

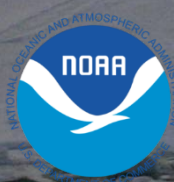
IDENTIFYING IMPORTANT PELAGIC AREAS IN THE PACIFIC ARCTIC: SEASONAL AND SPATIAL PATTERNS IN MARINE BIRD AND MAMMAL DISTRIBUTION

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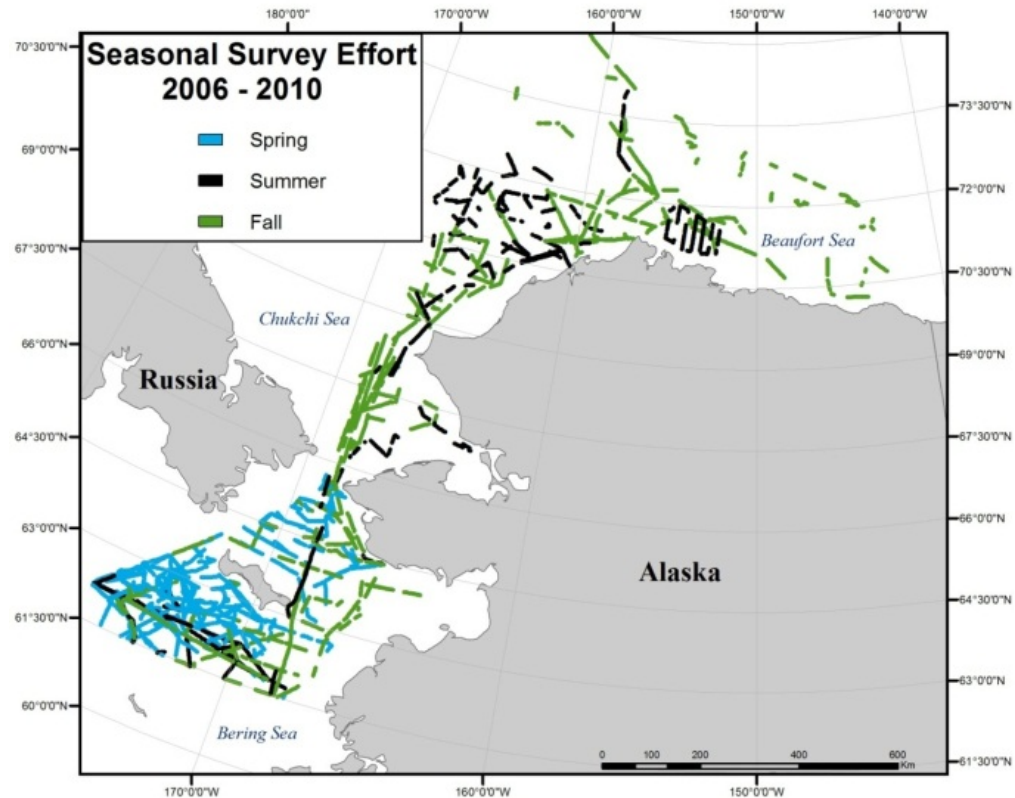
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Project Goals

- Describe the broad-scale pelagic distribution of marine birds and marine mammals in the North Bering Sea, northeastern Chukchi Sea, and Alaskan Beaufort Sea
 - Spatial and seasonal patterns
- Identify areas with high abundance/relative abundance and high species richness or diversity
 - Compare across taxa
- Generate hypotheses to focus future efforts on mechanisms affecting upper trophic levels



USFWS Seabird Surveys

Methods



- Survey data from 2006-2012
- 40 km x 40 km resolution
- Seasons
 - Spring: March 1 – June 15
 - Summer: June 16 – August 31
 - Autumn: September 1 – November 30
- Units
 - Marine mammals: encounter rate (# animals/km)
 - Marine birds: density (birds/km²)

Seabirds



- At-sea surveys
- Research ships of opportunity
- Strip transects (300m)
- GPS-integrated data
- 2006-2012: >158,000 km survey effort
 - ~35,000 km effort in PacMARS area



Key Seabird Species

Species Group	Species Codes						
shearwater	UNDS	STSH					
murre	UNMU	COMU	TBMU				
auklets	PAAU	CRAU	LEAU	USDA			
phalaropes	UNPH	REPH	RNPH				
puffins	UNPU	HOPU	TUPU				
kittiwakes	UNKI	BLKI	RLKI				
gulls	GLGU	GWGU	HEGU				
ice gulls	IVGU	ROGU	SAGU				
benthics	UNEI	COEI	KIEI	SPEI	WWSC	SUSC	BLSC
murrelets	BRMU	MAMU	KIMU	ANMU	UNML		
terns	ARTE	ALTE					
guillemots	UNGI	BLGU	PIGU				



