Influence Of Sea Ice And Oceanographic Conditions And Prey Availability On The Timing Of Fall Bowhead Whale Migration From The Canadian Arctic Along The Beaufort Shelf To Barrow And The Subsequent Whaling Success In Beaufort Sea Coastal Communities

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MOTIVATION: The timing of bowhead whale migrations from the Canadian Artic along the Beaufort Shelf to Barrow AK in the fall varies interannually. More days with upwelling favorable winds have been observed in recent (last five) years (Overland, pers. comm.) and whales have arrived at Barrow later than usual for two of the past five (6?) years (2007, 2011).

HYPOTHESIS: Bowhead whales "linger" or start their migration later in the fall in the Canadian Arctic when prey is plentiful, ice is minimal, and/or ocean temperature is warm

OJBECTIVE: Identify how environmental conditions (sea ice, hydrography, prey availability) in the Canadian Arctic (Amundsen Gulf and to the west) and on the Beaufort Shelf are associated with bowhead whale distributions on the shelf and the timing of their fall migration.

ASSUMPTION: Certain oceanographic conditions and patterns enhance prey availability on the shelf
- Upwelling on the Beaufort Shelf brings water, and *Calanus* spp. prey, onto the shelf
- Sea ice modulates intensity of this upwelling

APPROACH: Synthesize historic data from late summer/early fall on physical drivers, prey or prey proxies, and behavior

WHALE BEHAVIOR/CHARACTERISTICS
Migration timing (age-specific)
Feeding behavior (location, prey type)

PREY AVAILABILITY
Interannual variability in abundance and type
How physical drivers such as upwelling impact plankton prey availability (abundance, concentration)

PHYSICAL DRIVERS
Wind direction and magnitude
Sea ice extent and timing
Large-scale meteorological atmospheric patterns
Hydrography
Currents

TIMELINE AND MILEPOSTS

- Meet in January 2013 in Anchorage AK to collect the appropriate data sets for the synthesis and start to identify the linkages and associations between the physical drivers (e.g., winds and sea ice), the biological responses (e.g., prey availability, whale distributions), and whale migration behavior
- Communicate post-PI meeting using e-mail, phone, and Skype
- Ashjian, Okkonen, Maslowski will meet in Monterey CA to work on data synthesis in early summer
- Produce a collaborative, synthetic paper addressing the hypothesis and objective of this project

PROJECT KICKED OFF YESTERDAY!!

ANCHORAGE MEETING - 1/19/2013

Attendees: Carin Ashjian, Steve Okkonen, Susanna Blackwell, Robert G. Campbell, George Divoky, Matthew Druckenmiller, Craig George, Wieslaw Maslowski, Sue Moore, Kate Stafford, Tom Weingartner, Bill Williams

Meeting Activities

> Review of data and preliminary findings from most participants
> Data types (likely incomplete):
>> Oceanographic (T, S, Currents)
>> Prey availability relative to oceanography
>> Whale distributions from aerial surveys
>> Meteorological (winds)
>> Sea Ice
>> Modeled winds, sea ice, hydrography
>> Whale locations and/or presence from aerial surveys, passive acoustic moorings, small boat surveys, community records

>> Whale body condition
>> Whale harvest, whaling season start times
>> Krill washups at Cooper Island, sea ice, and guillemot feeding

Major Questions/Action Items/Considerations/Findings

1) Do we still like our hypotheses? Can we answer our hypothesis and fulfill our objectives with the data available?
2) Need to develop a synthesis of available data on whale migration start dates from Canada and along the Beaufort Shelf and arrival at Barrow
3) Need to match data from acoustic recorders with data from aerial surveys to see if they coincide/agree
4) Need to develop index for timing of whale migrations for aerial survey and other data. A simple index would be: early, intermediate, late. However, we might be able to do something more quantitative.
5) There seems to be a regime shift in many of the variables in the mid-1990s. We could consider the long-term, broad-scale data in terms of before and after 1995
6) Quite a lot of data available from 2007+. Much less available prior and the data available does not cover all variables. Therefore there are two scales that we could address:
    1) Longer term (decades) occurrence of indicator variables (e.g., upwelling winds, whale locations from BWASP). Regime shif.
    2) Shorter term, more mechanistic relationships between variables in the more extensive data sets of this period for 2007+ . Interannual variability.