

Puget Sound Nearshore Forage Fish Surveys

Phillip Dionne

Washington Department of Fish & Wildlife

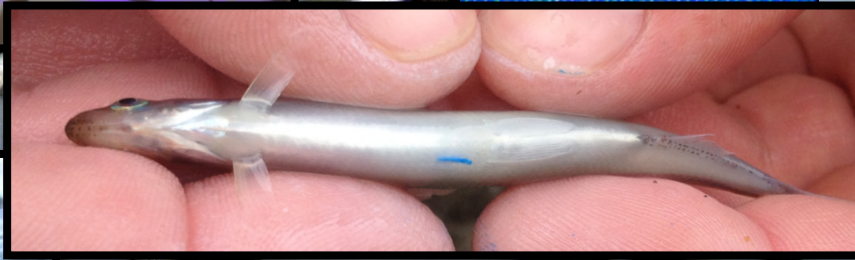
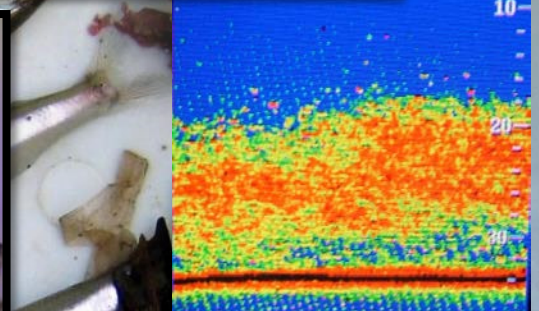
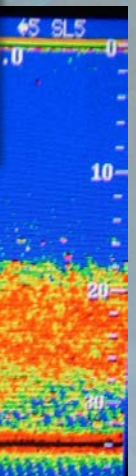
Habitat Program, Science Division

Phillip.Dionne@dfw.wa.gov

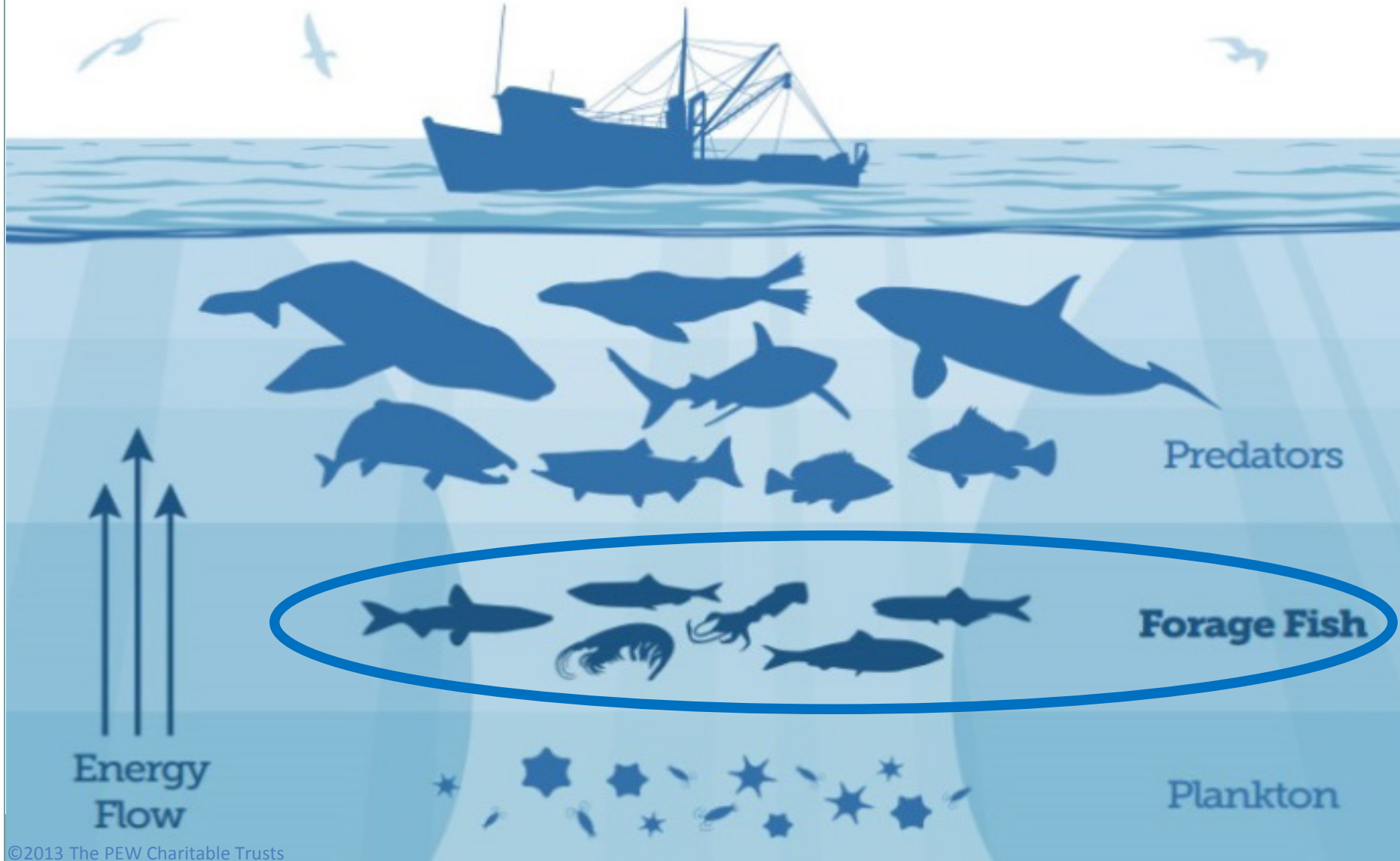


Thanks to:

- WCC
- Point Defiance Zoo & Aquarium
- USGS
- DNR
- DFW Marine Fish Unit
- Point No Point Treaty Council
- Suquamish Tribe
- Friday Harbor Labs
- NW Straits Commission
- County MRCs
- Nisqually Nature Center
- Squaxin Island Tribe
- NOAA
- FOSJ
- Audubon Society
- Lummi Tribe
- Evergreen College
- PSEMP
- and many more...



What are Forage Fish and Why are they Important?



Nearshore Forage Fish:

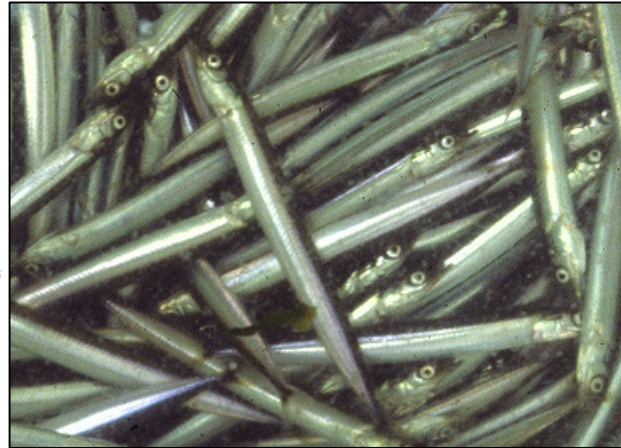
Surf Smelt

(Hypomesus pretiosus)



Pacific Sand Lance

(Ammodytes personatus)