Shearwaters

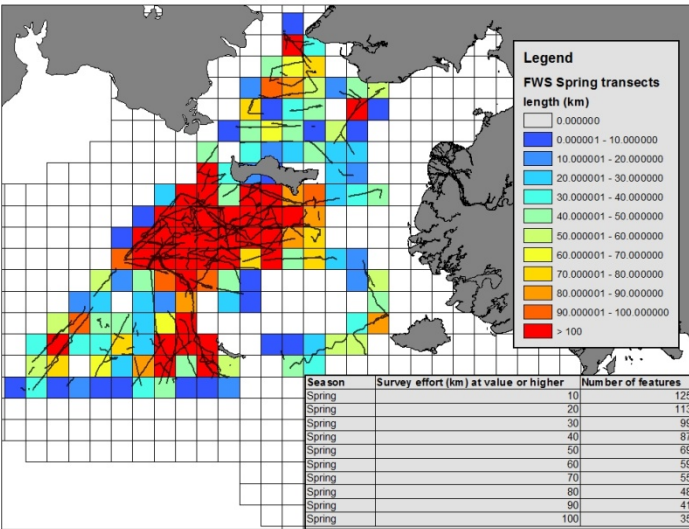
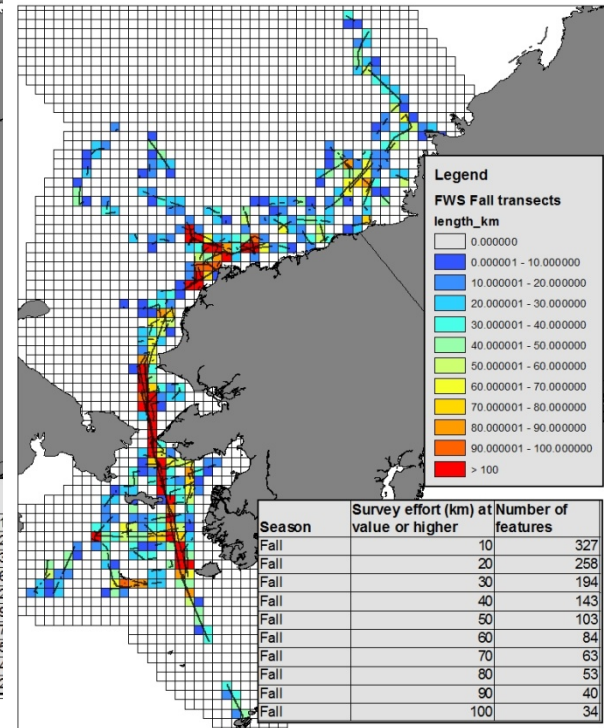
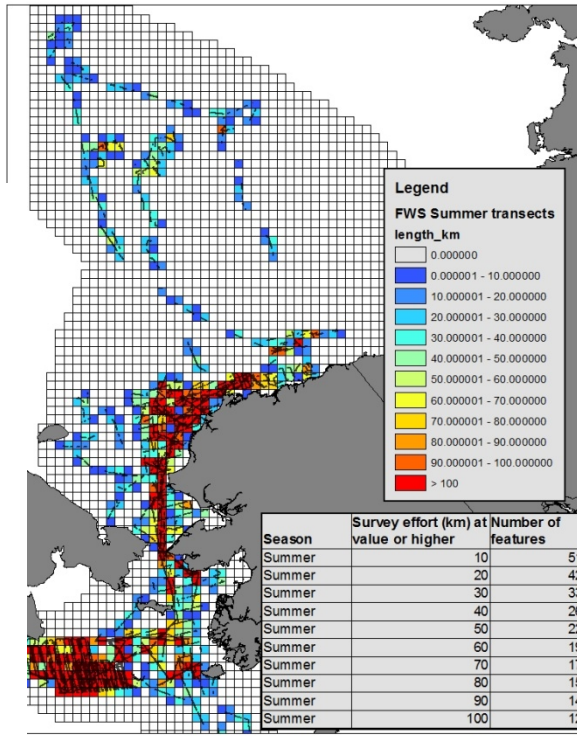
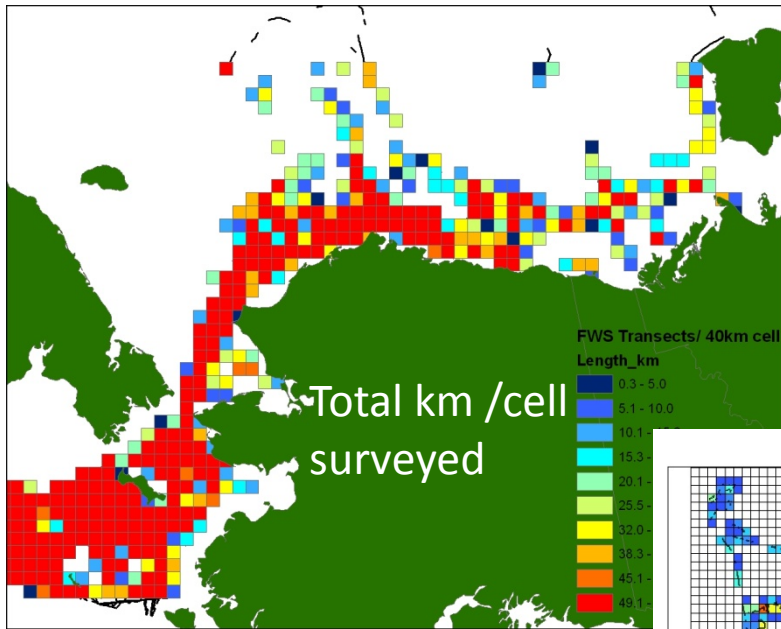
(surface-plungers, eat mainly inverts)



