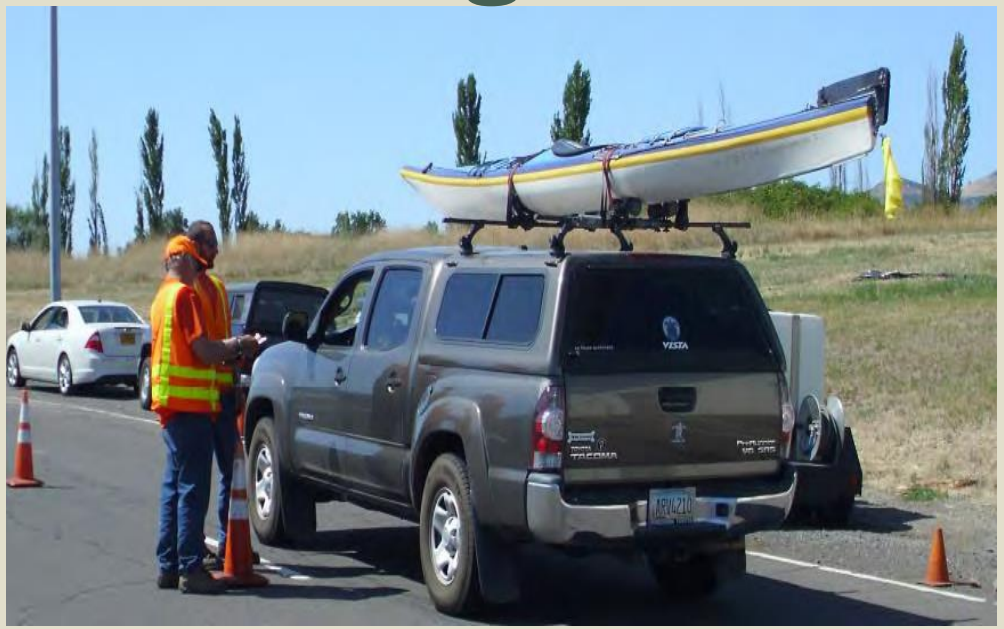
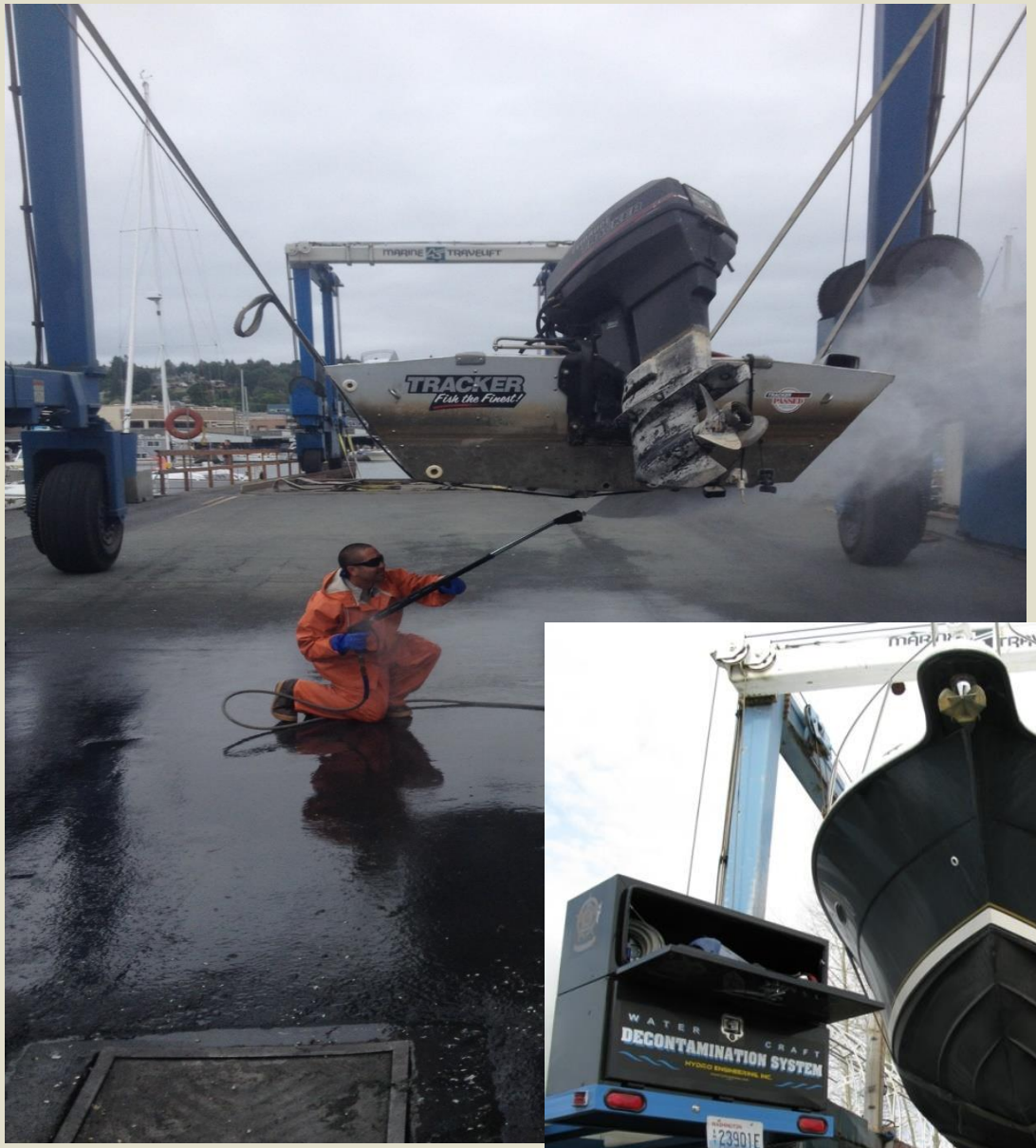
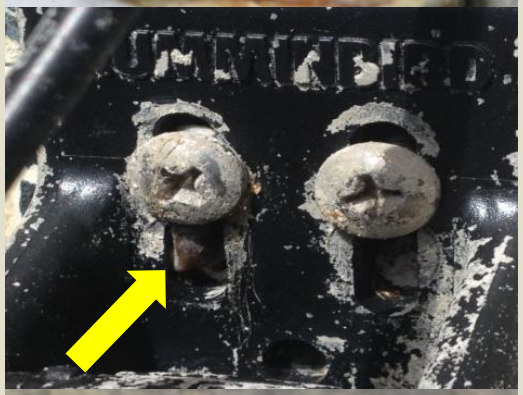