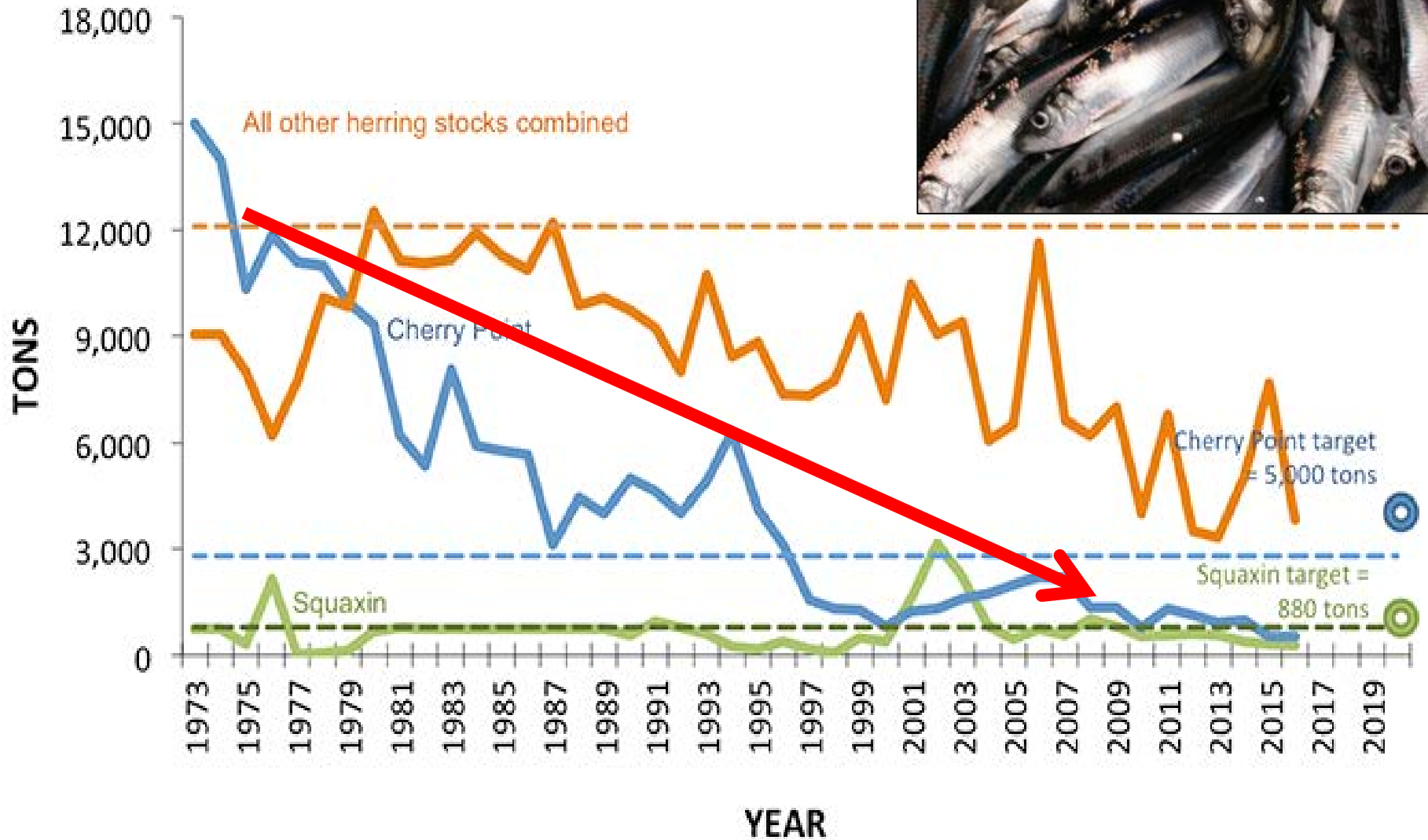


Pacific Herring

(Clupea pallasii)



Warning signs:



Warning signs:

Bird declines in WA State

-Birds that dive and forage for fish in the Salish Sea, including this western grebe, are 11 times more likely to experience population declines than other birds in the area. (Joe Gaydos, *journal of Conservation Biology*)

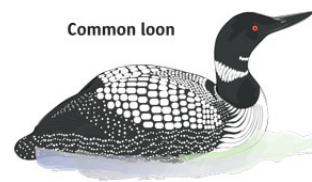


Plumas Audubon Society

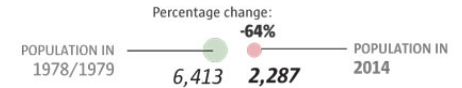
Bird declines in Washington state

Many species of common birds are declining in Puget Sound and other parts of the state and Northwest. Scientists increasingly are considering the possibility that declines in forage fish, particularly herring, may play an important role.

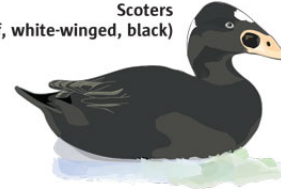
Common loon



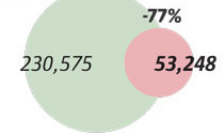
These thick-necked birds spend their breeding season on huge lakes but can be found in winter on saltwater, where they feed on invertebrates and small fish, usually less than 10 inches long.



Scoters (surf, white-winged, black)



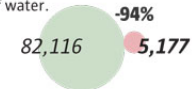
These mostly black or gray ducks spend winters on the coast, particularly in shallow bays or estuaries, and dive for mussels, insect eggs and herring eggs. In Alaska, there have been large die-offs that some suspect may be due to contaminants, such as pesticides.



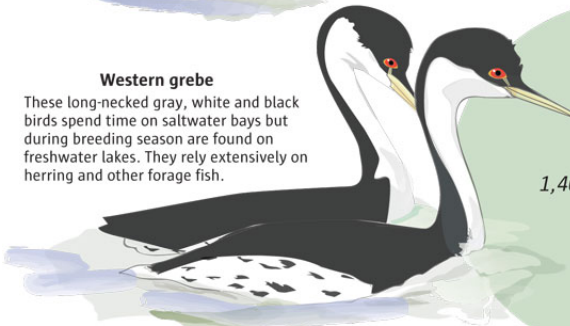
Long-tailed duck



These heavy, low-flying ducks often eat shellfish and feed within the top 30 feet of water.



Western grebe



These long-necked gray, white and black birds spend time on saltwater bays but during breeding season are found on freshwater lakes. They rely extensively on herring and other forage fish.



These species also are in decline in Washington.



Marbled murrelet



Common murre



Glaucous-winged gull

NOTE: Many of these bird populations are counted using an index, which is designed to help identify trends rather than precise numbers of birds. The percentage change over time is a more accurate reflection.

Sources: Washington Department of Fish and Wildlife; Puget Sound Partnership; Seattle Audubon; Washington Sea Grant

MARGARET NG / THE SEATTLE TIMES

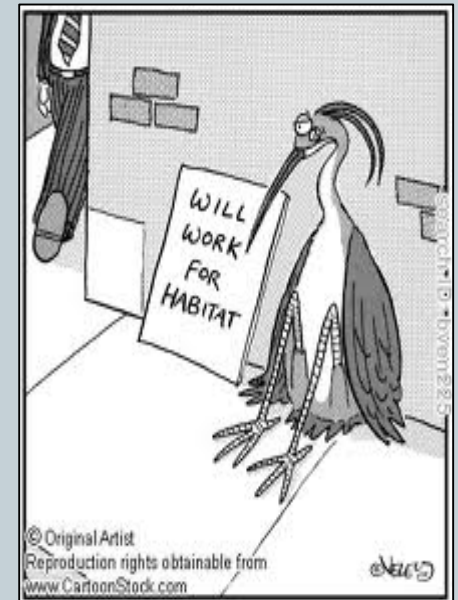
Challenges Facing Forage Fish

Forage

to:



