NORTH PACIFIC RIGHT WHALE VISUAL AND ACOUSTIC SURVEY IN THE NORTHWESTERN GULF OF ALASKA

Final Report

Prepared for:

Marine Mammal Commission
4340 East-West Highway, Suite 700
Bethesda, MD 20814

Submitted by:

National Marine Mammal Laboratory
Alaska Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way NE, Seattle, WA 98115-6349

Southwest Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
8901 La Jolla Shores Drive, La Jolla, CA 92037-7000

October 2015

CITATION:
Rone, B.K., P.J. Clapham, D.W. Weller, J.L. Crance, and A.R. Lang. 2015. North Pacific right whale visual and acoustic survey in the northwestern Gulf of Alaska. Final Report. Submitted to Marine Mammal Commission, Bethesda, Maryland. Prepared by National Marine Mammal Laboratory, Seattle, Washington; and Southwest Fisheries Science Center, La Jolla, California. October 2015.

Correspondence: Brenda.Rone@noaa.gov

I. Executive Summary

The Alaska Fisheries Science Center was awarded funding in partial support of a visual and acoustic survey for North Pacific right whales (*Eubalaena japonica*) in the northwestern Gulf of Alaska (GoA) in August of 2015. The survey was conducted onboard the NOAA Ship *Reuben Lasker*, utilizing 21 days of ship time provided in-kind by the Southwest Fisheries Science Center. This survey was part of a four month survey, entitled Collaborative Large Whale Survey (CLaWS), devoted to the assessment of several large whale species off the U.S. and Canadian west coast between northern California and Kodiak, Alaska. Research was conducted in collaboration between the Alaska and Southwest Fisheries Science Centers. Leg 2 (See Section III) of this survey was designed specifically to encounter right whales, Leg 1 (See Section II) and 3 (See Section IV) results are included in this report; survey effort during these additional legs provided coverage within historical right whale habitat (Figure 1).

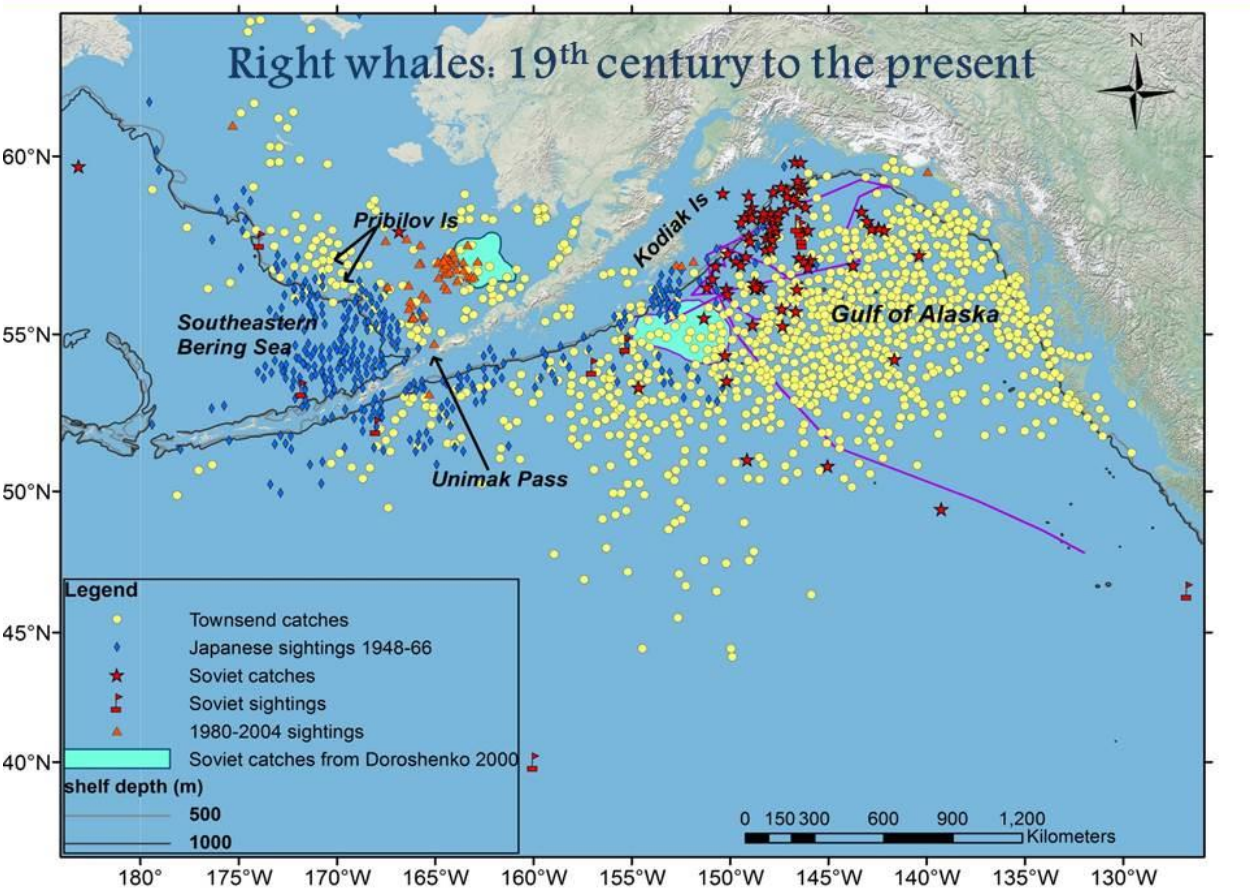

Figure 1. North Pacific right whale catches and sightings during historical and modern-era (*i.e.* Soviet) whaling (from Y. Ivashchenko, unpublished).

The study had four main objectives:

1. Survey historical right whale habitat in the Gulf of Alaska, with particular emphasis on the shelf and adjacent offshore waters off Kodiak, Alaska, using visual and acoustic monitoring.
2. If right whales were encountered, attempts would be made to conduct photo-identification and biopsy sampling.
3. If possible, satellite-monitored telemetry tags would be attached to determine movements and use of key habitats.
4. In addition, all cetacean species would be documented, and satellite telemetry attempts on fin (*Balaenoptera physalus*) and blue (*B. musculus*) whales would occur on an opportunistic basis.

These objectives were addressed using visual surveys during daylight hours and acoustic surveys using sonobuoys (Leg 2 only) conducted around the clock to maximize effort within the survey area.

Summary of Survey Effort and Visual sightings (Legs 1-3), and Acoustic Effort and Detections (Leg 2). See Sections II-IV for detailed information on Legs 1-3 of CLaWS.

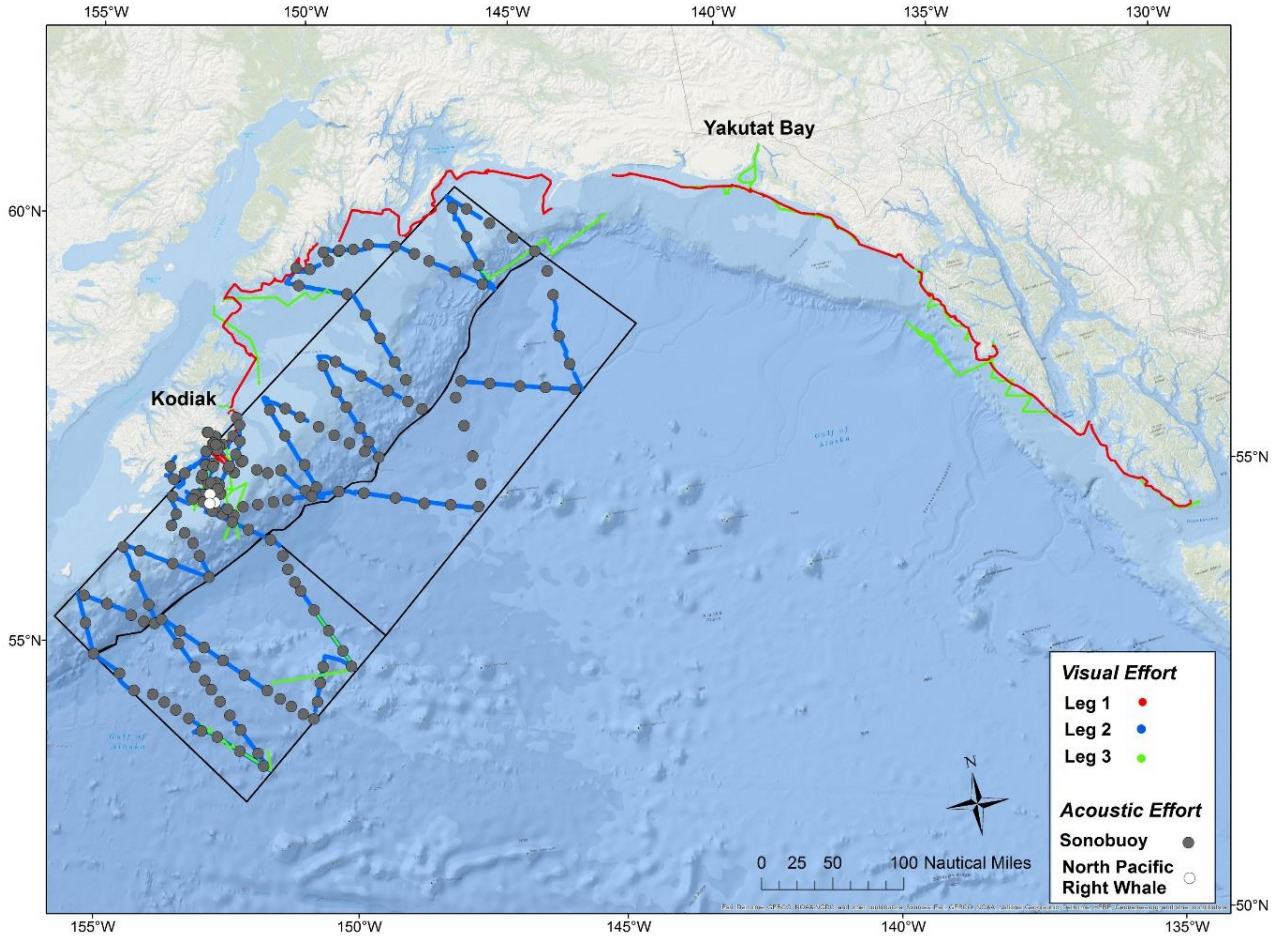

Figure 2. Survey effort, North Pacific right whale acoustic detections during CLaWS, 2015.

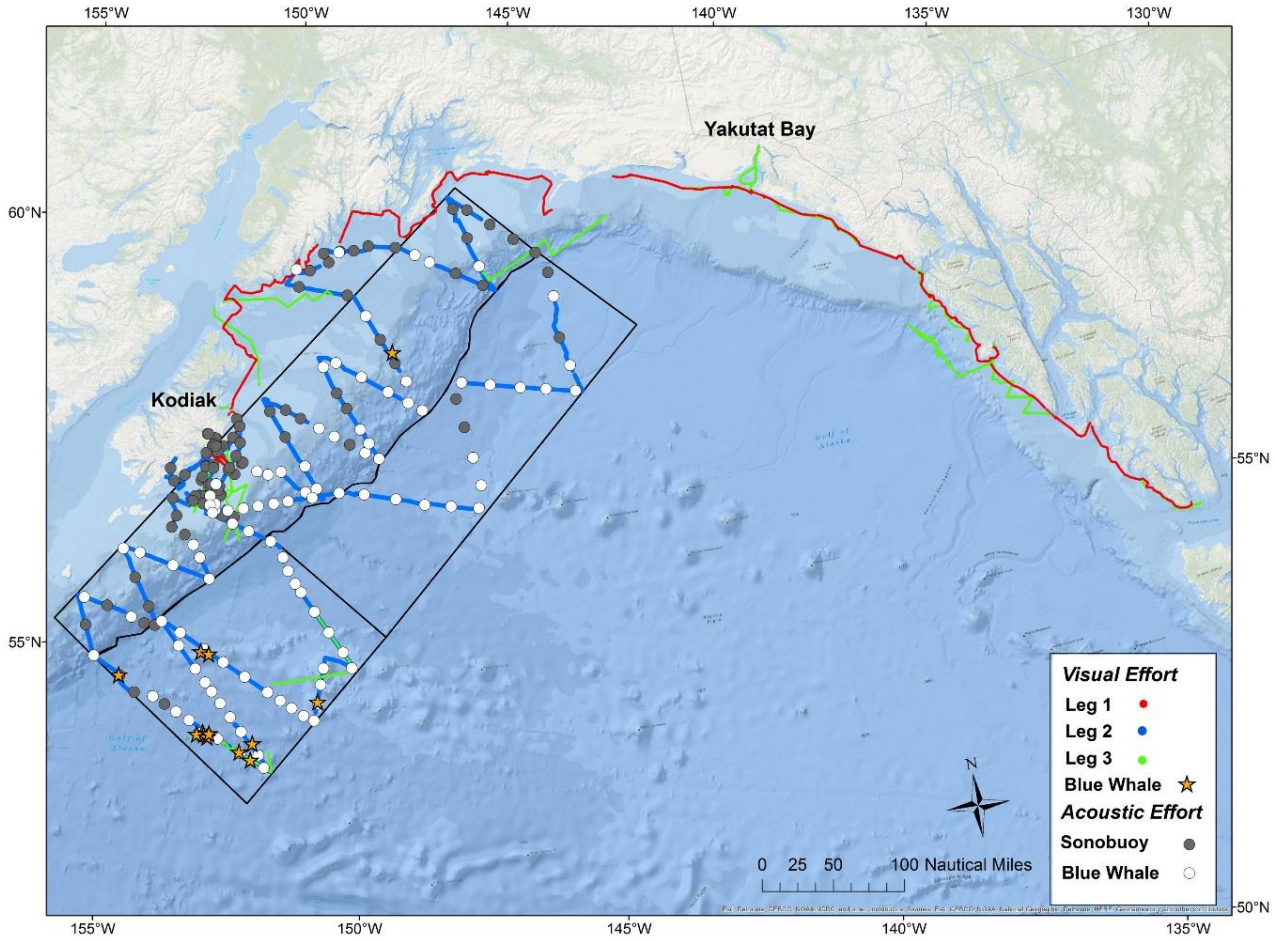

Figure 3. Survey effort, blue whale sightings and acoustic detections during CLaWS, 2015.

