



AKMAP  
ALASKA MONITORING AND ASSESSMENT PROGRAM  
Freshwater Coastal  
[www.dec.state.ak.us/water/akmap](http://www.dec.state.ak.us/water/akmap)



# NATIONAL AQUATIC RESOURCE SURVEY CORE INDICATORS – APPROPRIATE TO DETERMINING ARCTIC AND SUB-ARCTIC AQUATIC ECOSYSTEM STATUS?

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**2010 National Monitoring Conference**

# All Waters?

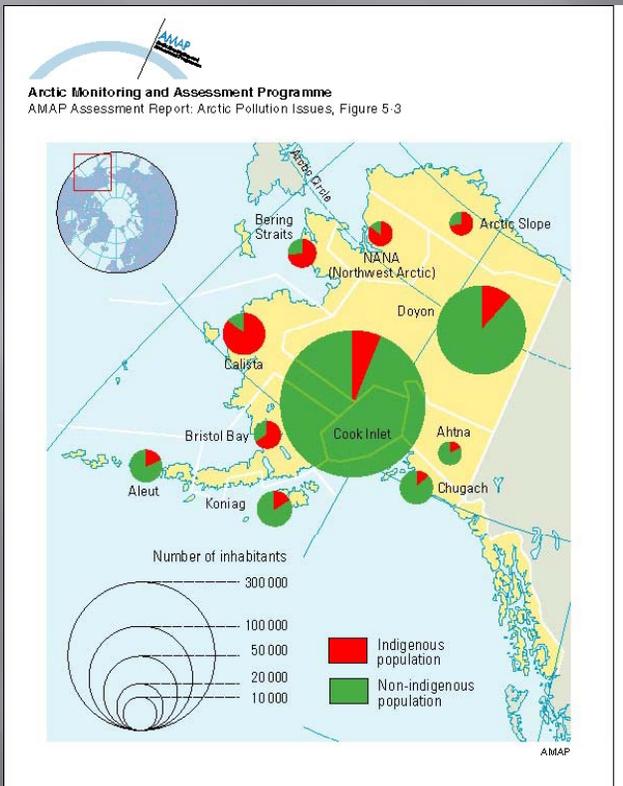


# National Aquatic Surveys Part 1

- ▣ Probabilistic sampling surveys
- ▣ Information to identify national priorities
  - Evaluate effectiveness of pollution control activities
  - What is the extent of waters that support healthy ecosystems, recreation, and fish consumption?
- ▣ How widespread are the most significant water quality problems?
  - Is water quality improving?
  - Are we investing in restoration and protection wisely?
  - Forecasting future risks to our national resources.

