Alaska Fisheries Science Center: 101 in 2012

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Alaska Feeds the Nation

Largest private sector employer in Alaska

US Domestic Commercial Fisheries

66% of US cont. shelf
47,300 mi of shorelines
Subsistence Harvests Critical for Many Coastal Communities
Current Status of Fish Stocks in Alaska

Ecosystem Based Management

- Catch accounting including non-targets, prohibited species, seabirds, other non-specified (e.g., forage fish)
- Buffer between ABC and OFL
- 2 million ton overall cap
- Retention cap on forage fish
- Peer Review
- Essential Fish Habitat – 5 year assessment and review

www.NPFMC.NOAA.gov
Summary status of age-structured BSAI species as measured by 2011 catch level relative to OFL (vertical axis) and projected 2012 spawning biomass relative to $B_{MSY}$. 
Evolving Research for NOAA’s Future: Three Case Studies

• Bering Sea Project – Improved stock assessments and management through an integrated ecosystem research project
• AFSC Arctic Research in FY12 – Bringing NOAA capabilities into Arctic ecosystems through partnership with BOEM
• Camtrawl – Advanced technology to improve survey methodology
Bering Sea Integrated Ecosystem Research Program (BSIERP)

Direct funding provided by NSF and NPRB ($52M total, all external)

In-kind support from USFWS and NOAA

100 PIs, dozens of institutions, small army of students, collaborators, technicians, field and ship crews
Climate Scenarios

Humans

Humpback and fin whales

Commercial/subsistence fish: Pollock, cod, arrowtooth flounder

Kittiwakes and murres, fur seals, walrus

Forage species: Juvenile pollock, capelin, myctophids

NPZ: Ichthyoplankton, euphausiids, copepods, phytoplankton

Infauna: Bivalves, gastropods, polychaetes

Atmosphere/ocean

Climate Scenarios
March and April ice extent – a decade of data

The average number of days in which sea-ice was present in March and April during 2001-2010
Recent runs of warm and then cold years
Se Bering Sea (< 60N)

North: Biomass of large fraction tripled in 2007 (E. bungii, P. elegans, Calanus spp.)
South: Biomass of large fraction doubled in 2008 (Calanus spp., P. elegans, E. indicans)
Pollock (to Age-1) Have Higher Energy Content And Recruitment in Cold Years

- Diets in cold years are high in lipid
  → more energy stored before winter.
  → high energy content before winter increases survival.
- Juveniles have a short critical period for lipid storage (Siddon et al.)
Optimal conditions for juvenile pollock survival are associated with moderate temperatures.
Conclusion: Selected Headlines

- Runs of warm, then cold years are not a new pattern
- Northern Bering Sea will remain cold
- Linkage between climate, ocean conditions and prey size/quality
- Linkage between prey, pollock fat, and survival
- Optimal temperature conditions for survival (where temperature is a proxy for ocean processes)
- Given new understanding of recent pollock declines, our goal is improved forecasts that help us understand and improve assessments in the Bering Sea
AFSC Arctic Research in FY12
NMFS “High” Arctic Research – Big Challenges

Management and regulatory decision makers are facing increased demands:

- Climate change -- regional shifts and uncertain developments
- Oil and gas -- exploration, development, production
- Commercial fishing -- precautionary approach in “uncharted waters”
- Co-management -- Alaska Native subsistence harvests
- Increased shipping -- regulation, preparedness, response
- Legal challenges -- petitions and suits under MMPA, ESA, NEPA

Growing expectations for reliable Arctic information from science programs:

- Continue and enhance current work – Arctic Vision and Strategy, 5-year, Arctic Research Plan (IARPC – soon to be completed)
- Promote long-term time series
- Produce complex, integrated analyses and forecasts
FY12 AFSC Research Activities

- Arctic Whale Ecology Study FY12-16 $4.8M BOEM
- Cetacean Aerial Surveys (ext. of COMIDA) FY12 $2.7M BOEM
- Bowhead Whale Feeding Ecology FY12 $.9M BOEM
- Ice Seal Ecology in Bering Sea FY12 $.3M NOAA
- Ice Seal Abundance Surveys FY12 $.8M BOEM/NOAA/Russia
- Arctic Ecosystem Integrated Survey FY12 $7M BOEM/UAF/NOAA partnership
- Chukchi Acoustics, Oceanography, and Zooplankton (CHAOZ) FY10-FY15 $6.3M BOEM
- Synthesis of Arctic Research (SOAR) NOAA consortium, BOEM
- Arctic Nearshore Fish Assemblages and Baseline NOAA
- Distributed Biological Observatory (DBO) NOAA-Academic consortium
Bottom trawl surveys in the eastern Bering and Chukchi Seas

- More fish
- More invertebrates

Average catch/hour (hundreds of Kg)

