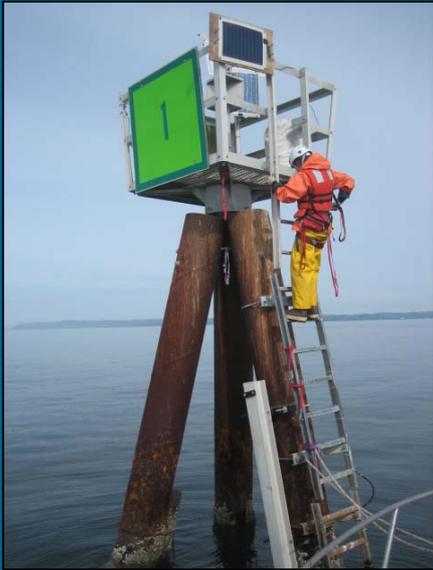
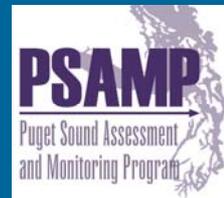


# Long-term Marine Monitoring in Willapa Bay



WA State Department of Ecology  
Marine Monitoring Program



# Ecology's Marine Waters Monitoring Program

Goal: *establish and maintain baseline  
environmental data*

- Characterize variability of basic water quality in space and time
- Identify significant changes in trends
- Collect data to support management
- Provide data for modeling and to the public

# Ecology's role



## Marine sediment monitoring

- Annual sampling of Puget Sound
  - Water quality, infaunal species, porewater toxicity, heavy metals, and organics

## Marine waters monitoring

- Monthly surveys by float plane
  - Water quality (e.g. temp, sal, sigma-t, D.O., chl a, pH, turbidity, nutrients, fecal colliform)
  - Profiles using SBE CTD and discrete sampling
- Intensive sampling on cruises for focused projects
- Continuous in-situ data from moorings



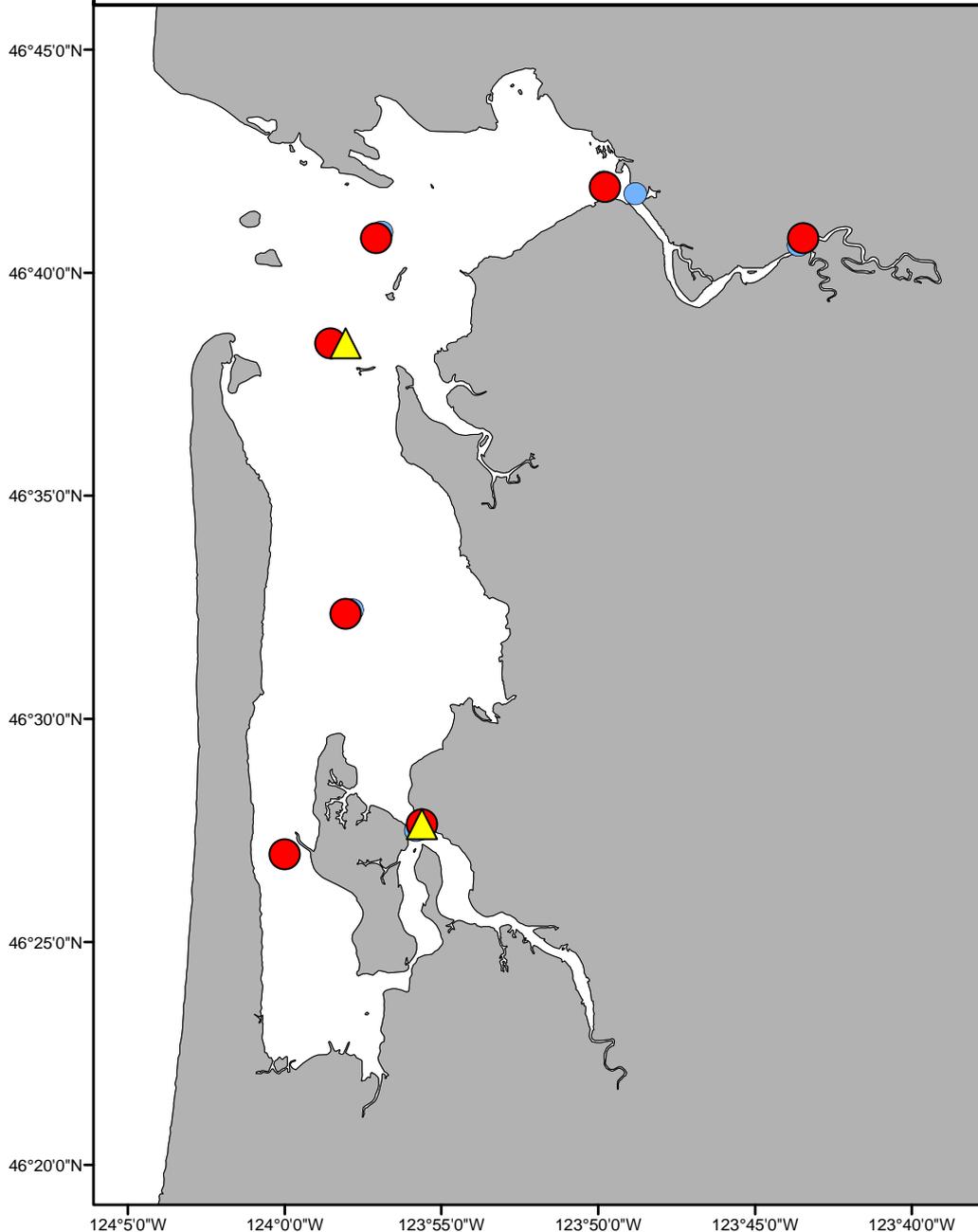
Holmes Harbor,  
Whidbey Island –  
plankton bloom in  
Sept. 06; *courtesy of  
J. Bos*