Over fishing



Habitat Loss

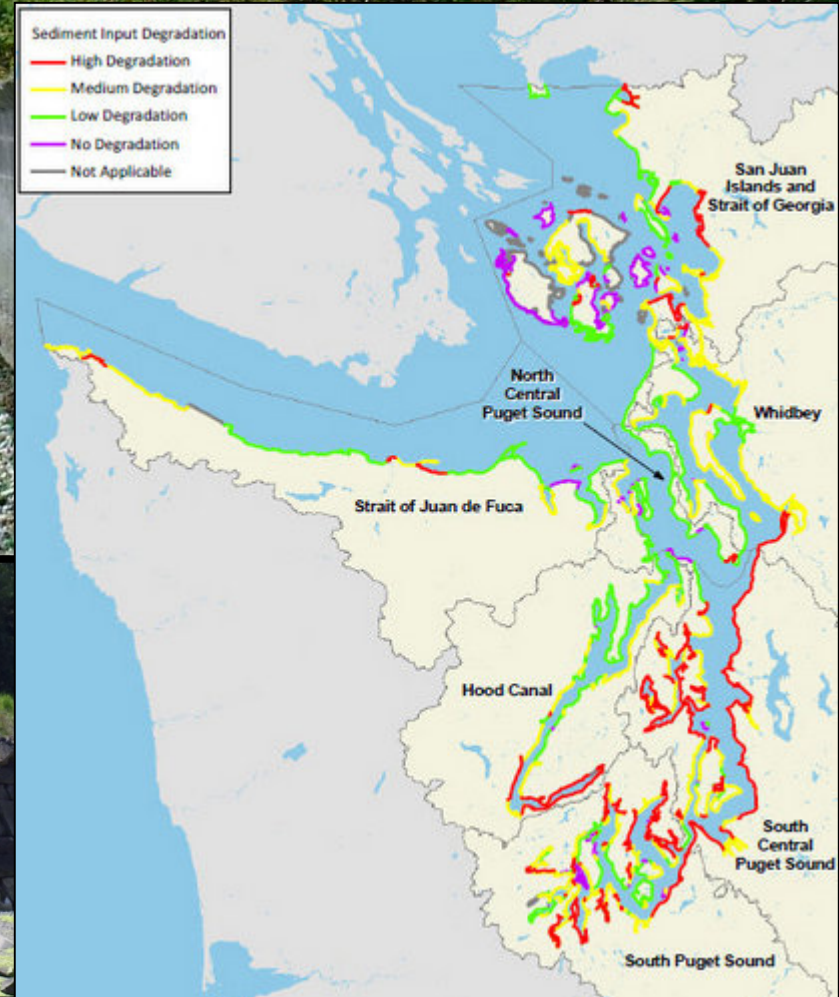
Surf Smelt & Sand Lance spawn on the beach





Risks to forage fish habitat include:

- Direct habitat loss
- Loss of riparian cover
- Change sediment supply and transport



Forage Fish Protection



Protected by law:

...the construction of all bulkheads or other bank protection must not result in a permanent loss of surf smelt or Pacific sand lance spawning beds...



Beach Surveys



Current Survey Goals:

Update Forage Fish Map

- Interactive map of documented forage fish spawning habitat (wdfw.wa.gov/conservation/research/projects/marine_beach_spawning/)

Model Habitat

- Use distribution and timing of spawning to develop statistical model to predict when and where eggs may be present

Occupancy Model

- Use habitat model and surveys to assess if spawning distribution is changing over time

WASHINGTON DEPARTMENT OF FISH & WILDLIFE

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Species & Ecosystem Science

Current Research

Project Leads

Publications

Research Posters

For more information on species & ecosystem science:

Wildlife Science
200-902-2315
wildlife@dfw.wa.gov

Fish Science
200-902-2100
fish@dfw.wa.gov

Habitat Science
200-902-2234
habitatprogram@dfw.wa.gov

Species & Ecosystem Science

Marine Beach Spawning Fish Ecology

Surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes hexapterus*) are important food for marine mammals, birds, and fishes, including Pacific salmon. The Washington Department of Fish and Wildlife protects these fish species and their spawning habitat by limiting human activities under the terms of a permit (called the Hydraulic Project Approval, HPA) on beaches where spawning has been documented. Extensive surveys have sampled many of the beaches in Puget Sound. However, despite good information on the distribution of spawning beaches our understanding of the ecology and protection needs for these species is very limited. The Washington Department of Fish and Wildlife conducts research that will allow us to better ensure adequate protection of Pacific sand lance and surf smelt given current and anticipated environmental conditions, without unnecessarily constraining human activity.

Lead Scientist: Philip Dionne, Kirk Kouger

Ecoregional: Puget Trough

Biological System(s): Not Available for Research Area

Surf Smelt (top) and Pacific Sand Lance (bottom)

Publications & Posters

- Surf Smelt Field Sheet, Biology and Fisheries
- Effects of Sea Level Rise and Bank Protection Structures on the Spawning Habitat of Two Beach Spawning Fishes
- Anticipated Effects of Sea Level Rise in Puget Sound on Beach-spawning Fishes
- Spatiotemporal Detection of Forage Fish Eggs Derived from Long-term Spawning Surveys
- Modeling Forage Fish Spawning Habitat Suitability on Camano Island

Forage Fish Beach Survey Training Materials

Disclaimer: The files below consist of background and survey protocol information for conducting forage fish spawning beach surveys. All surveys conducted by individuals not employed by WDFW require a scientific collection permit or memorandum of understanding from WDFW. Surveys related to HPA permits may only be conducted by WDFW or an approved biologist (WAC 220-110-271). To get details on how to become an "approved biologist" contact Philip Dionne, philip.dionne@dfw.wa.gov, 200-902-2241.

- Forage Fish Spawning Beach Survey Training, with notes
- Key Points about intertidal forage fish spawning habitat
- Forage Fish Spawning Beach Survey Manual (Moulton and Pentile 2001)
- Survey protocol handouts:
 - Bulk sediment sample collection (FF-01)
 - Bulk sediment sample processing (FF-02)
 - Laboratory analysis – presence/absence (FF-03)
 - Laboratory analysis – quantitative assessment (FF-04)

The SalmonScope web application can display beaches where Surf Smelt and Pacific Sand Lance spawning has been documented

Spawning Location Map

The map below shows the documented spawning locations of Pacific Sand Lance, Surf Smelt, and Pacific Herring in Washington State. This map should not be considered all inclusive of spawning habitat because not all potential spawning habitat has been surveyed, and it is possible for surveys to fail to detect eggs even when eggs are present.