Photo Oregon AIS Prevention Program


TRACKER
Fish the Finest!


WATER CRAFT
DECONTAMINATION SYSTEM



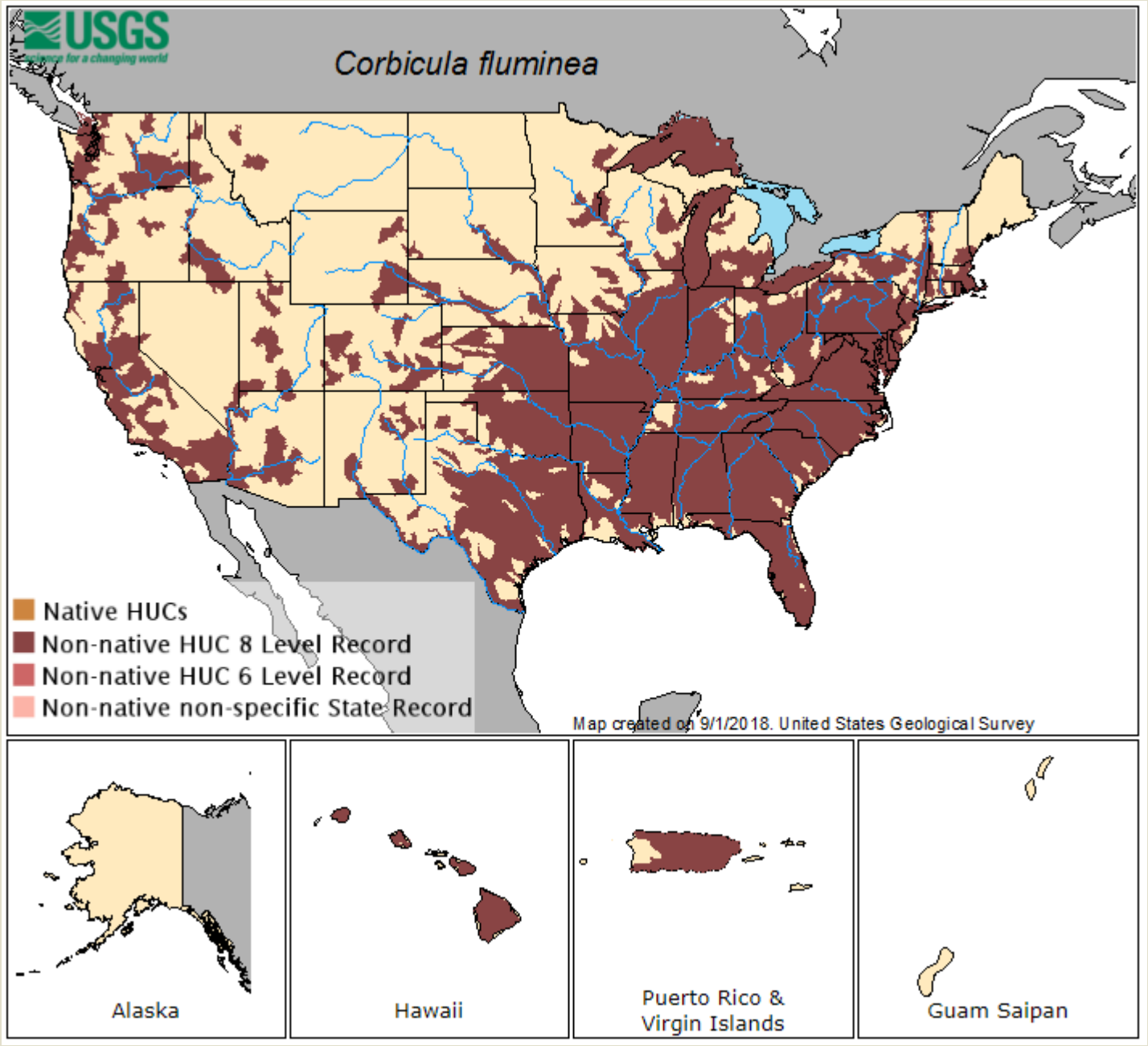
ASIAN CLAM

Corbicula fluminea

Corbicula (photo USGS)