# Long-term marine waters monitoring stations for 2006

- Historical monitoring since 1973
- Mooring data in Willapa Bay since 1997



# 2008 Marine Profiles 1 - Willapa Bay



## Ecology monitoring stations in Willapa Bay

● = monthly flight station

▲ = continuous mooring station

# Willapa Bay Moorings

## Objective

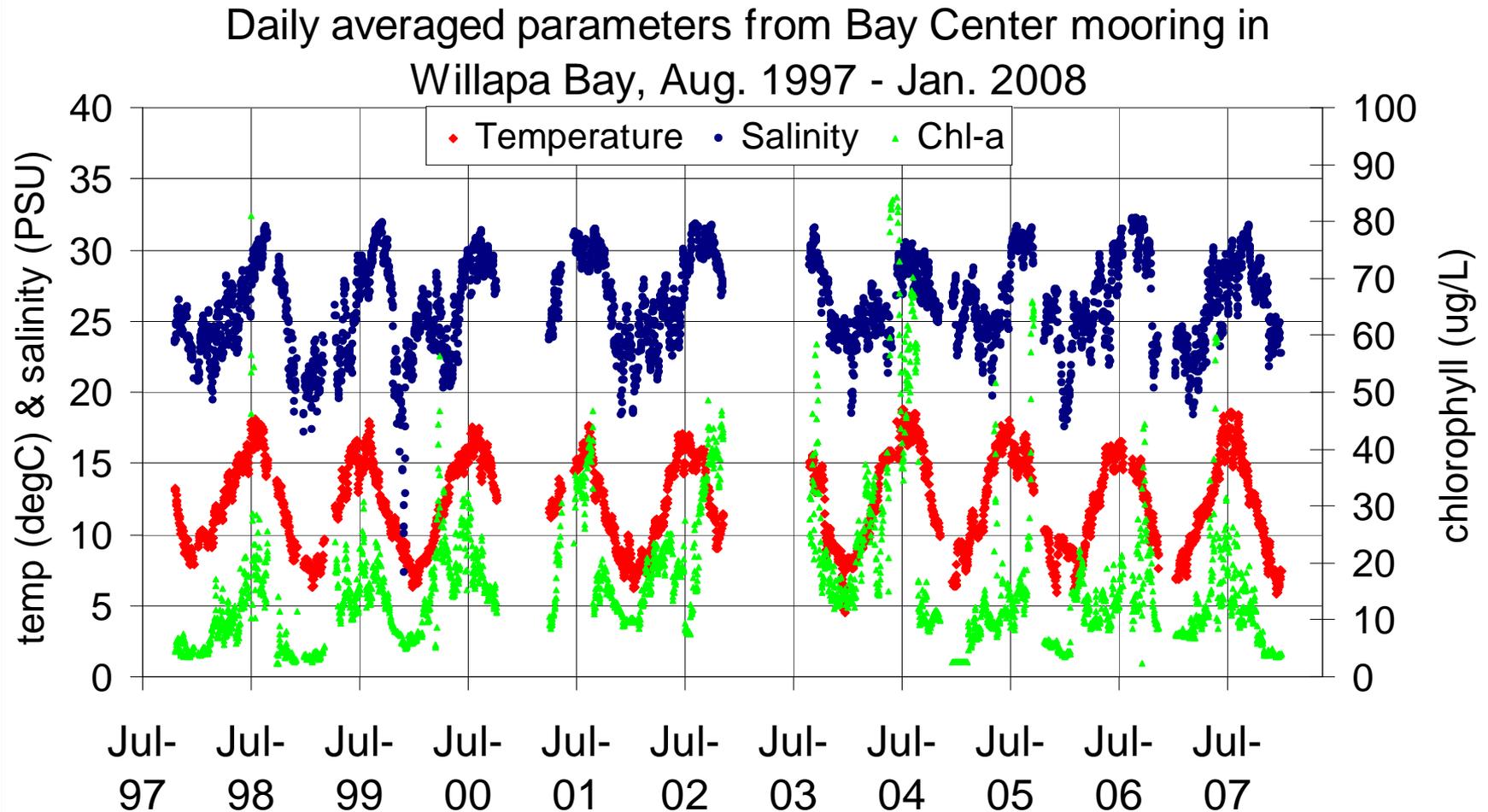
Assess tidal and seasonal change due to river and ocean influences

## Method

- Measure temperature, salinity, & fluorescence (proxy of chlorophyll concentration)
- Moorings sample near-surface every 15-min and travel with tide
- Serviced every 4 – 6 wks



# Willapa Bay Historical Data: Seasonal Trends



# Summary of findings for Willapa Bay

- Annual cycle varies much more than Pacific Ocean waters and varies by season.
- Ocean influence in summer and river influence in winter.
- Strongly affected by interannual climate variation, including El Nino and La Nina patterns.

# Summary of findings for Willapa Bay

- The influence of climate conditions show up in the physical data.
- Tides and winds have a strong role in mixing vs. stratification of the water column.
- Low dissolved oxygen does not appear to be a problem in Willapa Bay, but is observed periodically.
- Phosphorus may be important to phytoplankton production.

