Seasonal Hypoxia Cycle

- Highest oxygen in surface & mid-depths during spring
  - Begins dropping in mid-depths & deep water with spring phytoplankton growth
  - Reach minimum in late summer

www.hoodcanal.washington.edu/observations/historicalcomparison.jsp

Seasonal Hypoxia Cycle

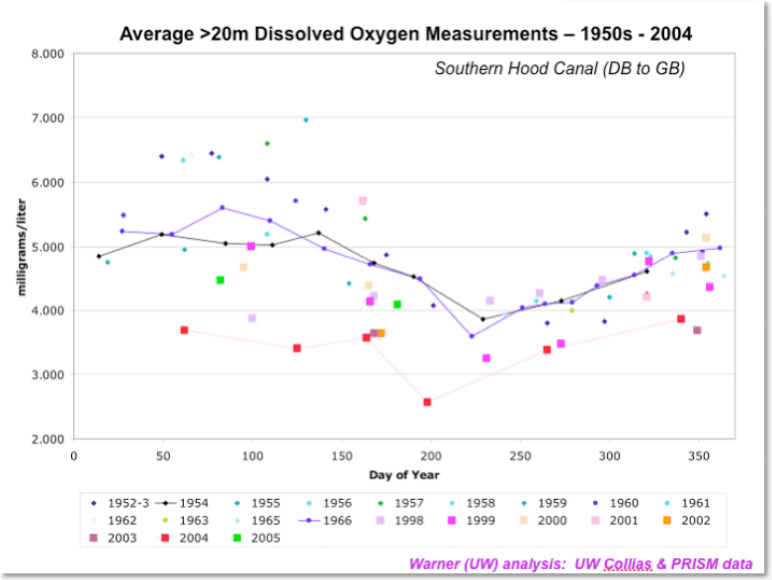
- Flushing of deep water typically occurs once a year in late summer
  - Dense cold ocean water from outer coast
  - More oxygen than deep HC water but less than surface
- Leaves low-oxygen layer "sandwiched" at mid-depths
  - Just below surface layer
  - Gradually gains oxygen through winter by mixing with surface water

www.hoodcanal.washington.edu/observations/historicalcomparison.jsp

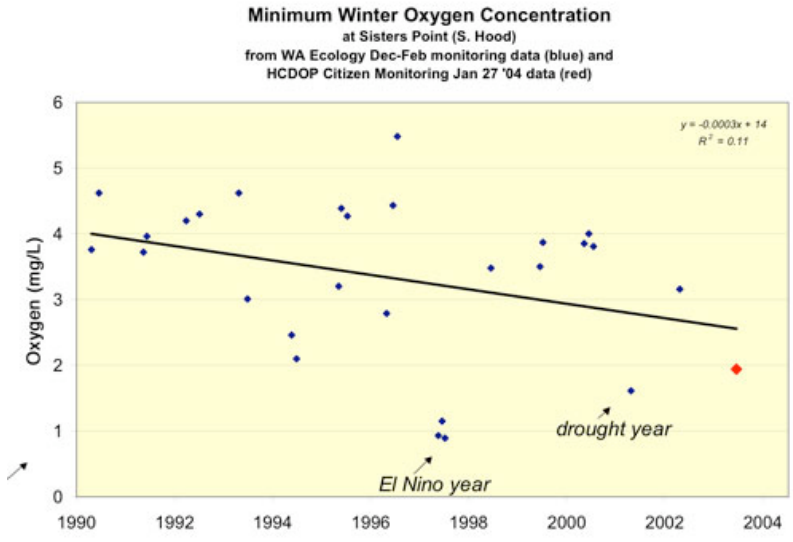
Hypoxia Getting Worse

- Oxygen in deep waters of Hood Canal reached an all-time low in 2004
  - Known to be low-O2 even in 1950's – 1960's
  - "More severe, more persistent" recently
  - Closed fisheries for bottomfish in 2002, 2003
    - Major fish kill because of low oxygen Oct. 2003
    - 2 milligrams/liter a "Dead Zone"
    - Closure made permanent Aug. 2004
    - Herring, smelt, crab, shrimp, squid, octopus, cucumbers

www.hoodcanal.washington.edu/observations/historicalcomparison.jsp
wdfw.wa.gov/fish/shelfish/crabreg/area12.shtml
wdfw.wa.gov/do/newreal/release.php?id=aug0904b



www.hoodcanal.washington.edu/observations/historicalcomparison.jsp



www.hoodcanal.washington.edu/observations/winterconditions03-04-3.html

Theories of Hypoxia

- Changes in production or input of organic matter
  - Natural due to better growth conditions
    - E.g. more sunlight, more nutrients
  - Human-caused nutrient enrichment
    - Septic tanks, fertilizer, salmon carcasses
- Changes in properties of incoming ocean water
  - Density, nutrients, oxygen
  - El Niño

www.hoodcanal.washington.edu/aboutHC/whatdoweneedtoknow.html

Theories of Hypoxia

- Changes river input or timing
  - Natural due to drought
  - Human-caused (dams, logging)
  - Affects mixing & flushing
- Changes in weather conditions
  - Wind speed & direction
  - Global warming?
- Supporting evidence for all of these
  - May be a combination of factors

