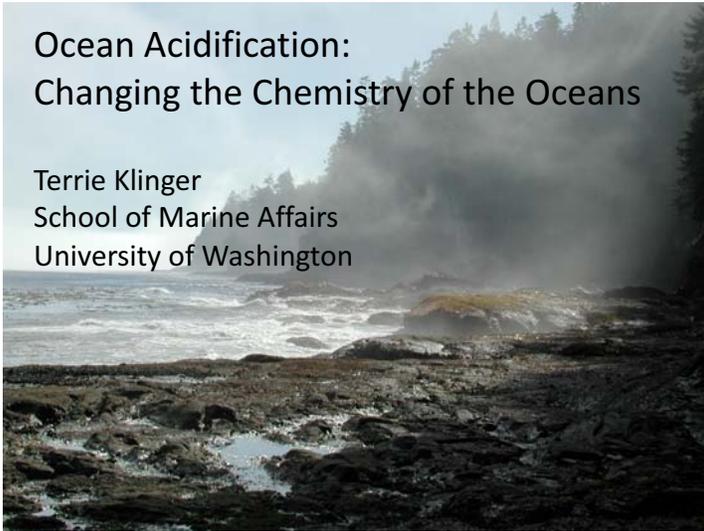
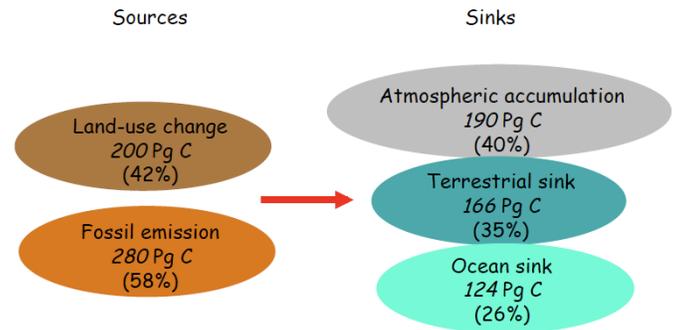
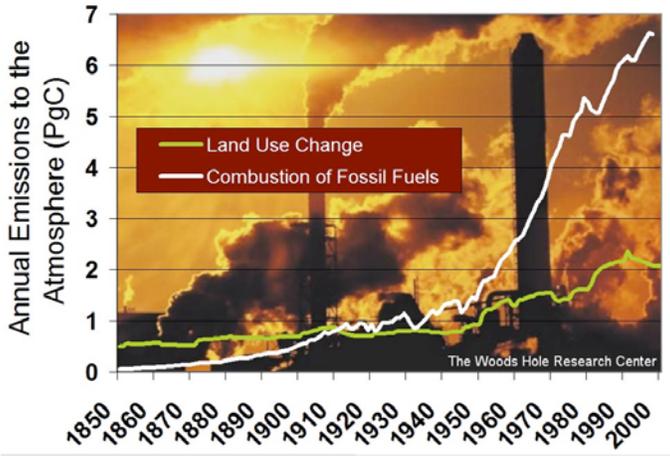
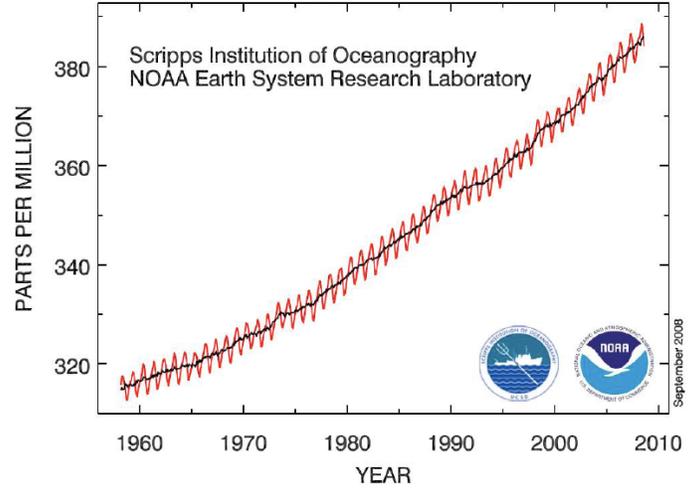