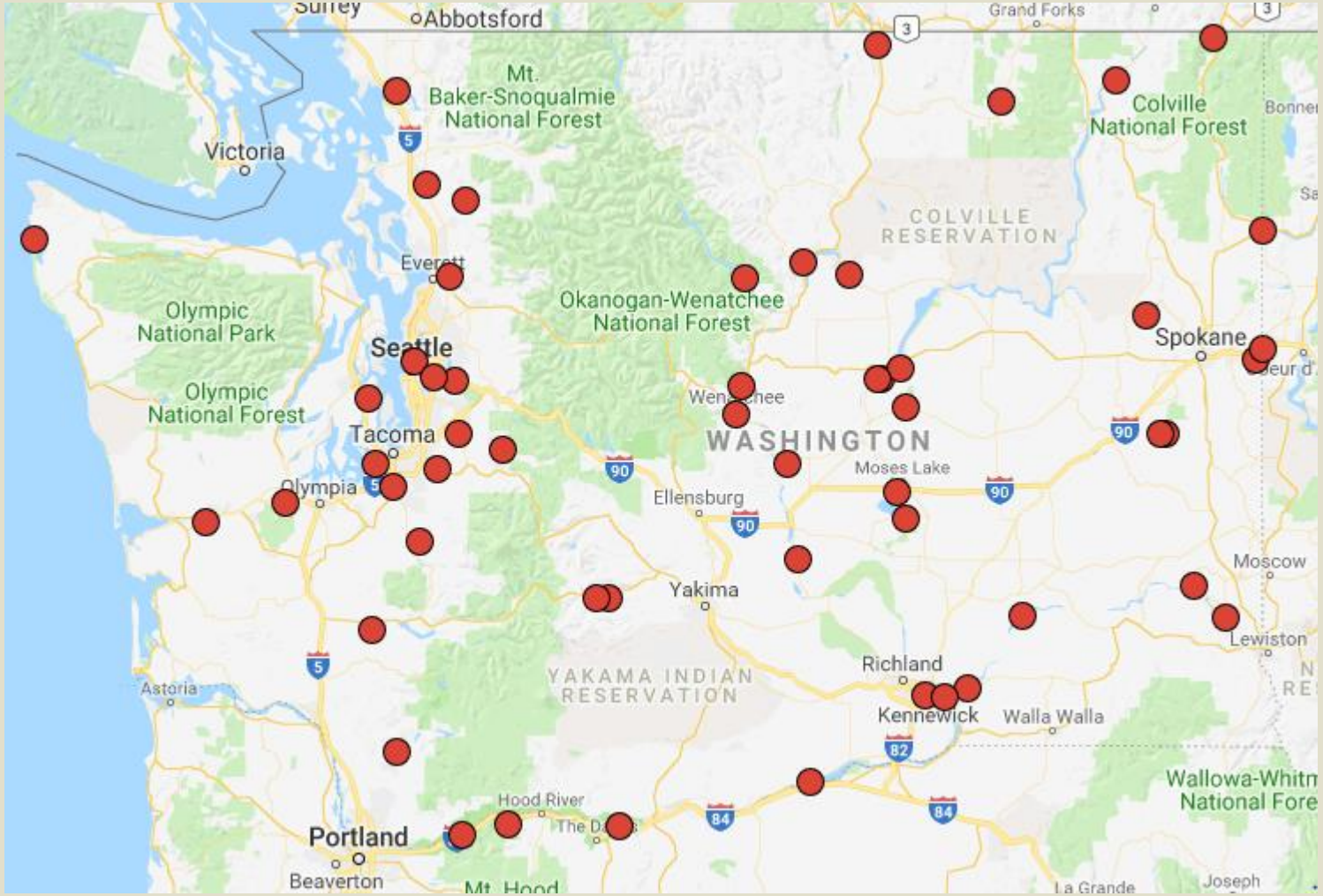
Distribution

- First discovered in WA in 1938
- North Dakota, Alaska, Guam remaining…
- Possibly introduced as a food source or with imports of Giant Pacific Oysters
- Native to temperate/tropical southern Asia west to the eastern Mediterranean; Africa (excluding the Sahara Desert); SE Asian Islands into central and eastern Australia



Distribution

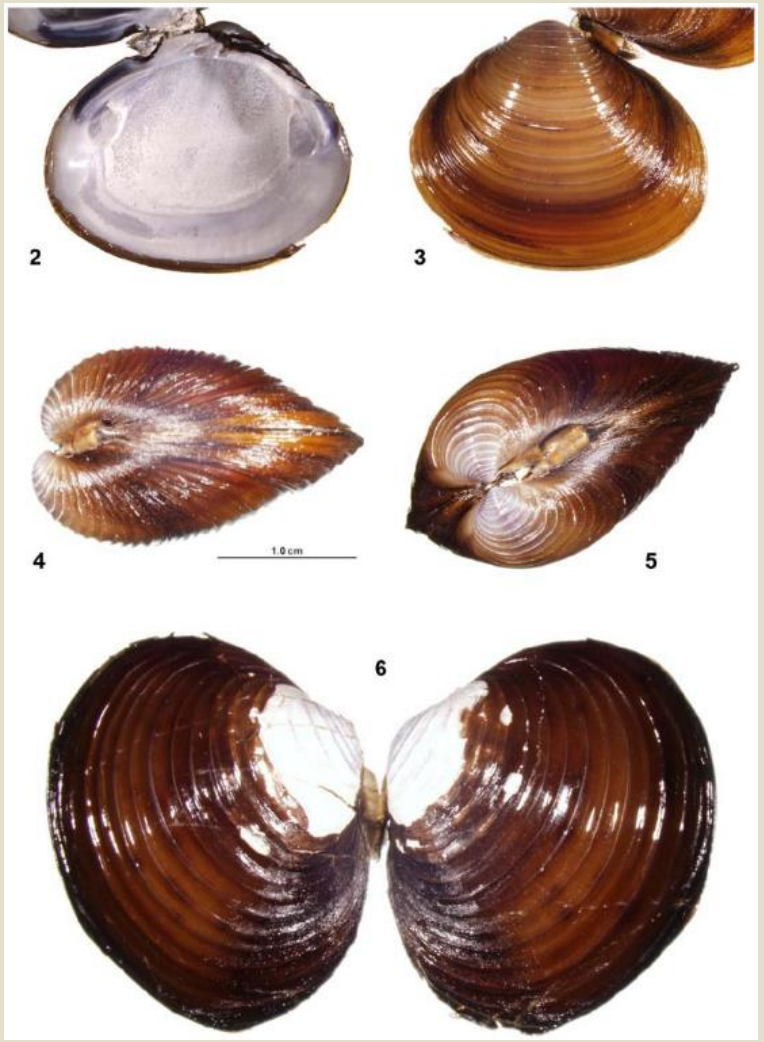
- Deschutes
- Hood Canal
- Lake Washington
- Lower Chehalis
- Lower Columbia
- Puget Sound
- Walla Walla
- Willapa Bay
- Many more sites…