www.hoodcanal.washington.edu/aboutHC/whatdoweneedtoknow.html

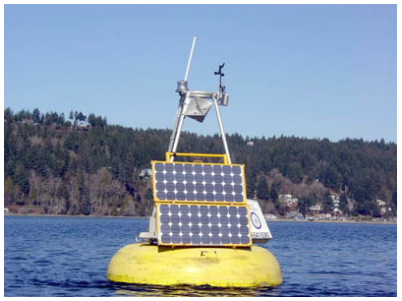
What Citizens Can Do

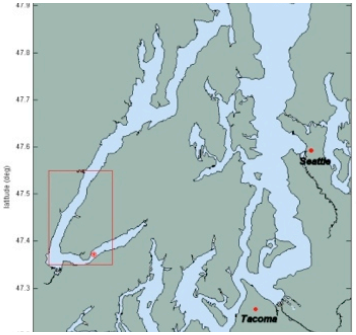
www.psat.wa.gov/Programs/hoodcanal/what_you_can_do.htm

- Take care of your septic system
  - Treat nutrients as well as bacteria
- Use little or no fertilizer (esp. before rain)
- No grass clippings, yard waste, pet or livestock waste in water
- Control stormwater runoff
- Grow shellfish (remove plankton)
- Control boating & fishing waste
- Get educated & involved

Monitoring Hood Canal

- ORCA (Oceanic Remote Chemical-Optical Analyzer) Buoy moored in upper Hood Canal

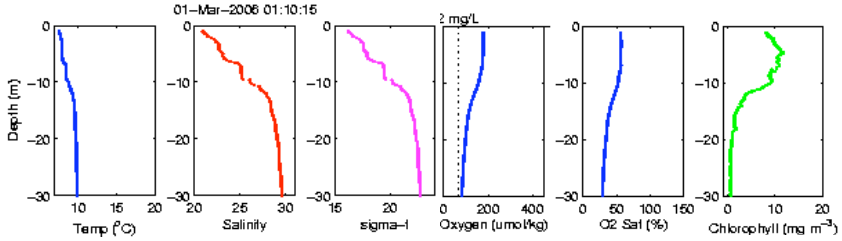




www.hoodcanal.washington.edu/observations/orca_buoy.jsp

Monitoring Hood Canal

- ORCA Buoy continuously monitors vertical profile of temperature, salinity, oxygen
  - Sends data by satellite to UW for archiving

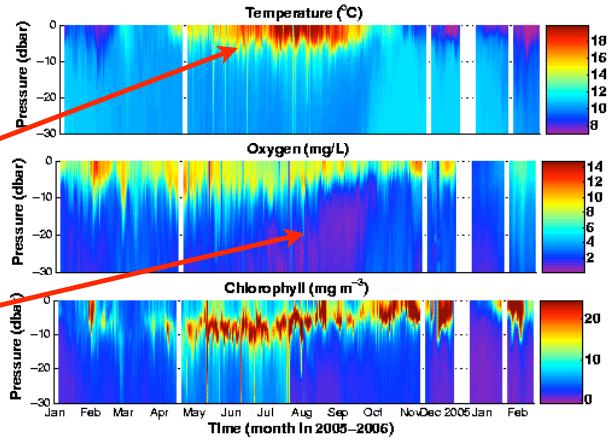


www.hoodcanal.washington.edu/observations/orca_buoy.jsp

ORCA BUOY 2005-06

www.hoodcanal.washington.edu/observations/orca_buoy.jsp

- Strong stratification July - Sept.
- Deep oxygen deficit same months



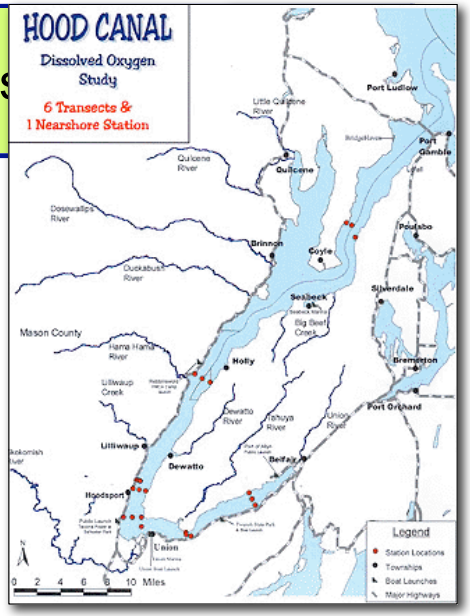
Long-term Research

- IAM (Integrated Assessment & Modeling) 3-year study
  - Whether & which human activities may contribute to hypoxia
  - Scientific monitoring & modeling
  - Cooperation with local, tribal, state & federal regulators
  - Begun 2005 with mainly U.S. Navy $$
    - UW Applied Physics Lab
    - Hood Canal Salmon Enhancement Group

www.hoodcanal.washington.edu/iam_study/approach.html

Long-term Res

- Citizen volunteer monitoring
  - Hood Canal Salmon Enhancement Group
    - hcseg.org
  - Trained by UW Aug. 2003
  - Weekly sampling at red dots



