



**NOAA
FISHERIES**

Alaska Fisheries Science Center

Protected Species Science Program Review



Theme 4: Large Cetacean Science Large Whales

Cetacean Assessment and Ecology Program

Phil Clapham

16-20 March 2015

PROGRAM OVERVIEW



Cetacean Assessment & Ecology Program

Phil Clapham (Program Leader)

Acoustics
Catherine Berchok

Arctic Studies
Megan Ferguson

ARCWEST
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Western Killer Whales
Paul Wade

Southeast Alaska
Porpoise & Killer Whales
Marilyn Dahlheim

Cook Inlet Beluga
Rod Hobbs
Kim Shelden

Genetics
Kim Parsons

Whale Tagging
Alex Zerbini
Amy Kennedy

International Whaling Commission & Large Whale Assessments
Phil Clapham, Paul Wade, Alex Zerbini, Yulia Ivashchenko



METHODS

- Surveys → Occurrence & distribution
- Acoustics → Occurrence & distribution
- Photo-id → Stock structure, life history
- Biopsy → Stock structure, life history
- Satellite tagging → Movements & habitat use
- Multi-disciplinary work → Habitat/process studies
- Modeling → Hocus pocus
- Historical reconstructions → Stock assessment

PROGRAM EMPHASES



- Collaboration
- Multi-disciplinary studies
- Innovative techniques
 - Open access
 - Publication

COMMUNICATION

- CAEP Publications (all species)
 - On average, 35 a year published or in press

Fiscal Year	Published or in press	In review	Total
FY10	30	20	50
FY11	44	15	59
FY12	53	11	64
FY13	32	19	51
FY14	18	18	36
Total	177	83	260

COMMUNICATION

- **Partners/Outreach**
 - Alaska Native groups
 - Bureau of Ocean Energy Management
 - Marine Mammal Commission
 - Canada Department of Fisheries and Oceans
 - US Fish & Wildlife Service
 - Pacific Marine Environmental Laboratory (PMEL)
 - AFSC RACE Division
 - Woods Hole Oceanographic Institution (WHOI)
 - Cornell University
 - Various other universities and research consortia
 - Synthesis of Arctic Research (SOAR)
 - Distributed Biological Observatory (DBO)
 - Scientific Review Groups
 - International Whaling Commission
 - NOAA Science Camp and other educational programs
 - Advisory work on wildlife documentaries
 - School talks

DATA ACCESS

- **Varies with project, but:**
 - Photo-id catalogues and associated databases freely shared
 - Satellite tagging data posted near-real time
 - Metadata compliance
 - All data available subject to simple proposal process
 - Not all data sets readily available electronically
 - Wide use encouraged for student and other projects

OVERVIEW

- Priority species:
 - North Pacific right whales
 - Humpback whales
- Others:
 - Bowhead, blue, fin, sei, gray, sperm whales



CURRENT THREATS & KEY ISSUES

- Entanglement
- Ship strike
- Pollution (including oil and gas development)
- Noise
- Habitat degradation/change & global warming
 - *A changing Arctic*



RESEARCH PRIORITIES

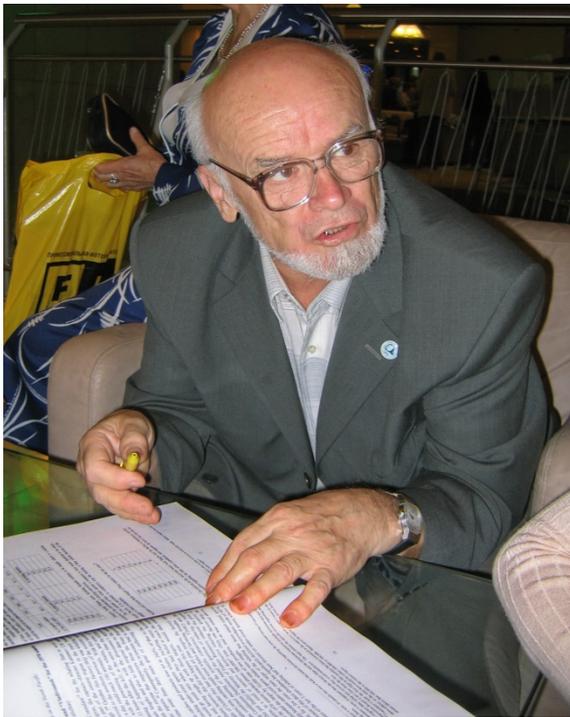


BACKGROUND: WHALING

Whale species	N Pacific 20 th century catch totals
Blue whale	8,838
Fin whale	75,538
Humpback whale	29,131
Sperm whale	314,942
Right whale	977
Bowhead whale	145
Gray whale	3,350
Sei whale	73,903
TOTAL CATCH	506,824



Reconstructing the true catches for assessments



Nikolai Doroshenko



Yulia Ivashchenko



- **Process/multi-species studies**
 - ASAMM (Aerial Surveys of Arctic Marine Mammals)
 - ARCWEST/CHAOZ (ARCTic Whale Ecology Study + Chukchi Acoustics Oceanography and Zooplankton study) + CHAOZ-X (Hanna Shoal)
- **Species-specific studies**
 - North Pacific right whales
 - Humpback whales

Aerial Surveys of Arctic Marine Mammals (ASAMM) - Overview

- Western Beaufort Sea & Northeastern Chukchi Sea
- July - October
- Funding Source: BOEM
- A 35-year time series
- Daily and annual reports can be found at <http://www.afsc.noaa.gov/nmml/cetacean/bwasp/index.php>
- Collaborators: BOEM, NMFS, NSB DWM, USFWS, USGS



Aerial Surveys of Arctic Marine Mammals: Selected Objectives



- Describe the annual migration of bowhead whales across the Alaskan Arctic, significant inter-year differences, and long-term trends in the spatial distribution and timing of the migration
- Document relative abundance, spatial and temporal distribution, & behavior of marine mammals (cetaceans, ice seals, walruses, and polar bears)
- Provide an objective wide-area context for understanding marine mammal ecology in the Alaskan Arctic, to help inform management decisions and interpret results of other small-scale studies
- Important to continue this 35-year time series in light of the changing Arctic



ARCWEST/CHAOZ: OBJECTIVES



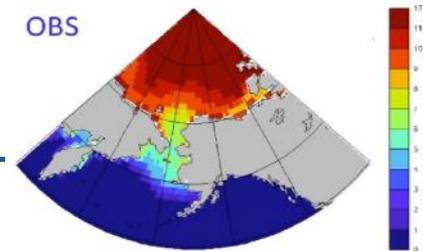
- Document the distribution and relative abundance of whales in areas of potential industrial activity
- Relate changes in those variables to oceanographic conditions, indices of potential prey density, and anthropogenic activities
- Main collaborators: PMEL, RACE, Cornell
- Funding source: BOEM



Additional Project Objectives



- Determine Chukchi Sea noise budget – CHAOZ
- Assess the population structure and origin of the whales in the region – ARCWEST
- Estimate future sea ice extent using climate modeling – CHAOZ
- Extension of work into the Hanna Shoal region – CHAOZ-X



Projects

CHAOZ (2010-2016): Chukchi Acoustics, Oceanography, and Zooplankton study

Long term recorders
Sonobuoys
Autodetection buoy

Oceanography, zooplankton, acoustics (noise modeling), visual, satellite tagging, and climate modeling



Hydrophones for Hunters (2010+) (NMFS-ADFG)