esri

Sampling Methods



Sample Collection



Reducing Sample Volume



Egg Extraction



Lab Analysis

Sampling Methods Updated



Sample Collection



Reducing Sample Volume



Egg Extraction



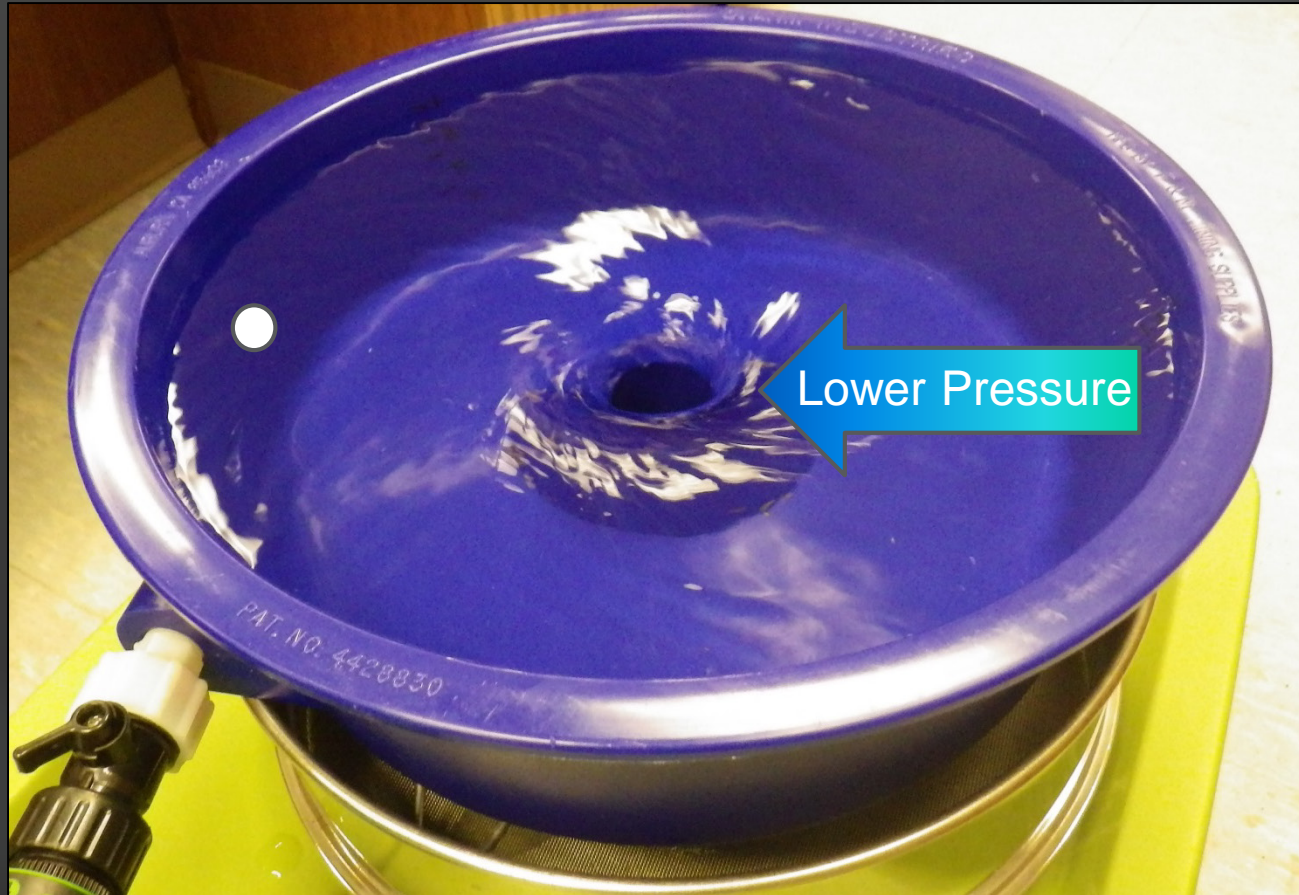
Lab Analysis

Vortex Method

How it works:

The movement of the water creates a pressure gradient

- Material moves from high pressure to low pressure in the middle



Seeded Smelt Egg Trials



Winnow

Vortex

Historical Surveys Vs. Current Surveys

Historical Surveys:

Maximize potential to document spawning:

- **Distribute effort in times and places where spawning is thought to be most likely**

Current Surveys:

Systematic Sample of Puget Sound to model occurrence:

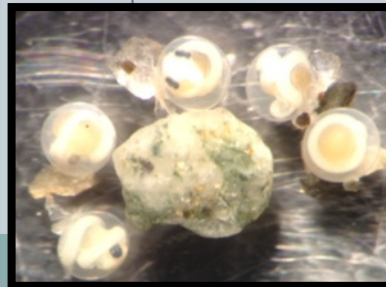
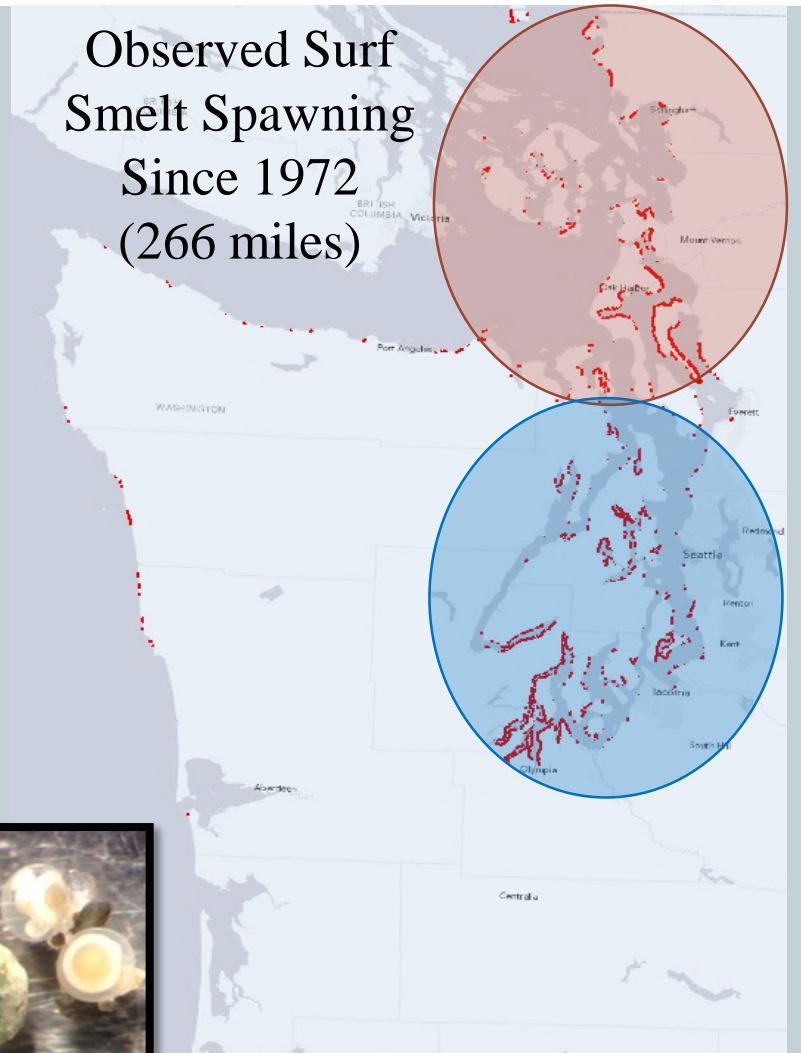
SmeltSurveys.exe

SmeltSurveysManual.exe

Surf Smelt

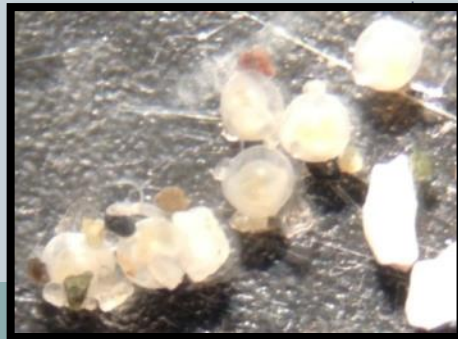
- **Spawn Year round**
 - North Sound, peak spawning in summer
 - South Sound, peak spawning in winter
 - Little known about life history, ecology, or abundance.

Observed Surf Smelt Spawning Since 1972
(266 miles)

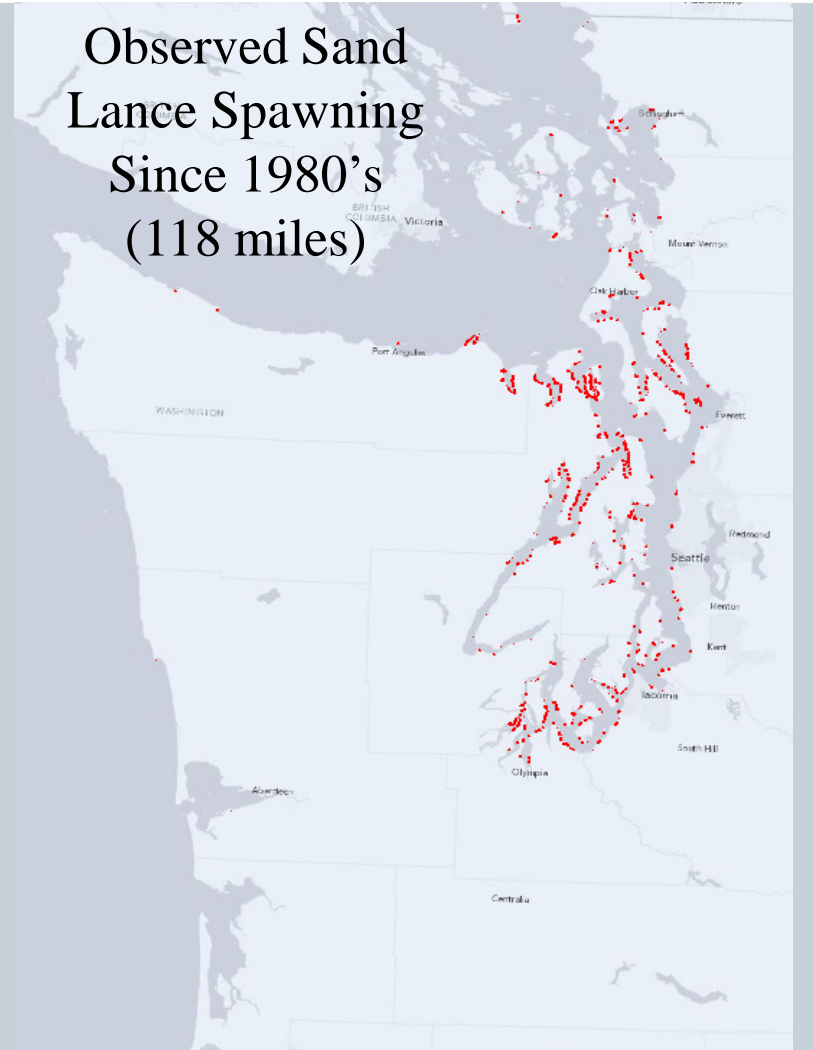


Sand Lance

- **Spawn during winter on fine grain beaches**
- **Bury in sand to avoid predators and conserve energy**
 - Little else known about life history or ecology
 - No population estimates or stock delineation work to date