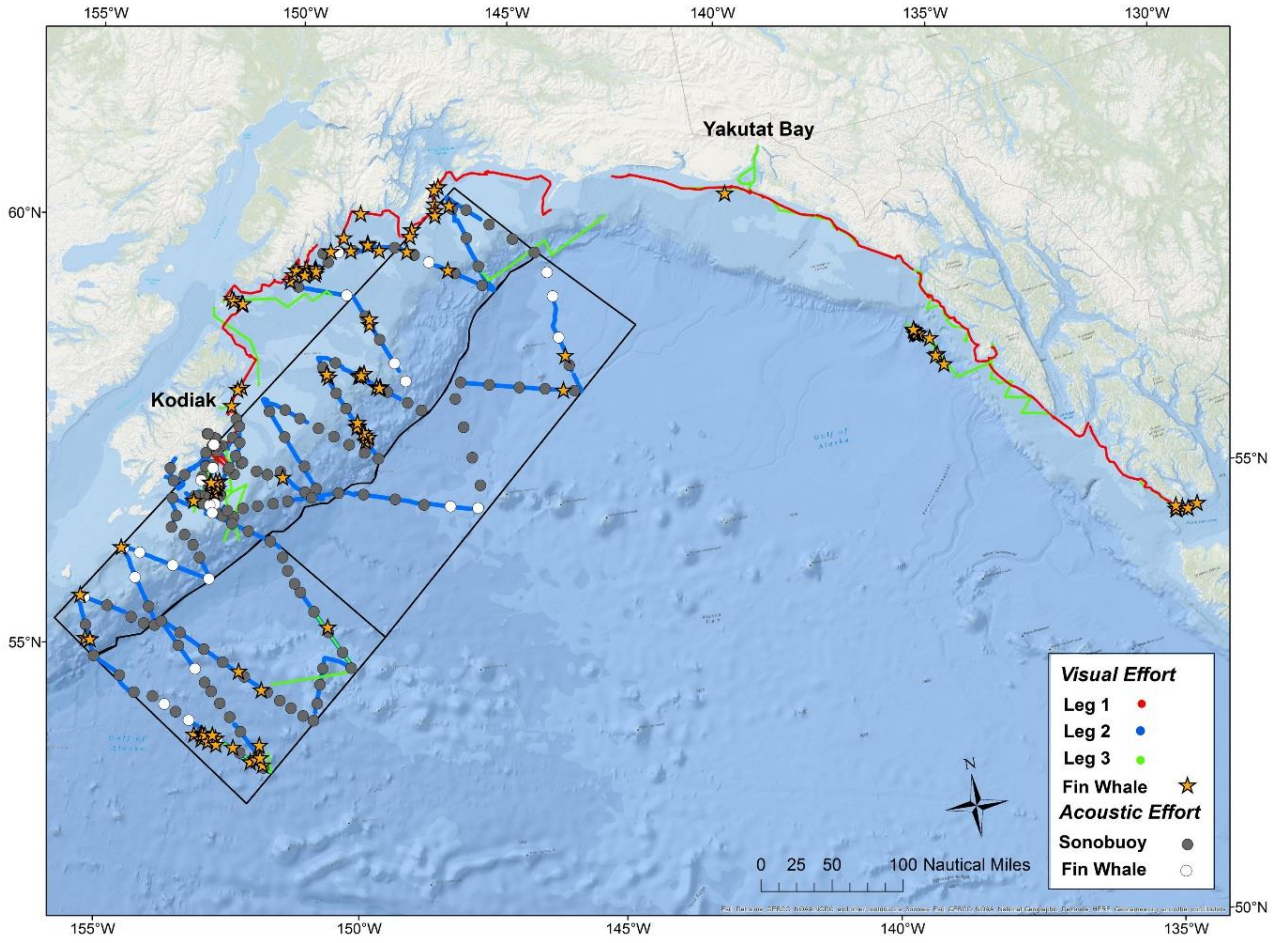

Figure 4. Survey effort, fin whale sightings and acoustic detections during CLaWS, 2015.

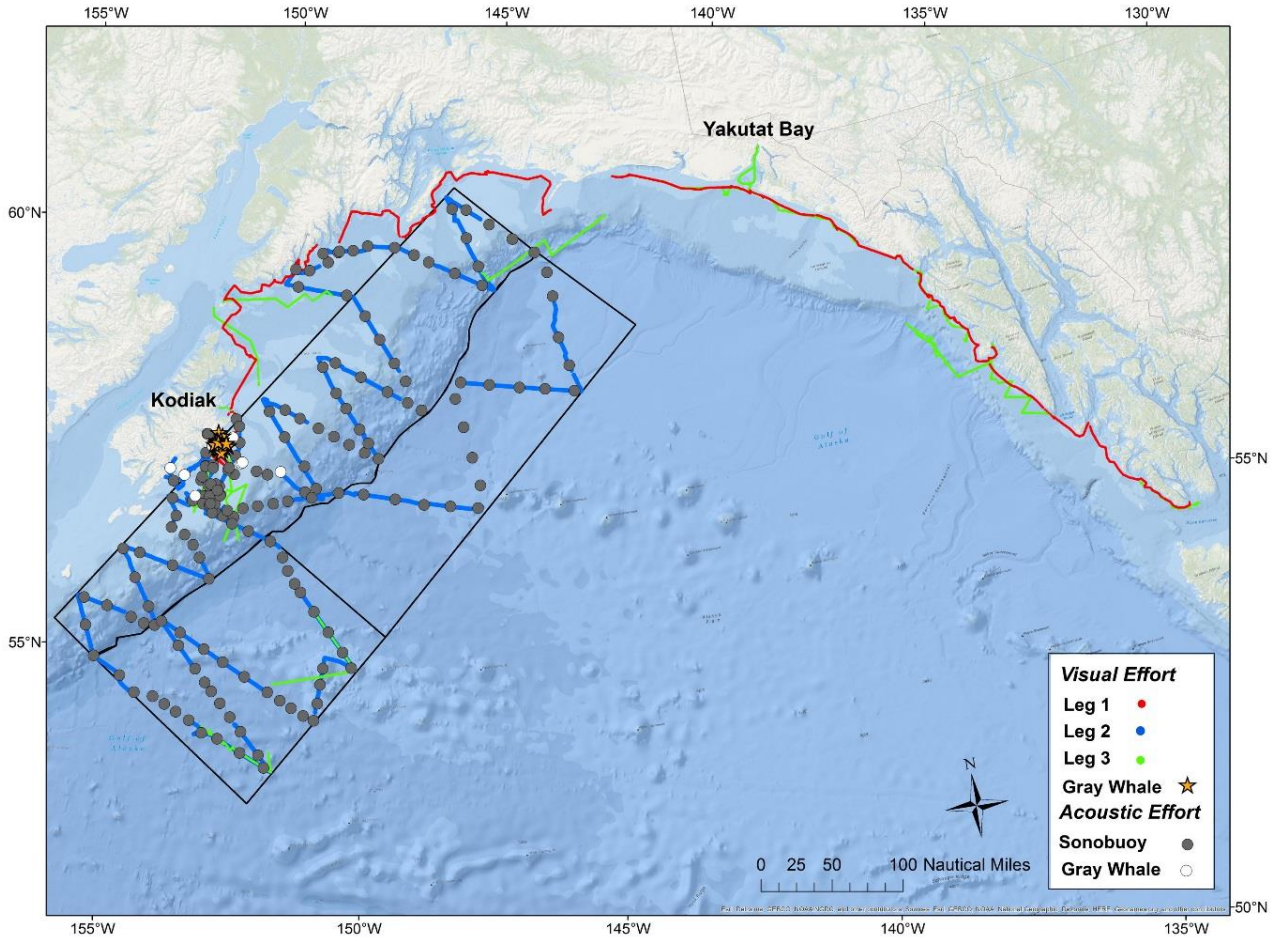

Figure 5. Survey effort, gray whale sightings and acoustic detections during CLaWS, 2015.

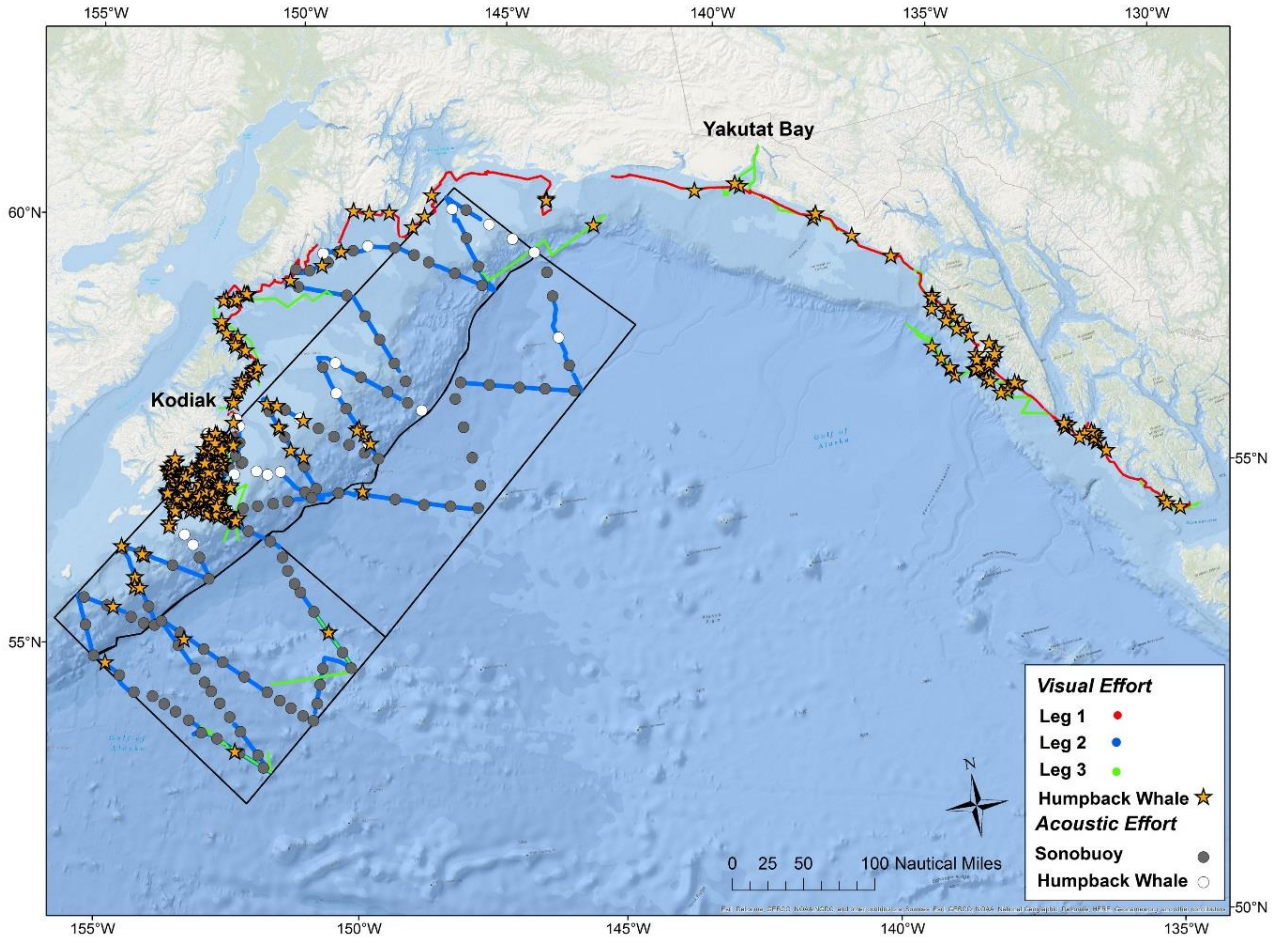

Figure 6. Survey effort, humpback whale sightings and acoustic detections during CLaWS, 2015.

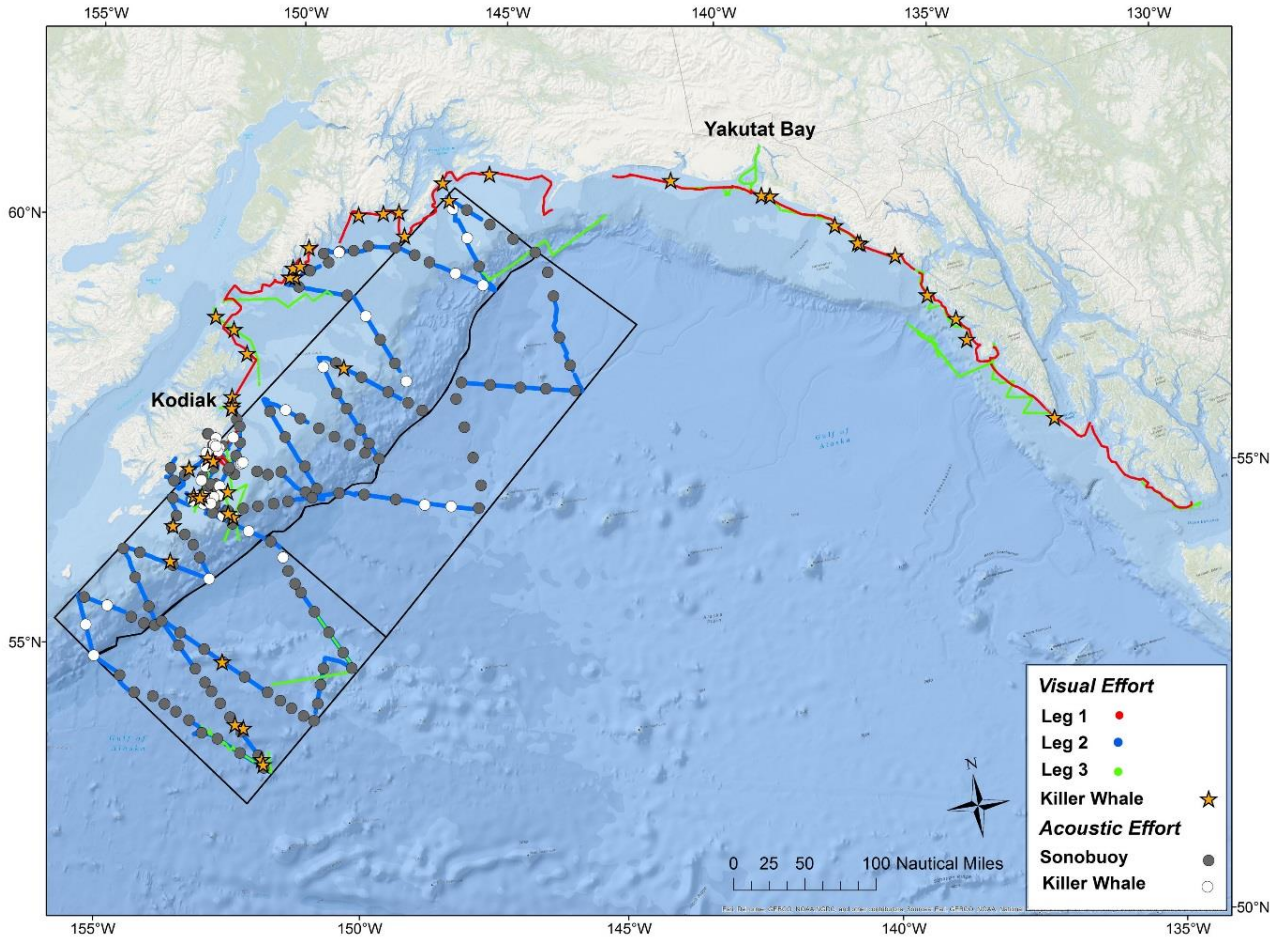

Figure 7. Survey effort, killer whale sightings and acoustic detections during CLaWS, 2015.