Simple, compact, dipping hydrophone kits

Outreach + getting more info out of long-term recorders

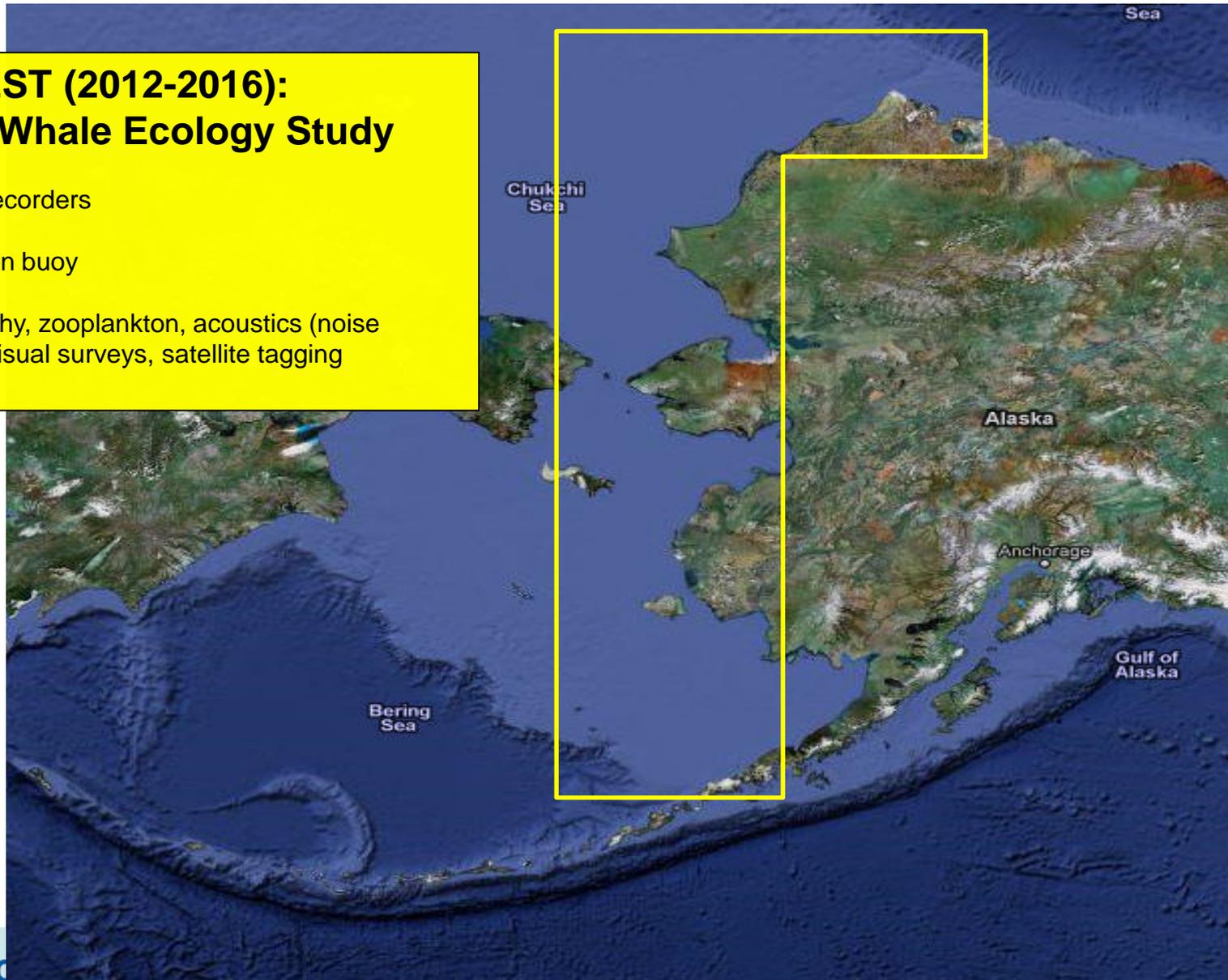


Projects

ARCWEST (2012-2016): ARCTic Whale Ecology Study

Long-term recorders
Sonobuoys
Autodetection buoy

Oceanography, zooplankton, acoustics (noise modeling), visual surveys, satellite tagging



ARCWEST/CHAOZ SURVEYS

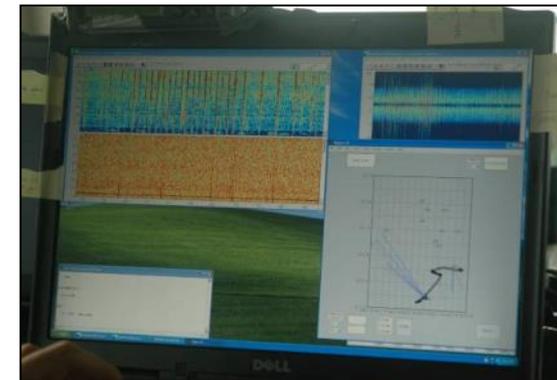
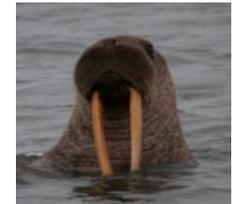


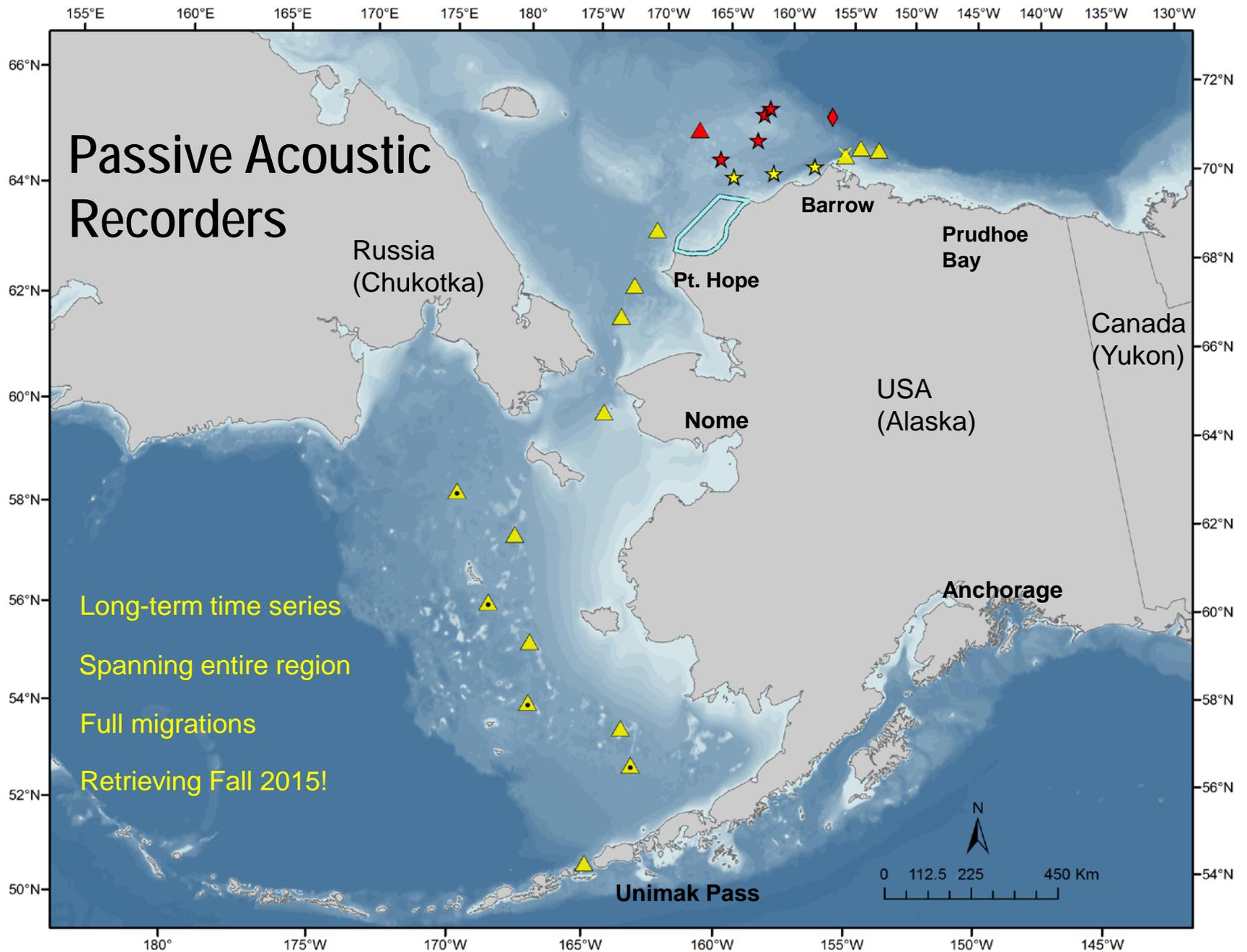
Visual line surveys

(Continuous along track - daylight hours)