# One implication of findings...

## Harmful algal bloom (HAB) development

- Toxic diatom species (*Pseudo-nitzschia spp.*) that produce domoic acid are associated with influx of ocean waters into estuary
- Bloom extent depends on light and nutrient concentrations  
(Roegner et. al, 2002; Trainer et. al, 2002)

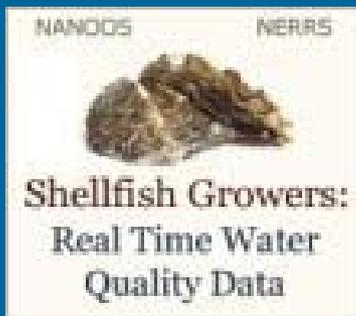


Microscope photo of toxic diatom, *Pseudo-nitzschia australis* (from NOAA)

# Another use of data...

environmental data for shellfish growers

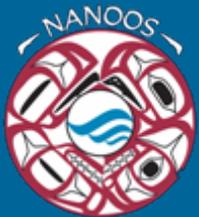
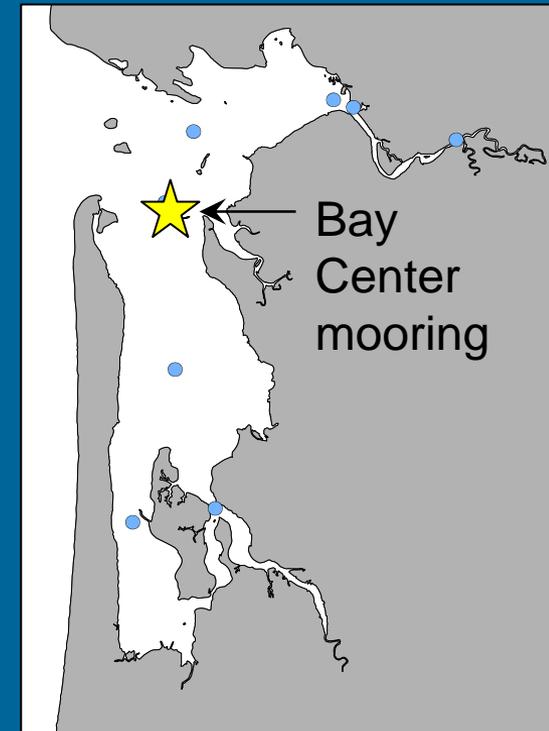
- Temperature related to spawning and mortalities
- Low salinities (more fresh water) can weaken shellfish
- Chlorophyll estimates phytoplankton biomass; food needed for shellfish growth



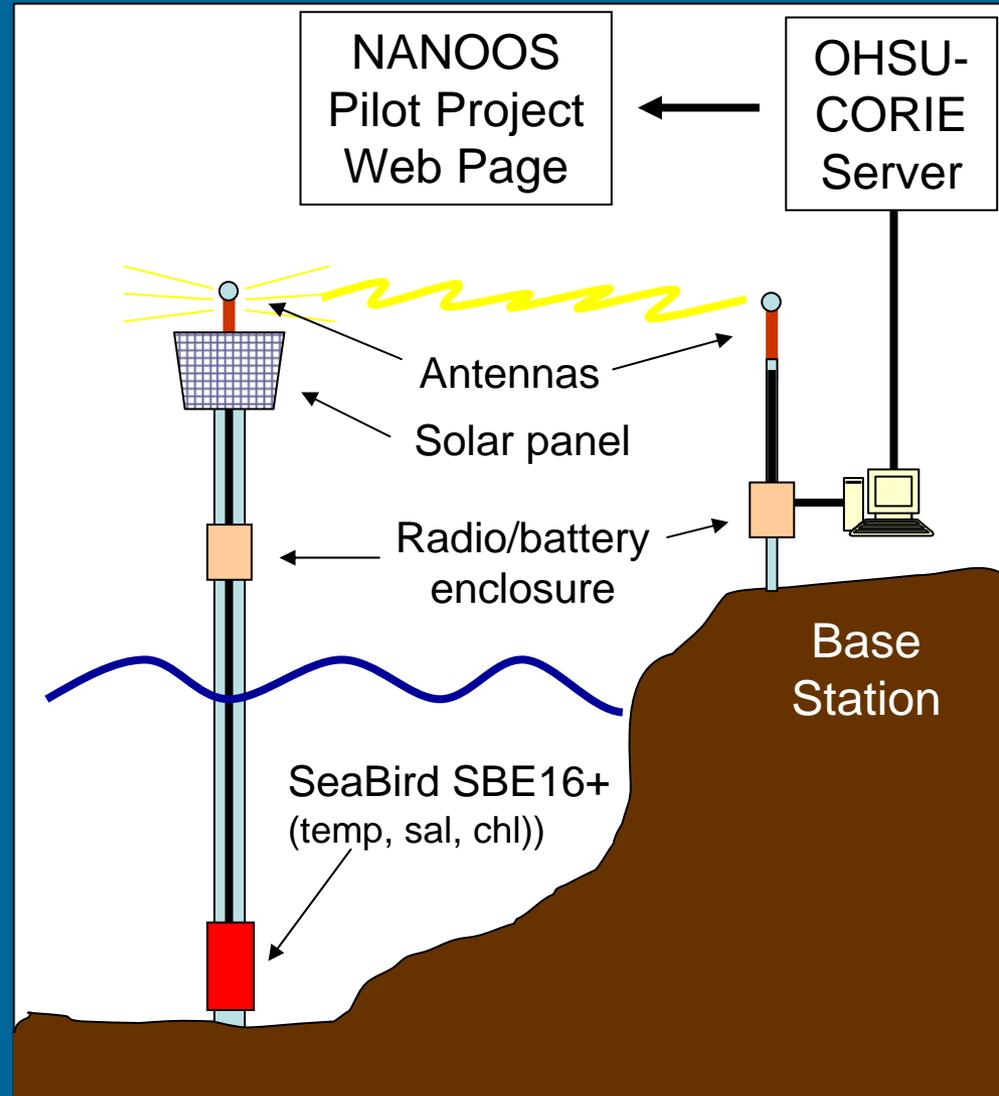
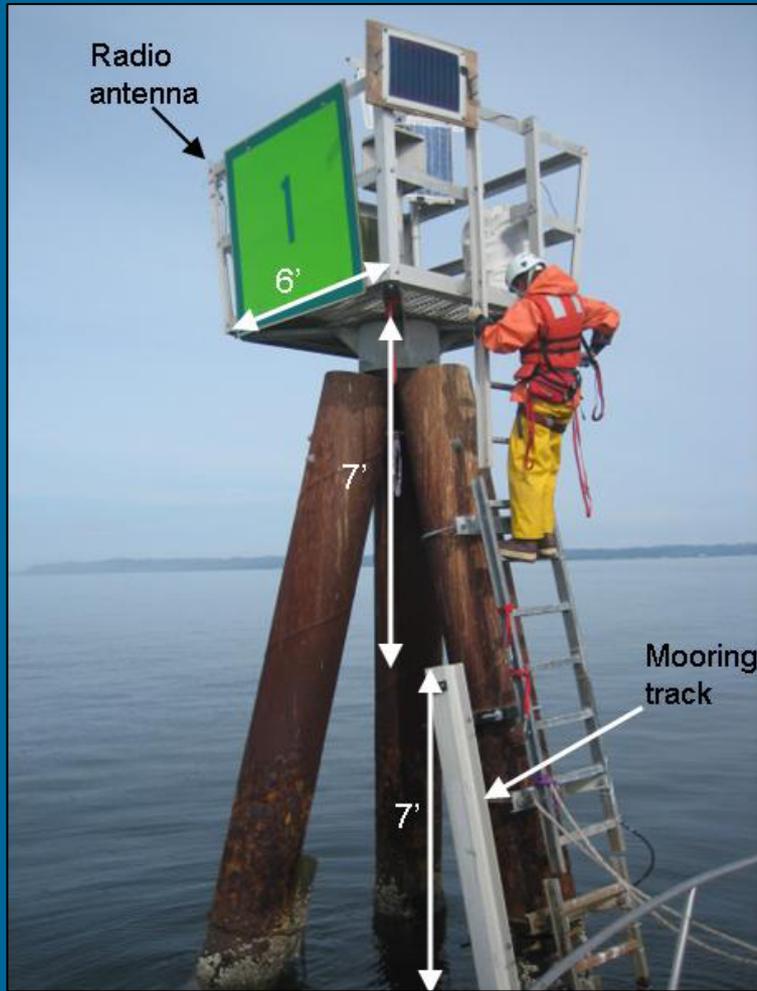
# Real-time data for public use