Observed Sand
Lance Spawning
Since 1980's
(118 miles)



Historical Surveys Vs. Current Surveys

Historical Surveys:

Maximize potential to document spawning:

- **Distribute effort in times and places where spawning is thought to be most likely**

SmeltSurveys.exe
SmeltSurveysManual.exe

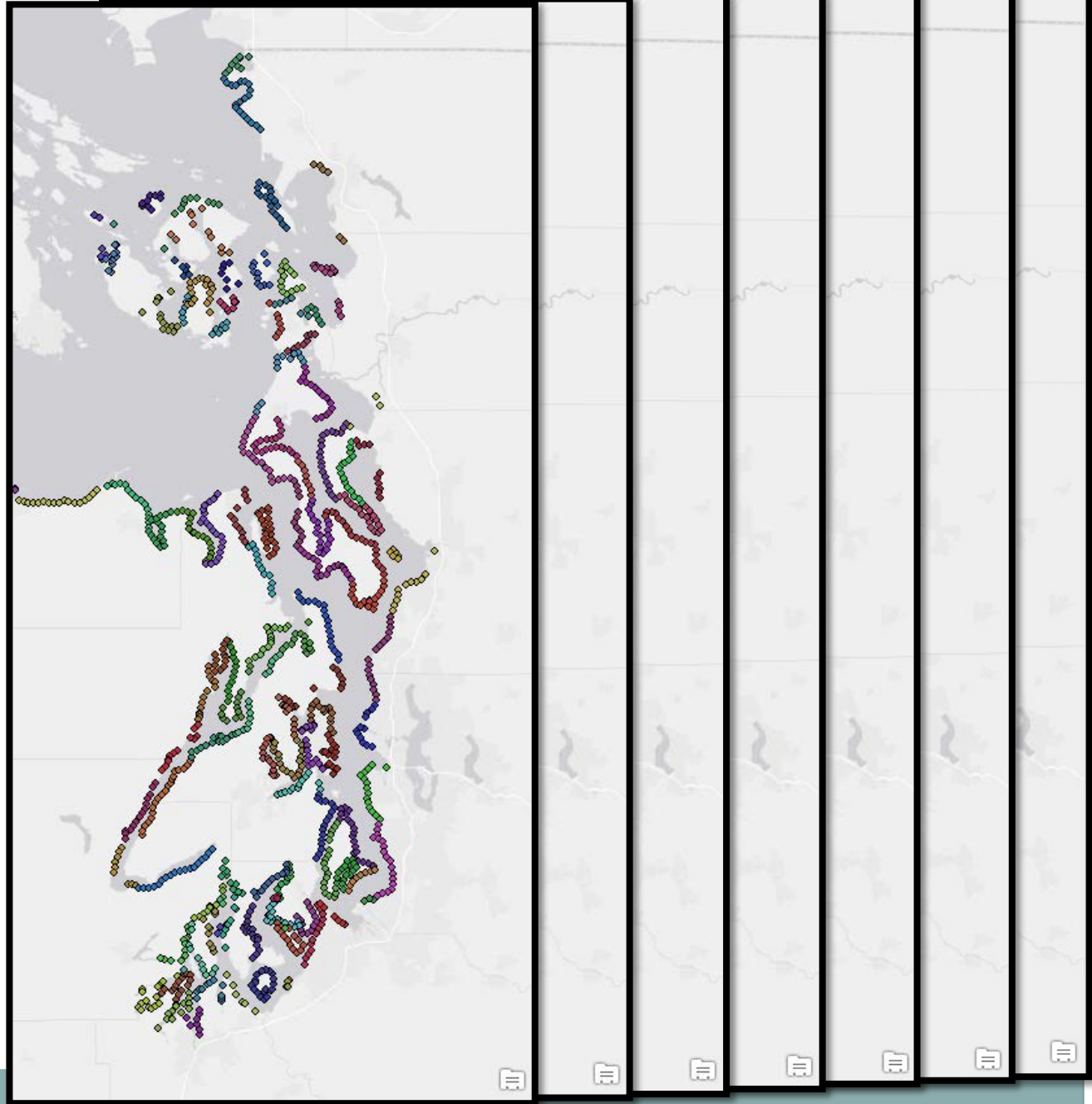
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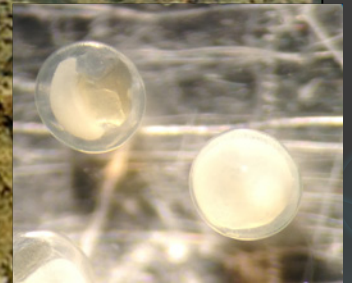
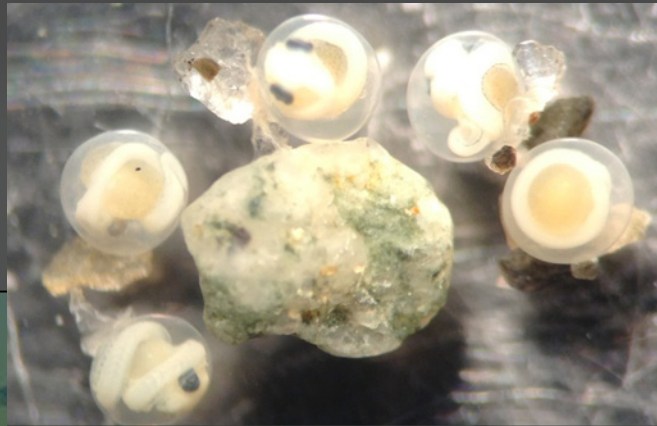
- **Sample year round and distribute effort around the Sound**
- **Established index sites to sample monthly**
- **Sample 150-200 sites per month**
- **Sites at least 1.2 km apart**
- **Typical field day: sample cluster of 20 sites**

January – July 2016...

Then started all over again in August with a new set of points.



Thank you!