Passive acoustic monitoring /sonobuoys

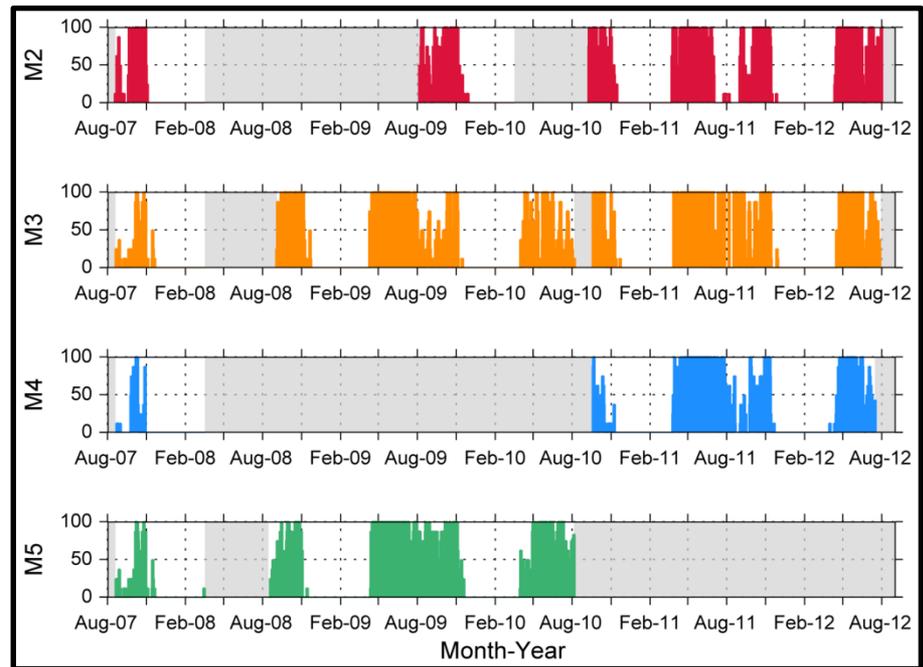
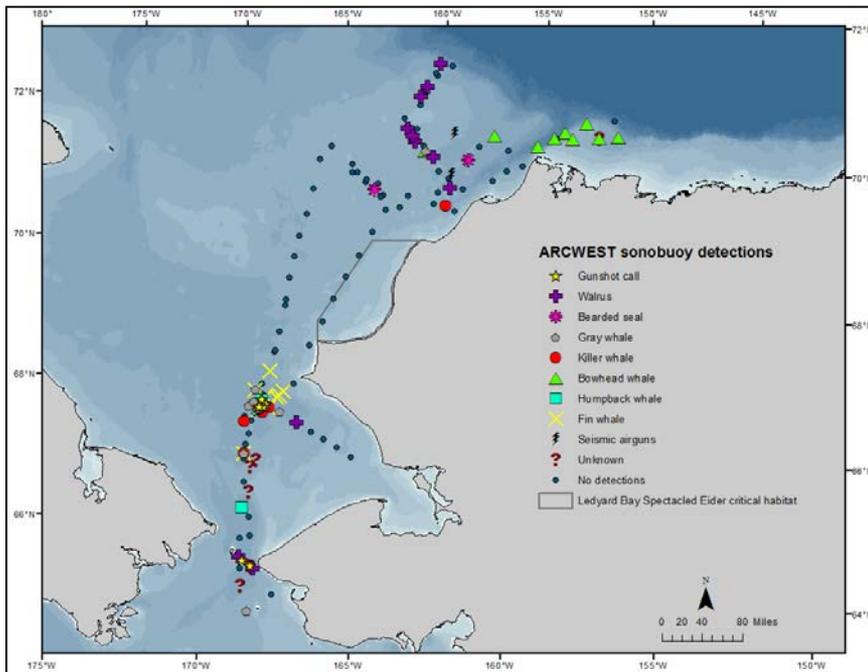
(Along track - every 3 hours – 24/7)





Acoustic studies

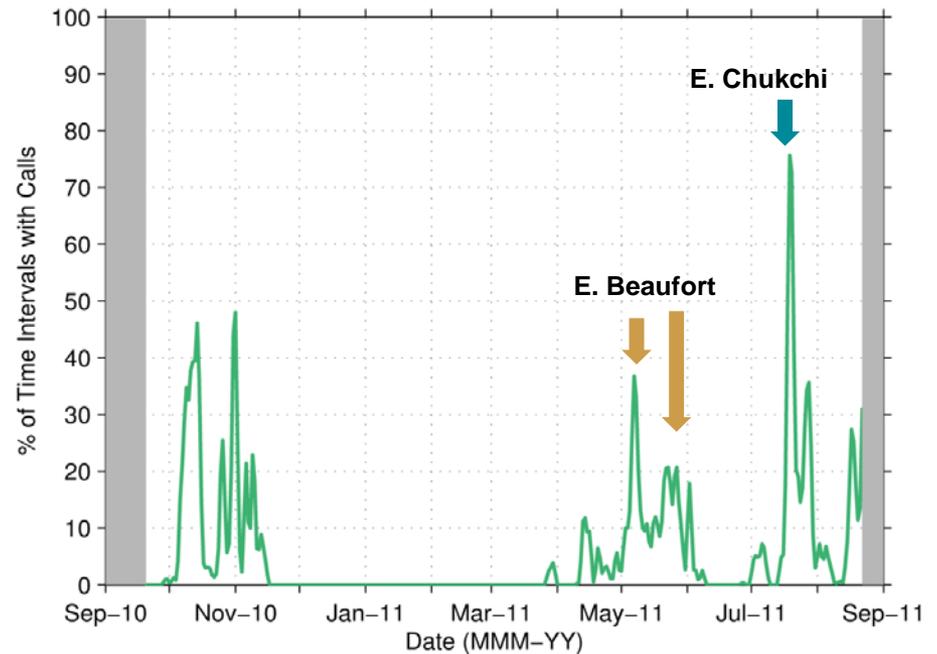
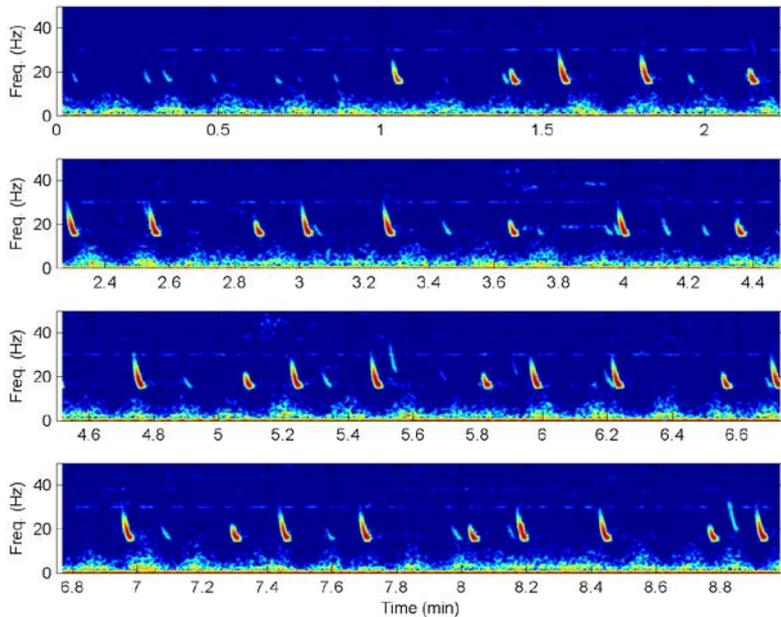
Determining spatial and temporal distributions (examples)



5-year record of bowhead calling from four recorders off Barrow

ARCWEST sonobuoy detections

Acoustic studies Differentiating populations (examples)