# Ocean Acidification: Changing the Chemistry of the Oceans

Terrie Klinger  
School of Marine Affairs  
University of Washington

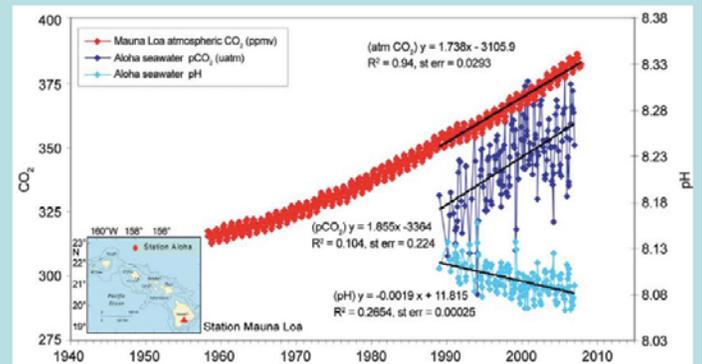


## Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



House et al. (2002) *GCB*  
Feely 2008

## Atmospheric CO<sub>2</sub> at Mauna Loa (ppmv) and surface ocean pH and pCO<sub>2</sub> (µatm) at Ocean Station Aloha in the subtropical North Pacific Ocean. (Feely 2008)



Mauna Loa data: Dr. Pieter Tans, NOAA/ESRL, [www.esrl.noaa.gov/gmd/ccgg/trends/](http://www.esrl.noaa.gov/gmd/ccgg/trends/); HOTS/Aloha data: Dr. David Karl, University of Hawaii, <http://hahana.soest.hawaii.edu/>. Graph excerpted from: Feely, R.A. 2008 "Ocean Acidification." In: *State of the Climate in 2007*. Available at: <http://www.ncdc.noaa.gov/oa/climate/research/2007/annbams/>

### Long-term change in seawater pH

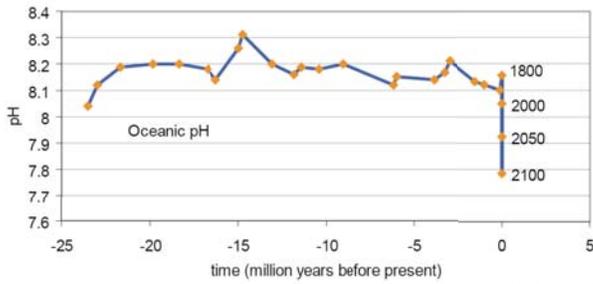
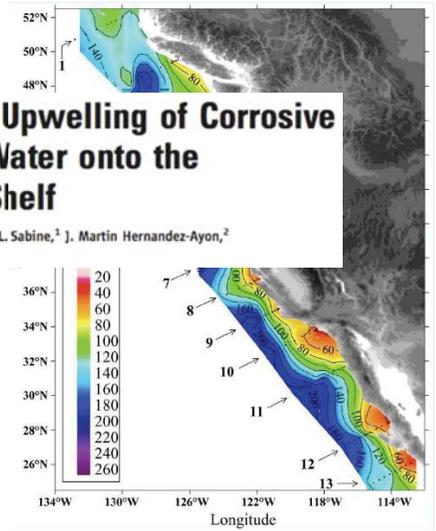


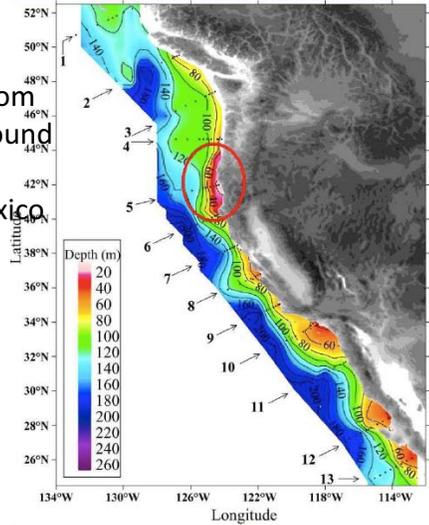
Figure 1. Past and contemporary variability of marine pH. Future predictions are model derived values based on IPCC mean scenarios (from Turley *et al.*, 2006, Cambridge University Press, 8, 65-70).

### Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf

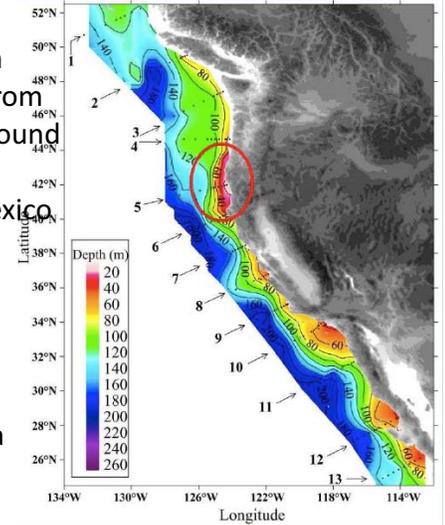
Richard A. Feely,<sup>1\*</sup> Christopher L. Sabine,<sup>1</sup> J. Martin Hernandez-Ayon,<sup>2</sup> Debby Ianson,<sup>3</sup> Burke Hales<sup>3</sup>



Corrosive water on continental shelf from Queen Charlotte Sound to Baja California, Mexico

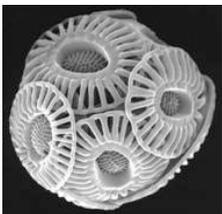


Corrosive water on continental shelf from Queen Charlotte Sound to Baja California, Mexico

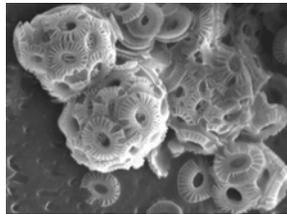


Corrosive water reaches surface in Oregon, northern California

normal coccolithophorid



coccolithophorids at low pH

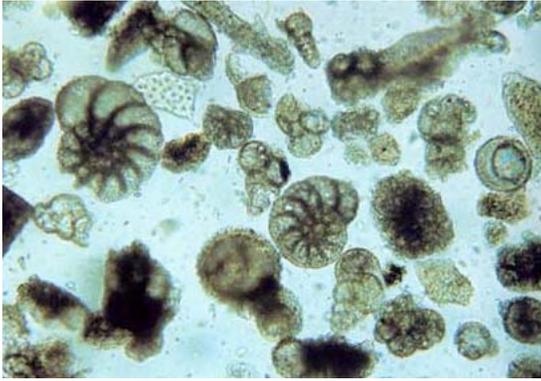


Riebesell *et al.* 2000

### Pteropods: calcified plankton



Calcified foraminifera  
benthic and planktonic



Calcified red algae



Calcified red algae



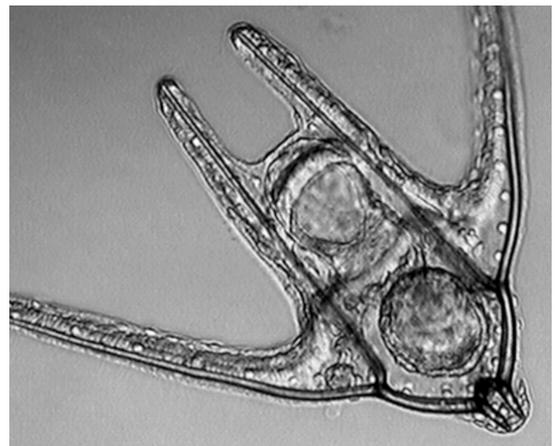
Cold-water corals



Barnacles and Mussels



Calcified larvae



Kelps?



Seagrasses: faster growth?



Problem calls for new research,  
rapid growth in knowledge,  
rapid institutional responses



Ocean Monitoring  
in partnership with  
NOAA

Existing moorings:  
Aberdeen  
Newport  
Monterey  
Los Angeles



Friday Harbor Labs



New facilities for experimental study  
of biological effects

Five West Coast  
Sanctuaries:  
adopted resolutions  
urging coordinated  
research  
and monitoring,  
use of Sanctuaries  
as sentinel sites

Ocean Acidification and the Channel Islands National Marine Sanctuary:  
*Cause, effect, and response*



Photo courtesy of the Channel Islands National Marine Sanctuary. Photo: © NOAA

A report by the Conservation Working Group of the CINMS Advisory Council  
Adopted by the CINMS Advisory Council September 19, 2008

Prepared by:  
Shirley Padilla, Marine Conservation Analyst, and Jodi Furgie, Program Intern,  
Environmental Defense Center, Santa Barbara, California (contact: [shirley@edcnet.org](mailto:shirley@edcnet.org))