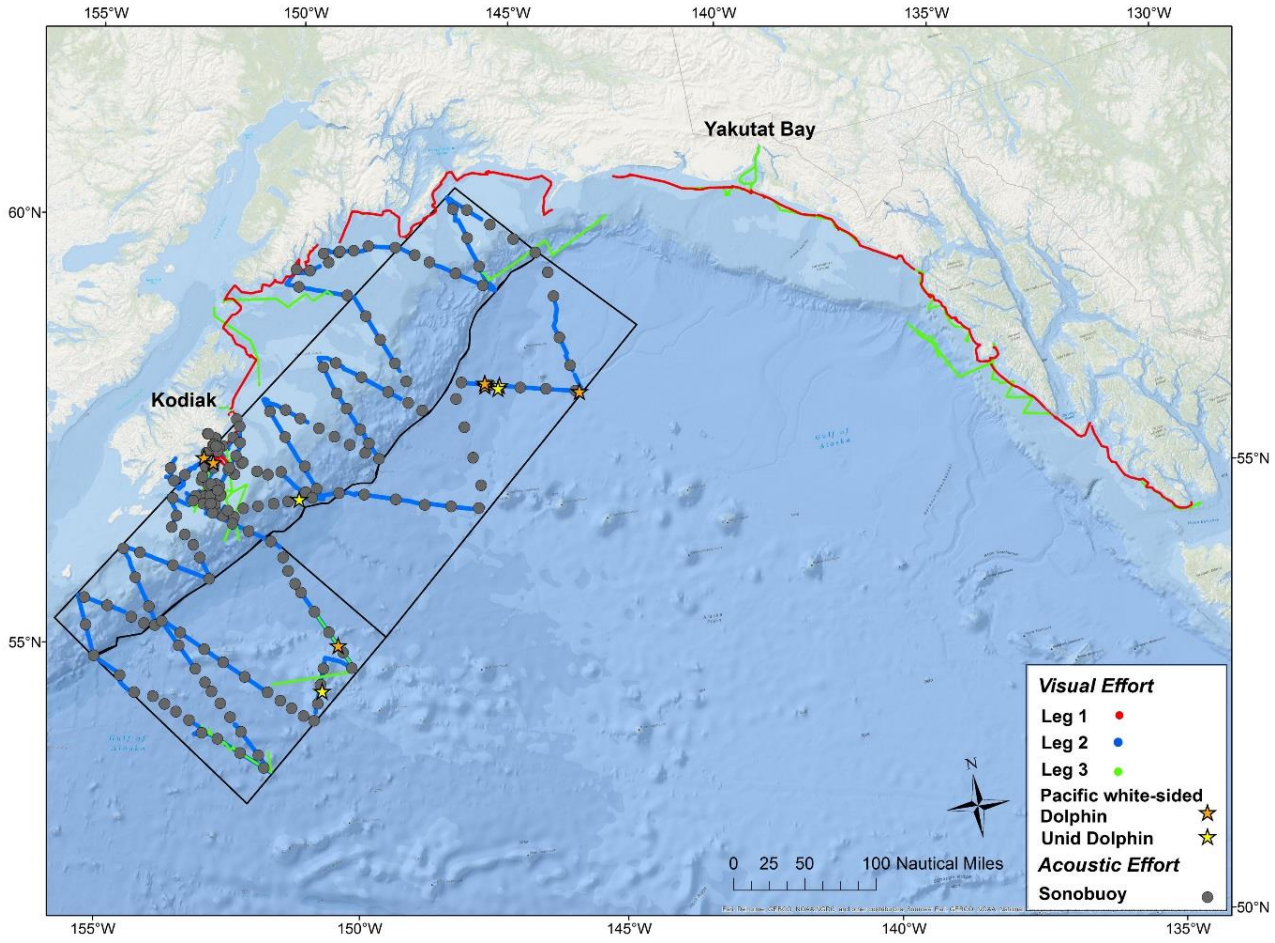

Figure 8. Survey effort and dolphin sightings during CLaWS, 2015.

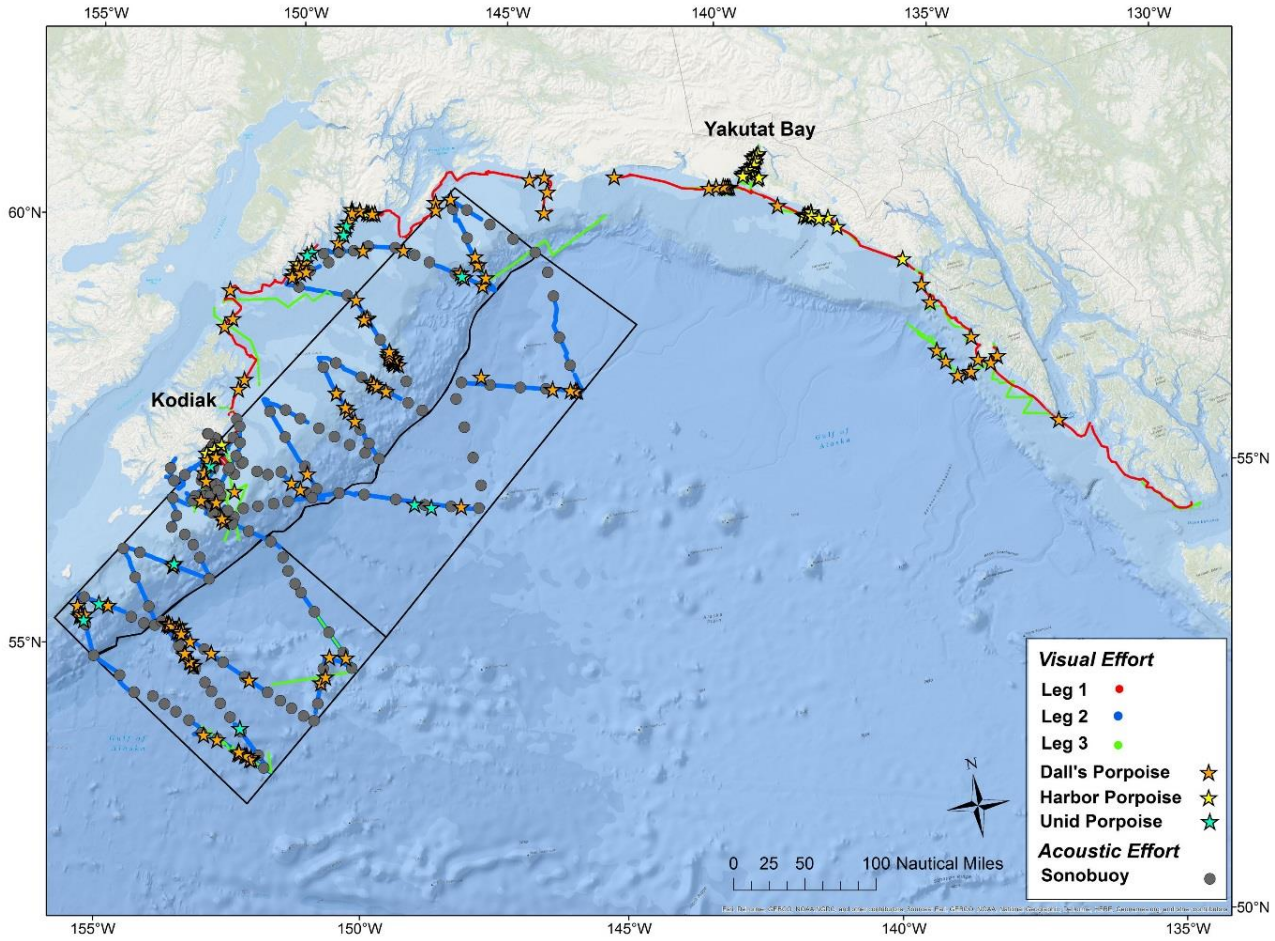

Figure 9. Survey effort and porpoise sightings during CLaWS, 2015.

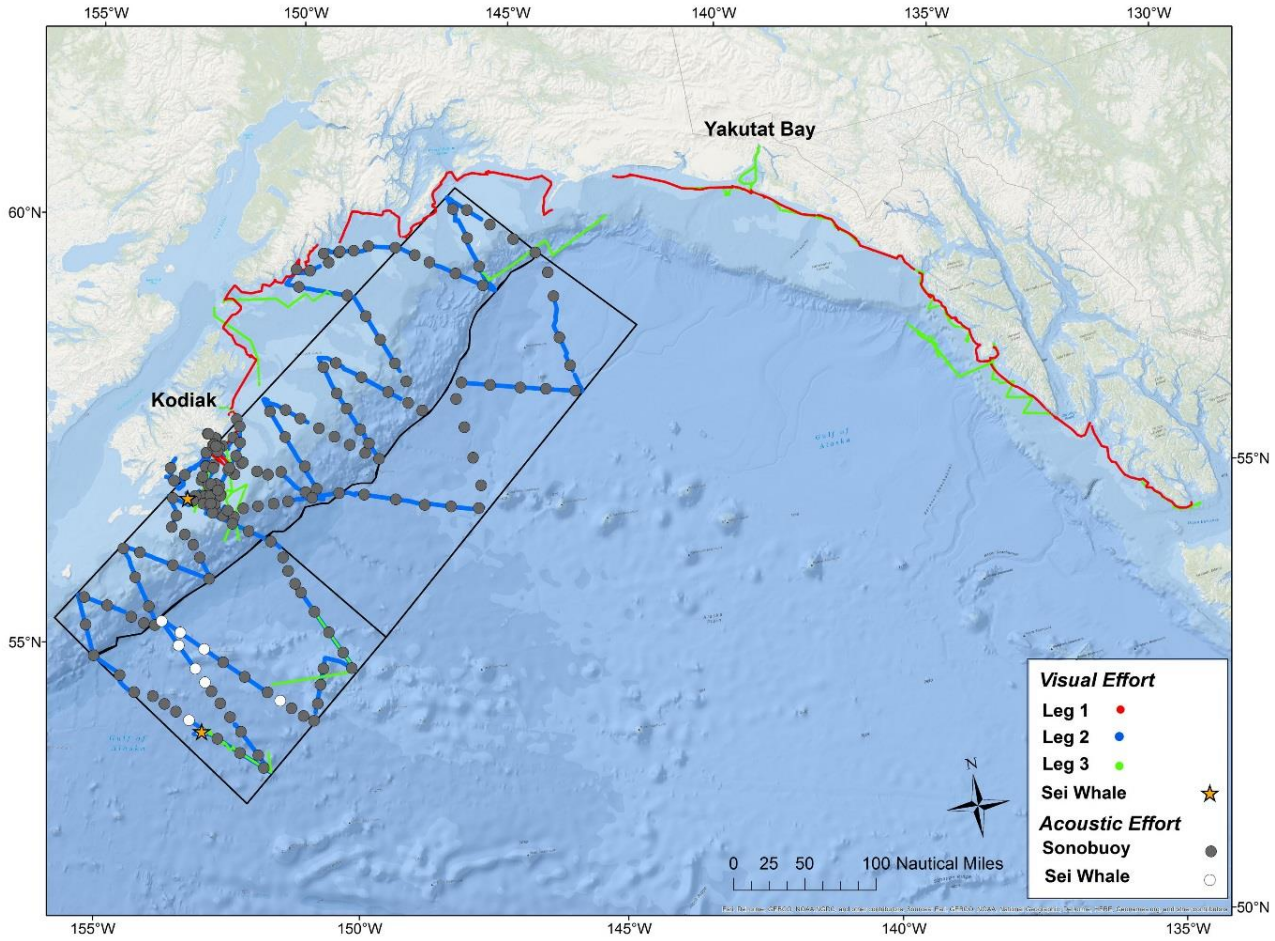

Figure 10. Survey effort, sei whale sightings and acoustic detections during CLaWS, 2015.