Two populations of belugas with
different migratory timing

Fin whale “triplet” call heard in
the Chukchi and Bering Seas

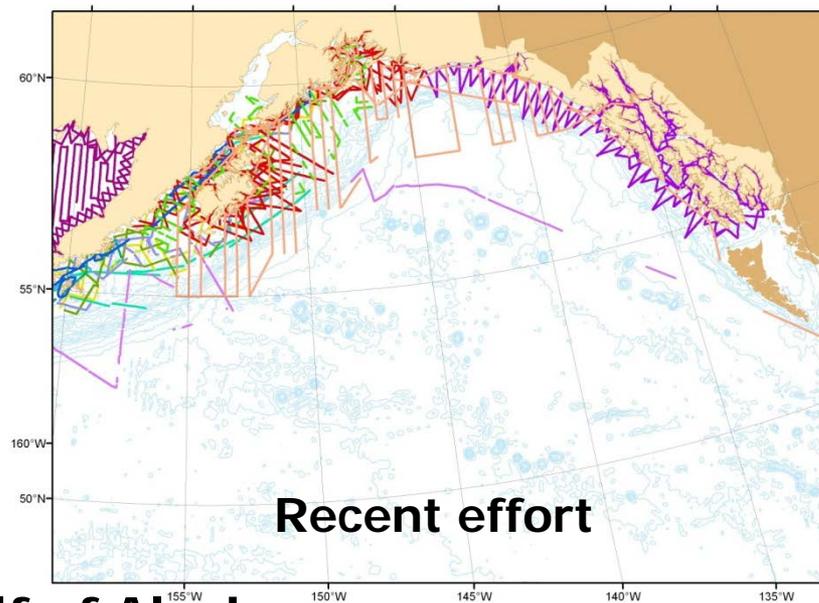
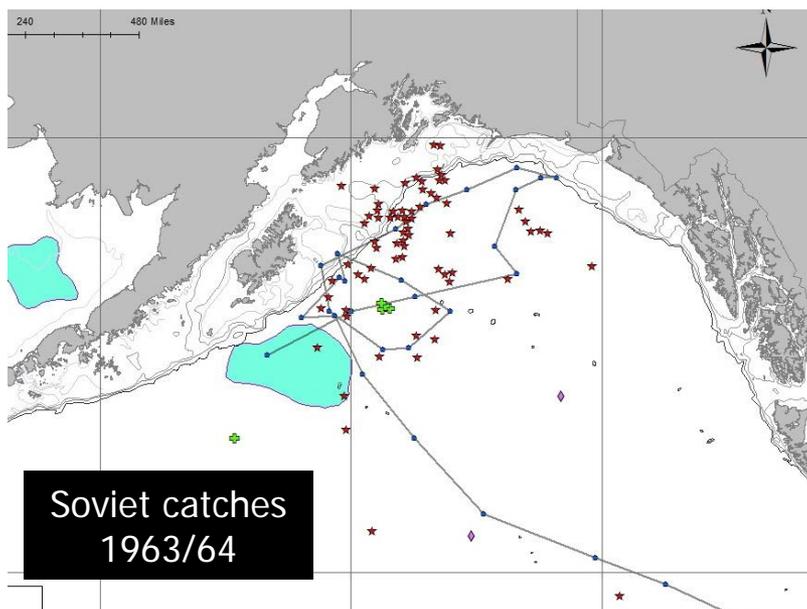
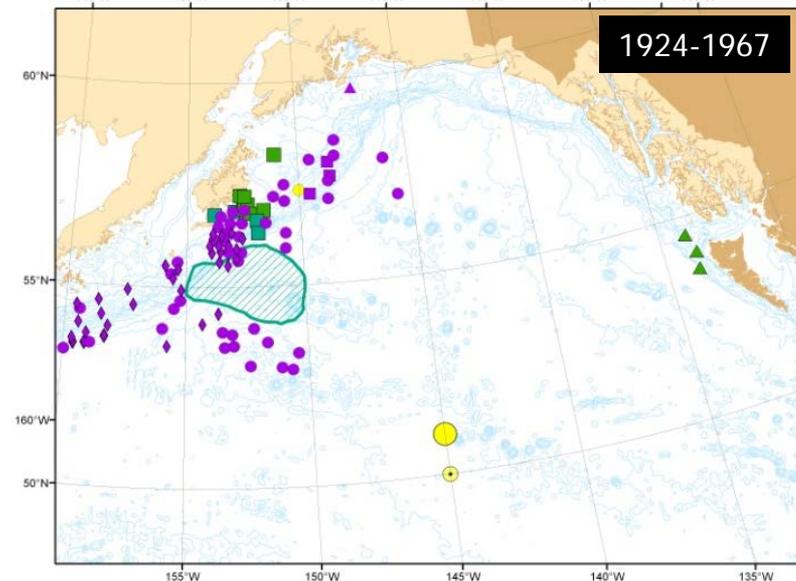
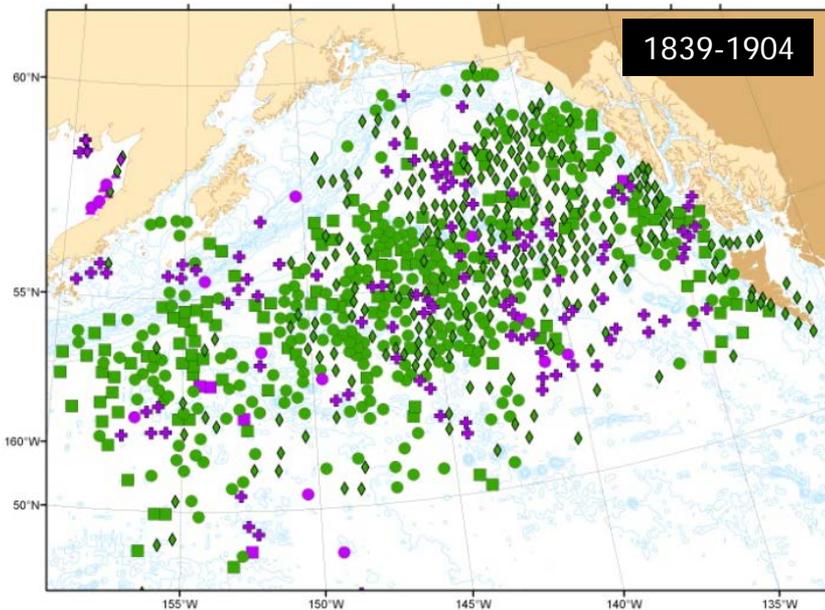
NORTH PACIFIC RIGHT WHALES



NORTH PACIFIC RIGHT WHALES

- **Background**
 - Whaling beginning in 1835
 - Devastated by illegal Soviet catches in the 1960's
- **Two stocks**
 - Eastern: Bering Sea, Gulf of Alaska
 - Western: Okhotsk Sea
- **Abundance**
 - Eastern: tens of animals (NMML Bering Sea estimate: 30)
 - Western: hundreds?
- **Status: Endangered (eastern stock critically so)**
- **Critical Habitat: Bering Sea & off Kodiak**