Characteristics


Corbicula (photo USGS)

- Freshwater, filter feeder
- Less than 50mm
- Periostracum (outermost layer)
  - *Light-colored, yellowish-green to light brown, flaked color resulting in white spots*
- Nacre (mother-of-pearl, aka, the inside)
  - *White to light blue or light purple*
- Low temperature tolerance 2-30°C
- Spawning
  - *Year around in waters >16°C (spring to fall in N. America)*
  - *Single clam can release 400 juveniles a day, 70,000/year*
- Densities can range from 10,000-20,000 per square meter



Moretzsohn and Barrera 2006

Impacts

- Environmental
  - *Biofouling,*
    - power plants and industrial water systems
    - Irrigation canals and pipes
    - Drinking water supplies
  - *Alters benthic substrates and competes with native species for resources*
- Economic
  - *Removal of dead/alive specimens cost $$$$*
- Ecological
  - *Consumed by fish and crayfish*
    - Carp, catfish, bullhead, sunfish, largemouth bass…

www.corpi.ku.lt/databases/index.php/aquanis/species/view/id/1018 (Photo: D. Minchin)

Webpages.uidaho.edu/LPOAsianclams/

FERAL SWINE

Sus scrofa

Photo: Texas Wildlife Services

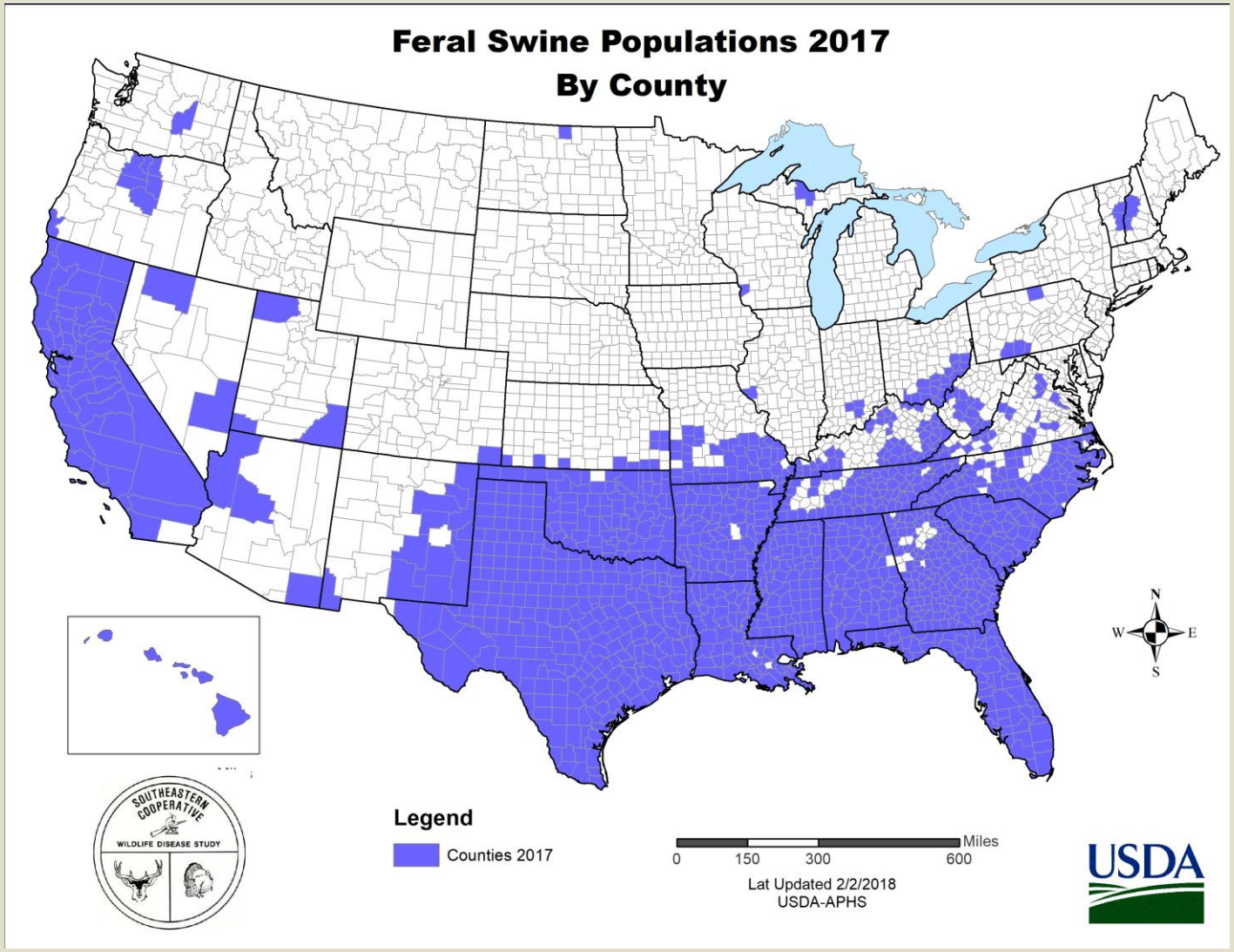
What are they and why do we care?