Proportion invertebrates

St. Lawr. Isl.
St. Matt. Isl.
Pribilof Isl.
Bering Strait
Documented or confirmed range extensions of four species:

- Pacific cod
- Walleye pollock
- Eyeshade sculpin
- Festive snailfish

All Four Ice Seals Under Status Review

Spotted Seal

Ringed Seal

Bearded Seal

Ribbon Seal
Proposed track lines for the 2012-2013 April Synoptic Aerial Surveys of Ice Seals in the Bering and Okhotsk Seas
Arctic Ecosystem Integrated Survey (Arctic Eis)

A collaboration between:

[Logos of UAF, NOAA, and BOEM]

With funding from:

Coastal Impact Assistance Program (CIAP)
A comprehensive ecosystem survey

**How:** Two survey vessels sampling a 30x30 mile grid:

- The *F/V Bristol Explorer*, equipped with a surface trawl (top 65'), a mid-water trawl, and hydro-acoustic survey equipment will collect data on **ocean circulation and physics, water chemistry, plankton, and fishes**

- A vessel TBD will conduct bottom trawl surveys within the Chukchi Sea and Kotzebue Sound areas of the survey to assess bottom fishes and invertebrates

- Both vessels will collect tissue samples and whole fish to study the biology of salmon, Arctic cod, saffron cod, snow crab, capelin, and other fishes & invertebrates
Understanding Cod Energetics

Objective: Compare “energy levels” (condition) between summer and winter for Saffron and Arctic cod

Winter Sampling- Under Ice
- Pilot project began April 2012 and saffron cod were collected from under the ice.

Summer Sampling- Open Water
- Planned for NMFS Cruise, Aug 2012
Future Needs for Sustainable Ecosystem Management in the Arctic

- Continue Distributed Biological Observatory effort
- Sustained fish surveys to the northern Bering, Chukchi and Beaufort Seas (every 3-5 years)
- Sustained marine mammals research: monitor and biosampling of harvest through co-management
- Baseline habitat mapping and identify sensitive areas
- Test sensitivity of Arctic cod to oil and dispersants
- Recovery plans/programs for ESA listed species
- Build capacity to handle consultation on development activities
- Build capacity for Arctic management: tribal consultation; and fisheries, environmental and economic analyses
The problem

Trawls are “blunt” tools for sampling marine environment

- Selective - optimized for catching larger market-sized fish
- Integrate over “large” time and space scales
- Excessive catch rates in high density situations problematic
- Extractive – lethal
- Require physical catch handling

Cameras are a good alternative, but…

- Avoidance behavior due to lighting or platform
- Fish targets often occur in low densities (< 1 / 10 m³)
- Data extraction from images is highly technical
- Some data (e.g., maturity, wt, age) not acquired by cameras
The solution

...develop a hybrid sampling approach using trawl-based camera system = CamTrawl

• Provide a viable non-extractive alternative for conducting fisheries surveys with minimal “disruption” to historic time series

• Improve survey efficiency through:
  - Increased spatial sampling resolution compared to traditional trawls
  - Reduced at-sea catch processing demands, thus reduced staffing needs
CamTrawl - the camera system

- Wide angle High-resolution machine vision stereo-cameras
- High power LED strobes
- Mini-PC, attitude and depth sensor, micro controller
- Secondary near-field camera
- Batteries
CamTrawl - the trawl (midwater) and camera attachment

Image chamber
Cross section

Image chamber with spreader bars

Trawl and camera entering the water

camera frame will rotate from downward-looking (photo) to laterally-looking when trawl is fully deployed.
Image examples (2011)
high resolution for improving species ID
Automated image analysis: **Lengths**

How good are stereo-based lengths?

**Length frequency comparison**

- **Physically caught**
- **Manual stereo-image based**
- **Automated**
CamTrawl data for acoustic surveys

Provides essential data to generate acoustic survey abundance estimates (...to convert echo integration data to fish numbers...):

1. Species and size composition
   - Count or tally animals by species from image data
   - Stereo-camera technology used to convert image-based measurements to true estimates of length

2. High spatial resolution data to determine species composition of acoustic backscatter (i.e., species classification)
   - Required to identify species responsible for acoustic backscatter
   - Virtually eliminates misinterpretation of species composition of backscatter as image data are collected throughout entire trawl path trajectory
Illustrative example: species classification

CamTrawl image data + acoustic backscatter

High spatial resolution annotated CamTrawl data used with trawl depth profile to create overlay in Echoview - required to ID and convert backscatter to biomass.
Summary:
AFSC Research supports Stewardship, Service, and Science within NOAA

Examples:
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Arctic Ecosystem Integrated Survey

Arctic Eis Nearshore Stations

• Distances to land

• Stations may be moved within grid cell due to depth or other hindrance to sampling.