Distribution: Gulf of Alaska

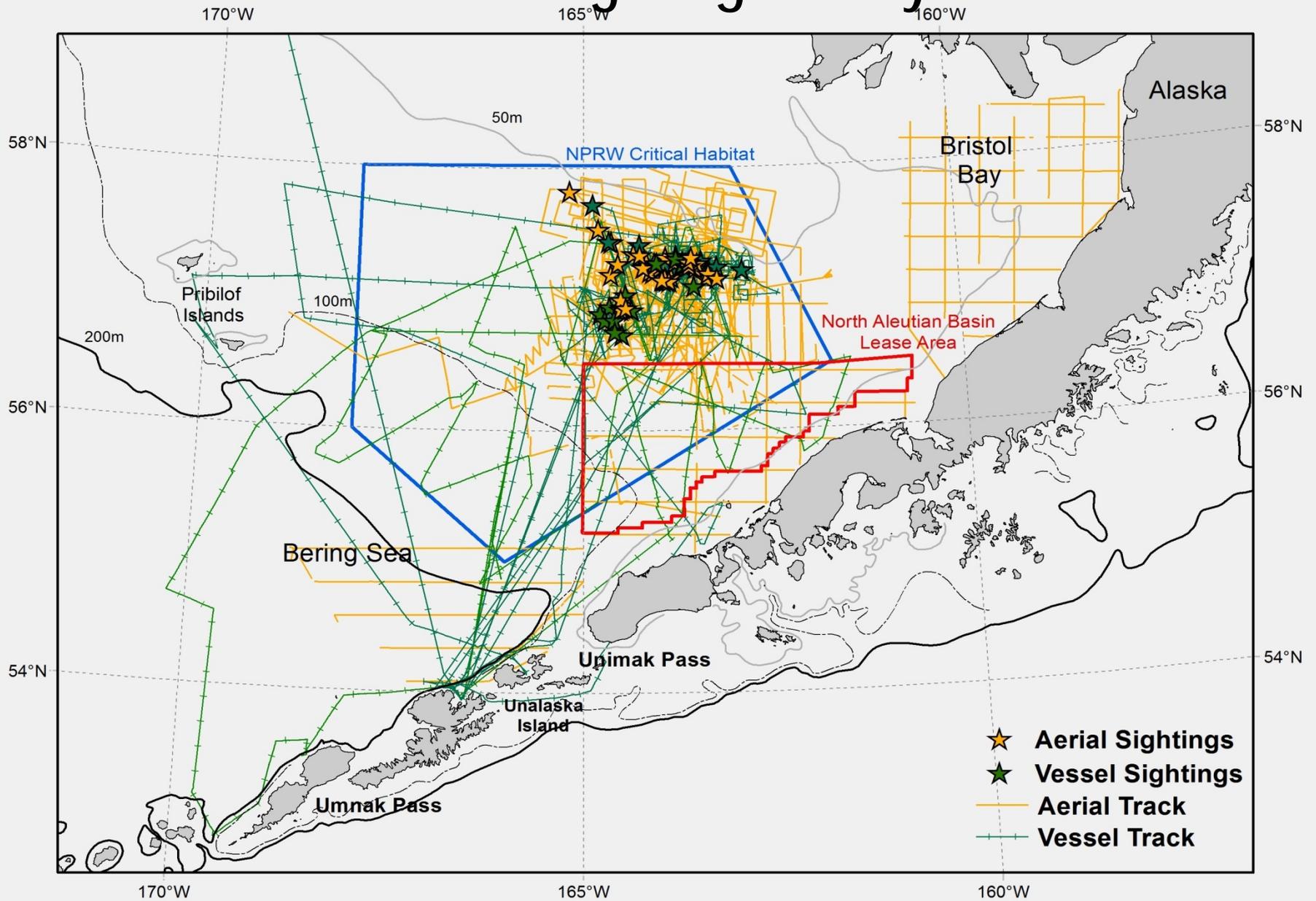
NORTH PACIFIC RIGHT WHALES

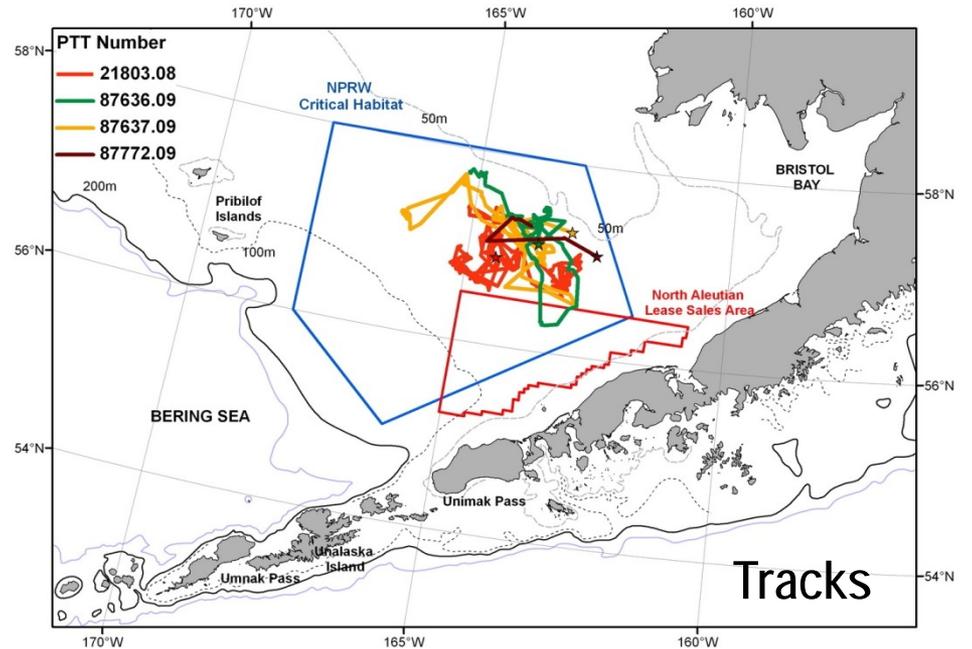
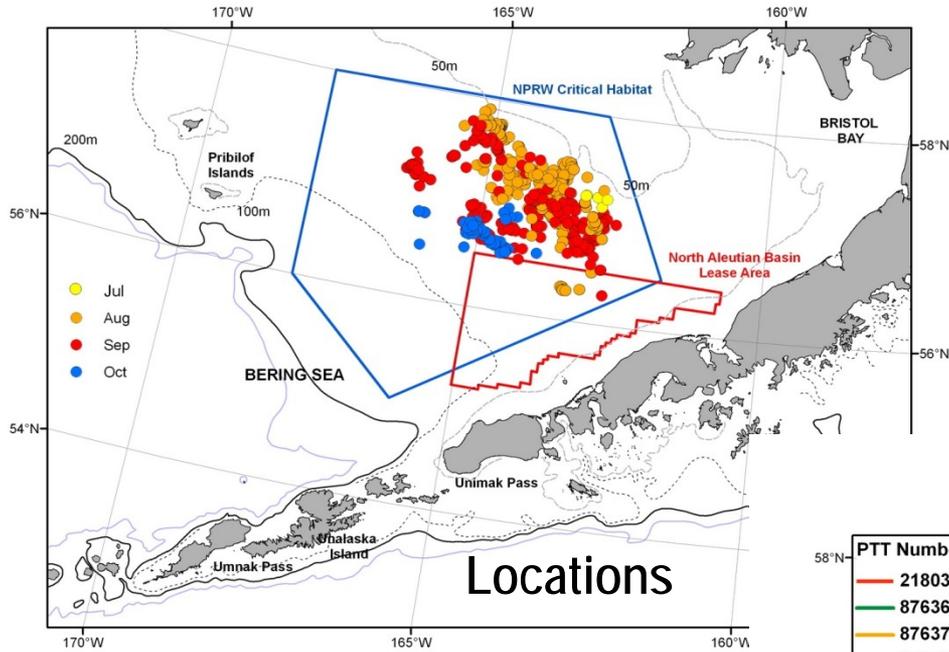
- Threats
 - Entanglement
 - Currently no evidence (scars) in Bering Sea
 - One known mortality in western stock, but no dedicated work
 - Ship strikes
 - No evidence at present
 - Increased trans-Arctic shipping represents a potential threat
 - Keep in mind...
 - Mortalities unlikely to be observed
 - *Any* mortality disproportionately significant in eastern stock

NORTH PACIFIC RIGHT WHALES

- Overview of Past Research:
 - Aerial and shipboard surveys in SE Bering Sea (mostly BOEM-funded)
 - Habitat/oceanographic studies in the Bering Sea
 - Genetics and photo-id
 - Reconstruction of the catch record
 - Satellite tagging