- Destructive non native pigs
- Introduced from Europe and Asia as domestic pigs
- Highly adaptable but like areas with abundant water resources and dense cover
- 3-8 (sometimes more) piglets per litter potentially twice/year
- Aggressive and destructive to fields, fences, and facilities
- Wallows may destroy aquatic vegetation
- They can wipe out crop fields overnight and disrupt habitat for other native/endangered species such as ground nesting birds
- Carriers/transmitters of diseases and parasites
- Economic damages $$$

Photo: Lloyd Loope, U.S. Geological Survey Bugwood.org

Where are they?

- Historical report of feral swine on the Olympic Peninsula
  - *No longer there*
  - *Quinault Indian Nation hunted them in the past*
- Sightings in SW Washington
  - *No confirmed established populations*
- Abundant in California, potentially moving north
- Oregon est. 5,000+ roaming the state
- Idaho keeping an eye on small group in Bruneau Valley



Map provided by: https://www.aphis.usda.gov/wildlife_damage/feral_swine/images/2017-feral-swine-distribution-map-county.jpg

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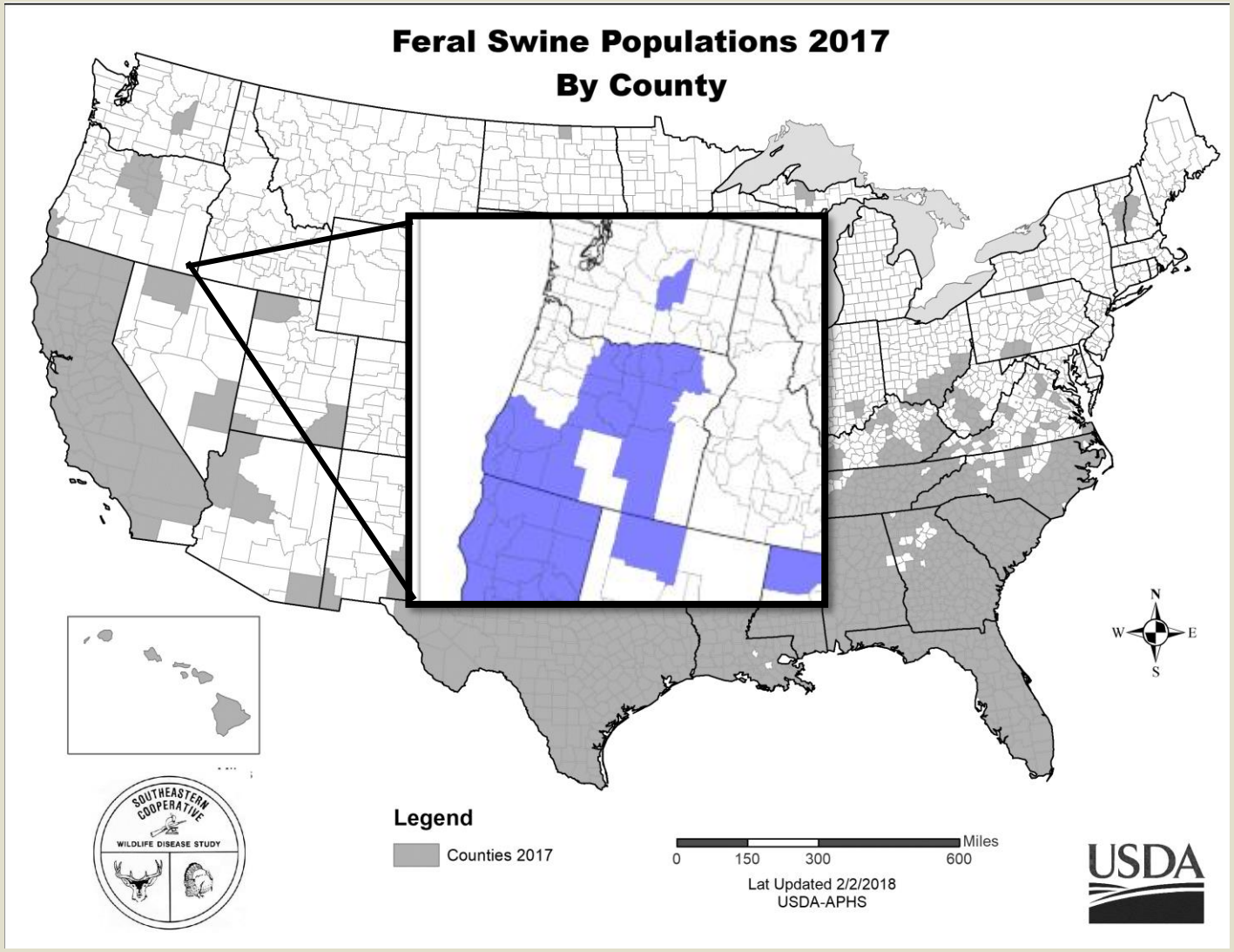