Project director:  
Linda Kemp, CINMS Advisory Council Conservation Seat and Chief Counsel,  
Environmental Defense Center

Supported by the Maricela Foundation

[www.channelislands.noaa.gov](http://www.channelislands.noaa.gov)

Potential responses:

mitigation (reduce emissions)  
risk management (minimize impacts)  
adaptation (learn to live with changes)



Mitigation:

Reduce CO<sub>2</sub> emissions and carbon footprints

Risk management:

Reduce/remove other sources of stress  
Implement Ecosystem-Based Management  
Maintain species and genetic diversity

Adaptation:

Look for 'winners'; conserve and cultivate

Policy responses:

Federal Ocean Acidification Research and Monitoring (FOARAM) Act  
directs federal agencies to collaborate in on OA research and education;  
establishes OA program within NOAA

Enacted by Congress (March 25, 2009)  
Signed by President Obama

New funds authorized for NOAA and NSF

Conclusions:

Changing ocean chemistry is certain  
Biological, ecological responses largely unknown  
Responses are not uniform across species  
Species distribution, abundance, food webs  
all could be affected  
Biogeochemical cycles could be affected

Conclusions:

Changing ocean chemistry is certain  
Biological, ecological responses largely unknown  
Responses are not uniform across species  
Species distribution, abundance, food webs  
all could be affected  
Biogeochemical cycles could be affected

Need to confront the problem on multiple levels:  
research, education, monitoring, institutional  
and policy responses, including carbon policies

Acknowledgements:

University of Washington  
Friday Harbor Laboratories  
National Science Foundation  
Education Foundation of America  
NOAA PMEL/RA Feely  
Channel Islands National Marine Sanctuary



Jefferson & Clallam County

# Exploratory Coastal Marine Resource Committees



EXPLORATORY

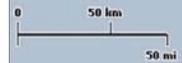
# Coastal MRC

(Coastal Marine Resources Committee)

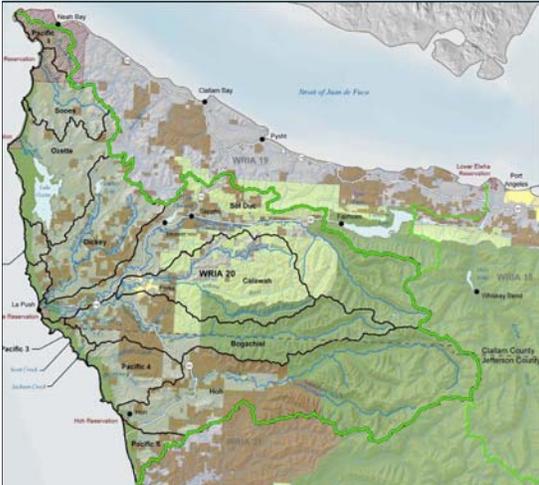


Exploratory - Marine Resource Committee (E-MRC)

FOR WESTERN CLALLAM AND JEFFERSON COUNTIES



## Watershed Resource Inventory Area 20



**WRIA 20**  
**Initiating Governments**



### Joint Jefferson & Clallam Progress & Activities

- Joint monthly meetings in Forks since January.
- Supported the Coast-wide Beach Clean-Up on April 18th (Equipment, Tipping Fees, Volunteers)
- Supported School Field Trips to Feiro Marine Life Center & Olympic Discovery Center (Queets/Clearwater, Quillayute and Cape Flattery School Districts – covered costs)
- Coast Community Potluck: Saturday May 30<sup>th</sup> at the Forks Community Center.
- Next E-MRC meeting: Thursday, June 11th 5-7PM at the Forks Community Center Cafeteria.
- Joint Jefferson/Clallam Draft Resolution to form a Coastal MRC is circulating (expect ratification by both county commissions this summer).



# Status of the Translocated Sea Otter Population in Washington

Steve Jeffries



Washington Ocean Caucus  
Forks WA  
1 June 2009



# Marine Mammal Protection Act 1972





## Jurisdiction for Marine Mammals is Divided

U.S Dept. of Commerce



U.S. Dept. of Interior



## Section 101 Take Moratorium

“There shall be a moratorium on the taking\* and importation of marine mammals and marine mammal products...except by ...”

\* Take is defined as “hunt, harass, capture or kill or attempt to hunt, harass, capture or kill”.