NMML Sighting Surveys

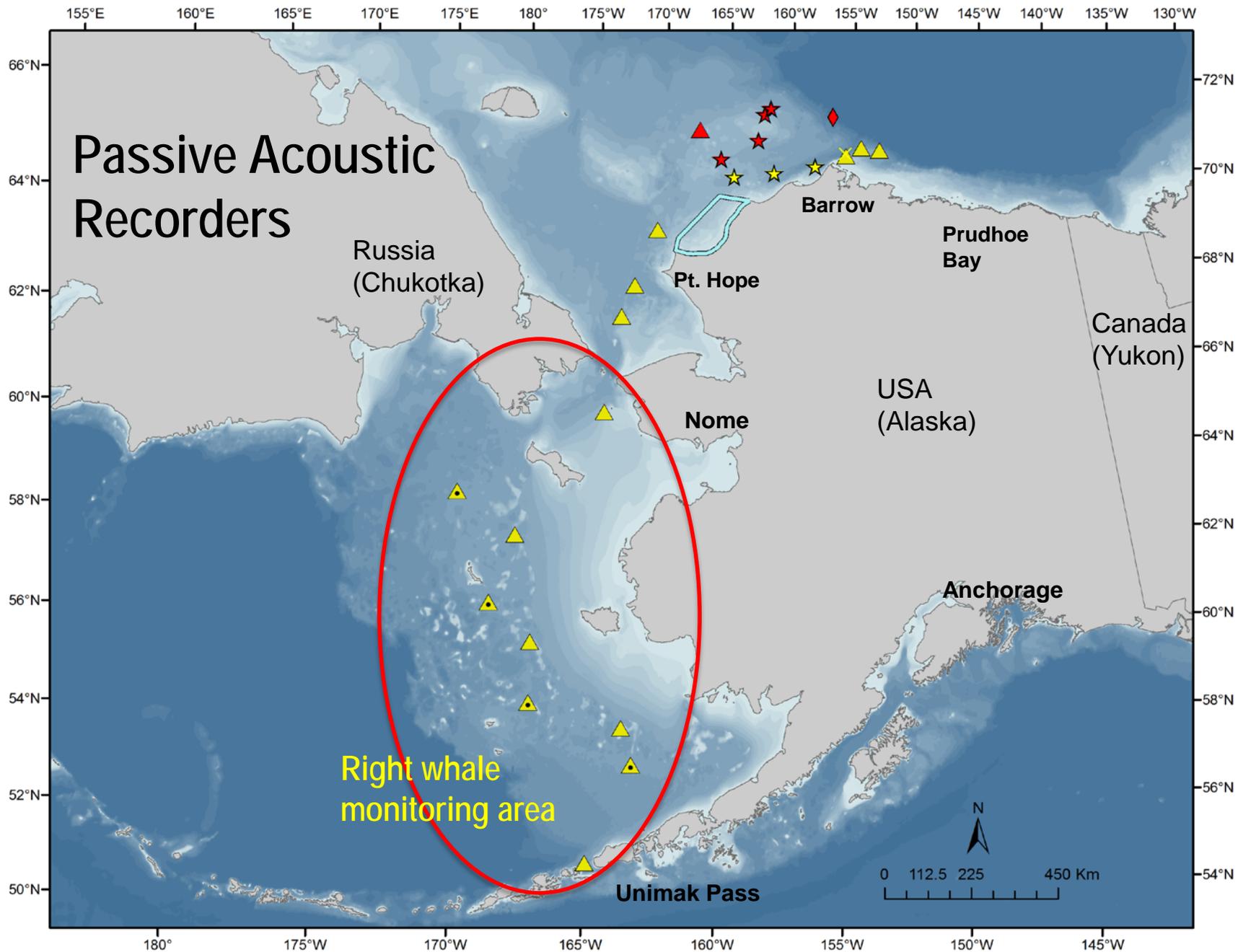




Satellite tagged right whales

NORTH PACIFIC RIGHT WHALES

- Present Research:
 - Acoustic studies of distribution and occurrence
 - Passive acoustic recorders in the Bering Sea and Aleutian passes



NORTH PACIFIC RIGHT WHALES

- Highest Priorities:
 - FUNDING!
 - \$0 dedicated by NMFS despite critically endangered status
 - We need basic information
 - Surveys, Bering Sea & Gulf of Alaska

RIGHT WHALE PRIORITIES: ABUNDANCE

- Partners
 - Opportunistic + DFO Canada
- Methods
 - Mark-recapture (MRR, photo-id + genetics)
 - NMML maintains the NPRW Photo-id Catalogue
 - Estimates published in Wade *et al.* (2011)
 - Sighting surveys for density
- Data quality
 - Varies – MRR is very opportunistic



RIGHT WHALE PRIORITIES: ABUNDANCE

- **Strengths**
 - We actually have some data despite the challenges below!
- **Weaknesses**
 - Small population in remote areas
 - Very difficult to find and work animals
 - Sighting & MRR surveys very expensive
 - Cannot easily control for sampling bias

RIGHT WHALE PRIORITIES: DISTRIBUTION & HABITAT USE

Partners

PMEL, WHOI, Cascadia Research

Methods

Sighting surveys

Oceanographic sampling

Satellite tagging

Acoustics

RIGHT WHALES - SUMMARY

- Soviet whaling probably removed the bulk of the remaining population in the 1960's
- Current population very small, with a low reproductive rate and diversity issues
- Diminished range
- Arctic shipping = a noisier, more dangerous future



RIGHT WHALES – RESEARCH NEEDS

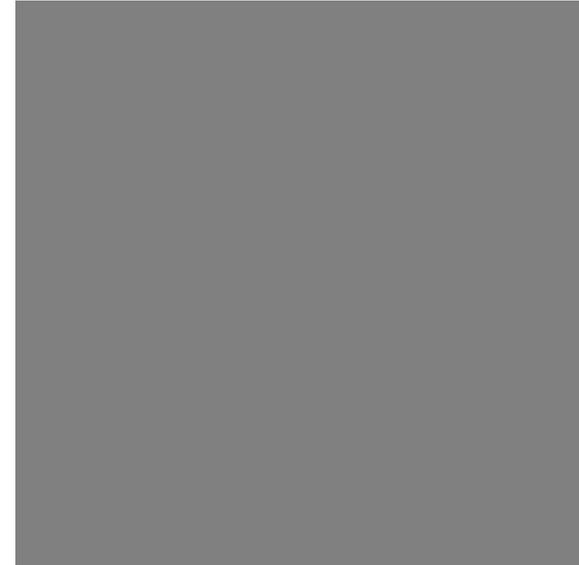
- Major funding for basic distribution surveys (plus other work) in the Bering Sea and Gulf of Alaska
- Ship time to turn around passive acoustic recorders for continued acoustic monitoring
- Satellite tagging to discover important habitats (and perhaps even the long-lost calving ground)
- Proactive inter-agency work on regulating ship traffic in the Bering Sea *before* trans-polar routes open up



HUMPBACK WHALES

HUMPBACK WHALES

- Background
 - 29,000 killed in the 20th century
 - Five breeding stocks proposed
 - Central America (west coast)
 - Mexico (coastal and offshore)
 - Hawai'i
 - Okinawa/Philippines
 - Second West Pacific (location unknown)



HUMPBACK WHALES

- Background
 - Abundance
 - 21,000 estimate for the North Pacific
 - 5-7% rate of increase
 - Status: Endangered
 - Subject of a recent Status Review
 - Some stocks likely candidates for delisting



HUMPBACK WHALES

- Threats
 - Entanglement
 - Known primarily from well-observed areas
 - Ship strikes
 - Occasional but unlikely to be significant at the population level