# Alaska

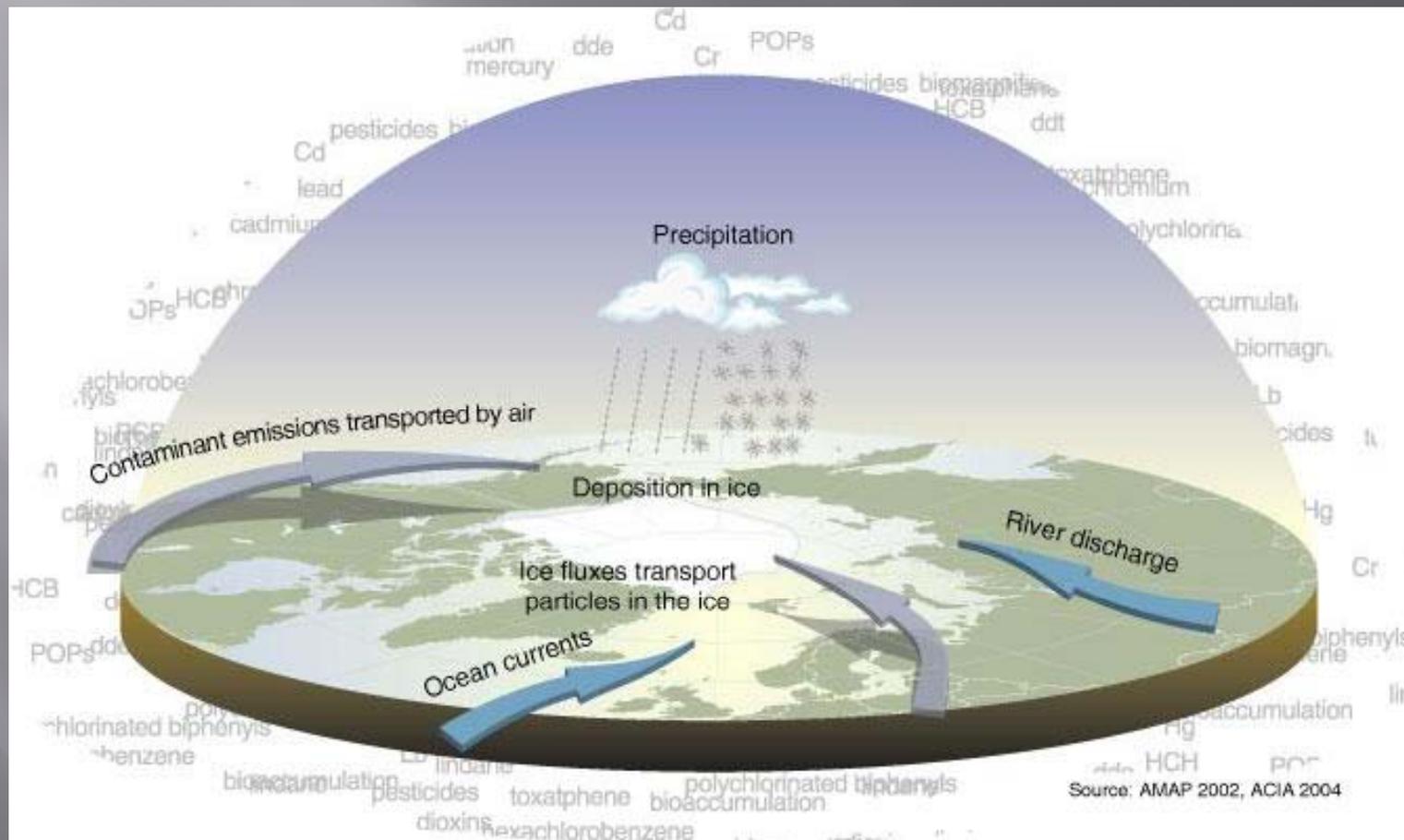
## POPULATION



## ECOREGIONS



# Contaminant Routes to the Arctic



# The Climate is Changing

“Arctic average temperature has risen at almost twice the rate as the rest of the world in the past few decades. Widespread melting of glaciers and sea ice and rising permafrost temperatures present additional evidence of strong arctic warming. These changes in the Arctic provide an early indication of the environmental and societal significance of global warming.”

[Executive Summary, “Impacts of a Warming Arctic,” Arctic Climate Impact Assessment, Cambridge University Press 2004]



# Some Climate Change Impacts



# National Aquatic Surveys Part II

- ▣ Information to identify national priorities
  - Evaluate effectiveness of pollution control activities
    - ▣ Small scale
      - Targeted monitoring within some small regional assessments.
  - What is the extent of waters that support healthy ecosystems, recreation, and fish consumption?
    - ▣ Large
      - Impacted by large scale events, such as climate change, over fishing, oil spills.
  - How widespread are the most significant water quality problems?
    - ▣ Point and Non-Point source limited.
      - Future resource extraction .
    - ▣ Climate Change potential most pervasive.
  - Is water quality improving.
    - ▣ By what measure?
      - For example ocean acidification or nutrient loadings?
      - Water temperature or ecosystem change?
  - Are we investing in restoration and protection wisely?
    - ▣ Are CO<sub>2</sub> reductions reducing climate change impacts?
    - ▣ Are treaties, such as the POPs Treaty, reducing trans boundary contaminants?
  - Forecasting future risks to our national resources.
    - ▣ Climate change
    - ▣ Trans-boundary contaminants

# Alaska Monitoring & Assessment Program (AKMAP)

- A research program to develop
  - Tools necessary to monitor and assess spatial and temporal trends in national ecological resources.
- Provides resource managers and decision makers with information to assess and protect the ecological condition of our natural resources.