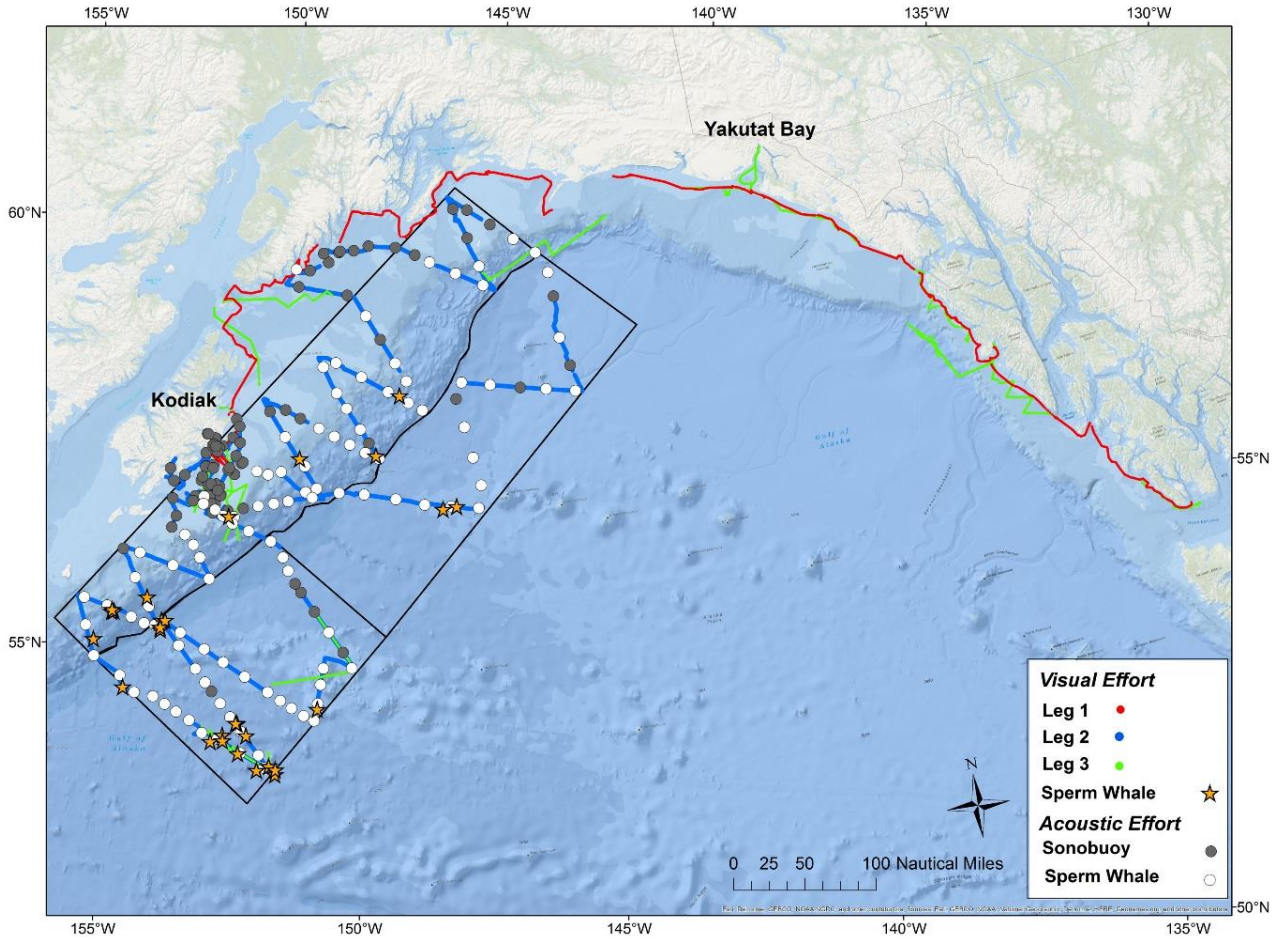

Figure 11. Survey effort, sperm whale sightings and acoustic detections during CLaWS, 2015.

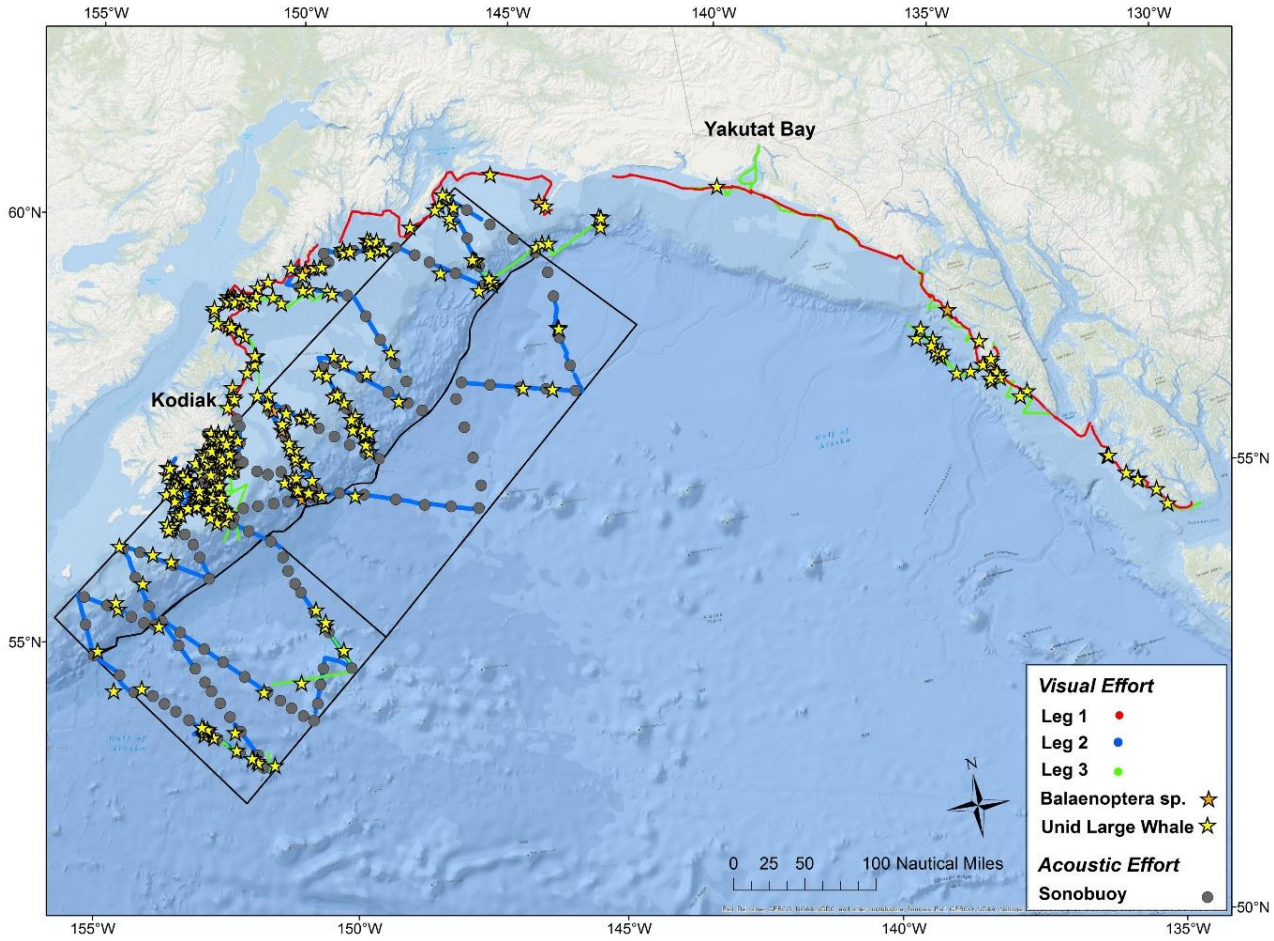

Figure 12. Survey effort and unidentified large whale sightings during CLaWS, 2015.

Key Findings

1. Over 3400 nm of trackline were visually surveyed between July 15th and September 20th, 2015 within the GoA. There were no sightings of North Pacific right whales.

2. Over 330 hours of acoustic monitoring occurred between August 6th -27th, 2015. Right whale vocalizations (gunshots and up calls) were detected on two days, August 10th and 16th, 2015. These right whale vocalizations were documented within the Barnabas Trough region on Albatross Bank within Critical Habitat. It continues to be an important habitat well into late summer.

3. A large number of blue whales (13 individuals) were documented on Leg 2 in offshore waters.

Conclusions

Only a scant number of right whales have been documented in the GoA since the last right whale catch in 1968; however, there has been little survey effort in the offshore waters where this species was widely distributed during historical times. This was the first dedicated survey for North Pacific right whales in the GoA that provided the opportunity to survey areas of historical importance in offshore waters, *e.g.*, the High Density Historical Whaling Stratum (Figure 16). There were no visual sightings of right whales during this survey and acoustic detections occurred only within the GoA Critical Habitat. The results from this survey confirm that the status of this population warrants significant conservation concern and increased research efforts.

Recommendations

The management and conservation of North Pacific right whales continues to be greatly hindered by the lack of basic information about this population. In the absence of the very substantial funding required to mount a more detailed, GoA-wide survey, we recommend future effort be focused within the GoA Critical Habitat and surrounding waters on Albatross Bank where there appears to be the greatest chance of encountering a right whale for the purpose of photo-identification, biopsy sampling, and satellite tag deployment.

II. Leg 1

Collaborative Large Whale Survey 2015 (CLaWS): End-of-Leg Report: 15-31 July 2015

David W. Weller, Chief Scientist/Cruise Leader

Synopsis

The Collaborative Large Whale Survey 2015 (CLaWS) is a joint field effort by Southwest Fisheries Science Center and Alaska Fisheries Science Center. The 4-month survey is devoted to the assessment of several large whale species off the U.S. and Canadian west coast between northern California and Kodiak, Alaska. Major components of this effort include: (1) the first range-wide assessment of gray whales (*Eschrichtius robustus*) that summer south of the Aleutian Islands, (2) a dedicated visual line-transect and acoustics survey for right whales in the Gulf of Alaska, and (3) sampling (photographic and biopsy) of blue and fin whales. The work is being supported by SWFSC, AFSC, NOAA Fisheries Office of Science & Technology and Office of Protected Resources, NOAA Fisheries' Alaska Regional Office and the U.S. Marine Mammal Commission. The survey started on 9 July from San Diego amid news coverage and excitement about the large whale research and NOAA Ship *Reuben Lasker* undertaking its first scientific project. The 106-day survey will have five legs (tracklines are shown in Figure 1) and is scheduled to end in San Diego on 9 November 2015. Contact Dave.Weller@noaa.gov for additional information.

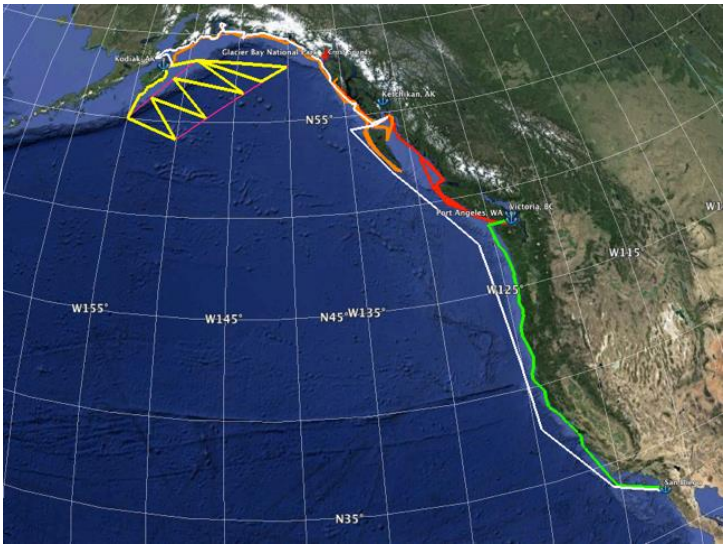

Figure 13. Survey track lines: Leg 1 = white; Leg 2 = yellow; Leg 3 = orange; Leg 4 = red; Leg 5 = green.

Figure 14. NOAA ship *Reuben Lasker* working off Alaska with Mt. Fairweather in the background.

Marine Mammal Observations

On 15 July, NOAA Ship *Reuben Lasker* arrived to the Dixon Entrance in Alaska's southern waters. At this time the survey trackline assumed as close of a parallel line with the coast as bathymetric conditions permitted for safe navigation of the ship. In the following week, humpback whale (*Megaptera novaeangliae*) sightings began to outweigh those of any other cetacean, as many were observed along the coastline travelling, feeding, and breaching. Several pods of killer whales (*Orcinus orca*) were observed and photographed (see photographic report for details). The survey neared the outer waters of Kodiak, Alaska, during the final week of Leg 1. Here, the survey focused on areas surrounding Ugak Bay, a location having historically documented sightings of gray whales since the late 1990s. Transect lines were generated to systematically cover the area by ship and small boat, focusing on regions where the highest densities of gray whales had been reported in the past. It was in this region that the first gray whales of the survey were encountered (Figure 15). The remaining days of Leg 1 were filled with consistent sightings of gray whales, during which sampling and photographic work continued. Weather was favorable throughout the entirety of Leg 1, with about three days of significant wind and swell and only a few partial afternoons lost to fog.

Figure 15. Gray whale photographed off Ugak Bay, Alaska, on 28 July 2015.

Table 1. Search effort by day for Leg 1. Survey distance reflects “on-effort” status and does not include bridge watch effort (during inclement weather).

Date	Time Start/End	Latitude	Longitude	Survey Distance (nmi)	Average Beaufort
71515	736	N54:38.35	W132:35.17	88.1	3.3
	1836	N55:51.76	W134:02.51		
71615	630	N55:54.35	W134:03.57	72.4	2.6
	1637	N56:53.17	W135:41.90		
71815	1025	N57:03.87	W135:32.32	41.6	3.8
	1810	N57:30.25	W136:09.85		
71915	737	N57:30.54	W136:10.08	41.5	2.2
	1405	N58:08.22	W136:41.13		
72015	735	N58:11.84	W136:47.08	70.1	1.3
	1900	N59:04.42	W138:34.53		
72115	731	N59:04.93	W138:39.17	50.6	1.3
	1929	N59:37.26	W140:20.82		
72215	732	N59:36.50	W140:21.24	84.3	2.6
	1720	N59:59.34	W143:01.42		
72315	1307	N59:42.55	W144:33.47	32.9	3.6
	1840	N60:07.50	W145:08.51		
72415	729	N60:07.85	W145:10.21	72.9	3.0
	1842	N59:51.34	W147:13.84		
72515	730	N59:50.67	W147:16.12	80.2	2.7
	1840	N59:35.66	W149:30.86		
72615	732	N59:34.27	W150:02.80	75.6	3.5
	1841	N58:59.41	W152:12.48		
72715	730	N58:59.84	W152:10.80	84.6	2.4
	1841	N57:43.36	W152:08.02		
72815	1458	N57:25.21	W152:01.45	9.4	2.0
	1617	N57:18.48	W152:16.18		
72915	1449	N57:20.24	W152:29.21	4.4	2.0
	1608	N57:15.98	W152:23.32		
73015	734	N57:12.94	W152:38.10	27.5	3.2
	1509	N57:20.23	W152:26.32		
73115	747	N57:21.36	W152:26.00	13.1	3.0
	1801	N57:15.03	W152:17.36		

Table 2. Visual sighting summary for Leg 1.