Map provided by: https://www.aphis.usda.gov/wildlife_damage/feral_swine/images/2017-feral-swine-distribution-map-county.jpg

Characteristics

- Wide variation in color and size
- Hair: coarse long bristles ranging from black, gray, brown, blonde or red, solid or spotted combinations.
  - *Generally black*
- Tail: moderately long with sparse hair
- Female weight: 77-330lbs
- Boar weight: 130-440lbs
- Snout: elongated and flat on end, tough, and flexible.
- Males: 4 tusks that grow continuously and can be very sharp
  - *Upper tusks can be 3-5inches long and may seem worn or broken from use*

Photo: Billy Higginbotham, Texas AgriLife Extension Service, Bugwood.org

Feral swine: One of the IUCN's 100 worst non-native invasive species in the world[5] (Credit: USDA– APHIS).

Identification

- Tracks: rounded shape, possible dewclaws
- Variety in scat appearance due to diets

Figure 9. Feral hog scat.
Photo by Craig Hicks, Bugwood.org.

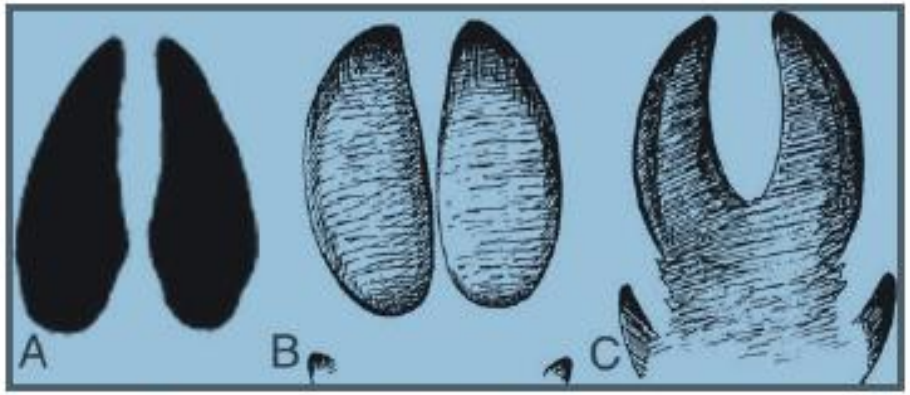


Figure 5. A deer track (A) can be distinguished from feral hog (B) and European wild boar (C) tracks by its shape.
Illustration by the University of Missouri.

Photo: Laurence Schafer, USDA Wildlife Services

DECONTAMINATION

WASHINGTON DEPARTMENT OF FISH & WILDLIFE
Clean Drain Rinse
STOP AIS IN YOUR TRACKS
wdfw.wa.gov/ais
Eradicate
AQUATIC INVASIVE SPECIES (AIS) PREVENTION

HOW CAN YOU HELP?

Prevention: Education and Outreach

Voluntary actions to minimize spread

Infested site/boat launch sign

Infested site/walk in sign

General boat launch sign

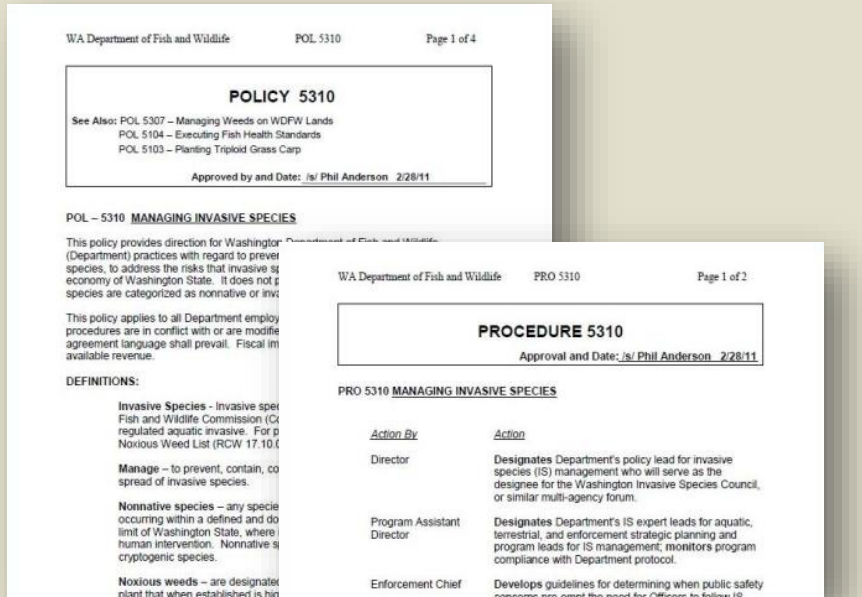
Resource manager decontamination protocols

Containment: active management to minimize spread

- Regularly inspect and clean gear while working
- Use dedicated equipment for a water body
- Progress from least to most likely infested waters and *with*, not against water flow
- Minimize contact with water or equipment with lake/stream sediments and vegetation
- Keep plants/sediments out of boats and gear
- Minimize use of multi-piece wading gear
- Minimize use of felt soled boots/waders

Policy, procedures, and protocols

- Policy and procedure 5310
  - *Effective 28 February 2011*
  - *Agency-wide directive to "adopt and actively maintain science-based protocols for minimizing the risk that field and property management activities will contribute to the spread of invasive species"*
- Protocols
  - *Effective July 26, 2011*
  - *Applies best available science*



WA Department of Fish and Wildlife POL 5310 Page 1 of 4

POLICY 5310

See Also: POL 5307 – Managing Weeds on WDFW Lands
POL 5104 – Executing Fish Health Standards
POL 5103 – Planting Triploid Grass Carp

Approved by and Date: /s/ Phil Anderson 2/28/11

POL – 5310 MANAGING INVASIVE SPECIES

This policy provides direction for Washington
(Department) practices with regard to prevent
species, to address the risks that invasive sp
economy of Washington State. It does not p
species are categorized as nonnative or inva

This policy applies to all Department employ
procedures are in conflict with or are modifie
agreement language shall prevail. Fiscal im
available revenue.

