

Spatio-temporal Distribution of Bowhead Whales off Barrow, AK 2007-2012

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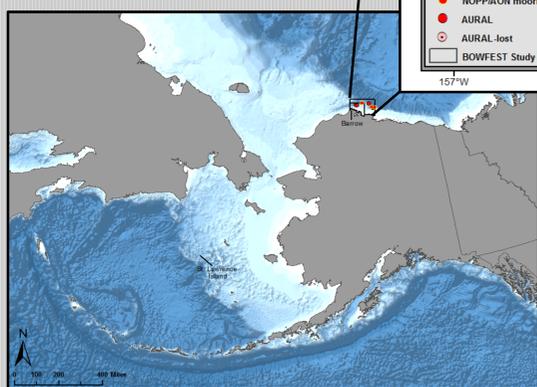
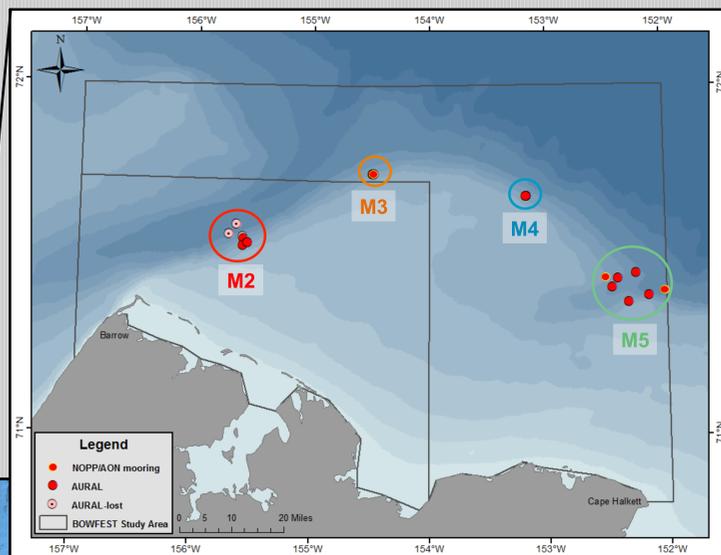
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ABSTRACT

To minimize potential impacts from petroleum development activities in the Beaufort and Chukchi Seas, an increased understanding of bowhead whale behavior and distribution is needed. From 2007-2012, year-round autonomous passive acoustic recorders were deployed on subsurface moorings along the 100m isobath from Point Barrow to Cape Halkett as part of the interdisciplinary Bowhead Whale Feeding Ecology Study (BOWFEST). These long-term recorders had a sampling rate of 8192 Hz and recorded on a 20-45% duty cycle. Over the course of the BOWFEST study period, 6056 days of data recordings were collected. All recordings were reviewed for bowhead whale signals manually, on a three-hour time interval. The spring migration was detected from 2009 through 2012 (earliest onset in 2011, latest in 2012). In all four years, a sudden and near-simultaneous onset of bowhead whale calling was observed at the long-term sites around the beginning of April. Fall migration was detected in all five years of the study. The main pulse of the fall migration, however, had a lower peak and was more compressed in time than the spring migration peak. The end of the main pulse of calling for the fall migration varied between early November (2007) to mid-November (2008 to 2011). Bowhead whale calls were recorded throughout the summer in the BOWFEST study area, not just during the spring and fall migrations, as had been previously believed. This can be seen most clearly in 2009 and 2011, where peak or near-peak presence continued between the migrations. [Work supported by BOEM/NOAA/NOPP]

BACKGROUND

- BOWFEST study area: northern coast of Alaska out to 72°N and between 152°-157°W
- Moorings deployed in four locations (M2-M5)
- Triad of moorings at M2 lost in the 2008-2009 season
- Results from M3 and M5 include data collected as part of Stafford's National Ocean Partnership Program (NOPP) and Arctic Observing Network (AON) funded projects



METHODS

- Autonomous passive acoustic recorders deployed yearly on 100m isobath
- Sampling rate of 8192 Hz
- 20-45% duty cycle
- 6056 days of data collected
- Data manually analyzed for bowhead whale calls