Species	Sightings (Individuals)
Killer whale	22(182)
Harbor porpoise	11(29)
Dall's porpoise	32(143)
Gray whale	15(44)
Balaenoptera sp.	3(3)
Fin whale	20(34)
Humpback whale	84(198)
unid. large whale	48(69)
unid. porpoise	4(6)
Total	**239(708)**

Biopsy Sampling

Given the lack of gray whale sightings during most of Leg 1, sampling opportunities were limited to the final four days, when we neared the waters in and offshore of Ugak Bay, Kodiak Island, Alaska. Several groups of gray whales were encountered in this area. While obtaining biopsy samples from these whales proved challenging, we were able to collect tissue samples from two individuals in different groups. In most of the groups that we encountered, whales were observed defecating frequently, indicating that collecting fecal samples may be feasible during future legs and could allow samples suitable for genetic analysis to be obtained from a larger number of individuals.

Although no biopsy samples were obtained from other species, a sample and associated photographs from a small humpback whale whose carcass was found floating in Ugak Bay was collected. General health assessment data were collected from this specimen and sent to the Alaska stranding coordinator.

Table 3. Tissue samples collected during Leg 1.

Species	No. samples collected	Comments
Gray whale	2	
Humpback whale	1	Collected from floating carcass in Ugak Bay

Photo-identification

A photo-identification catalogue incorporating all gray whales photographed during Leg 1 was completed. Currently, this catalogue contains 13 whales. Thus far, comparison of gray whale photographs from different sightings has revealed that many of the same whales were photographed on multiple days in the same general area.

Leg 1 photo-identification catalogues were also compiled for the killer whales photo-identified (n=90). Photographs of these individuals will be compared to the existing photo-identification catalogues maintained at SWFSC and by other groups in the near future.

Table 4. Summary of photo-identification photographs collected during Leg 1.

Species	No. Sightings	No. Photos	Comments
Killer whale	12	2520	Two groups (n=1652 photos) photographed during transit to study area
Gray whale	9	1368	
Humpback whale	1	53	

Acknowledgements

The CLaWS 2015 project is funded by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NMFS Office of Science and Technology, NMFS Office of Protected Resources, NMFS Alaska Regional Office and the Marine Mammal Commission. Doug DeMaster was instrumental in securing funding for this survey. John Ford and Annely Greene generously assisted with Canadian research permits. Chris Gabriele and Lewis Sharman provided support for obtaining Glacier Bay National Park research permits. Shore-side support in preparation for this cruise was provided first and foremost by Annette Henry. Additional support, both conceptual and physical, was provided by: Eric Archer, Lisa Ballance, John Bengtson, Jim Carretta, Phil Clapham, John Durban, Lynn Evans, Paul Fiedler, Terry Henry, Roger Hewitt, Robert Holland, Al Jackson, Kelly Jacovino, Kristen Koch, Jeff Laake, Karen Martien, Jeff Moore, Shannon Rankin, Kelly Robertson, Brenda Rone, Jeremy Rusin, Gaby Serra-Valente, Barb Taylor, Wayne Perryman, Mridula Srinivasan and Cisco Werner. Regional scientific advice was generously offered by: John Calambokidis, Jim Darling, John Ford, Pat Gearin, Dawn Goley, Jeff Jacobsen, Sue Moore, Jan Straley and Bree Witteveen. The crew of the NOAA Ship *Reuben Lasker* were extraordinarily helpful and a pleasure to sail with.

Leg 1 Scientific party, before (L) and after (R). Left photo L to R: S. Martínez, H. Colley, S. Yin, D. Weller, A. Lang and C. Bryant. Right photo front row L to R: S. Yin, C. Bryant, A. Lang. Back row L to R: D. Weller, M. Simpson, S. Martínez.

III. Leg 2

Collaborative Large Whale Survey 2015 (CLaWS): End-of-Leg Report: 6-27 August 2015

Brenda K. Rone, Chief Scientist/Cruise Leader

"It's very sobering to think about how many right whales were caught out here and the fact that we've yet to find a single animal" – Brenda Rone

Introduction

The eastern stock of the North Pacific right whale (*Eubalaena japonica*) is arguably the world's smallest whale population for which an abundance estimate exists. Hunted extensively by Yankee and other whalers beginning in 1835 (Scarff 1991), the population was likely making a slow recovery in the 1960's, when it was devastated by illegal Soviet catches. Ivashchenko and Clapham (2012) found records of 529 Soviet catches of right whales in the eastern North Pacific, and suggested that this represented the bulk of the population. Today, the population is estimated at about 30 animals (Wade et al. 2011), and while this may represent a sub-stock that feeds in the Bering Sea, the extreme paucity of sightings suggest that the true population is not significantly larger.

While the eastern population is currently considered to encompass both the Bering Sea and the GoA, nothing is known regarding any rate of exchange between these two widely separated regions. In recent years, the National Marine Mammal Laboratory (NMML) of the Alaska Fisheries Science Center in Seattle conducted several vessel and aerial surveys in the southeastern Bering Sea, and satellite-tagged five individual right whales (Zerbini et al. 2015). These surveys and tag tracks demonstrated the importance of the current Bering Sea Critical Habitat area west of Bristol Bay, but since none of the tagged whales moved beyond the southeastern Bering Sea, potential connections to other regions remain unknown. Very few right whale sightings have been

made in the GoA since the last right whale catch there in 1968; however, there has been little survey effort in the offshore waters where the species is known from whaling records to have been widely distributed (Townsend 1935; Ivashchenko and Clapham 2012).

The management and conservation of North Pacific right whales is currently hindered by a lack of even basic information about the population. Unlike with North Atlantic right whales which are frequently found close to inhabited coastlines, the North Pacific population exists in extremely remote areas off Alaska, and often far from shore. Consequently, any research on this species inevitably requires a large research vessel, thus incurring high costs. Work on right whales in recent years has often been piggy-backed opportunistically onto NMML research cruises centered on other projects (notable the Arctic Whale Ecology Study, ARCWEST, funded by the Bureau of Ocean Energy Management), and has largely consisted of deployment and retrieval of passive acoustic recorders in the Bering Sea. With the exception of two cetacean surveys of the U.S. Navy's Temporary Maritime Activities Area training range in 2009 and 2013 (Rone et al. 2009; 2013), there has been no dedicated survey effort in the GoA.

Survey Design and Methods

Methods

From August 6 – 27th, a line-transect survey was conducted over a large area of the northwestern Gulf of Alaska, departing and returning to Kodiak (Figure 16); the survey area was loosely based upon locations of catches and sightings of right whales in historical and modern-era (i.e. Soviet) whaling in addition to covering shelf waters where right whales have been observed in recent years (notably Albatross Bank off Kodiak, see Figure 1).

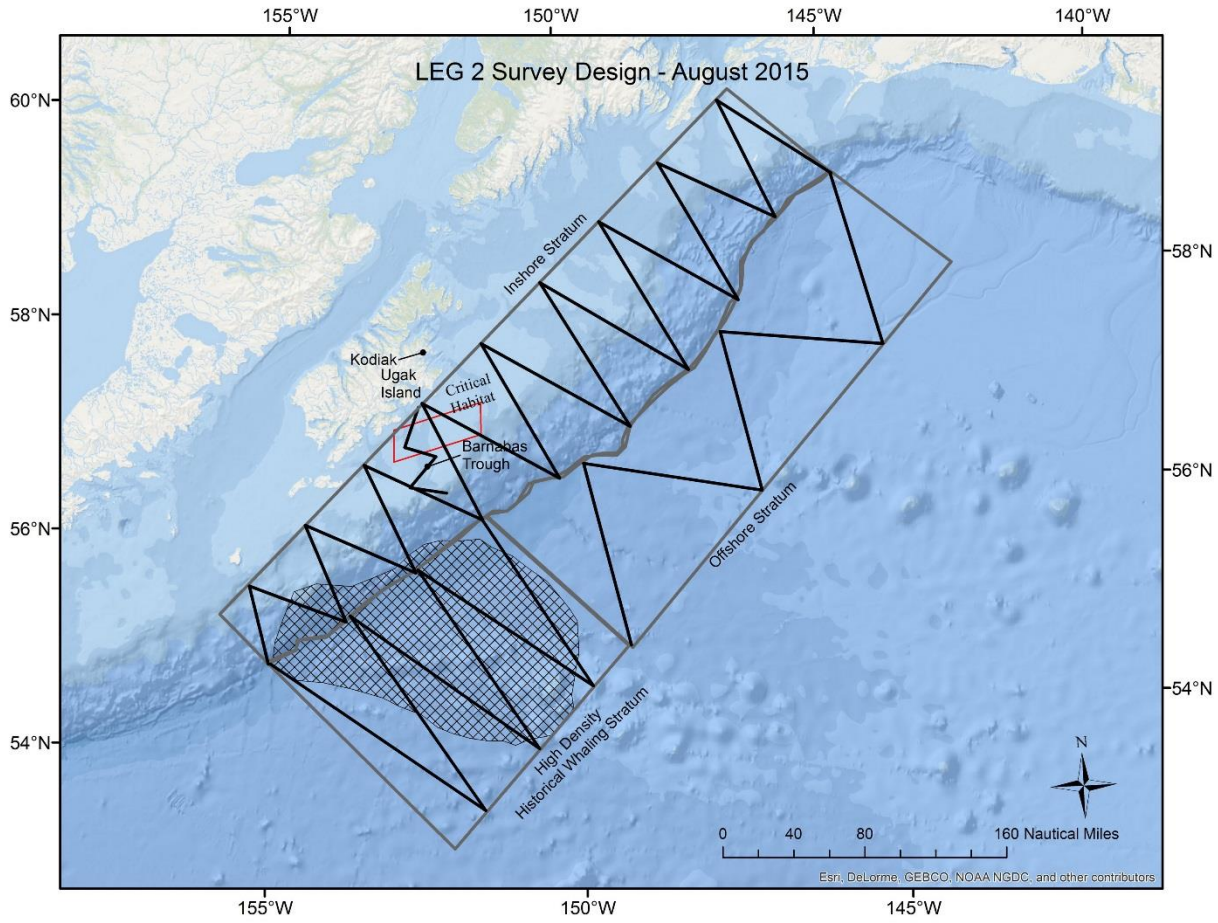

Figure 16. Survey design for Leg 2 of the CLaWS survey, 2015.

Goals and Objectives

The objectives for Leg 2 were as follows:

1. Survey as much of the shelf and adjacent offshore waters off Kodiak as possible, using visual and acoustic monitoring.

2. If right whales were encountered, attempt to conduct photo-identification and biopsy sampling of the animals.

3. If possible, attach satellite-monitored radio tags to right whales to determine their movements and use of key habitats.

4. When other cetacean species were documented during the survey, opportunistic photo-identification, biopsy and satellite tagging, particularly of fin and blue whales, would be conducted if possible.

Visual Survey

Rotating teams of three scientists collected sighting data using standard line-transect methods during on-effort mode. Operations began at 0700 Alaska Daylight Time (AKDT) and ceased at 2230 (AKDT), or as long as conditions would allow. A full observation period for each observer was 1.5 hours (30 minutes in each position) and was followed by a 2-hour rest period. All three scientists (starboard and port observers and data recorder) were stationed on the flying bridge. Observers used 25×150 'big-eye' binoculars (Fig. 17) with reticles to scan from 10 degrees past the bow on the opposite side to 90 degrees abeam.

The data recorder surveyed the trackline with 7 × 50 binoculars while scanning through the viewing areas of the two primary observers. When a sighting was made, the primary observer conveyed to the recorder the horizontal angle and number of reticles from the horizon to the initial sighting. Additional information collected included sighting cue; course and speed; species identity; and best, high, and low estimates of group size.

Figure 17. Sergio Martinez looking for whales using the "Big Eyes".

The computer program Wincruz (http://tinyurl.com/qhtakea) was used to record all sighting and environmental data (sea state, swell height, glare, precipitation, and visibility). During poor weather conditions (visibility ≤ 1 km and/or heavy rain), off-effort watches were conducted on the bridge with two observers.

Ship-Based Passive Acoustics – DiFAR Sonobuoys

Throughout the survey, sonobuoys were deployed continuously when in historical high density right whale areas (Fig. 18). When transiting through non-high density areas, sonobuoys were deployed approximately every 2-2.5 hours to obtain an evenly-sampled cross-survey census of marine mammal vocalizations. Four types of sonobuoys were used: SPW 77C, 53F (UND and SPW), SPW 53D, and 57B (SPW and MN). The 53D and 57B sonobuoys were very old surplus buoys from 1991 or older, and all but one failed to transmit properly. The 53F sonobuoys have either omnidirectional or DiFAR (Directional Frequency Analysis and Recording) capabilities, although all were deployed in DiFAR mode to obtain directional bearing information. The 77C sonobuoys were DiFAR only. When in DiFAR mode, the maximum frequency range is 2.5 kHz. All sonobuoys were modified by tying up portions of the buoy to prevent deployment. These modifications ensured that all hydrophones were shallower than 150 ft. Because right whales tend to vocalize near the surface, the modifications to the buoys ensured that the hydrophones were close enough to the surface layer to detect any vocalizations. In addition to shortening deployment depth, the UND 53F sonobuoys had dead display batteries that needed to be replaced. Sonobuoy crates were stored on the aft deck, and individual buoys were removed from the crates and prepped for deployment.