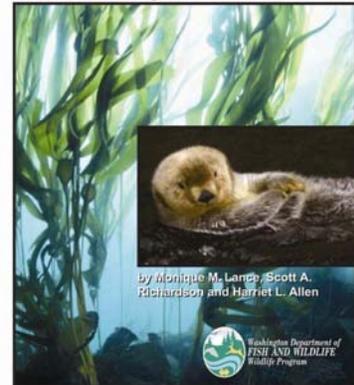


## Sec.109 Cooperation With States

- States may not make or enforce state regulations on take of marine mammals without return of management
- States may request return of management authority for conservation and management
- Federal, state and local officials may take marine mammals in the course of official duties.
  - Protection of the animal
  - Protection of the public health & welfare
  - Non-lethal removal of nuisance animals

STATE OF WASHINGTON December 2004

## Sea Otter Recovery Plan



by Monique M. Lange, Scott A. Richardson and Harriet L. Allen



## Historic Range in Washington

Prior to their extirpation from Washington by maritime fur trade hunting in the early 20<sup>th</sup> century, sea otters ranged from CR to Neah Bay including Grays Harbor and Willapa Bay



# Sea Otters in Washington



- Extirpated by 1911
- Translocations in 1969-70
- 59 moved from Amchitka, AK

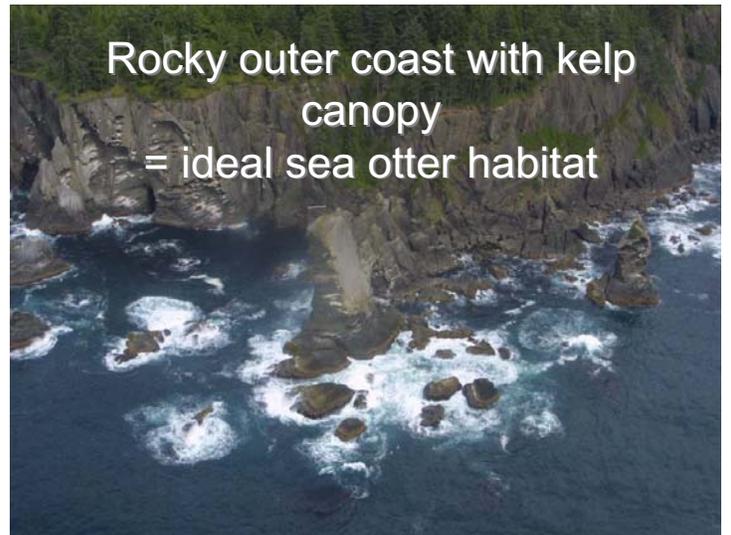
# LaPush-1970



# Sea Otter Ecology

- Top predators
- Live close to shore but can forage to 20 fathoms
- High metabolism 30-40% of body wt per day
- Small home ranges but travel from DI to Neah Bay
- Conflicts with shellfish resources
- Vulnerable to oil spills

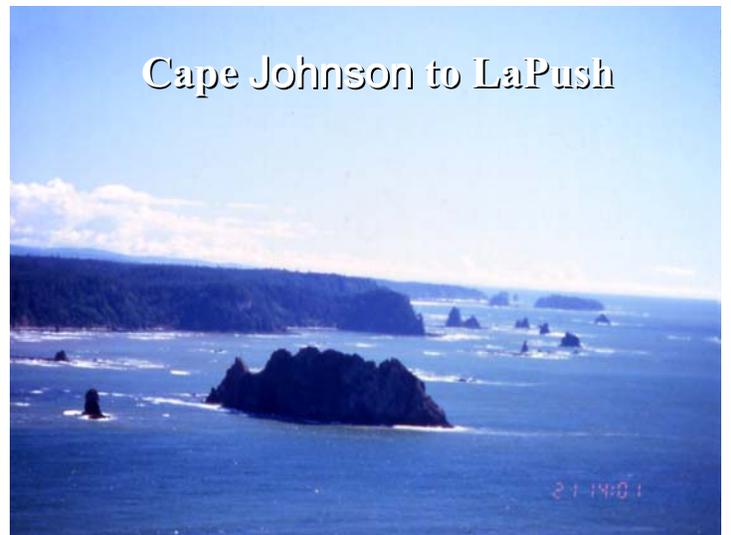
Rocky outer coast with kelp canopy  
= ideal sea otter habitat



