Bering Sea Integrated Ecosystem Research Project B92: Top predator hotspot persistence

Project #: B92

Title: Top predator hotspot persistence

Principal Investigator(s) and Recipient Organization(s):
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Contract Period and Amount of Funding: January 1, 2008 – September 30, 2012

Report Period: October 1, 2008 – April 30, 2009

Report Date: March 26, 2009

Lead Author of Report: Mike Sigler

Proposed timeline and milestones within report period:

What	*Who*	*Start (2009)*	*Other key dates*
Receive data from acoustic (B58), whale (B66) and seabird (B64) surveys	**Sigler, Kuletz, Friday, Wilson**	December	Annually 2008-2010
Complete preliminary persistence analysis	**Sigler, Kuletz, Friday, Wilson**	March 2009	
Complete NPRB progress reports	**Sigler**	April, October	Semi-annually 2008-2012

Project Summary:
Core goal: Seabird and cetacean foraging locations from at-sea visual surveys will be analyzed in relation to prey type and abundance data. We will quantify the distributions of pelagic forage fish, i.e., the existence of prey hot spots, whether these hot spots persisted across years and the location of apex predators relative to hot spot persistence based on apex predator frequency of association with persistent hot spots.

Hypotheses addressed: This project addresses BSIERP hypothesis 4. Hypothesis 4 states that: Climate and ocean conditions influencing circulation patterns and domain boundaries will affect the distribution, frequency and persistence of fronts and other prey-concentrating features and thus the foraging success of marine birds and mammals largely through bottom-up processes. Specifically:

a. Climate-ocean changes will displace predictably located, abundant prey (hot spots) necessary for successful foraging by central place (seabirds and fur seals while nurturing young) and hot spot (baleen whales, walrus) foragers.
b. Central place foragers will shift their diet, foraging locations or rookery locations to increase foraging opportunities (based on differential foraging success).

Progress Summary: The data and preliminary analysis milestones were met during this reporting period.

Data: Data for 2008 were received from acoustic (B58), whale (B66) and seabird (B64) surveys including pollock and euphausiid density (Patrick Ressler), whale count (Nancy Friday) and seabird density (Kathy Kuletz). In addition, Patrick Ressler sent pollock and recently compiled euphausiid data for 2004, 2006 and 2007. These data were not part of the original study plan because the euphausiid data were not

available until recently. Adding these prey data strengthens the study by adding more years to compute prey persistence. The prey data and a subset of the predator data were compiled into a standard format and then housed together in a single spreadsheet to facilitate preliminary data analysis.

Preliminary analysis:

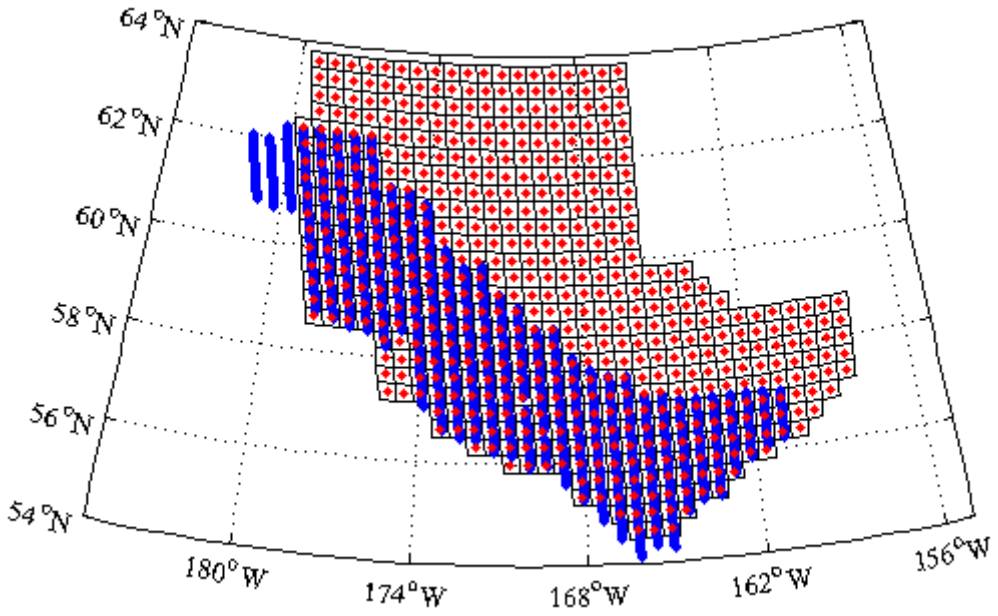
Prey data: Acoustic backscatter data (18, 38, 120, and 200 kHz) were collected along north-south survey transects (20 nmi east-west spacing) on the middle and outer shelf of the eastern Bering Sea during June and July of 2004, 2006, 2007, and 2008 as part of the NOAA-AFSC acoustic-trawl survey of Bering Sea walleye pollock. Acoustic backscatter at 38 kHz was attributed to walleye pollock using a visual examination of echosign and the composition of midwater and bottom trawl catches. Pollock biomass density (kg nmi^{-2}) was computed for 20 x 20 nmi blocks corresponding to the NOAA-AFSC bottom trawl survey sampling grid by summing pollock biomass from the acoustic survey for each block and then dividing by the area for each block (400 nmi^2). The bottom trawl survey covers the same area as the acoustic-trawl survey, and the bottom trawl blocks line up with acoustic survey transects (Figure 1). Acoustic backscatter at 120 kHz was attributed to euphausiids using an objective analysis that compared the observed backscatter frequency response at 18, 38, 120, and 200 kHz to a known frequency response signature for euphausiids. Euphausiid backscatter densities (nautical area scattering coefficient or s_A, m^2 nmi^{-2}) in 0.5 nmi EDSUs were averaged into the same 20 x 20 nmi blocks used for pollock biomass above. The average s_A for each block is proportional to euphausiid biomass density in each block.