# Perspective

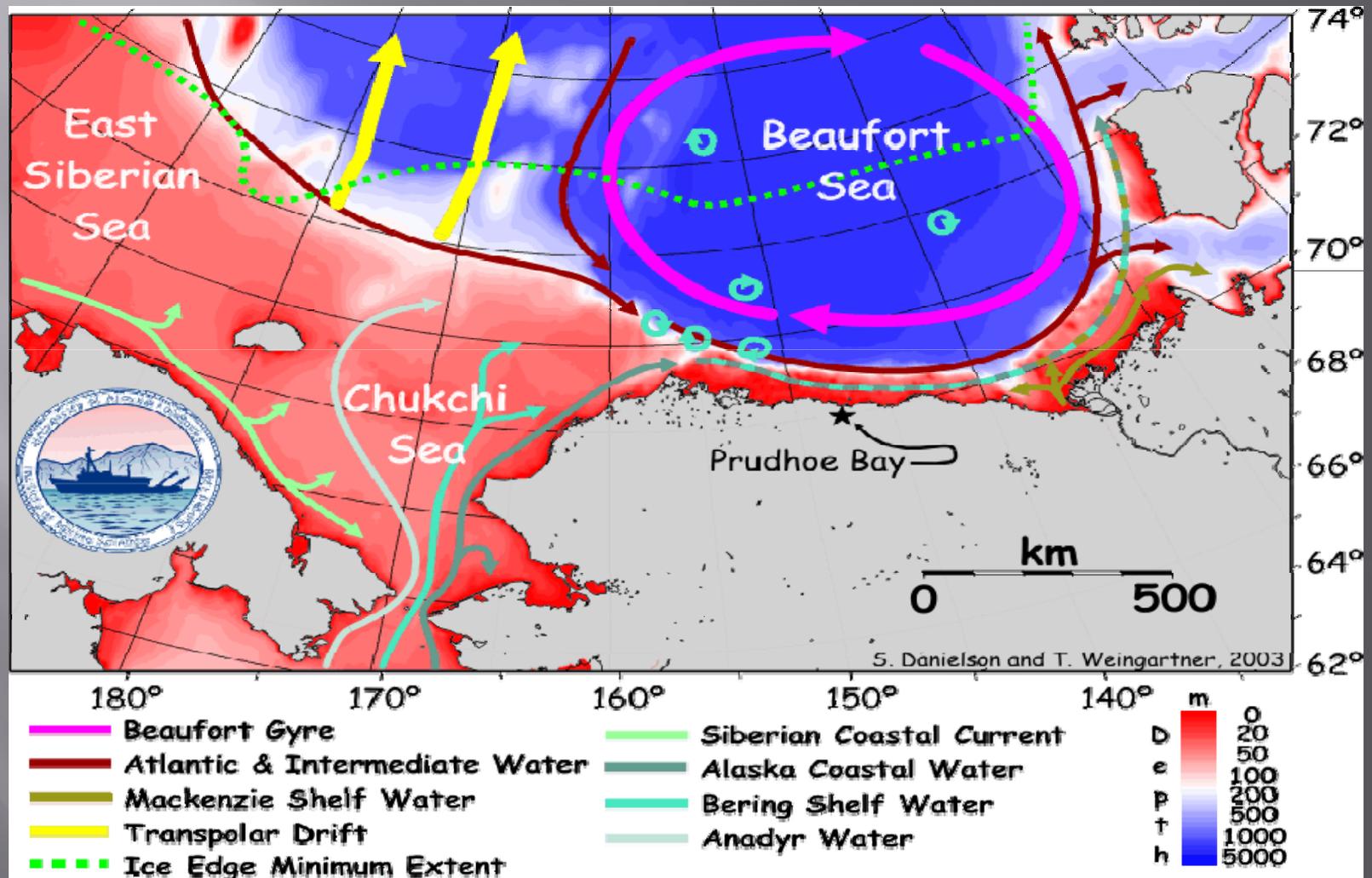


# Chukchi Sea OVERVIEW

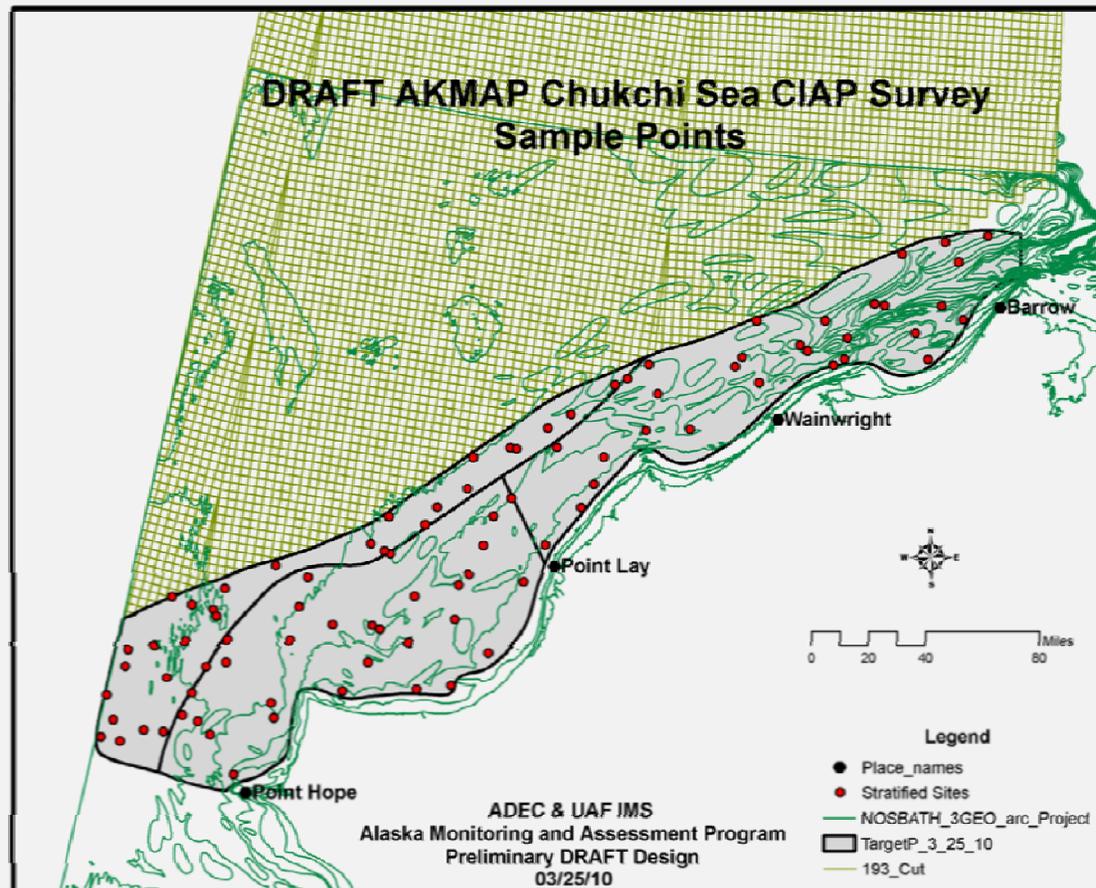
▣ Environmental managers wanted a monitoring and assessment program to take into account the unique features of this oceanic shelf region:

- Large (582,000 km<sup>3</sup>, but shallow (~50 m average)
- A fairly warm current entering the Chukchi Sea through the Bering Strait dividing into two branches north of Point Hope.
- In general, movement of water through the Bering Strait is that of Pacific Ocean Waters into the Chukchi Sea, and to a small extent a flow of Chukchi Sea water to the south.
- For seven months the temperatures of the surface waters varies between -1.5C and 7C.
- Salinity shows much variation owing to the waters flowing into it from ~31.7 to 32.6 PSU.