## Planned addition of Willapa Bay mooring to real-time network

- Using Bluetooth and radio technology to broadcast data to computer and post to internet
- By the end of this summer (2008)



# Telemetry for Bay Center mooring





For more information:

Stephanie Jaeger

[sjae461@ecy.wa.gov](mailto:sjae461@ecy.wa.gov)

(360) 407-6519

Washington Dept. of  
Ecology  
Environmental  
Assessment Program



# Real-time Water Quality Data for Shellfish Growers in the Pacific NW

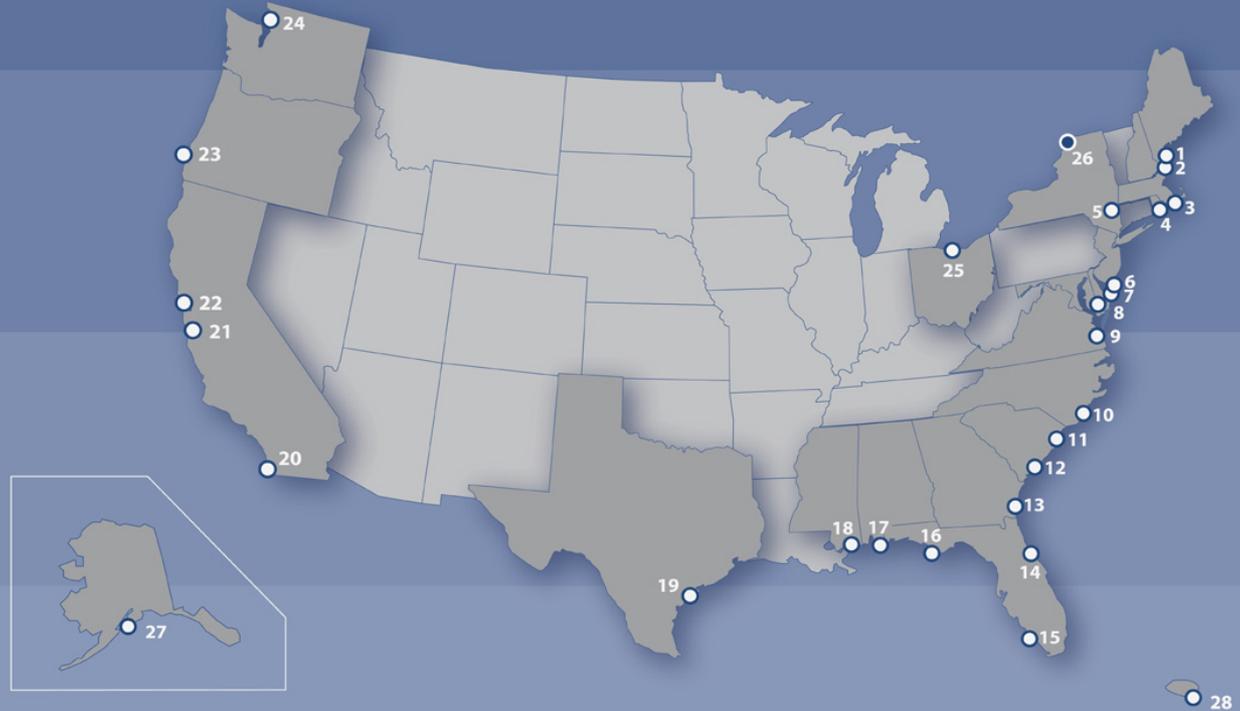
A Pilot Project

**Cathy Angell, Coastal Training Program Coordinator  
Padilla Bay NERR**



# NATIONAL ESTUARINE RESEARCH RESERVES

A network of 27  
protected areas



1. Wells, Maine

2. Great Bay, New Hampshire

3. Waquoit Bay, Massachusetts

4. Narragansett Bay, Rhode Island

5. Hudson River, New York

6. Jacques Cousteau, New Jersey

7. Delaware

8. Chesapeake Bay, Maryland

9. Chesapeake Bay, Virginia

10. North Carolina

11. North Inlet-Winyah Bay, South Carolina

12. ACE Basin, South Carolina

13. Sapelo Island, Georgia

14. Guana Tolomato Matanzas, Florida

15. Rookery Bay, Florida

16. Apalachicola, Florida

17. Weeks Bay, Alabama

18. Grand Bay, Mississippi

19. Mission-Aransas, Texas

20. Tijuana River, California

21. Elkhorn Slough, California

22. San Francisco Bay, California

23. South Slough, Oregon

24. Padilla Bay, Washington

25. Old Woman Creek, Ohio

26. Proposed—St. Lawrence River, New York

27. Kachemak Bay, Alaska

28. Jobos Bay, Puerto Rico





Kachemak  
Bay Reserve

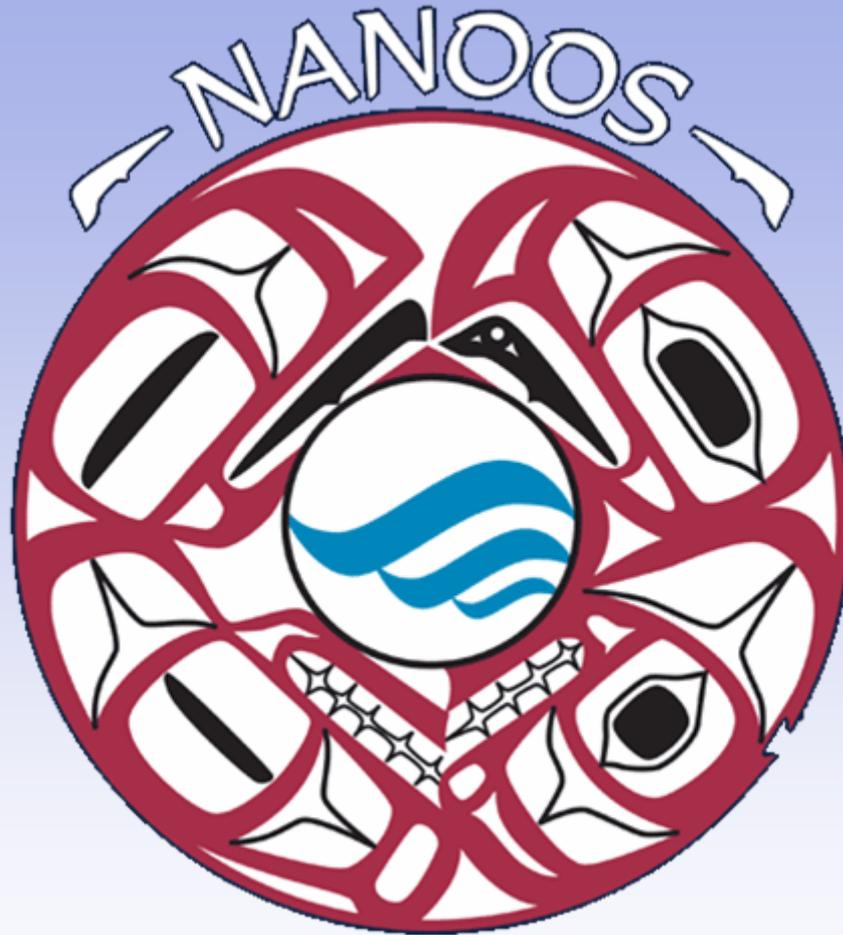
Padilla Bay  
Reserve

South Slough  
Reserve

# Pilot Project

Making Real-Time Water  
Quality Data available to  
Shellfish Growers





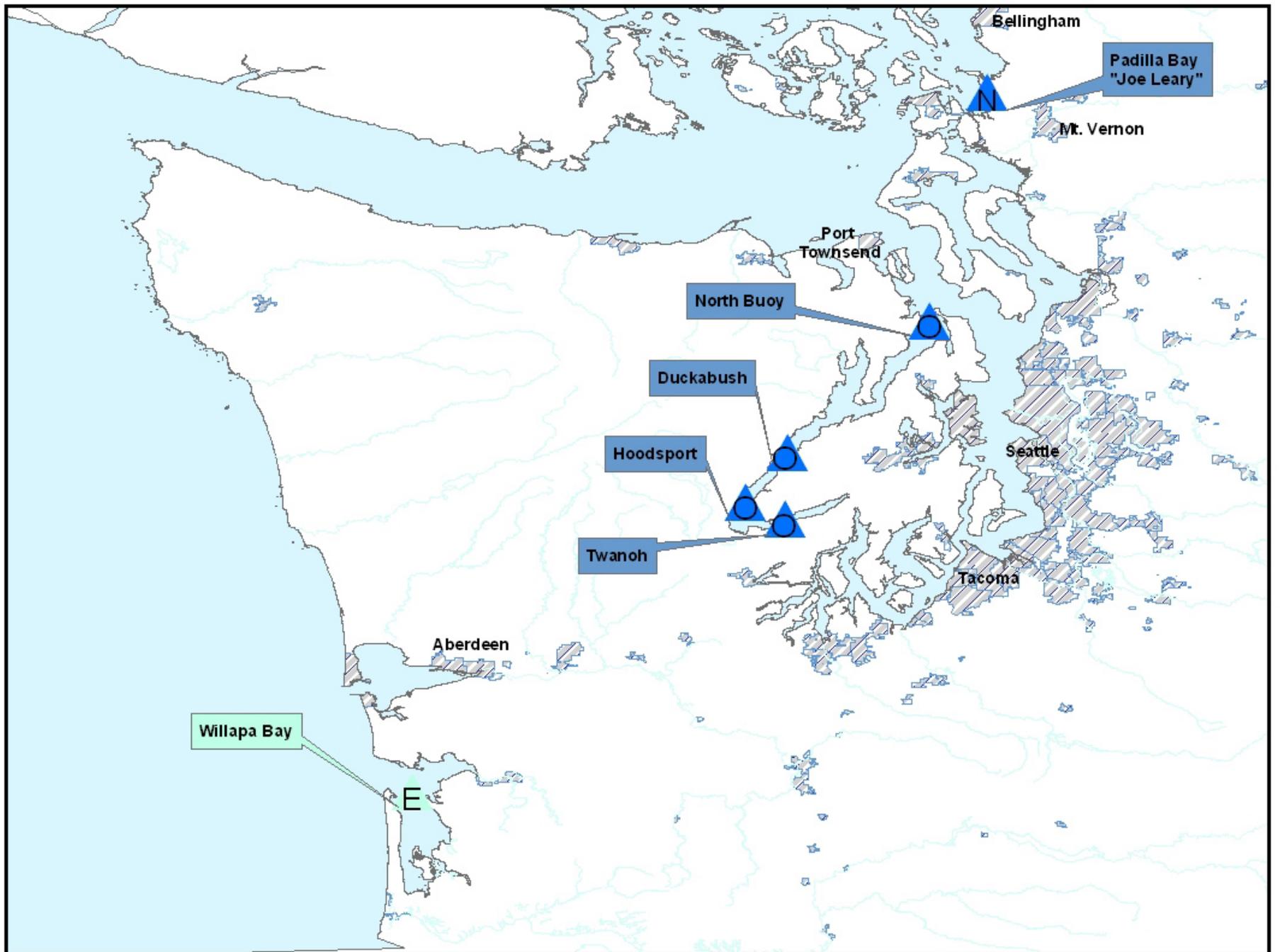
NORTHWEST ASSOCIATION OF NETWORKED OCEAN  
OBSERVING SYSTEMS

# NANOOS Website

<http://www.nanoos.org>