Murres

(divers, eat fish & inverts)

Seabird Survey Effort 2006-2012

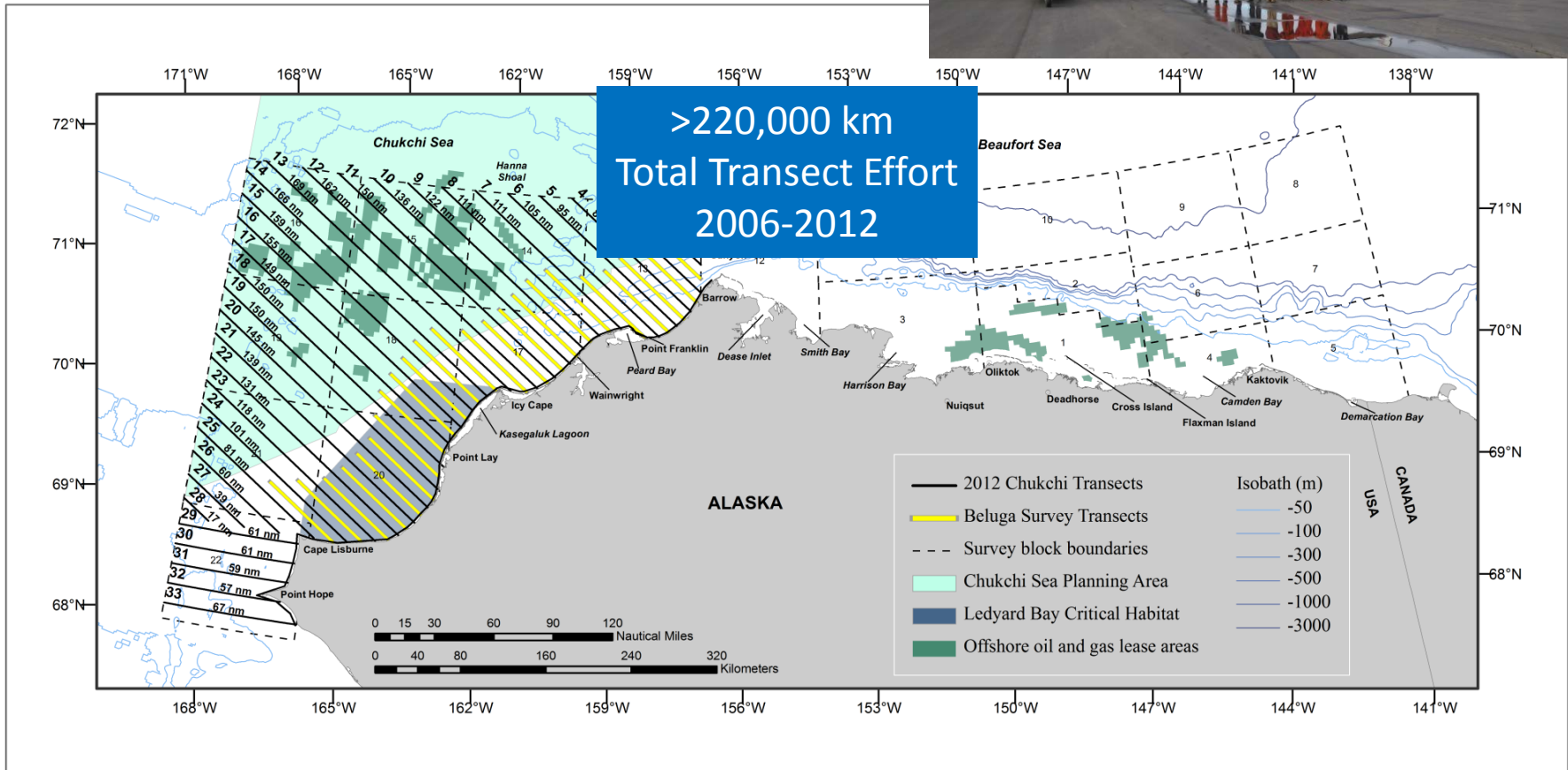


SPRING (March-May)

Summer (June-Aug)

Autumn (Sept-Nov)

Aerial Surveys of Arctic Marine Mammals

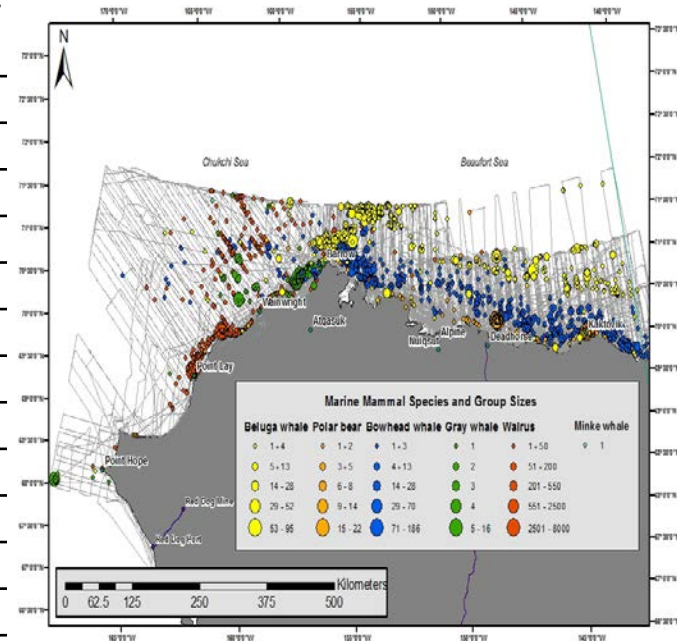


Marine Mammal Species

Hot Spot Analysis

	Single Species	Cetaceans	Pinnipeds	Species Diversity & Richness
beluga	X	X		X
bowhead whale	X	X		X
fin whale		X		X
gray whale	X	X		X
harbor porpoise		X		X
humpback whale	X*	X		X
minke whale	X*	X		X
killer whale		X		X
small unid cetacean		X		
unid cetacean		X		