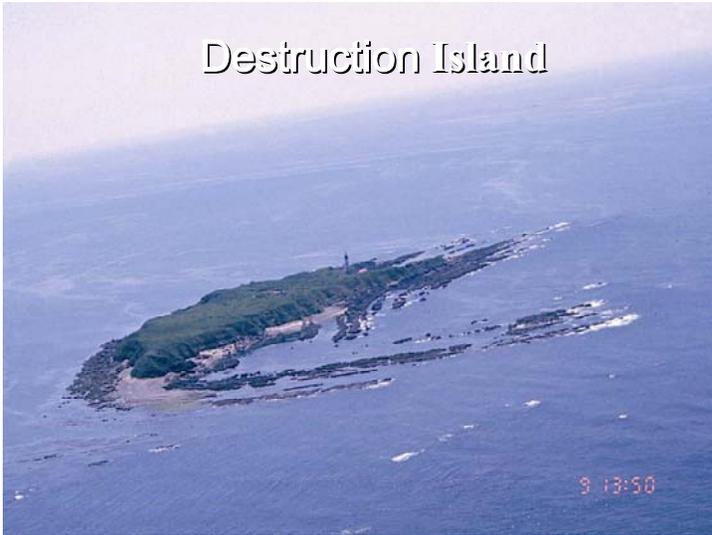
# Cape Alava



# Cape Johnson to LaPush



# Destruction Island



STATE OF WASHINGTON December 2004

## Sea Otter Recovery Plan

by Montague M. Lange, Scott A. Richardson and Harriet L. Allen

Washington Department of FISH AND WILDLIFE  
Habitat Program

Part One ~ Background  
Part Two ~ Recovery

Recovery strategies and tasks include:

1. Monitor the population
2. Protect the population
3. Protect the habitat
4. Information mngmt.
5. Public info and education
6. **Research\*\***
7. Coordinate all interested
8. Prepare for direct mngmt.

## 6. Undertake research that will facilitate and enhance recovery efforts

- Determine long-term growth and expansion of the population in Washington
- Determine abundance, distribution and diet of sea otters in Washington

## Washington Sea Otter Surveys

- 2<sup>nd</sup> week in July
- aerial with ground observers
- Cessna 185 @ 700-900 feet
- 3 days with 2 passes each day
- photos of groups
- adult:pup ratios from ground



Figure 1. Growth of Washington sea otter population, showing 3-yr running average of counts, 1989-2008

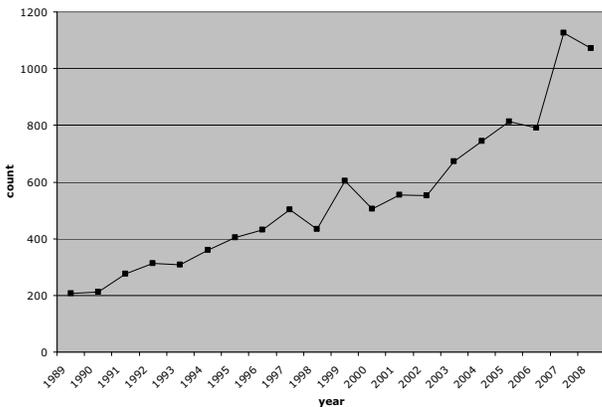
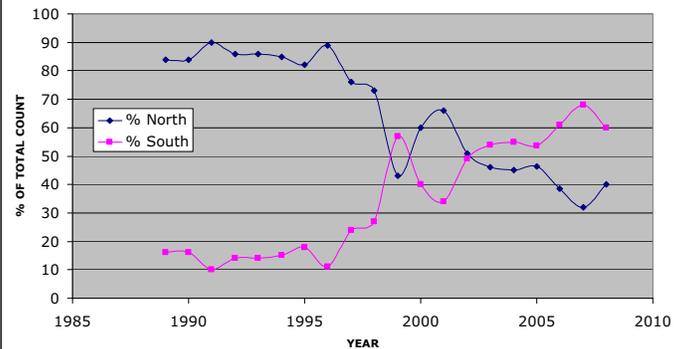


Figure 2. Distribution of sea otters in Washington as a percentage of total population count within north and south segments, 1989-2008.