# Chukchi Sea Shelf & Regional Oceanography

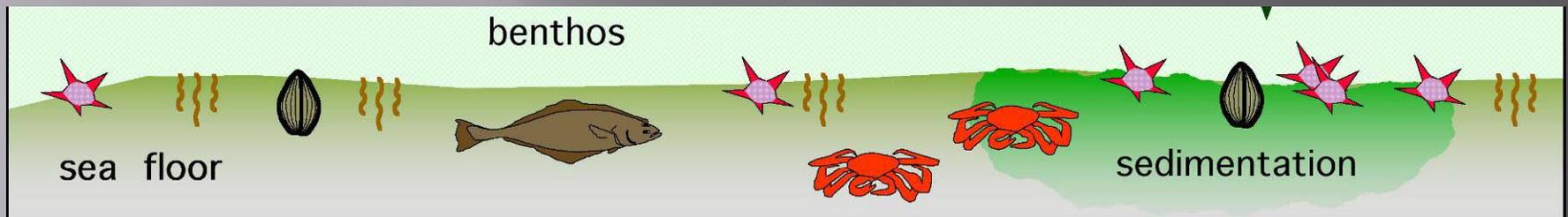


# Working AKMAP Design



# Schematic Food Web for Arctic Systems

High trophic benthic feeders:  
Fishes, walrus, gray whales, sea birds.



Walrus prey:  
Bivalves  
including *Mya*  
*spp.* and  
*Serripes*  
*groenlandicus*