bearded seal			X	
ringed seal			X	
small unid pinniped			X	
spotted seal			X	
unid pinniped			X	
polar bear	X			X
walrus	X		X	X

*If sample sizes allow



Fall 2008-2011 Marine Mammal Sightings

Seasonality of Marine Mammal Survey Effort

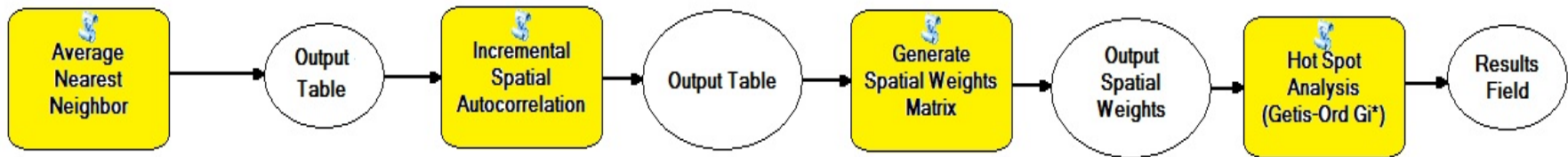


Year	Beaufort Sea	Chukchi Sea
2006	2 Sep - 16 Oct	--
2007	3 Sep - 10 Oct	--
2008	5 Sep - 18 Oct	16 Jun - 7 Jul 3 - 26 Aug 21 Oct - 10 Nov
2009	1 Sep - 18 Oct	24 Jun - 29 Oct
2010	1 Sep - 15 Oct	3 Jul - 25 Oct
2011	19 Aug - 24 Oct	17 Jun - 26 Oct
2012	19 Jul - 14 Oct	4 Jul - 28 Oct