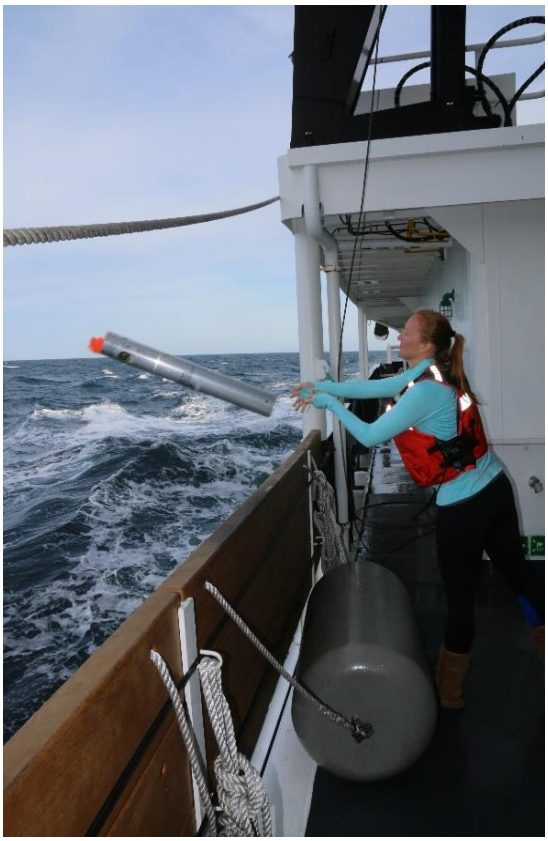

Figure 18. Sonobuoy being deployed off the starboard rail.

A preamplified omnidirectional antenna was installed on the vessel prior to the start of Leg 1. The antenna was positioned on the port side of the mast, approximately 30 m above the surface of the water. The preamp was positioned inside the bridge, with ~100 ft. of antenna cable fed from the preamp in the bridge into the Acoustics lab three decks below. The acoustics monitoring station was set up at the table in the Acoustics lab. During the survey, a problem occurred with the antenna cable from the preamp into the Acoustics lab. As a result, the monitoring station was moved into the bridge for the remainder of the survey.

Results

Visual Observations

A total of 1683 nm of trackline were surveyed under "on-effort" conditions (Figures 2-12, 19 and Table 5). Additional trackline was surveyed either on the flying bridge or bridge in off effort conditions during inclement weather.

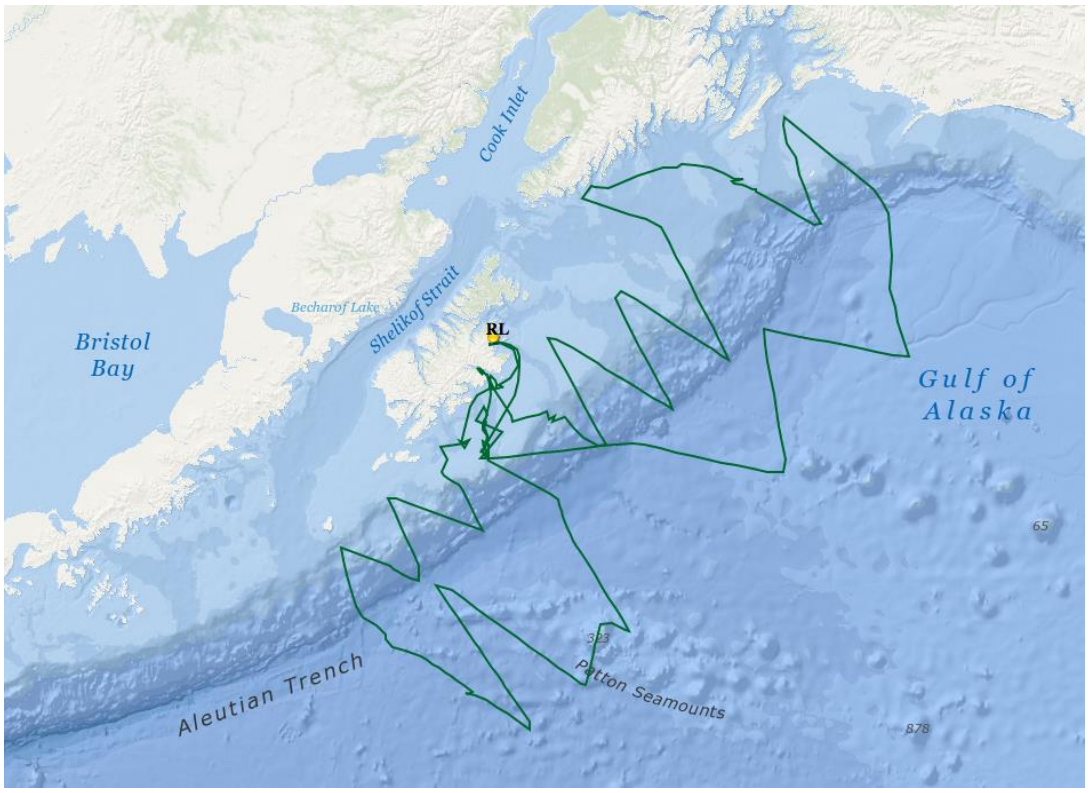

Figure 19. The survey track during Leg 2 of CLaWS, 2015.

There were a total of 409 sightings (1277 individuals) from 10 confirmed species (Table 6). There were an additional 207 sightings (327 individuals) of unidentified large whales, dolphins, and porpoise.

Table 5. Search effort by day for Leg 2. Survey distance reflects "on-effort" status and does not include bridge watch effort (during inclement weather).

Date	Time Start/End	Latitude	Longitude	Survey Distance (nmi)	Average Beaufort
80615	1629	N57:37.61	W152:01.60	15.8	3.2
	2004	N57:16.65	W152:17.32		
80715	0702	N57:23.32	W152:29.03	37.8	3.3
	1839	N57:09.17	W153:21.35		
80815	0659	N56:54.61	W153:24.62	56.7	4.0
	2100	N57:04.03	W152:42.20		
80915	0701	N46:51.65	W152:29.30	57.4	5.3
	2154	N56:34.04	W152:20.68		
81015	0700	N56:38.48	W152:48.61	54.9	5.3
	2149	N56:22.47	W153:26.46		
81115	0701	N55:59.14	W152:51.53	114.5	4.2
	2147	N55:13.05	W153:46.28		
81215	0703	N55:22.26	W154:26.67	103.2	3.0
	2120	N54:26.03	W154:13.91		
81315	0700	N54:02.49	W152:59.26	57.5	1.2
	2158	N54:01.71	W152:13.74		
81415	0701	N54:41.87	W152:59.78	134.4	2.4
	2118	N54:25.27	W151:36.12		
81515	0701	N54:41.87	W152:59.78	101.9	4.5
	2118	N54:25.27	W151:36.12		
81615	0659	N56:06.13	W151:12.35	84.3	3.1
	2143	N56:53.61	W152:29.22		
81715	0659	N56:54.70	W152:36.44	0	5.2
	1659	N57:27.49	W152:42.01		
81815	1862	N57:25.14	W152:36.35	29.7	3.5
	2130	N56:59.78	W152:07.67		
81915	0659	N56:56.12	W151:04.16	115.9	2.5
	2130	N57:31.68	W150:28.38		
82015	0700	N57:02.18	W148:58.28	108.0	3.3
	2123	N57:43.53	W148:24.87		
82115	0700	N58:04.35	W148:24.36	84.6	3.0
	2131	N59:19.85	W150:00.26		
82215	1200	N59:30.54	W149:47.55	60.7	4.2
	2118	N59:23.09	W147:51.28		
82315	0659	N59:13.89	W147:21.07	118.1	2.9
	2121	N59:42.45	W146:12.10		
82415	0700	N58:33.93	W144:45.63	125.9	3.8
	2111	N57:51.05	W147:05.26		
82515	0700	N56:22.44	W146:57.69	130.6	3.0
	2117	N56:36.87	W151:02.95		
82615	0659	N56:58.14	W152:45.81	91.2	4.6
	1935	N57:34.62	W151:57.05		

Table 6. Visual sighting summary for Leg 2.

Species	Sighting(individual)
Pacific white-sided dolphins	6(140)
Killer whale	20(114)
Harbor porpoise	2(3)
Dall's porpoise	96(397)
Sperm whale	28(46)
Gray whale	5(16)
Balaenoptera sp.	5(5)
Sei whale	2(2)
Fin whale	66(102)
Blue whale	13(13)
Humpback whale	171(444)
unid. dolphin	4(54)
unid. large whale	190(240)
unid. porpoise	8(28)
Total	**616(1604)**

Biopsy Sampling

A total of six biopsy samples were collected during Leg 2 (Table 7). Biopsy samples of gray whales were collected in Ugak Bay. Blue whale samples were collected in the 'High Density Historical Whaling' stratum (Figure 16).

Table 7. Tissue samples collected during Leg 2.

Species	No. samples collected	Comments
Gray whale	4	One sample is a duplicate.
Blue whale	2	One sample is skin only.

Photo-identification

Photographs were collected of gray (Figure 20), blue, fin, humpback, sperm and killer whales, and Pacific white-sided dolphins (Table 8). Catalogs were compiled for: gray, blue, fin, humpback and killer whales. The gray whale catalog now has 18 individuals, 12 from Leg 1 and 6 from Leg 2. Three additional individuals documented during Leg 2 were duplicates from Leg 1. The killer whale catalog now has 98 individuals; 8 were photographed during Leg 2. Additional individuals photographed during Leg 2 were: 3 blue whales, 4 fin whales, 8 humpback whales and 1 sperm whale. These photographs will be compared to the existing photo-identification catalogues maintained at SWFSC and AFSC, and by other groups.

Figure 20. Gray whale photographed in Ugak Bay, Alaska.

Table 8. Photo-identification data collected during Leg 2.

Species	No. Sightings	No. Photos
Gray whale	5	870
Sperm whale	1	14
Killer whale	1	390
Humpback whale	2	459
Blue whale	4	853
Fin whale	5	99
Pacific white-sided dolphin	1	797

Acoustics

A total of 219 sonobuoys were deployed of which 191 were successful deployments. Of these, 95 were modified (taped and tied) SPW 77C's, 29 were SPW 53F's, 84 were modified (new battery and tied up) USS 53F's, 9 were older (1991-92) SPW 53D's and 2 were older (1991) MN 57B omnidirectional buoys. The overall sonobuoy success rate was 86%; however, when the old 53D and 57B sonobuoys were excluded, success rate increased to 91%.

Average reception range during the entire survey was 8.4 nm (range 3.4 – 20.4 nm). However, it is important to note that this average includes those ranges received when the antenna cable and preamp failed. Reception range at the start of the survey averaged 9.3 nm (range: 7.3-11.4 nm), until the technical issues arose. After moving the monitoring station into the bridge, bypassing the faulty cable, and switching pre-amps, reception range averaged 8.9 nm (6.7 – 20.4 nm) for the remainder of the survey.

A total of over 330 hours of acoustic monitoring occurred. A map of all sonobuoy deployments and species detected are presented in Figures 2-12, 21-23). North Pacific right whale vocalizations (upcalls and gunshots, Figures 24 and 25, respectively) were detected on a total of 6 sonobuoys (3%); on two buoys on 10 August, and four buoys on 16 August. These detections resulted in four distinct localizations of calling animals, two on 10 August (Figure 23, red stars) and two on 16 August (Figure 23, green stars). Given the distance between the two localizations on 10 August (approx. 13 km), it is likely that these are two different animals. However, the margin of error when localizing on a calling animal can be considerable if the calls are faint or distorted due to propagation effects. Because visual confirmation was not made, the number of callers cannot be confirmed.

The two most commonly detected species were sperm whales and blue whales, detected on 107 and 100 sonobuoys (56% and 52%), respectively. Humpback whales and killer whales were the next most commonly detected, on 55 and 41 sonobuoys (28.7% and 21%), respectively. Fin whales were detected on 28 sonobuoys (14.6%), and both gray whales and sei whales were detected on 9 sonobuoys (4.7%).

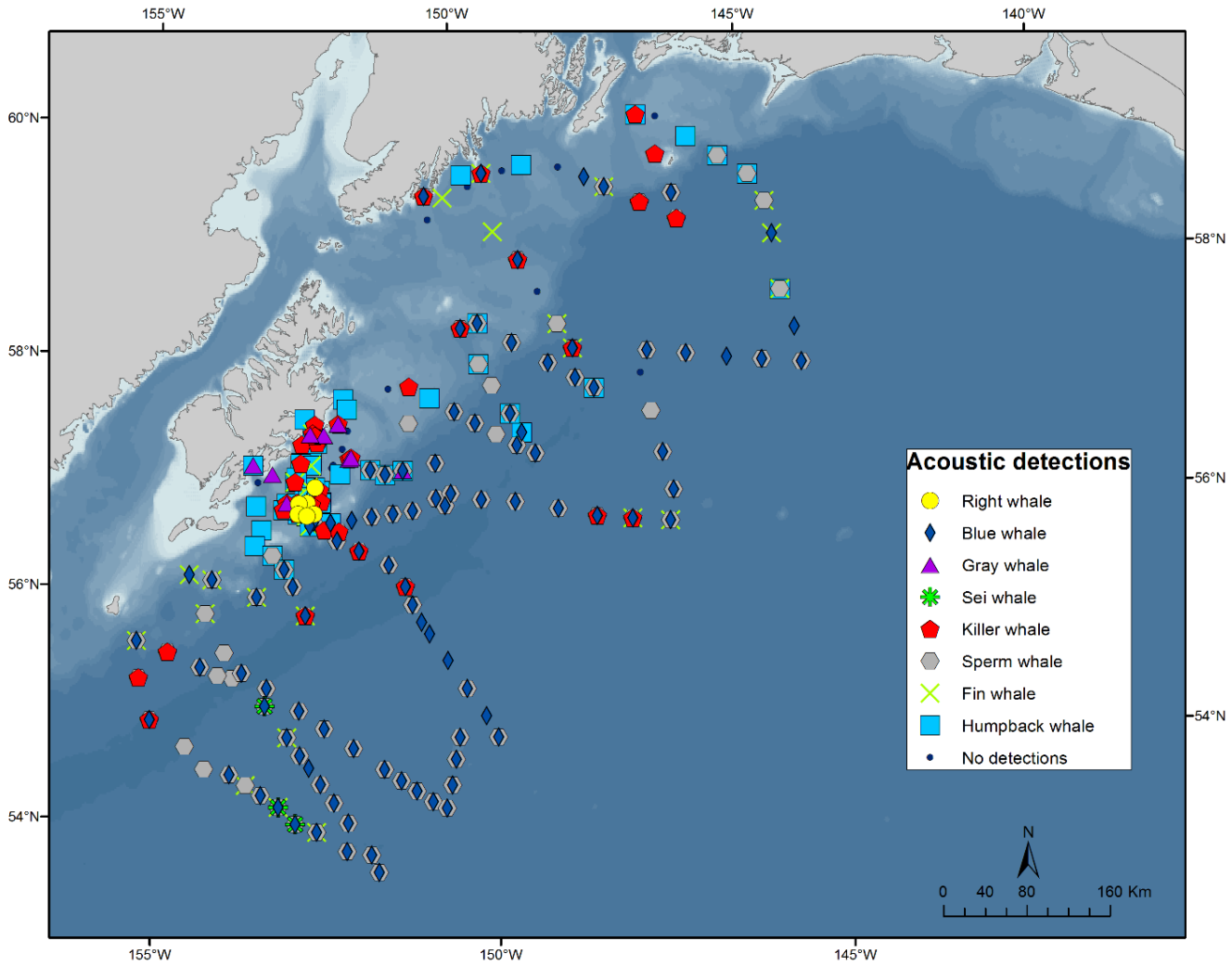

Figure 21. Sonobuoy deployments and species detected during Leg 2 of CLaWS, 2015.