The screenshot shows the homepage of the NANOOS Pilot Project website. The browser window title is "NANOOS Pilot Project - Mozilla Firefox". The address bar shows the URL "http://www.ccaltr.org.edu/nanoos/". The page features a red header with the NANOOS logo on the left, the text "NANOOS Pilot Project Pacific Northwest estuaries and shores" in the center, and the Ocean.US logo on the right. A left sidebar contains navigation links: "About", "Contact us", "FAQ", "Estuaries", "Shores" (with sub-links for North Beach, Grayland Plains, Lona Beach, Clatsop Plains, and Rockaway), "Observatories" (with sub-links for CORIE, ORCA, PRISM, SSHERB, and WDE), and "Help". Below the sidebar is a map of the Pacific Northwest coast with various colored markers indicating sites. A "Display" section at the bottom left has checkboxes for "Shore sites" and "Forecasts", and a "Go" button.

The screenshot shows a page from the Northwest Association of Networked Ocean Observing Systems (NANOOS) website. The browser window title is "Welcome to NANOOS - Mozilla Firefox". The address bar shows the URL "http://www.nanoos.org/hydrotemperature/sum06.html". The page header reads "Northwest Association of Networked Ocean Observing Systems" and "Oregon, Washington, Northern California, British Columbia". The main content area is titled "Puget Sound Near-Surface Water Temperatures" and features a map of the Puget Sound region with orange temperature markers. A legend on the left lists various NANOOS services: "NANOOS home", "About the logo", "About NANOOS", "Joining and becoming", "Join-in Work", "Transport data access", "Ocean Conditions", "For PDA's", "Education", "Surface Currents", "Contact Us", and "Join email list". A "Gulf of Maine Ocean Observing" link is also visible at the bottom left. A blue box on the map indicates "Water Temperature Degree Centigrade 13-July-2006 10:00 PST". The map axes are labeled "Latitude °N" (46.5 to 49.5) and "Longitude °W" (127 to 120).