Managing Puget Sound

www.psat.wa.gov/Who_we_are/Whoweare.htm

- Federal programs
  - Clean Water Act
  - National Estuary Program
  - Both administered by Environmental Protection Agency (EPA)
    - Supervise state agencies
    - In Washington, Puget Sound Action Team
    - Provides some funding

Puget Sound Water Quality Action Team

www.psat.wa.gov/

- A branch of the Governor's Office
  - Mainly a planning & coordinating agency
  - No enforcement power
- Main functions
  - Work with all constituencies to formulate long-term Puget Sound Water Quality Management Plan
  - Work with all constituencies to develop two-year Puget Sound Work Plan
  - Guide implementation of the plan

Managing Hood Canal

www.psat.wa.gov/

- Puget Sound Water Quality Action Team
  - Chair + Directors of 10 state agencies
  - Representatives from tribal, federal, local governments
  - Puget Sound Council advises Action Team
    - Representatives from community & industry
  - Action Team staff
    - Conducts & guides research
    - Gathers & disseminates information
    - Conducts public education
    - Advocates for Sound conservation

Highlights of Puget Sound Plan 2005-07

www.psat.wa.gov/Publications/biennialplan/05_07_PSplan.htm

PRIORITY: Improve Water Quality in Hood Canal

Improve sewage management

- Designs completed for sewage treatment in Skokomish-to-Hoodsport area, and Belfair area. / *Ecology, CTED, PSAT staff*
- Belfair sewer construction begins when design is completed. / *CTED, Ecology, PSAT staff*
- Failing onsite sewage systems identified in Mason, Kitsap and Jefferson counties. / *Ecology, Health*
- Homeowners and businesses receive low-interest loans to fix failing onsite sewage systems. / *Ecology*
- New sewage disposal system constructed for Dosewallips State Park. / *Parks, Ecology, Health*
- Nitrogen-removing technologies for onsite sewage systems tested and recommendations for adoption developed. / *PSAT staff, Health, Ecology*
- Report completed by Hood Canal Coordinating Council on sewage treatment options. / *PSAT staff, Ecology*

Improve management of other waste

- Salmon carcasses kept out of Hood Canal, and economic options for use developed with Skokomish Tribe. / *PSAT staff*
- Anaerobic digester for animal waste disposal undergoes feasibility study, design and construction. / *CC, Ecology*
- Design and install new pollution abatement pond at the Hoodsport fish hatchery. / *WDFW, Ecology*

Mitigate impacts from stormwater runoff

- Mason County completes stormwater management plan for Hoodsport and Belfair. / *Ecology, PSAT staff*

Improve scientific understanding

- Scientific model of Hood Canal completed in mid-2006. / *UW Applied Physics, US Navy*

Inform and involve the public

- At least 1,650 homeowners and boaters educated to change practices related to onsite sewage systems and waste from boats, pets and livestock. / *WSU Extension, Sea Grant, PSAT staff*

Managing Hood Canal

www.psat.wa.gov/Programs/hoodcanal/hc_helping.htm

- State House of Representatives has "Select Committee on Hood Canal"
  - www1.leg.wa.gov/house/Committees/hood
- HCDOP has two branches
  - IAM (research)
  - "Corrective Action & Education Group"
    - Run by Puget Sound Action Team & Hood Canal Coordinating Council
    - Educates & involves residents for water quality
    - Preliminary assessment, corrective actions, demonstration projects

Legislative Actions 2005-2007 Biennium

www.psat.wa.gov/Programs/hoodcanal/hc_funding.htm

- Total $21.2 million appropriated
  - Test septic technologies to capture nitrogen
  - Support fish carcass removal from tribal hatchery, abatement ponds at state hatchery
  - Public education & involvement
  - Rehabilitation planning program
  - Design & build sewer & storm water systems
  - Fund tracking of failing septic tanks
  - Low-interest loans to homeowners
  - Control & process livestock waste

Legislative Proposals 2006

www.psat.wa.gov/Programs/hoodcanal/hc_monthly_reports.htm

- State Senate
  - Require dischargers & onsite sewage systems (septic) to remove nutrients on Hood Canal
- State House
  - Sales & use tax exemptions for construction of onsite sewage systems on Hood Canal
  - Separate state fund for Hood Canal protection & restoration (no funding source identified)
  - Study fate & transport of nutrients from onsite sewage systems into Hood Canal ($600K)

Governor's Budget Proposals 2006

www.governor.wa.gov/priorities/budget/2005PugetSoundPolicyBrief.pdf

- $4 million to make state parks environmental models
  - Replace sewage systems @ 2 HC parks
- $6.5 million for grants & low-interest loans
  - To low-income homeowners for repairing & replacing failing septic systems
- $2.5 million for stormwater control
  - To local governments
  - Natural drainage systems, permeable pavement, etc.