Predator data: Trained observers onboard the NOAA-AFSC acoustic-trawl survey vessel conducted standard visual line-transect surveys for cetaceans and visual strip-transect surveys for seabirds. For this preliminary analysis, densities for two seabird species (number km^{-2}) were averaged into the same 20 x 20 nmi blocks used for pollock biomass above. The two seabird species are thick billed murre and black legged kittiwake. These species are focal species for the BEST-BSIERP study and represent a dive forager (thick billed murre) and a near surface forager (black legged kittiwake).

Persistence analysis: The prey data were analyzed to determine which 20 x 20 nmi blocks consistently held above average prey (pollock or euphausiid) densities. Persistence was defined as the number of years (up to four) that a block was above average. Few blocks were above average all four years, only 10% for pollock and 1% for euphausiids. Somewhat more blocks were above average three or more years, 17% for pollock and 11% for euphausiids. Even though few blocks contained consistent prey, a large fraction of black legged kittiwakes and thick billed murres were found in these blocks. 45% of thick billed murres and 27% of black legged kittiwakes were found in the most persistent pollock blocks. 71% of thick billed murres and 49% of black legged kittiwakes were found in blocks where euphausiids were above average three or more years. This preliminary analysis indicates that predators choose reliable foraging locations.

Fig. 1: NOAA-AFSC bottom trawl survey sampling grid is shown by black squares and red dots; 2008 NOAA-AFSC acoustic-trawl survey transects are shown by blue lines.

2008



Lessons learned and project adjustments: Patrick Ressler provided a MATLAB program that compiles the predator and prey data into the analysis resolution of 20X20 nmi blocks. We will continue to apply this program to classify the data.

Integration activity: Mike Sigler participated in data management, EMC, PI, Lead PI and SAB meetings. Nancy Friday, Kathy Kuletz and Patrick Ressler participated in the BEST-BSIERP PI meeting in October 2008.

Education and Outreach: Mike Sigler presented a seminar on climate and fisheries. The seminar focuses on the role of BEST-BSIERP in improving understanding of the Bering Sea ecosystem. The seminar is posted at http://bsierp.nprb.org/posted/home/02.08_climate_and_fisheries_sigler.pdf. Mike Sigler presented the seminar several times in the last reporting period and twice during this reporting period including:

- Fishery Management Council training, Washington DC, October 21, 2008
- Yale School of Forestry and Environmental Studies, New Haven, CT, October 28, 2008

Next year's Work plan (not part of the 5 page target length):

BSIERP B92, Top predator hotspot persistence, Mike Sigler, Mike.Sigler@noaa.gov, 907-789-6037

2009-2012 Tasks, Assignments, Timeline

What	*Who*	*Start (2009)*	*Other key dates*
Receive data from acoustic (B58), whale (B66) and seabird (B64) surveys	**Sigler, Kuletz, Friday, Wilson**	Annually December 2009-2010	
Complete NPRB progress reports	**Sigler**	Semi-annually (April, October) 2009-2012	
Complete persistence analysis	**Sigler, Kuletz, Friday, Wilson**	March 2011	
Supply data to data manager	**Sigler**	June 2011	
Complete manuscript	**Sigler, Kuletz, Friday, Wilson**	September 2011	