## Research: sea otter captures

- Wilson traps
- Tangle nets



## More captures...

- Surgically implant radiotags



## Research: focal observations

- Questar from land
- Data recorded included: date, time, location, dive time, post dive surface time, dive success, prey species, prey size, number of prey



## Results

### Dive and surfacing behavior

- Avg. dive time 55 s did not differ b/w M and F
- Avg. surface time 45 s did not differ b/w M and F
- Ad longer surface times than SAd
- Surface time did not differ b/w successful vs unsuccessful dives

## Results

### Prey capture success

- No significant difference b/w M and F when all ages pooled
- Success rate higher for Ad

### Prey selection

- Dive time highest for other prey and sea stars and lowest for urchins (change over time, availability)



## Results

- Sea otters in Washington are generalists, but will preferentially prey upon sea urchins where available
- Sea otters will impact the nearshore environment and fishery resources as they like red urchins, Dungeness crab and razor clams

## Fisheries Interactions

- Set and Drift Gillnets-SJF
- Lots of crab pots-18,000
- Razor clams in sandy habitat near DI and to the south



## Summary

- +1,000 and growing
- Open question where, when and if they will expand range
- Anticipate potential conflicts with urchin, crab and razor clams in the future
- Protect population: oil spills



## Questions ??



## Alternative Ocean Energy in Washington

Jennifer Hennessey

*Washington State Department of Ecology  
Coastal Program*

## Outline

- Coastal impacts of wave and tidal energy
- Regulatory process
- Status of alternative energy proposals, projects and activities in Washington

## What do we know about coastal impacts?



December 2006  
OpenHydro  
Scotland's European Marine Energy Centre



September 2007  
Finavera AquaBuOY  
Oregon



May 2003  
Marine Current Turbines  
United Kingdom



September 2006  
Clean Current at Race Rocks  
British Columbia



Winter 2006/2007  
Verdant Power  
New York's East River

## Regulatory Process



- **Federal Energy Regulatory Commission (FERC)** issues licenses for hydrokinetic technologies in state waters.
  - **Preliminary permits** allow feasibility studies only.
  - **Licenses** allow construction of a project. Incorporate most state authorizations and usually take years to complete.
  - Over the past year, FERC developed new policies:
    - strict scrutiny policy over issuing and oversight of preliminary permits
    - pilot licensing process
    - “conditional” license policy

## Regulatory Process: How can the public get involved?



- Access and inspect via [eLibrary](#) all public documents
- Submit written concerns via [eFiling](#) to the Commission and its staff
- Participate in [public meetings](#) held near the proposed project area
- Participate in [site visits](#) near the proposed project area
- Submit [eFiling](#) comments on draft Environmental Assessments and Environmental Impact Statements
- [Intervene](#) on a specific proposed project
- Have federal court review a Commission's decision (you must be an intervener)
- [File a Critical Energy Infrastructure Information Request](#)

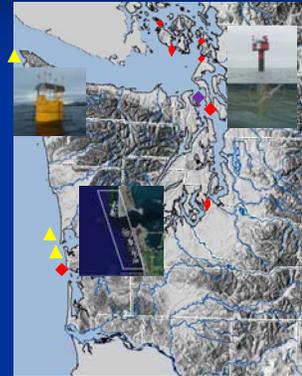
More information on [www.ferc.gov](http://www.ferc.gov)

## Regulatory Process



- **Minerals Management Service** for federal waters
  - Regulations for offshore renewable energy program issuing leases.
  - Nomination areas for testing technologies.
- **MMS and FERC Memorandum of Understanding.**
  - FERC does licensing for tidal and wave, but in federal waters MMS must first issue a lease.
  - MMS leases for wind in federal waters (3 n.m. out)

## Washington proposals



- ▲ **Wave Energy:**
  - AquaEnergy/Finavera project at Makah Bay recently surrendered license.
  - Grays Harbor Ocean Energy Project with FERC preliminary permit.
- ◆ **Tidal Energy:**
  - Project proposals with FERC preliminary permits.
  - Proposed Navy pilot project.

## Washington activities

- **Governor's Office of Regulatory Assistance:**
  - coordinates permitting and communication
  - facilitates technical team for potential pilot projects
- Informal interagency collaboration on policy and regulatory issues.
- Regional collaboration through West Coast Governors' Agreement. Held 2008 regional workshop. Planned activities: data and information, siting, regulatory communication, and education and outreach.
- Drafted Memorandum of Understanding with FERC.

## Questions?