Analytical Methods

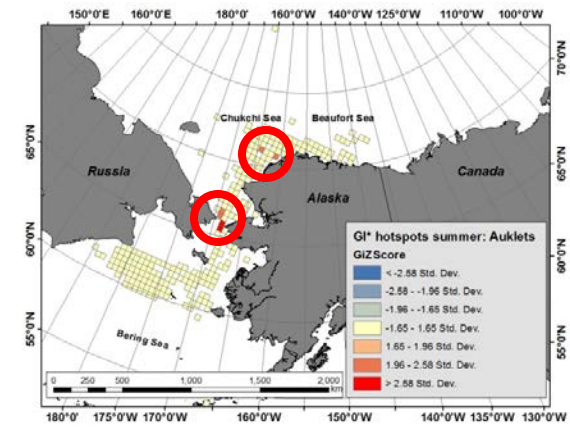
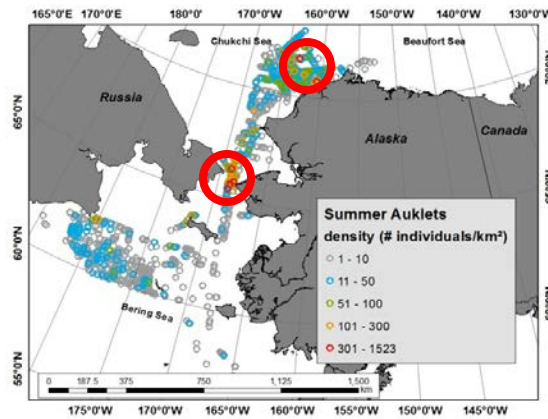
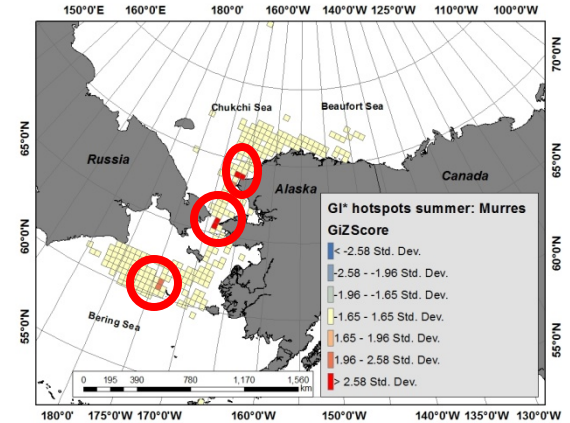
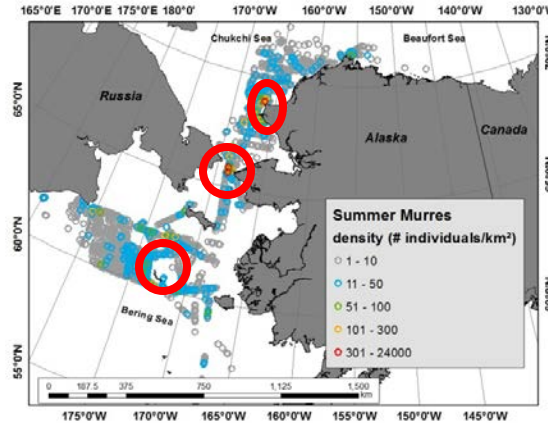
- Hotspot analysis by species/species group and season, then overlay within season

	Hotspot Analysis	Species Diversity & Richness
Marine Mammals	~7 species/2 species groups	~10 species
Marine Birds	10 species or species groups	~45 species



- Species diversity & richness

Preliminary Seabird Results



Acknowledgments

Our project is part of SOAR (Synthesis of Arctic Research), funded by the Bureau of Ocean Energy Management (BOEM). Most of the arctic surveys were supported with Interagency Agreements between BOEM and NOAA (for marine mammals, IA No. M11PG00033;) and USFWS (for seabirds, IA No. M10PG00050). Some of the USFWS data were collected during separate projects funded by the North Pacific Research Board. Data were collected by many dedicated observers, and with the collaboration of many chief scientists, support vessels and aircraft crews.

Thanks to Sue Moore, Phyllis Stabeno, and Lisa Guy for their advice and support.