# ORCA BUOY

Oceanic  
Remote  
Chemical  
-Optical  
Analyzer



Pacific Shellfish Institute

Pacific Coast  
Shellfish Grower's Association



# Needs Assessment Survey

1. Temperature (99%)
2. Dissolved Oxygen (97%)
3. Salinity (96%)
4. Chlorophyll (92%)
5. Turbidity (89%)
6. pH (83%)

- Website with near-real time data (98%)
- Website that graphs historic data (97%)
- Website that plots time-series of recent data (95%)

- Automatic alerts – when conditions rise above or fall below certain thresholds (87%)
- Automatic emails - weekly data (66%)

# Website Design



<http://www.nanoos-shellfish.org/>

# Northwest Association of Networked Ocean Observing Systems

Oregon, Washington, Northern California, British Columbia



## NANOOS PILOT PROJECT

A NANOOS prototyping project.



A project to develop strategies and build assets for the

integrated observation of the estuaries and shorelines of the Northwest. The project is developing nowcast and predictive capabilities for this environment, as well as interactive access to archival data, real-time data, and selected forecasts.

**NANOOS Planning and Implementation:**  
Workshops, Reports, Presentations, Documents, and the MOA : [This Link!](#)

- NANOOS Home
- About the logo
- About NANOOS
- In the News
- Dial-A-Buoy
- OpenDAP data access
- Ocean Conditions
- Atmospheric Conditions
- For PDAs

## Buoy & Station Data

### NOAA Buoy Data



Hourly data developed for marine operations:

visibility, air temperature, water temperatures at various depths, salinity and more.

### Water Quality Data

Real-time Water Quality Data for Shellfish



Growers. A pilot project between NANOOS and the National Estuarine Research Reserve System.