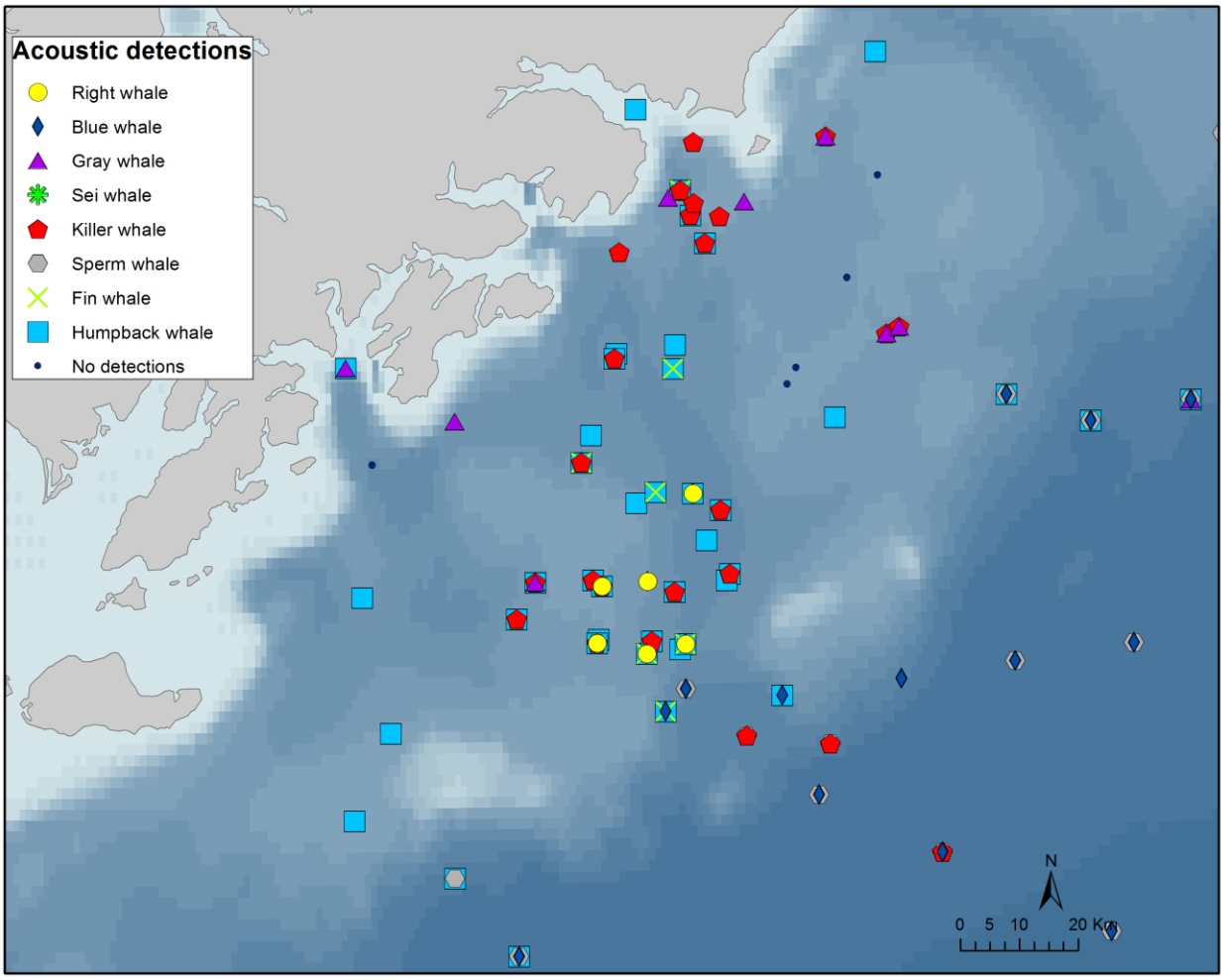

Figure 22. Zoomed-in map of sonobuoy deployments and species detected around Barnabas Trough.

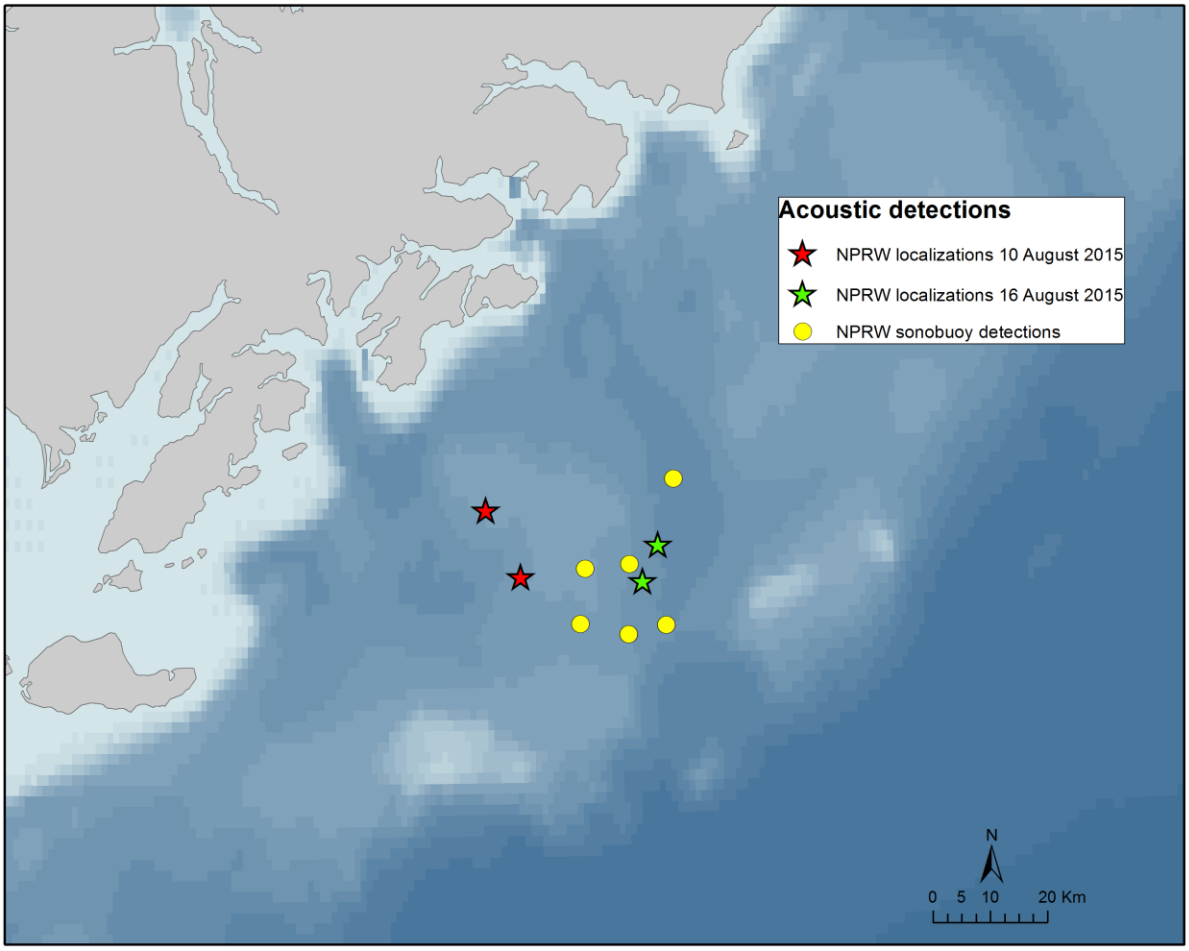

Figure 23. North Pacific right whale localizations (stars) in relation to sonobuoy acoustic detections (yellow circles) in Barnabas Trough.

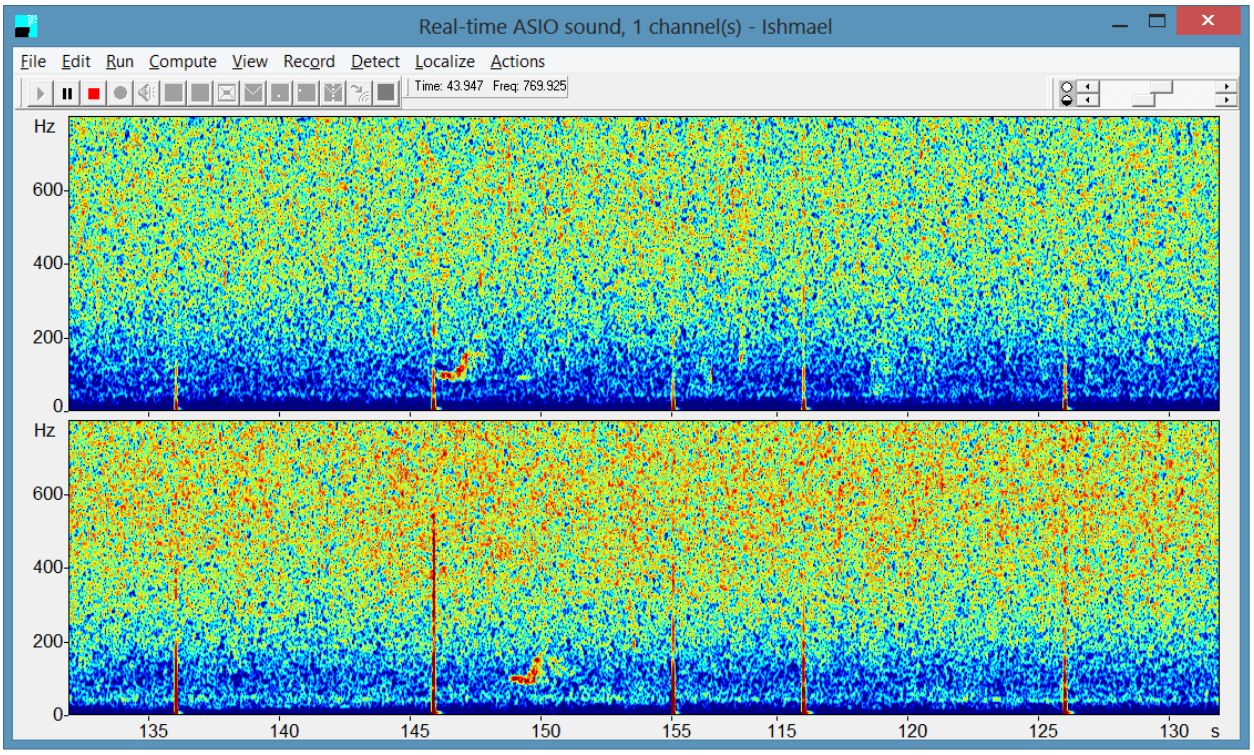

Figure 24. Screenshot of North Pacific right whale upcalls (at 146 s and 149 s) recorded on two different sonobuoys simultaneously, resulting in an acoustic localization. Clip recorded on 16 August 2015 at 19:07:44 ADT.

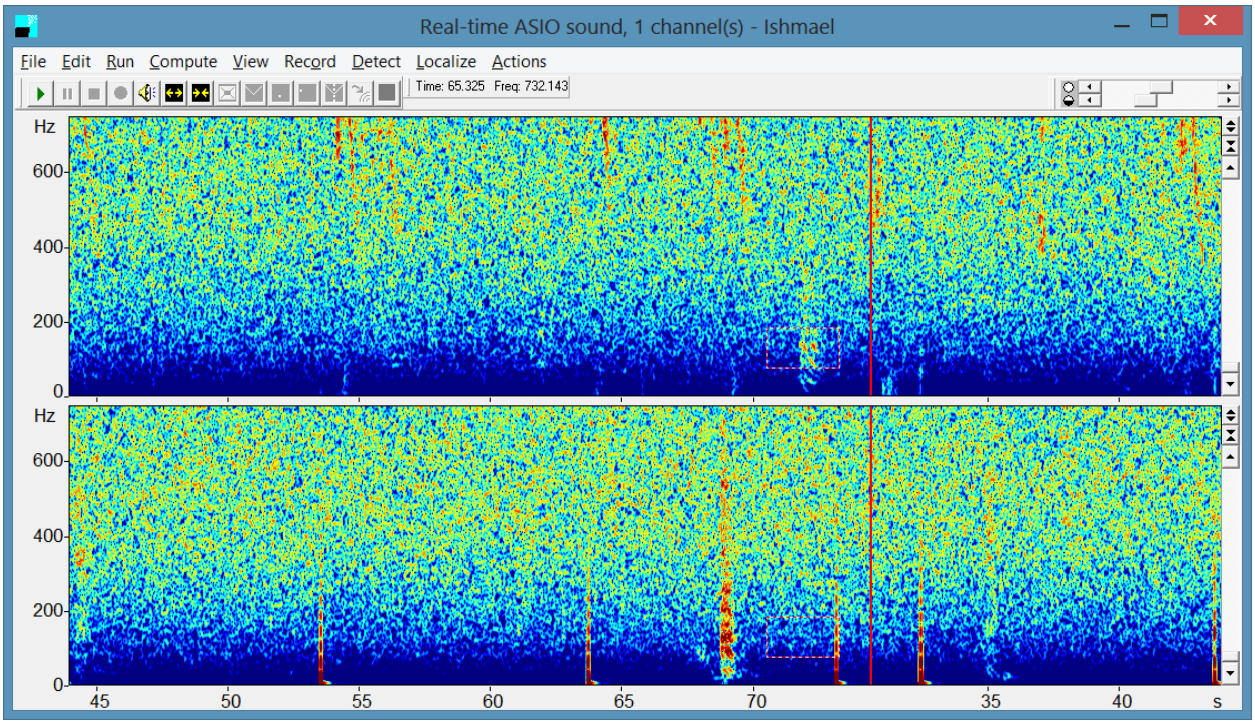

Figure 25. Screenshot of North Pacific right whale gunshot calls (at 68 s and 72 s) recorded on two different sonobuoys simultaneously, resulting in an acoustic localization. Clip recorded on 10 August 2015 at 10:13:31 ADT. Note that killer whale calls are also present in the upper channel (e.g., at 53-57 s).