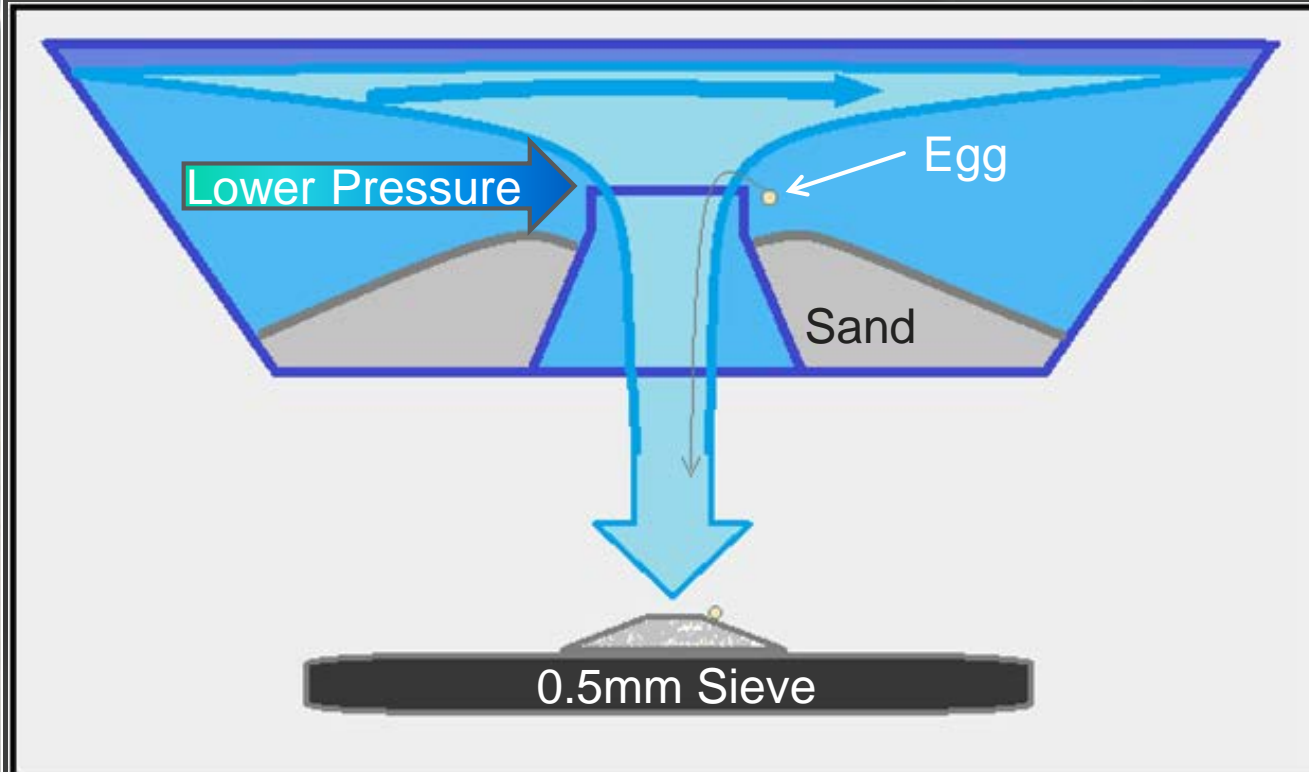


Vortex Method

How it works:

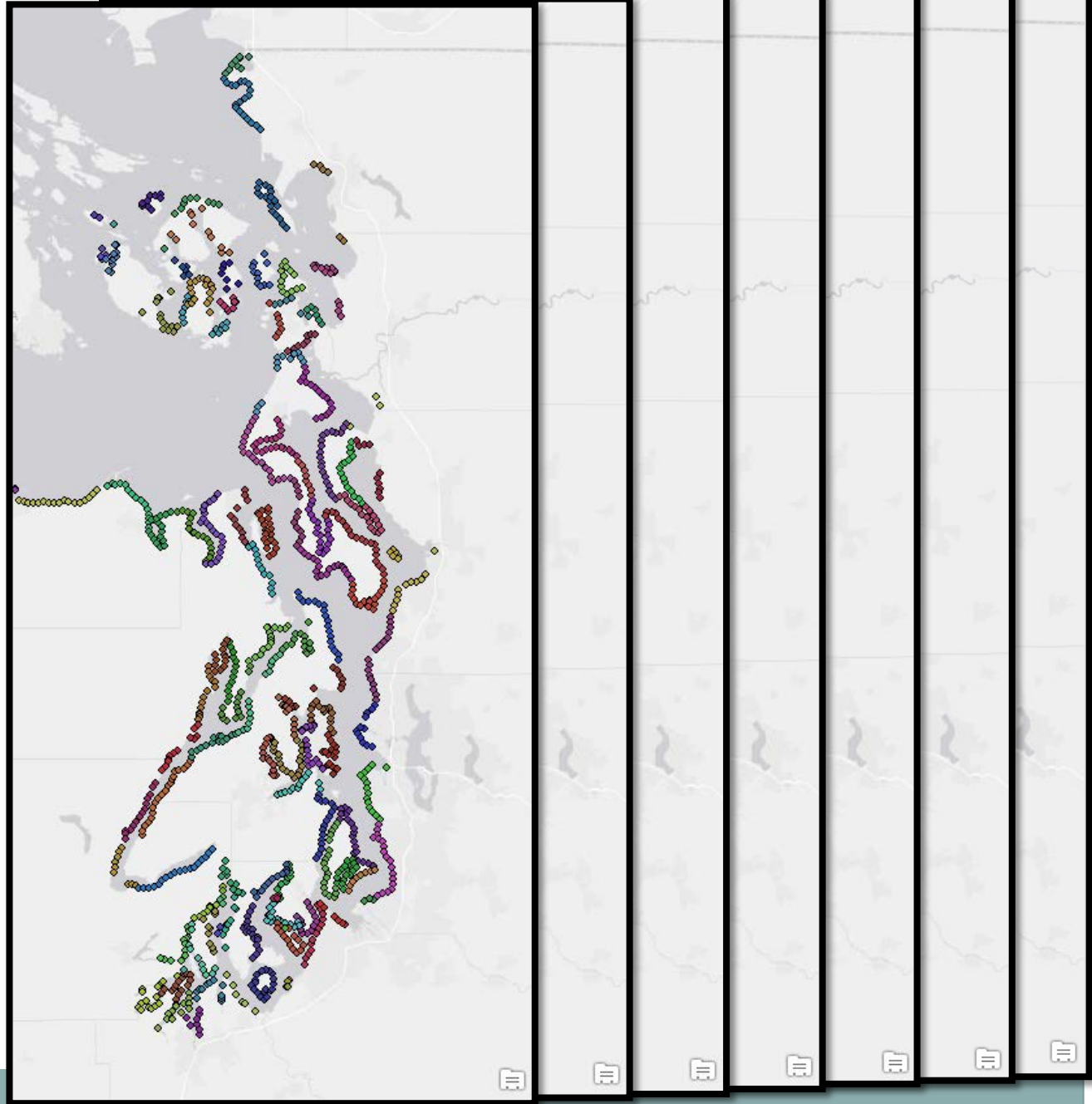
The movement of the water creates a pressure gradient

- Material moves from high pressure to low pressure in the middle
- The elevated cone in the middle reduces the amount of sand that leaves the bowl
- The sieve collects only the material large enough to be an egg



January – July 2016...

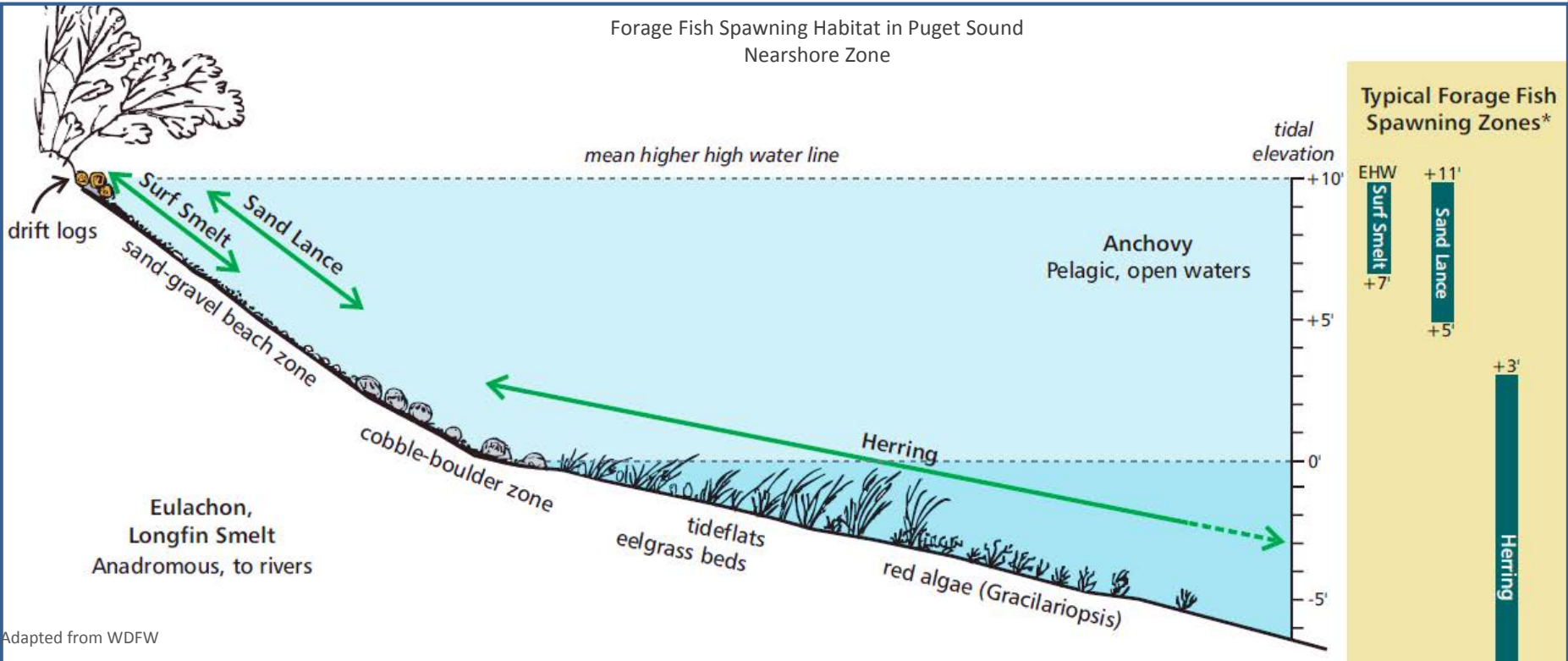
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Questions?