DEFINITIONS:

Invasive Species - Invasive spec
Fish and Wildlife Commission (Co
regulated aquatic invasive. For p
Noxious Weed List (RCW 17.10.0

Manage – to prevent, contain, co
spread of invasive species.

Nonnative species – any specie
occurring within a defined and do
limit of Washington State, where
human intervention. Nonnative s
cryptogenic species.

Noxious weeds – are designate
plant that when established is hig

WA Department of Fish and Wildlife PRO 5310 Page 1 of 2

PROCEDURE 5310

Approval and Date: /s/ Phil Anderson 2/28/11

PRO 5310 MANAGING INVASIVE SPECIES

Action By	Action
Director	**Designates** Department's policy lead for invasive species (IS) management who will serve as the designee for the Washington Invasive Species Council, or similar multi-agency forum.
Program Assistant Director	**Designates** Department's IS expert leads for aquatic, terrestrial, and enforcement strategic planning and program leads for IS management; **monitors** program compliance with Department protocol.
Enforcement Chief	**Develops** guidelines for determining when public safety

Decontamination Level 1

- Clean
- Drain
- Rinse

Decontamination Level 2

- Objective: Eradicate
  - *Kill all remaining invasive species after level 1 removal*
- 2 Options
  - *Hot water*
    - 140°F/60°C at 15 seconds or 5 minutes
    - Environmentally friendly!
  - *Virkon Aquatic*
    - 2% for 20 minutes – bath
    - Equipment must be rinsed with potable water
    - Rinse water must be captured and properly disposed according to the label
    - Vendor: Western Chemical
      - *1.800.283.5292*

Decontamination Options for AIS

Treatment	Concentration or Temperature	Exposure Time	Comments
Hot water wash or soak	60° C (140° F)	5 minutes for felt-soled boots and nets; 10 seconds for all other equipment	Ensure all parts of the equipment reach temperature for the full exposure time.
Cold/Freezing	-4° C	4 hours minimum	Time starts after the equipment reaches -4° C.
Drying	low humidity, in sunlight is best	48 hours on average (temperature and humidity dependent: see dry time calculator link below)	Time starts after the equipment is thoroughly dry.
Formula 409 All-Purpose Cleaner[1]	100 percent (full strength)	10 minutes	Follow proper procedures for storage and handling.
Sparquat 256	*No longer recommended due to safety concerns*		
Quat 128	4.60 percent	10 minutes	Follow proper procedures for storage and handling.
Hydrogen peroxide	30,000 ppm (3 percent)	15 minutes	Spray on until soaked, then keep damp for contact time (cover or place gear in a dry bag)

(Decontamination protocols developed by the Washington Department of Ecology, Environmental Assessment Program)

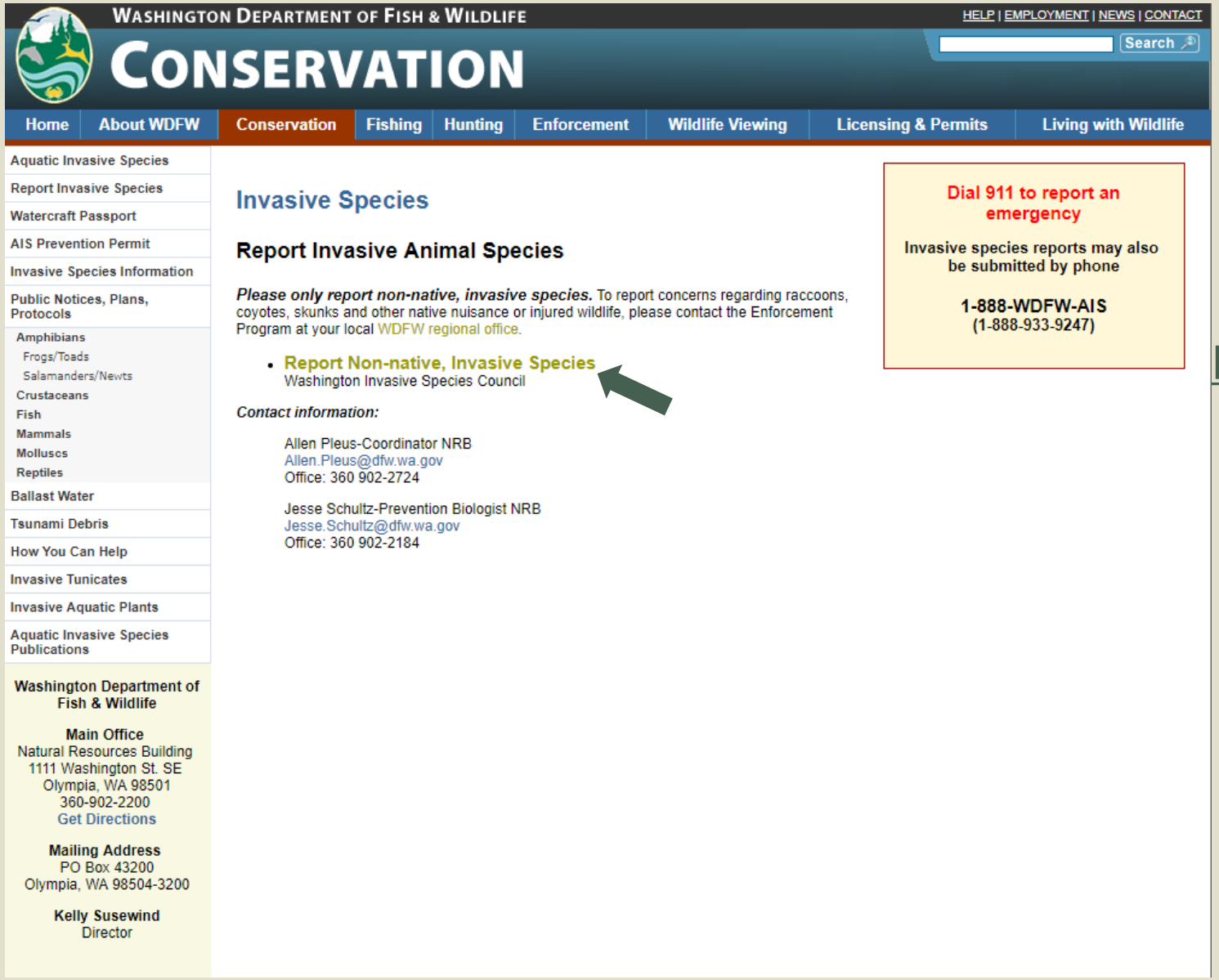
[1] Must be antibacterial. (Make sure it has quaternary ammonia, otherwise it is ineffective.)