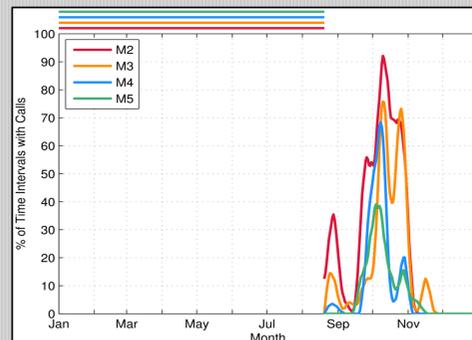
Acoustic recorder deployment
Photo by: Amy Kennedy
(NOAA/AFSC/NMML)
Permit #: 14245



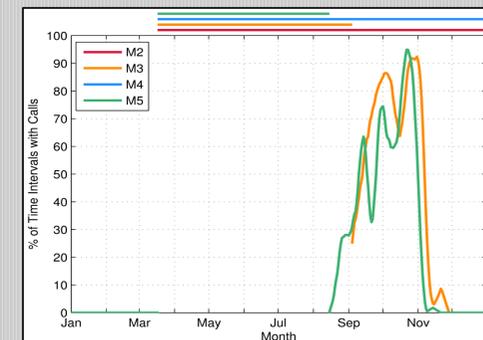
Bowheads in an ice lead during the Spring migration
Photo by: Vicki Beaver (NOAA/AFSC/NMML)
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RESULTS

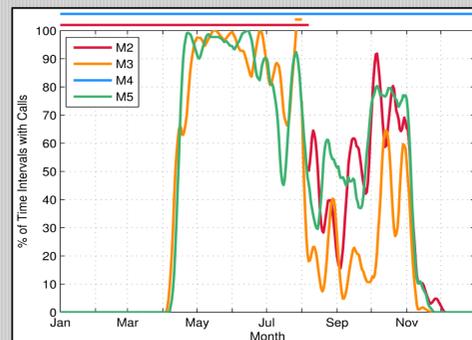
Bars above plots represent periods of no data. All plots use data that are zero-phase moving-averaged by week. Peak presence is defined as % of time intervals with calls being > 50%



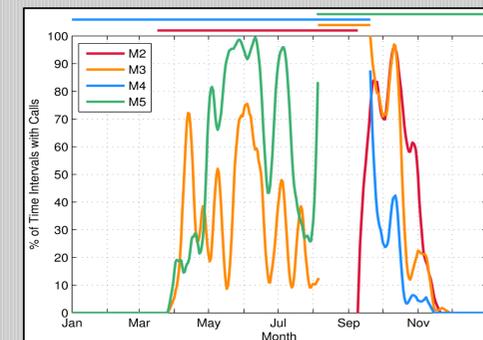
- ← **2007**
- Recorders deployed in August
 - Peak presence: mid-September until late October
 - Higher % of time with calling in West



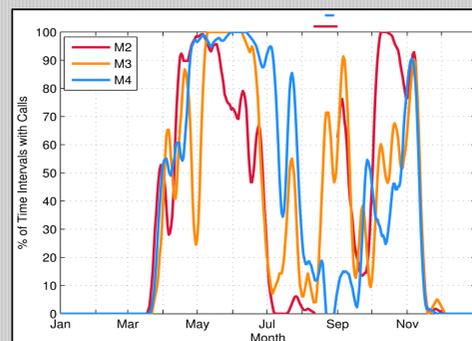
- ← **2008**
- All recorders failed in mid-March before the start of the spring migration
 - Peak presence: late August until mid-November
 - M4 not deployed in the fall



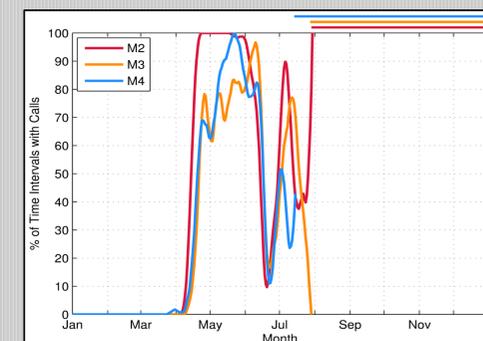
- ← **2009**
- First spring detection: April 10th
 - Peak presence: Mid-April until early November
 - M5: strong presence of calling in August and September
 - M4 not deployed