## Weather forecasts

### Regional forecasts

Weather Services:

- NWS, Seattle
- NWS, Portland
- NWS, Northwest - Experimental
- British Columbia

Coastal Marine Forecasts

National Data Buoy Center

Pacific Offshore

Ocean Prediction

Center - Wind/Waves/

Sea State Forecasts

National and Canadian

forecasts

- [Weather Channel.com](#)
- [WeatherUnderground.com](#)
- [Canadian weather](#)



# Real-time Water Quality Data for Shellfish Growers in the Pacific NW

A pilot project between NANOOS and the National Estuarine Research Reserve System



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**Make Informed Decisions Based on Real-Time Data!** This pilot project represents an effort to bring real-time water quality data to shellfish growers in the Pacific Northwest. The project has started with nine monitoring sites in Alaska, Washington, and Oregon. Expansion to other sites is anticipated.

**Alaska**  
Are you at risk for a Vibrio bacterium outbreak in Kachemak Bay? Check temperature and other readings here.

**Washington**  
Do your oysters have enough oxygen to thrive in the Hood Canal? Get the latest information now.

**Oregon**  
What impact did the last rainfall have on salinity? See what's happening near Charleston and Valino Island.



## Spotlight Data



South Slough Research Reserve: Valino Island  
Valino Island, OR  
43° 19' 1.92 N, 124° 19' 17.76 W  
10/4/2007 1:45:00 PM

Temperature 56.1 degrees F  
Salinity 29.1 ppt  
DO concentration 9.9 mg/L  
DO Saturation 113 %  
Turbidity -4 NTU  
pH 8.1  
Insitu Chlorophyll No Data





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## Current Data : Alaska



Kachemak Bay Research Reserve : Homer Ferry Terminal Dock

Homer, AK  
 59° 36' 10.44 N, 151° 24' 29.16 W  
 10/4/2007 12:15:00 PM

Temperature 49.8 degrees F  
 Salinity 29.6 ppt  
 DO concentration 6.3 mg/L  
 DO Saturation 67 %  
 Turbidity 5 NTU  
 pH 7.8

Insitu Chlorophyll No Data



Kachemak Bay Research Reserve : Seldovia Ferry Dock

Seldovia, AK  
 59° 26' 28.68 N, 151° 43' 6.96 W  
 10/4/2007 12:45:00 PM

Temperature 49.1 degrees F  
 Salinity 30 ppt  
 DO concentration 9.2 mg/L  
 DO Saturation 98 %  
 Turbidity 1 NTU  
 pH 8.2

Insitu Chlorophyll No Data



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 site by Mindfly | xhtml



### Current Data : Homer Dolphin Deep

- Temperature
- Salinity
- Dissolved O2
- Turbidity
- PH

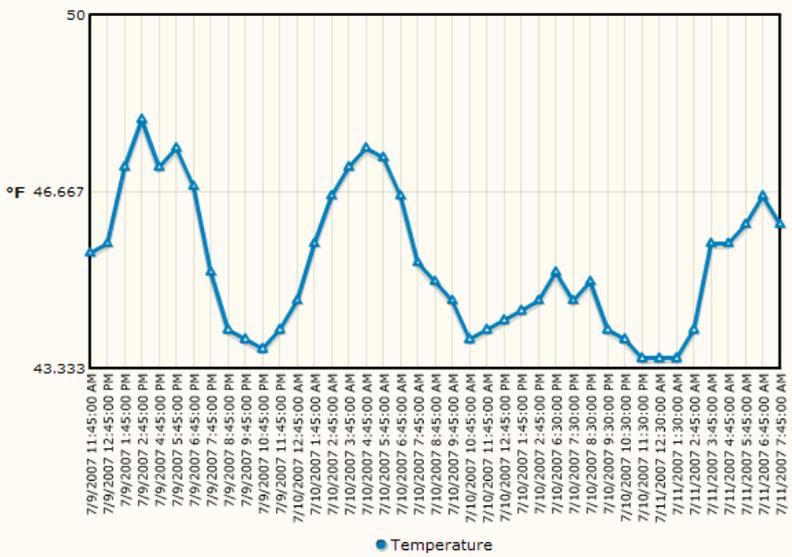
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### Current Data

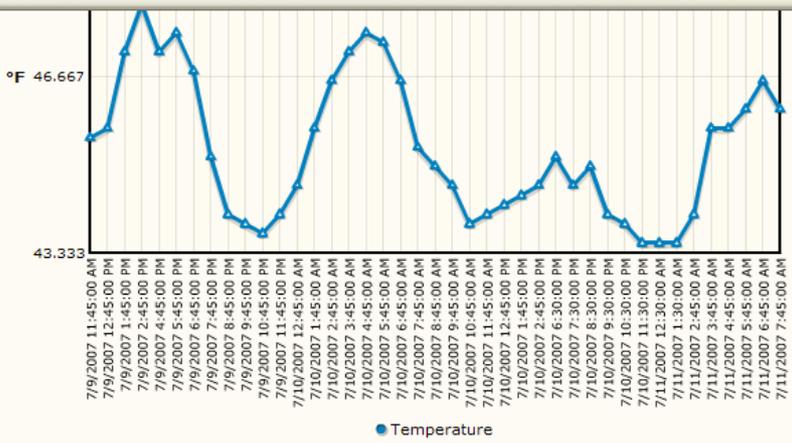
Last 48 Hours



Fahrenheit  Celsius

Time Period (click to change)  12 hrs  24 hrs  48 hrs  72 hrs

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Fahrenheit  Celsius

Time Period (click to change)  12 hrs  24 hrs  48 hrs  72 hrs

**Site References** Elevated water temperatures are associated with increased mortalities. They also signal possible spawning. In the summer, normal temperatures range from 46 to 80 degrees Fahrenheit. If the temperatures surpass 64 degrees for more than 24 hours, this is cause for concern. In the winter, normal temperatures range from 38 to 50 degrees Fahrenheit.