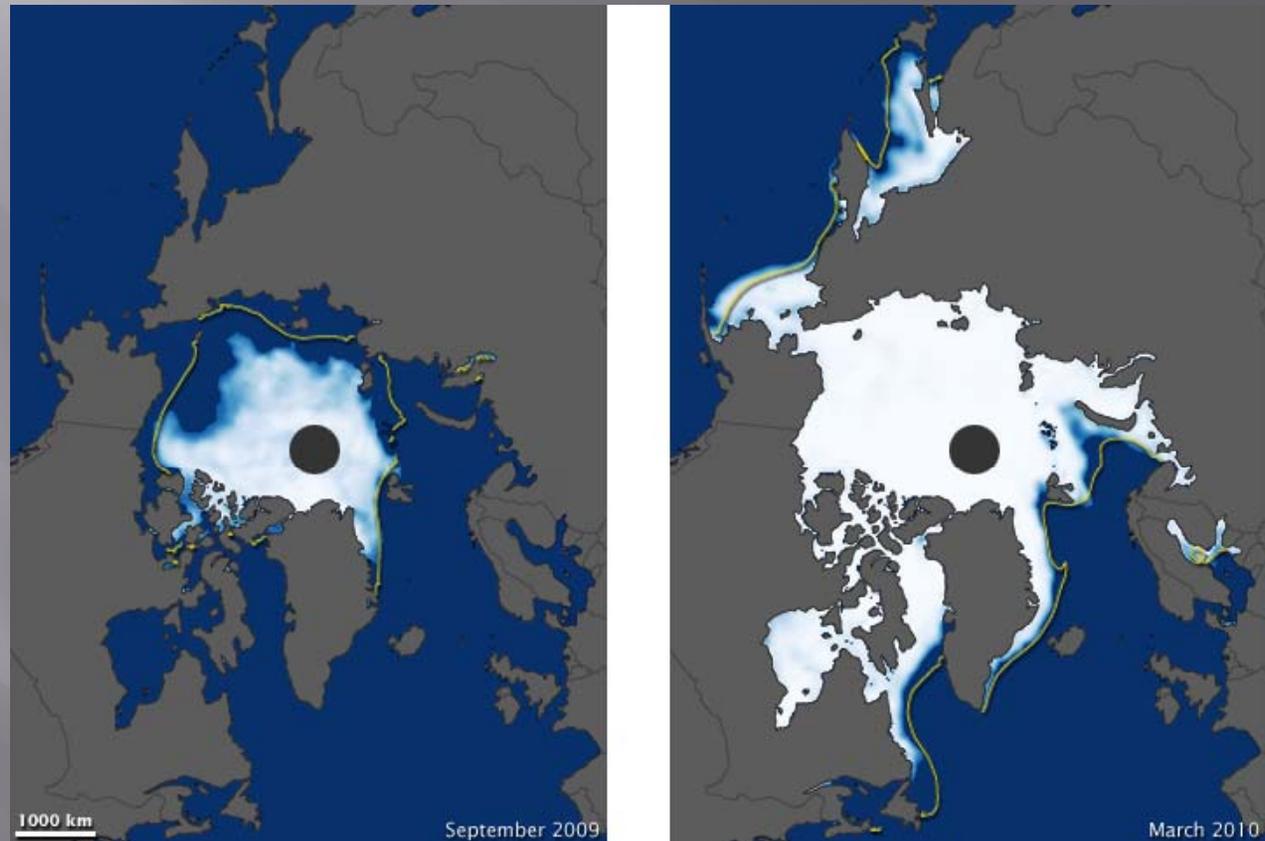
*Serripes*  
*groenlandicus*

*Mya*  
*arenaria*



Photos by A. Blanchard and K. Iken, drawing by Bluhm et al, unpublished

# September 2009 and March 2010

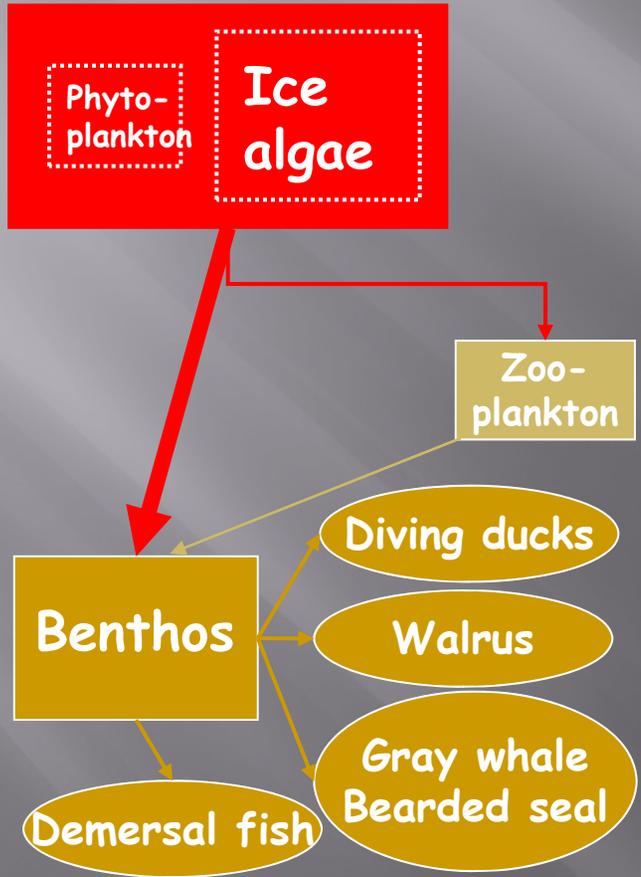


National Snow and Ice Data Center

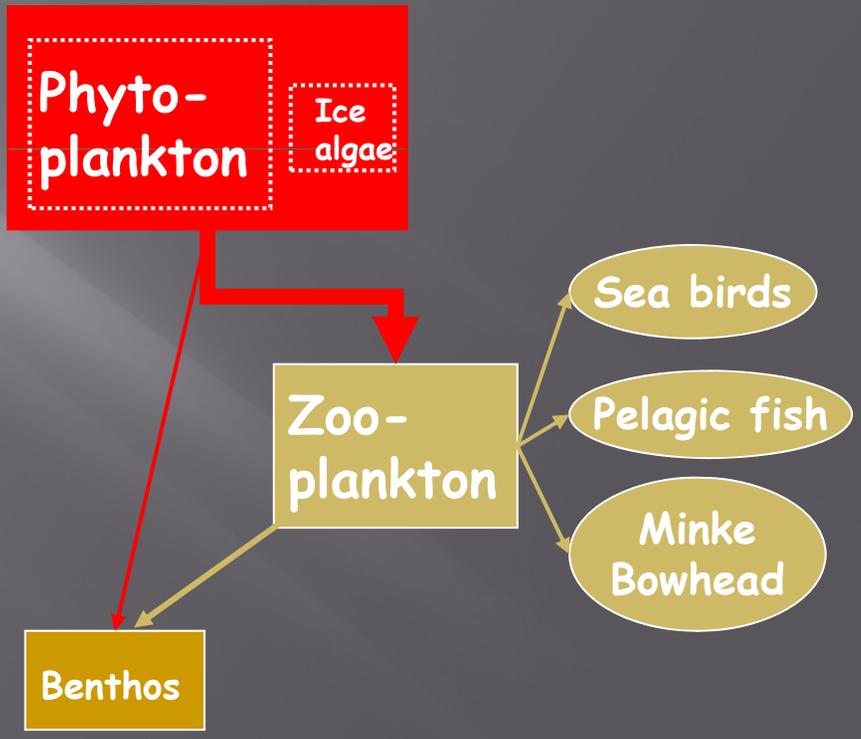
# Possible Climate Change Scenarios in the Arctic

## Changes in ice cover

Abundant sea ice



Limited sea ice



[Iken and Bluhm, modified after Carroll and Carroll 2003]

# Chukchi Sea Anthropogenic Stresses

- ▣ Oil and gas extraction activities
  - ▣ Discharges at drilling sites.
  - ▣ Sea Bed Floor Pipelines
  - ▣ Platform discharges
  - ▣ Point and non-point.
  - Oil spills
- ▣ International Marine Traffic
  - ▣ Spills
  - ▣ Invasive Species
- ▣ Coastal Watershed or marine mining.
  - ▣ Industrial wastewater discharges.
  - ▣ Spills from ore carriers
- ▣ Trans-boundary pollutants.
- ▣ Climate Change
  - ▣ Change in yearly ice presence and temperature changes
    - Ecosystem change
  - ▣ Ocean acidification
- ▣ Community point and non-point discharges.
  - ▣ Small population limited impacts.

# Alaska Monitoring and Assessment Program Chukchi Sea Assessment

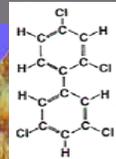
- ▣ Uses probabilistic spatially balanced sampling to assess aquatic resource status over large region.
  - Working with University of Alaska statisticians and environmental scientists to integrate with targeted sampling and long term trend assessment.
- ▣ Advantages
  - Gain unbiased estimate of the current status of the region.
  - Gain geographic coverage of percent area sampled for indicators.
  - Can use small-scale grid data for traditional analyses of local variations.

# Management Goals and Objectives

- Estimate the geographic coverage and extent of the aquatic resources with known confidence.
- Seek associations between indicators of natural and oil/gas development activities of condition of aquatic resources.
- Establish natural conditions for aquatic resources to detect changes brought about by oil and gas resource development, transboundary contaminants, ocean acidification and climate change.
- Provide for long-term status and trends assessments based on the initial monitoring and assessment work.
- Use sediment cores to evaluate historical trends in anthropogenic chemicals.
- Identify natural or other anthropogenic sources of contaminants to the study area.