- ← **2010**
- First spring detection: April 1st
 - Peak presence: early April until mid-October (M4)/early-November (M2 & M3)
 - M4 redeployed in fall



- ← **2011**
- First spring detection: March 25th; the earliest in all years
 - Peak presence: late March until mid-November



- ← **2012**
- Lone call detected on March 31st
 - Spring migration detected: April 12th
 - Peak presence: mid-April until July
 - Large drop in % of time intervals with calls occurs in late June at all moorings

Detection and Peak Presence Dates

Cluster	Year	# of days w/data	# of days w/calls	Date of first call detected	Date of last call detected	% of days w/calls	# of days w/peak presence	Start date of peak presence	End date of peak presence	% of days w/calls w/peak presence
M2	2007	134	55	20-Aug-07	3-Nov-07	41.04	37	24-Aug-07	31-Oct-07	67.27
M3	2007	134	53	22-Aug-07	20-Nov-07	39.55	21	7-Oct-07	16-Nov-07	39.62
M4	2007	134	25	24-Aug-07	29-Oct-07	18.66	11	26-Sep-07	29-Oct-07	44.00
M5	2007	134	32	19-Sep-07	11-Nov-07	23.88	8	21-Sep-07	28-Oct-07	25.00
M2	2008	78	0	N/A	N/A	0.00	0	N/A	N/A	0.00
M3	2008	197	69	4-Sep-08	22-Nov-08	35.03	53	6-Sep-08	21-Nov-08	76.81
M4	2008	78	0	N/A	N/A	0.00	0	N/A	N/A	0.00
M5	2008	217	70	20-Aug-08	14-Nov-08	32.26	50	26-Aug-08	2-Nov-08	71.43
M2	2009	147	91	7-Aug-09	28-Nov-09	61.90	56	7-Aug-09	8-Nov-09	61.54
M3	2009	361	174	11-Apr-09	15-Nov-09	48.20	129	11-Apr-09	4-Nov-09	74.14
M4	2009	0	0	N/A	N/A	0.00	0	N/A	N/A	0.00
M5	2009	365	207	13-Apr-09	18-Nov-09	56.71	167	14-Apr-09	13-Nov-09	80.68
M2	2010	191	61	10-Sep-10	14-Nov-10	31.94	47	10-Sep-10	7-Nov-10	77.05
M3	2010	321	129	2-Apr-10	22-Nov-10	40.19	75	8-Apr-10	8-Nov-10	58.14
M4	2010	103	30	20-Sep-10	8-Nov-10	29.13	13	20-Sep-10	14-Oct-10	43.33
M5*	2010	217	109	1-Apr-10	5-Aug-10	50.23	80	2-Apr-10	5-Aug-10	73.39
M2	2011	346	165	25-Mar-11	26-Nov-11	47.69	128	25-Mar-11	12-Nov-11	77.58
M3	2011	363	154	29-Mar-11	28-Nov-11	42.42	135	29-Mar-11	12-Nov-11	87.66
M4	2011	359	184	27-Mar-11	20-Nov-11	51.25	140	28-Mar-11	11-Nov-11	76.09
M5*	2011	0	0	N/A	N/A	0.00	0	N/A	N/A	0.00
M2	2012	211	97	12-Apr-12	30-Jul-12	45.97	82	15-Apr-12	30-Jul-12	84.54
M3	2012	211	94	16-Apr-12	26-Jul-12	44.55	68	16-Apr-12	22-Jul-12	72.34
M4	2012	197	84	31-Mar-12	15-Jul-12	42.64	62	16-Apr-12	8-Jul-12	73.81
M5*	2012	0	0	N/A	N/A	0.00	0	N/A	N/A	0.00

*Incomplete data

CONCLUSIONS

- Passive acoustic monitoring is an effective tool for monitoring bowhead use of the BOWFEST study area year round
- Earliest spring migration was in detected in 2011
- The spring migration saw an extensive pulse of calling that was maintained at or near peak presence levels through August in all years, except for 2010 when levels dropped in July
- The main pulse of the fall migration had a lower peak and was much more compressed than that from the spring migration
- 2009 and 2011 show continual presence of bowheads in the study area throughout the summer and not just during the spring and fall migrations

ACKNOWLEDGEMENTS

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- Communities of the North Slope