\*Disclaimer

**Send Me Alerts by Email**  
(click here to customize your alerts)



Temperature

Fahrenheit  Celsius

Time Period  12 hrs  24 hrs  48 hrs  72 hrs  
 (click to change)

**Site References** Elevated water temperatures are associated with increased mortalities. They also signal possible spawning. In the summer, normal temperatures range from 46 to 80 degrees Fahrenheit. If the temperatures surpass 64 degrees for more than 24 hours, this is cause for concern. In the winter, normal temperatures range from 38 to 50 degrees Fahrenheit.

\*Disclaimer

**Disclaimer**

The datasets enclosed within this package/transmission are only as good as the quality assurance and quality control procedures of the associated monitoring program. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal Government and the associated authors do not assume liability to the Recipient or third persons, nor will the Federal Government or the associated authors indemnify the Recipient for its liability due to any losses resulting in any way from the use of this dataset. Please contact the Research Coordinators for the National Estuarine Research Reserve Sites (see contact list) for the proper citation before publishing data.

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## Reference

The following information covers general ranges. Summer = May through October; Winter = November through April.

### Temperature

Elevated water temperatures are associated with increased mortalities. They also signal possible spawning. In the summer, normal temperatures range from 46 to 80 degrees Fahrenheit. If the temperatures surpass 64 degrees for more than 24 hours, this is cause for concern. In the winter, normal temperatures range from 38 to 50 degrees Fahrenheit.

### Salinity

Low salinities over a long duration can weaken and/or kill shellfish. Shellfish's resistance to low salinities decreases with increasing water temperatures. In the summer, normal salinity levels range from 5 to 32 psu (practical salinity units). If the salinity levels fall below 10 psu for more than 48 hours, this is cause for concern. In the winter, normal salinity levels range from 5 to 30 psu. If the salinity levels drop below 5 psu for more then 48 hours, this is cause for concern.

### Dissolved Oxygen

Very low dissolved oxygen levels will weaken or kill shellfish. High levels are reported to cause "gas bubble" disease. In the summer, normal DO levels range from 5 to 140+ percent saturation. If the levels fall below 20% saturation or rise above 115% saturation for more than 24 hours, this is cause for concern. In the winter, normal DO levels range from 5% to 100% saturation.

### Turbidity

Resistance to elevated turbidity varies with species, with oysters being most resistance; very high turbidity will reduce feeding rates and growth. Normal levels range from 0 to 200 NTU (nephelometric turbidity units). If the turbidity level rises above 50 NTU 24 hours, this is cause for concern.

### Chlorophyll

Bivalve shellfish require sufficient phytoplankton (as measured by chlorophyll content) to sustain growth; very low levels indicate reduced growth potential. Normal levels range from 2 to 60 µg/l (micrograms per liter). If the chlorophyll levels drops below 5 µg/l for more than 72 hours, this is cause for concern.

### pH

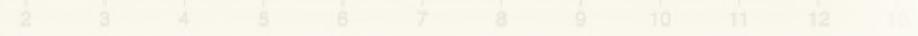
Low or high pH levels are unusual in marine waters, but can indicate a serious water quality issue associated, for example, with reduced dissolved oxygen, elevated ammonia levels, etc. Normal pH levels range from 7 to 9. If they drop below 7 or rise above 9 for more than 12 hours, this is cause for concern.



# Real-time Water Quality Data for Shellfish Growers in the Pacific NW



A pilot project between NANOOS and the National Estuarine Research Reserve System



## Email Notification Sign-Up Form

You may choose a range of parameters for each dataset. Email alerts will only go out after the range has been surpassed for a critical period of time.

**Please Login or Join to use the email alerts.** If you would like to receive automatic email alerts for specific datasets, please enter your email address and create a password (we suggest the last four digits of your social security number for easy recall.) This information will remain confidential.

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## Sign Up for Your New Account

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Password: (The last 4 digits of your social)

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Send My Alerts to this Email Address:

This is your Security Question:

Write your answer:

email address:

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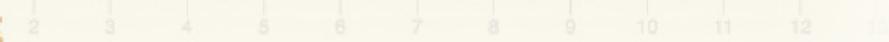




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Welcome cathy angell (cangell@padillabay.gov)

Please enter the information below that specifies your personalized email alerts.

logged In:  
  
  
  
 update profile  
 logout

Send me an alert for

when the

drops below  degrees F

rises above

for more than

**Add This Alert**

### Your Current Alerts:

- Joe Leary Slough:** Temperature must be Above 64 degrees F for 24 hours delete
- Charleston Bridge:** Salinity must be Below 10 ppt for 48 hours delete

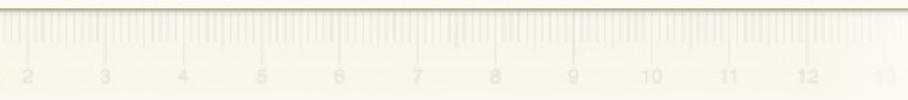




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## Links



The **Centralized Data Management Office (CDMO)** is housed at the North Inlet-Winyah Bay NERR in South Carolina. It was established in support of the National Estuarine Research Reserve's (NERR) System-wide Monitoring Program (SWMP) that is currently implemented at 27 reserves in the US and Puerto Rico. Click here for current and historic data.



The **Northwest Association of Networked Ocean Observing Systems (NANOOS)** was established to address the ocean observing and prediction needs of users in the Pacific Northwest.



The **Oceanic Remote Chemical Analyzer (ORCA)** is an autonomous moored profiling system providing near real-time data streams of water and atmospheric conditions. There are currently 4 ORCA mooring systems deployed, all in Hood Canal, in Washington State.

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