Forage Fish Spawning Habitat in Puget Sound
Nearshore Zone



Adapted from WDFW

Overview



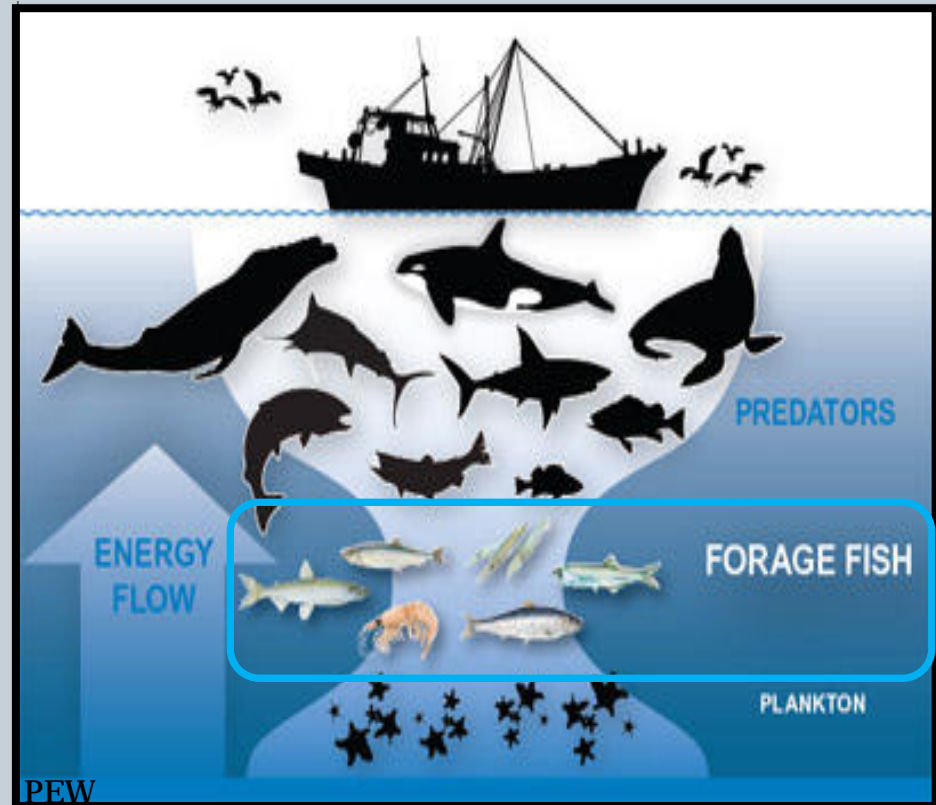
- **Forage fish**
 - What they are and why are they important
- **Beach Surveys**
 - Spawning distribution
 - ✦ *Side note on methods*
- **Questions?**



Forage fish

Forage fish are:

- **An ecological, not genetic, group**
- **Generally small, highly fecund, schooling fish at the middle of food webs**
- **A vital conduit between primary producers and higher level consumers**
- Commercially, recreationally, and culturally important
 - ✦ Currently account for over $\frac{1}{3}$ of overall marine harvest by weight
- A valuable indicator species of ecosystem health



What are forage fish & why are they important?

Forage fish are:

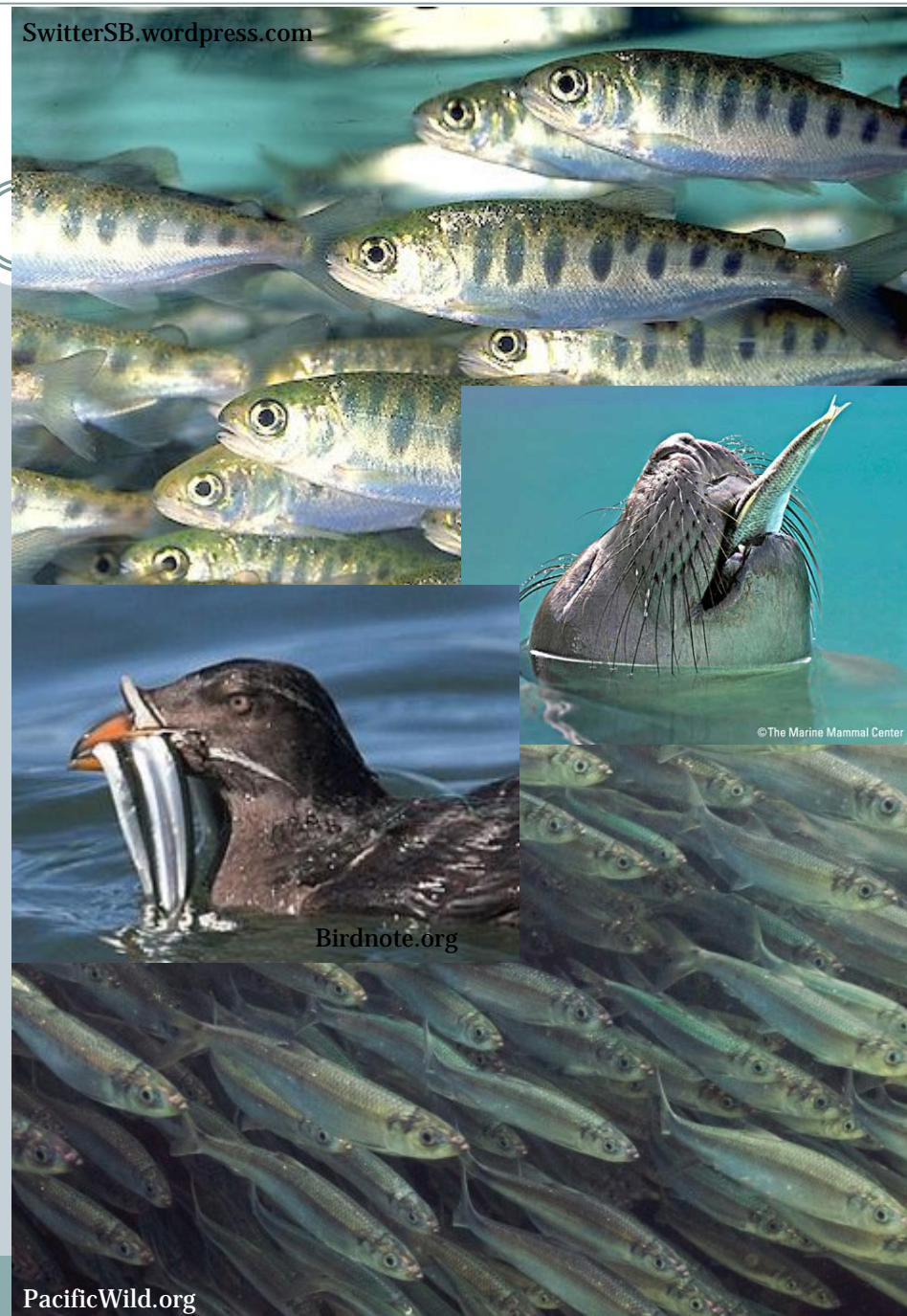
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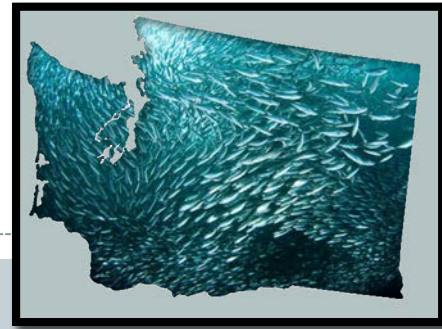
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Puget Sound Forage Fish Surveys