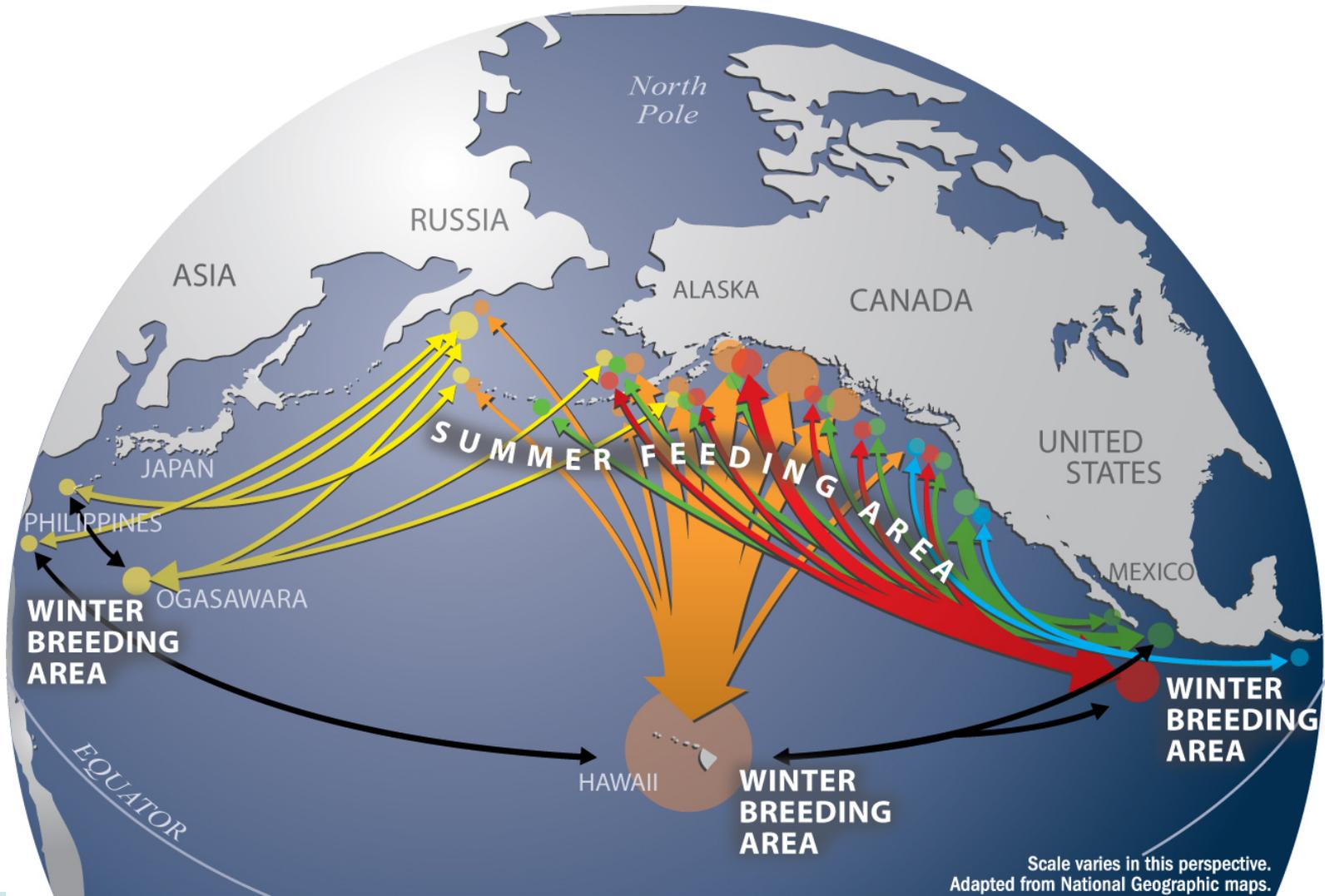


HUMPBACK WHALES

- Overview of Past Research:
- The SPLASH study
 - 2004-2007
 - Abundance and population structure
 - Coordinated photo-id and biopsy sampling in all known feeding and breeding areas across the North Pacific
 - 9 countries, 30 organizations
 - Thousands of photos and samples

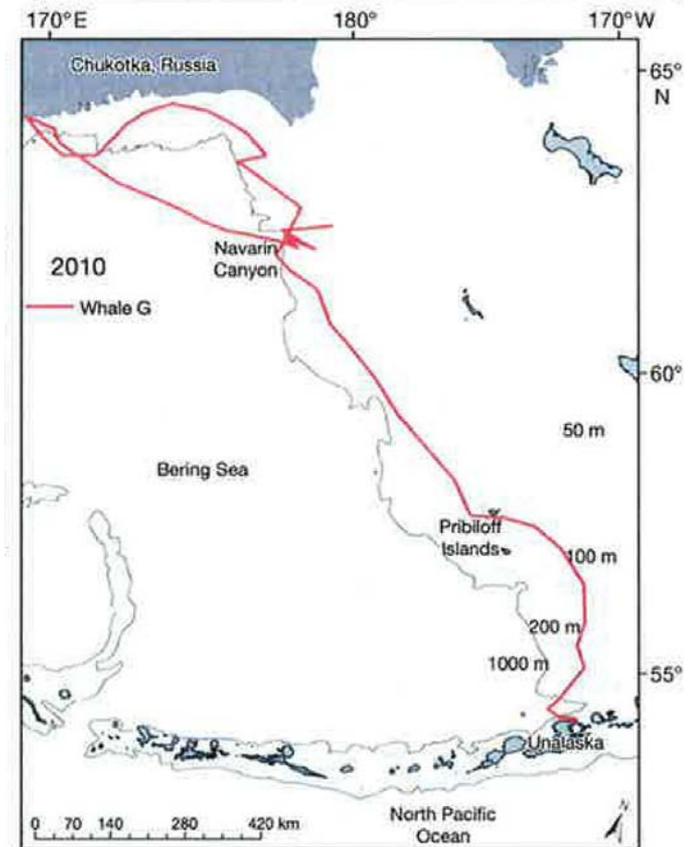


SPLASH – MOVEMENTS AND STRUCTURE



HUMPBACK WHALES

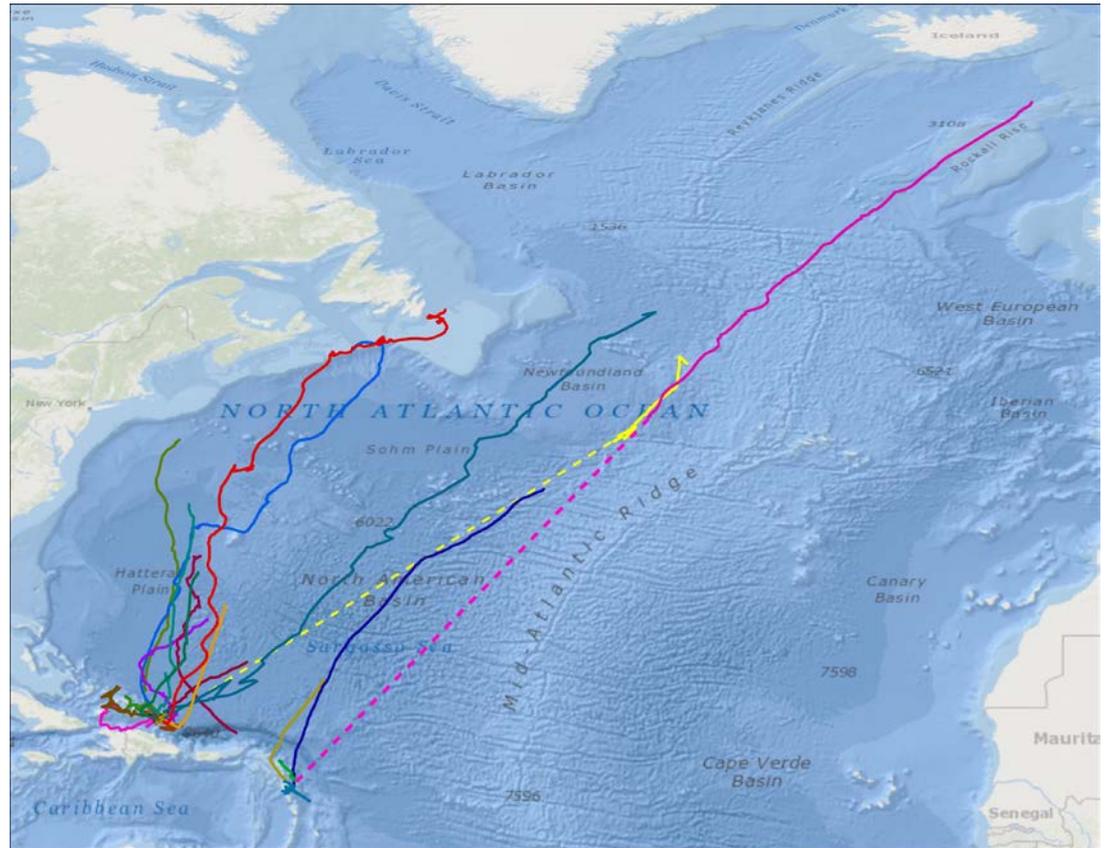
- Past and Present Research:
- Passive acoustics studies for distribution and stock structure
- Satellite tagging
 - Bering Sea (Aleutians)
 - Distribution and movements
 - Gulf of Maine
 - Study of tag performance and impacts on whales using frequently resighted individuals of known sex and age



HUMPBACK WHALES

- Tagging in other areas

- West Indies
- Brazil
- South Pacific
- South Africa
- Arabian Sea



Satellite-tagged humpbacks, North Atlantic

HUMPBACK WHALE PRIORITIES: DISTRIBUTION AND HABITAT USE

- **Partners**
 - Center for Coastal Studies, WHOI, Marine Mammal Stranding Center, various international researchers in other countries
- **Methods**
 - Satellite tagging
- **Data quality**
 - Varies with tag deployment: short- to long-term depending on how the stars align

Assessment of Potential Satellite Tag Effects on Large Whales and Development of New Technology

