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
- $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
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

Photo Courtesy: Chelsey Bumington
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
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?

- 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 Niño vs La Niña: https://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).
  - *Humboldt 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.
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
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
What is being done about EGC in WA?

- **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

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

Identification Diagram of EGC

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

Color Variation
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
- 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
- If you’re interested in more information about green crab in particular check out:
  - Washington Sea Grant’s: Crab Team
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

- NO NATIVE FRESHWATER MUSSEL HAS BYSSAL THREADS IN WASHINGTON
- 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
Early detection ZQ mussel monitoring

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

<table>
<thead>
<tr>
<th>Sampler</th>
<th>Water Body</th>
<th>Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chelan County PUD</td>
<td>Columbia River</td>
<td>Rocky Reach</td>
</tr>
<tr>
<td>City of Everett and Snohomish PUD</td>
<td>Sultan River</td>
<td>Spada</td>
</tr>
<tr>
<td>Douglas County PUD</td>
<td>Columbia River</td>
<td>Pateros</td>
</tr>
<tr>
<td>Grant County PUD</td>
<td>Columbia River</td>
<td>Priest Rapids and Wanapum</td>
</tr>
<tr>
<td>National Park Service</td>
<td>Columbia River</td>
<td>Roosevelt</td>
</tr>
<tr>
<td>National Park Service</td>
<td>Spokane River</td>
<td>Confluence of Roosevelt</td>
</tr>
<tr>
<td>Spokane Tribe</td>
<td>Columbia River</td>
<td>Roosevelt</td>
</tr>
</tbody>
</table>
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

Visibility

Calcium

Salinity
pH
Temperature
Dissolved Oxygen
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

<table>
<thead>
<tr>
<th>Sample Method</th>
<th># of Samples</th>
</tr>
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<tbody>
<tr>
<td>eDNA</td>
<td>118</td>
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<tr>
<td>Calcium</td>
<td>144</td>
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<tr>
<td>Artificial Substrates</td>
<td>303</td>
</tr>
<tr>
<td>Vertical and Horizontal Plankton Tows</td>
<td>560</td>
</tr>
<tr>
<td>Visual Shoreline</td>
<td>310</td>
</tr>
</tbody>
</table>

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

TRANSPORTATION OF WATERCRAFT CARRYING AQUATIC INVASIVE SPECIES IS PROHIBITED
PROTECT STATE WATERS - AVOID FINES

FREE INSPECTION INFO - REPORT SIGHTINGS
1-888-933-9247 OR WDFW.WA.GOV
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
Neighboring states watercraft check stations

Idaho

Oregon

Photo Idaho Invasive Species Program

Photo Oregon AIS Prevention Program
ASIAN CLAM

Corbicula fluminea
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

- 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
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...
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
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- Idaho keeping an eye on small group in Bruneau Valley

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 3-5 inches long and may seem worn or broken from use
Identification

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

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

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
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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Concentration or Temperature</th>
<th>Exposure Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot water wash or soak</td>
<td>60° C (140° F)</td>
<td>5 minutes for felt-soled boots and nets; 10 seconds for all other equipment</td>
<td>Ensure all parts of the equipment reach temperature for the full exposure time.</td>
</tr>
<tr>
<td>Cold/Freezing</td>
<td>-4° C</td>
<td>4 hours minimum</td>
<td>Time starts after the equipment reaches -4° C.</td>
</tr>
<tr>
<td>Drying</td>
<td>low humidity, in sunlight is best</td>
<td>48 hours on average (temperature and humidity dependent; see dry time calculator link below)</td>
<td>Time starts after the equipment is thoroughly dry.</td>
</tr>
<tr>
<td>Formula 409 All-Purpose Cleaner¹</td>
<td>100 percent (full strength)</td>
<td>10 minutes</td>
<td>Follow proper procedures for storage and handling.</td>
</tr>
<tr>
<td>Sparquat 256</td>
<td></td>
<td></td>
<td>No longer recommended due to safety concerns</td>
</tr>
<tr>
<td>Quat 128</td>
<td>4.60 percent</td>
<td>10 minutes</td>
<td>Follow proper procedures for storage and handling.</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>30,000 ppm (3 percent)</td>
<td>15 minutes</td>
<td>Spray on until soaked, then keep damp for contact time (cover or place gear in a dry bag)</td>
</tr>
</tbody>
</table>

(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**


**State**

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