# Sediment Quality Triad

Sediment  
Physical  
Characteristics



Sediment  
Chemistry



Benthic  
Community and  
Organism Health

Photo  
Brenda  
Norcross



Sediment  
Toxicity

Photo S. Camus

Photo Stephen Jewett, UAF

# Measured Parameters Water Column

- ▣ 2010 NCCS
- ▣ Water Column
  - CTD
    - ▣ pH, DO, PAR, Salinity, Temperature, Depth
  - Secchi Depth
  - Samples
    - ▣ Dissolved inorganic N
    - ▣ Dissolved inorganic P
    - ▣ Total N
    - ▣ Total P
    - ▣ Chlorophyll a
    - ▣ Enterococci
- ▣ 2010/2011 AKMAP
- ▣ Water Column
  - CTD
    - ▣ pH, Temperature, Salinity, Chl a (fluorescence), Depth, DO, PAR (water and surface).
  - No secchi depth.
  - Samples (1M, Mid, bottom, Chl a maximum)
    - ▣ Dissolved Nutrients +
    - ▣ DIC
    - ▣ Total Alkalinity
    - ▣ Chlorophyll a
    - ▣ TSS
    - ▣ pH, DO, Salinity (check samples)
    - ▣ Methane

# Measurement Parameters Sediment

- ▣ 2010 NCS
- ▣ Sediment
  - TOC
  - Grain Size
    - ▣ Fines
  - Chemistry
    - ▣ PAH's, PCB's, Pesticides, Metals
  - Toxicity
- ▣ 2010/2011 AKMAP
- ▣ Sediment
  - TOC
  - Grain Size (full range)
  - Chemistry
    - ▣ PAH's+, PCB's+,
    - ▣ Metals +
    - ▣ Pesticides +
  - Chlorophyll a
  - C/N Isotopes
  - Sediment Cores

# Measured Parameter Biological

- ▣ 2010 National Coastal Survey (NCS)
  - Chemicals
    - ▣ Whole Fish
      - PAHs
      - PCBs
      - Organochlorines
      - Trace metals
  - Macroinvertebrates 0.5 mm
  - Enterococci.
  - Sediment Toxicity
- ▣ 2010/2011 AKMAP Chukchi Sea Survey
  - Chemicals
    - ▣ Mollusk, Fish, etc.
      - PAHs +
      - PCBs +
      - Organochlorines +
      - Trace Metals +
  - No sediment toxicity
  - Macroinvertebrates 1 mm
  - Trawls
    - ▣ Otter Trawl
    - ▣ Beam Trawl
  - Zooplankton
    - ▣ Vertical tow

# Contaminants Sampling Lease Sale 193 Area

*Neptunea heros*



Ken Dutton

# Potential Arctic Test Species

Slide courtesy of Dr. Lionel Camus

## Bivalves



*Astarte sp.*



*Mya truncata*

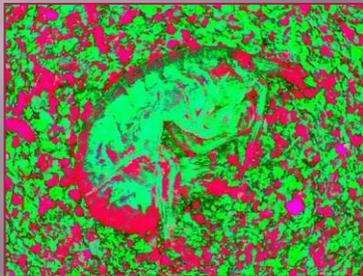


*Liocyma fluctuosa*



*Arctica islandica*

## Amphipods



*Gammarus setosus*



*Gammarus wilkitzkii*



*Onisimus litoralis*

## Shrimps and Crabs



*Sclerocrangon boreas*



*Hyas araneus*

# Closing

- ▣ ADEC AKMAP program adopted the probabilistic survey sampling design methodology, but
  - ▣ National aquatic survey indicators are not justified if they do not:
    - ▣ Provide information on a regions significant water quality problem.
    - ▣ Meet the needs of management agencies to protect the environment.
    - ▣ Help forecast future risks to the natural resources.
    - ▣ Provide relevant information to stakeholders.
- ▣ Work is ongoing to determine appropriate indicators for Alaska Arctic and Sub-Arctic fresh and marine water resources.

# Partnerships



- Cook Inlet RCAC
- University of Alaska
- International Pacific Halibut Commission
- University of Washington
- National Marine Fisheries Service
- Washington Dept. of Ecology
- Alaska Dept. of Natural Resources
- Alaska Ocean Observing System

- US Environmental Protection Agency
- University of Alaska
- National Oceanic Atmospheric Administration
- US Geological Survey
- Bureau of Land Management
- Alaska Dept. of Fish & Game
- Yukon Inter-Tribal Watershed Council
- Many other volunteers