OBJECTIVES

- Assess physical and physiological effects of intradermal implantable tags (short, medium and long-term), Gulf of Maine humpback whales
- Evaluate possible causes of tag failure and tag loss, and improve designs

RESULTS

- Physical/physiological effects vary by individual and tag location
- Tag failure from design flaws contributed to more pronounced physiological reactions
- Improvements in tag design resulted in greater tag duration and minimized body reaction (improvement in animal welfare)

Physical/physiological reactions

Variability in tag site post-deployment



Wound healing



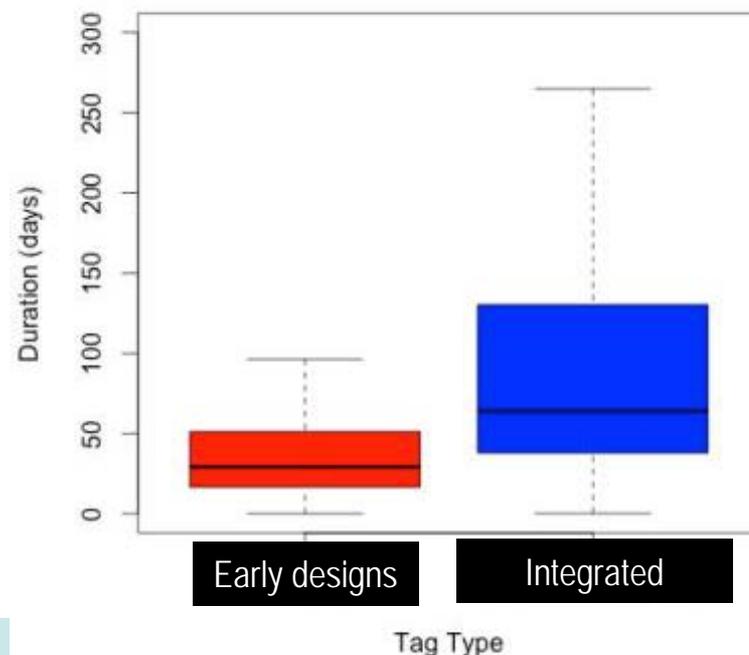
Technology improvements resulting from this study

Fully integrated tag (no breakable interfaces)



Improvements in tag duration

	Early designs	Integrated tag
Median duration	29 days	65 days
Mean duration	38 days	87 days
Sample size	20	26

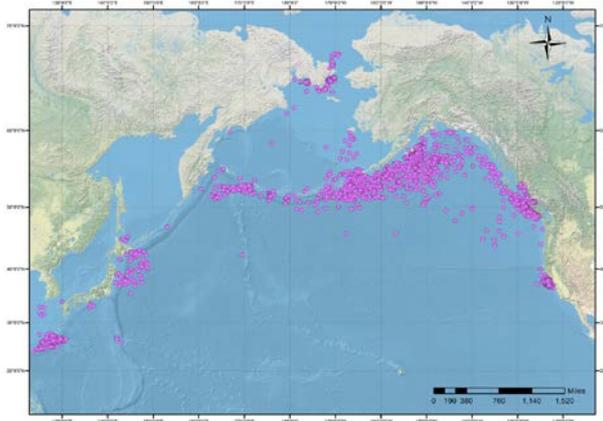


HUMPBACK WHALE PRIORITIES: DISTRIBUTION AND HABITAT USE

- **Strengths**
 - New data on distribution and on which habitats are important
 - Tags are constantly improving
 - Gulf of Maine study has taught us a great deal with broad application to the work of NMML and other tagging groups
- **Weaknesses**
 - Long-term tag retention is still a challenge

HUMPBACK WHALES - SUMMARY

- North Pacific population recovering well
- Western North Pacific stock of most concern
- Delisting of some stocks?
 - If so, post-delisting monitoring will be required – potentially big \$\$\$



HUMPBACK WHALES – RESEARCH NEEDS

- Funding to complete the SPLASH genetic analyses (to obtain estimates of breeding stock mixing rates in the feeding areas)
- Satellite tagging in the Aleutians in late summer to attempt to identify the “missing” (second W Pacific) breeding ground

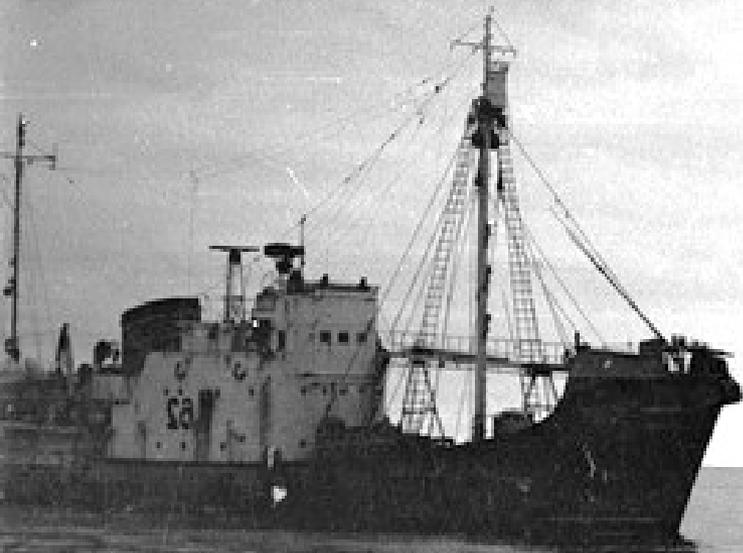
BRIEFLY: BOWHEAD WHALES

- The “western Arctic” (BCB) stock is large, recovering, well-studied and well-managed

- AFSC collaborates with North Slope Borough and others in periodic abundance surveys and other work

BRIEFLY: SPERM WHALES

- Largest N Pacific catch total: 300,000 animals
- Unlikely to be the subject of anything but local studies (e.g. involving depredation) because of huge pelagic range and consequent expense of study
- Pre-exploitation size cannot be reliably assessed until catch statistics are corrected (serious concerns about reliability of non-Soviet data)
- Need stock structure data (depredation issues)



LARGE WHALES: 3 KEY RECOMMENDATIONS

1. Secure major funding for distribution surveys for North Pacific right whales

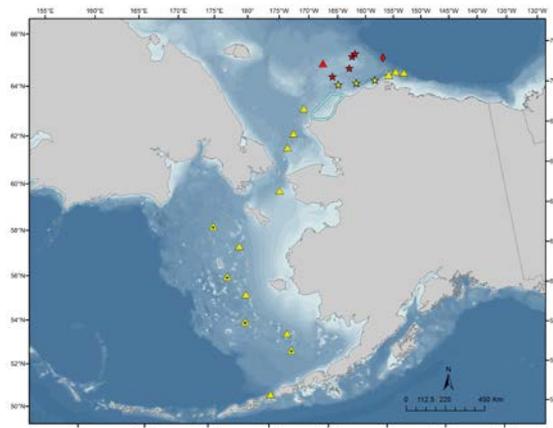
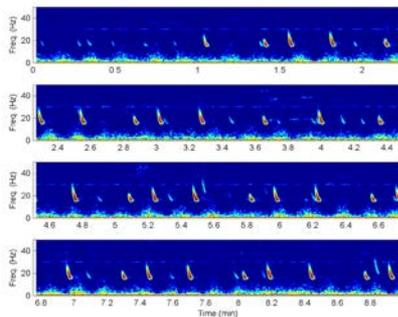
- Aerial and/or vessel surveys in Bering Sea and Gulf of Alaska
- Needed to establish current distribution and abundance
- Can be combined with other work (e.g. photo-id, biopsy, habitat characterization)



LARGE WHALES: 3 KEY RECOMMENDATIONS

2. Obtain ship time to service passive acoustic recorders for continued acoustic monitoring

- Cost-efficient way of long-term, year-round monitoring of multiple species' occurrence and distribution
- Unless funding is found, recorders will not be redeployed after 2015



LARGE WHALES: 3 KEY RECOMMENDATIONS

3. Satellite tagging for right and humpback whales to track movements and identify important habitats

- Can be combined with vessel line-transect surveys
- New tag designs increase chances of long-term attachments
- Need to locate right whale winter calving grounds and the “missing” humpback whale breeding area



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