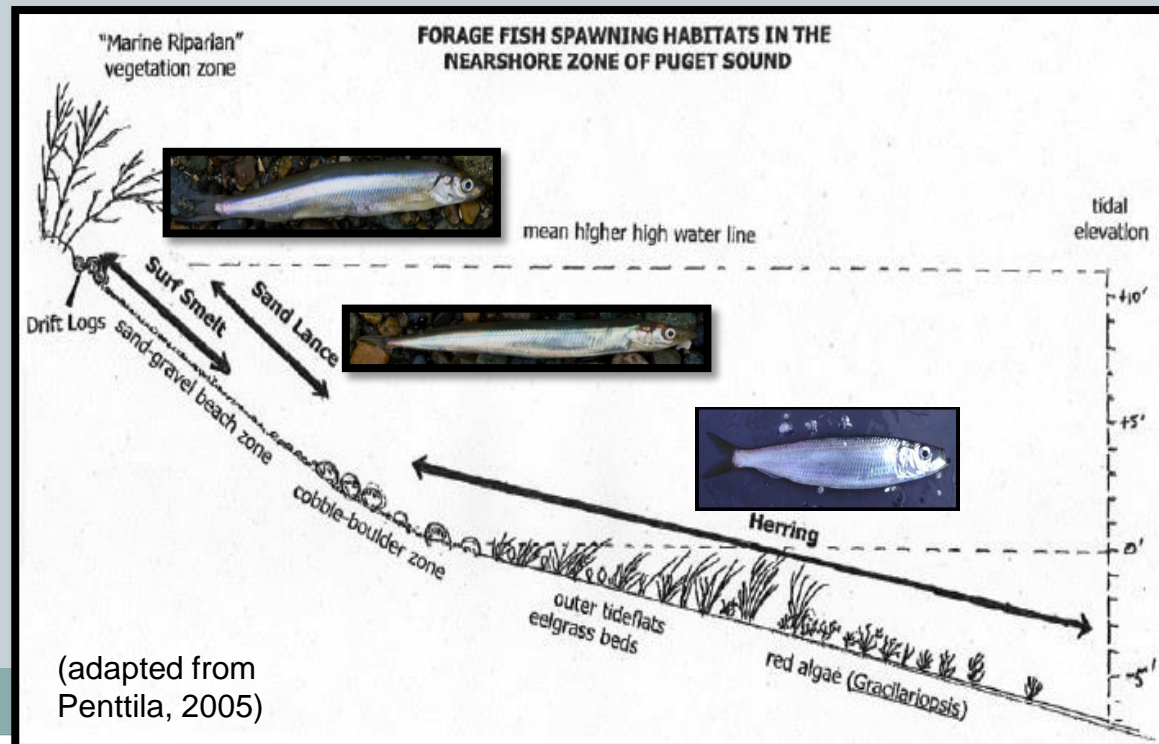


Forage fish protection



Washington State Law protects forage fish and their spawning habitat to:

avoid “*permanent loss of critical food fish and shellfish habitat*” (WAC 220-660)



Sampling Methods



Sample Collection



Reducing Sample Volume

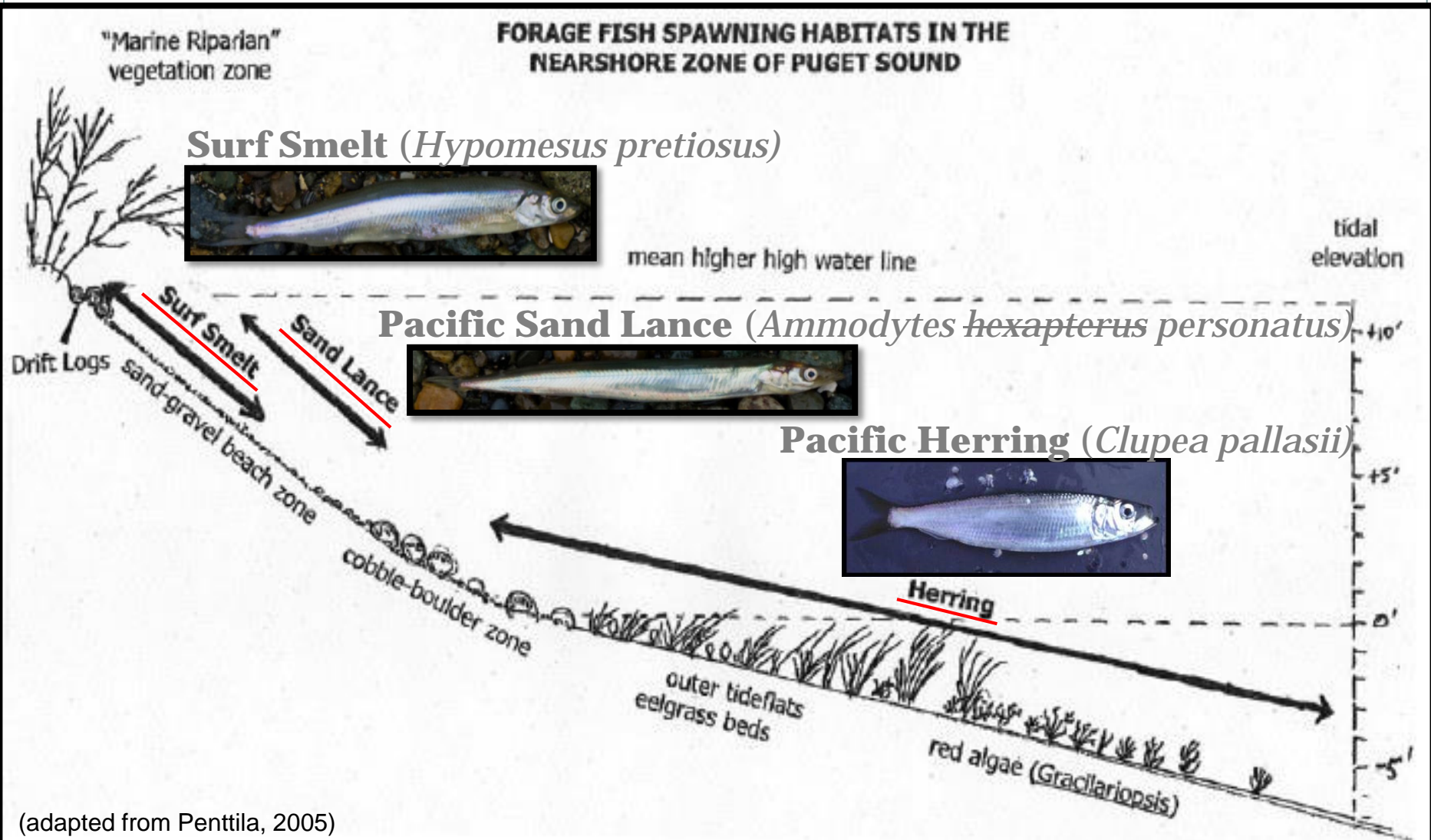


Egg Extraction



Lab Analysis

Nearshore Forage Fish:



(adapted from Penttila, 2005)

Surf Smelt & Sand Lance are Forage Fish



Isolating the “light-fraction”: winnowing method