REPORT A SIGHTING

1.888.WDFW.AIS
(1.888.933.9247)
Online
Smart phone app

REMEMBER! PICTURE OR IT DIDN'T HAPPEN!

Online



http://wdfw.wa.gov/ais/reporting/

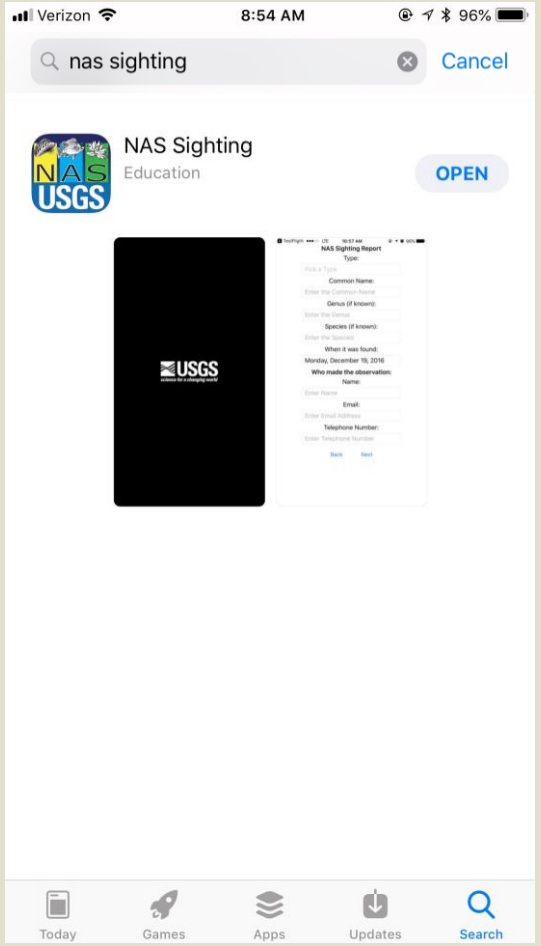
Online

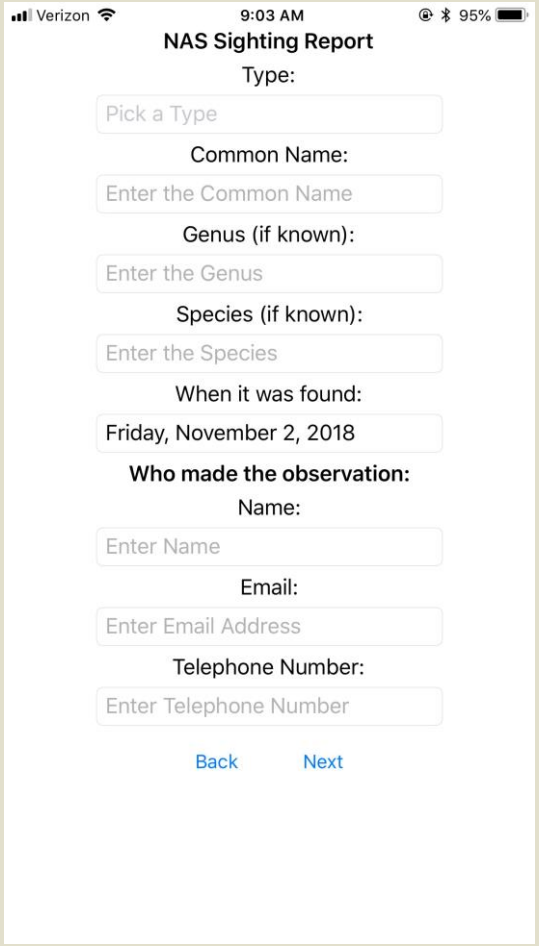
https://invasives.wa.gov/report.shtml

Smart Phone Apps

National

https://nas.er.usgs.gov/mobilesightingreport.aspx





State

http://www.invasivespecies.wa.gov/report.shtml