Literature Cited

Ivashchenko, Y.V. & Clapham, P.J. 2012. Soviet catches of bowhead (*Balaena mysticetus*) and right whales (*Eubalaena japonica)* in the North Pacific and Okhotsk Sea. *Endangered Species Research* 18: 201-217.

LeDuc, R.G., Taylor, B.L., Kartien, K., Robertson, K.M., Pitman, R.L., Salinas, J.C., Burdin, A.M., Kennedy, A.S., Wade, P.R., Clapham, P.J. & Brownell, R.L. Jr. 2012. Genetic analysis of right whales in the eastern North Pacific confirms severe extinction risk. *Endangered Species Research* 18: 163-167.

McDonald, M. A. 2004. DIFAR hydrophone usage in whale research. *Canadian Acoustics* 32(2):155-160.

Mellinger, D. K. 2001. *Ishmael 1.0 User's Guide*. NOAA Technical Memorandum OAR-PMEL120. Seattle, WA: NOAA Pacific Marine Environmental Laboratory. 30 pp.

Rone, B.K., Douglas A.B., Zerbini A.N., Morse L., Martinez A., Clapham P.J., and Calambokidis J. 2010. *Results from the April 2009 Gulf of Alaska Line Transect Survey (GOALS) in the Navy training exercise area*. NOAA Technical Memorandum NMFS-AFSC-209. Seattle, WA: Alaska Fisheries Science Center, National Marine FisheriesService. 39 pp.

Rone, B.K., Berchok, C.L., Crance, J.L., and Clapham, P.J. 2012. Using air-deployed passive sonobouys to increase detections of the critically endangered North Pacific right whale.*Marine Mammal Science* 28(43):E528-538.

Rone, B.K., Douglas A.B., Yack T.M., Zerbini A.N., Norris T.N., Ferguson E., Calambokidis J., and Clapham P.J. 2014. *Report for the Gulf of Alaska Line-Transect Survey (GOALS) II: Marine Mammal Occurrence in the Temporary Maritime Activities Area (TMAA)*. Submitted to Naval Facilities Engineering Command (NAVFAC) Pacific, Honolulu, Hawaii under Contract No. N62470-10-D-3011, Task Order 0022, issued to HDR Inc., San Diego, California. Prepared by Cascadia Research Collective, Olympia, Washington; Alaska Fisheries Science Center, Seattle, Washington; and Bio-Waves, Inc., Encinitas, California. April 2014.

Robbins, J., Zerbini, A.N., Gales, N.; Gulland, F.M.D., Double, M., Clapham, P.J., Andrews-Goff, V., Kennedy, A.S., Landry, S., Mattila, D. and Tackaberry, J. 2013. Satellite tag effectiveness and impacts on large whales: preliminary results of a case study with Gulf of Maine humpback whales. Paper SC/65a/SH05 presented to the IWC Scientific Committee, Jeju Island, South Korea. 10pp.

Scarff, J.E. 2001. Preliminary estimates of whaling-induced mortality in the 19th century North Pacific right whale (*Eubalaena japonicus*) fishery, adjusting for struck-but-lost whales and non-American whaling. *Journal of Cetacean Research and Management*, Special Issue 2: 261-268.

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica* NY 19:1-50.

Wade, P.R., De Robertis, A., Hough, K.R., Booth, R., Kennedy, A., LeDuc, R.G., Munger, L., Napp, J., Shelden, K.E.W., Rankin, S., Vasquez, O., and Wilson. C. 2011. Rare detections of North Pacific right whales in the Gulf of Alaska, with observations of their potential prey. *Endangered Species Research* 13: 99-109.

Wade, P., Kennedy, A., LeDuc, R., Barlow, J., Carretta, J., Shelden, K., Perryman, W., Pitman, R., Rone, B., Salinas, J.C., Zerbini, A. & Clapham, P. 2011. The world's smallest whale population? *Biology Letters* 7: 83-85.

Zerbini, A.N., Baumgartner, M.F., Kennedy, A.S., Rone, B.K., Wade, P.R. & Clapham, P.J. 2015. Ecological and management implications of endangered North Pacific right whale (*Eubalaena japonica*) space-use patterns in the Bering Sea. *Marine Ecology Progress Series* (in press).

Zerbini, A.N., Mendez, M., Rosenbaum, H., Sucunza, F., Andriolo, A., Harris, G., Clapham, P.J., Sironi, M. and Uhart, M. 2015. Tracking southern right whales through the southwest Atlantic: new insights into migratory routes and feeding grounds. Paper SC/66a/BRG22rev1 presented to the IWC Scientific Committee, San Diego, USA.

Acknowledgements

The CLaWS 2015 project is funded by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NMFS Office of Science and Technology, NMFS Office of Protected Resources, NMFS Alaska Regional Office and the Marine Mammal Commission. Doug DeMaster was instrumental in securing funding for this survey. John Ford and Annely Greene generously assisted with Canadian research permits. Chris Gabriele and Lewis Sharman provided support for obtaining Glacier Bay National Park research permits. Shore-side support in preparation for this cruise was provided first and foremost by Annette Henry. Additional support, both conceptual and physical, was provided by: Eric Archer, Lisa Ballance, John Bengtson, Jim Carretta, Phil Clapham, John Durban, Lynn Evans,

Paul Fiedler, Terry Henry, Roger Hewitt, Robert Holland, Al Jackson, Kelly Jacovino, Kristen Koch, Jeff Laake, Karen Martien, Jeff Moore, Shannon Rankin, Kelly Robertson, Brenda Rone, Jeremy Rusin, Gaby Serra-Valente, Barb Taylor, Wayne Perryman, Mridula Srinivasan and Cisco Werner. Regional scientific advice was generously offered by: John Calambokidis, Jim Darling, John Ford, Pat Gearin, Dawn Goley, Jeff Jacobsen, Sue Moore, Jan Straley and Bree Witteveen. Daryl Jordan of the Marine Mammal Commission was exceptional in facilitating last minute travel and logistics for Leg 2 scientists. The crew of the NOAA Ship *Reuben Lasker* were extraordinarily helpful and a pleasure to sail with.

Leg 2 Scientific party. Front: S. Martínez. Second Row: L to R: R. Pitman, N. Tucker, J. Crance, A. Burke, M. Slack, K. Miller, K. Beach, B. Rone, A. Martínez. Third Row: L to R: B. Alps, K. Cates, T. Johnson

IV: Leg 3

Collaborative Large Whale Survey 2015 (CLaWS)
End-of-Leg Report: 1-20 September 2015

Aimée R. Lang, Cruise Leader

The plan for CLaWS Leg 3 (see Figure 26) was to continue survey effort in the waters off Kodiak Island and then head east across the Gulf of Alaska to survey coastal and shelf-break waters off southeastern Alaska. The science party for Leg 3 included seven observers: Alyssa Baldo (volunteer, University of California Santa Cruz), Bernardo Alps (volunteer, California Whales & Wildlife and the Cabrillo Marine Aquarium), Elyssa Watford (volunteer, Humboldt State University), Nicole Vollmer (National Systematics Laboratory, NOAA Fisheries), Charlotte Boyd (SWFSC), Eric Archer (SWFSC), and Aimée Lang (SWFSC).

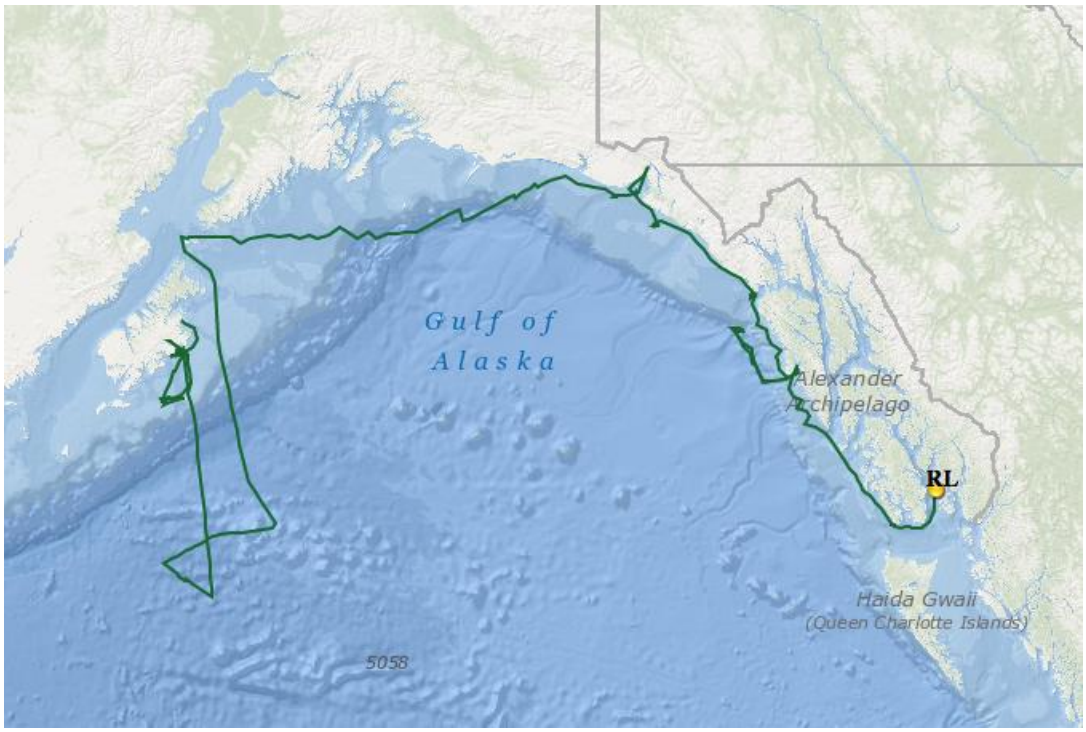

Figure 26. The survey track for Leg 3.

Over 900 nm were surveyed during Leg 3, including approximately 186 hrs of visual observation effort and 254 cetacean sightings. At the end of Leg 3, Aimée Lang handed over scientific responsibilities to incoming cruise leader Susan Chivers (SWFSC) and an almost entirely new scientific crew; the exception is Sergio Martínez who sailed on Legs 1 and 2.

Marine Mammal Observations:

The first week of Leg 3 (1-6 September) was spent surveying the waters off Kodiak Island, Alaska. Most of this time was dedicated to small boat work aimed at collecting photographs and biopsies from gray whales in the nearshore waters of Ugak Bay, in the same general area that gray whale sightings were made during Legs 1 and 2. In addition, a couple of days were spent surveying the waters near the Barnabas Trough, where right whale calls were recorded during Leg 2. Although sightings of killer whales, Pacific white-sided dolphins, Dall's porpoises, and humpback whales were made, no right whales were sighted during this time.

At the beginning of week 2 (7-13 September), we headed further offshore to an area where multiple blue whales were sighted during Leg 2. Although no blue whales were found, we were able to photograph several fin whales before heading back towards shore to wait out the first gale of this leg in the lee of the Barren Islands. After the gale passed, we began our transit across the Gulf of Alaska toward Yakutat Bay, and ended the week with numerous harbor porpoise sightings inside the Bay as well as an intimate view of the Hubbard Glacier.

The final week of Leg 3 (14-19 September) began with a survey of the coastal waters between Yakutat Bay and Sitka Sound in search of gray whales. As in Leg 1, no gray whales were sighted in this area. We then headed offshore to the shelf break with the hope of finding sperm whales. Multiple humpback and fin whales appeared to be feeding in these waters, but no sperm whales were found. Unfortunately, our time surveying the shelf break was limited by the approach of yet another gale, forcing us back toward the coast and the shelter of Sitka Sound. Unexpectedly, conditions improved markedly for the last two days of the survey, with high swell but sunny skies and relatively low winds as we surveyed from Sitka Sound south to Dixon Entrance. The majority of sightings during these two days were of humpback and fin whales. We ended our Leg 3 efforts working with a group of ~45 fin whales in the waters on the U.S. side of Dixon Entrance.

Table 9. Visual sighting summary for Leg 3.

Species	Sightings (Individuals)
Pacific white-sided dolphin	5(861)
Killer whale	4(17)
Harbor porpoise	30(75)
Dall's porpoise	22(142)
Sperm whale	1(1)
Gray whale	10(59)
Fin whale	18(85)
Humpback whale	82(281)
Unidentified dolphin	1(4)
Unidentified large whale	81(151)
Total	**254(1676)**

Table 10. Search effort by day for Leg 3. Survey distance reflects "on-effort" status and does not include bridge watch effort (during inclement weather).

Date	Time Start/End	Latitude	Longitude	Distance Surveyed (nmi)	Average Beaufort
090115	1409	N57:44.00	W152:22.53	16.6	3
	1718	N57:22.31	W152:08.90		
090215	746	N57:23.14	W152:29.39	5.1	2.3
	942	N57:18.27	W152:26.65		
090315	1600	N57:19.63	W152:22.92	5.4	5
	1647	N57:13.82	W152:28.93		
090415	734	N56:10.98	W152:21.27	60.4	3.4
	1606	N56:36.00	W152:43.59		
090515	737	N56:32.13	W152:58.34	38.5	2.9
	1310	N57:13.71	W152:26.90		
090615	731	N57:19.81	W152:23.69	56.5	2.6
	1840	N56:11.43	W152:03.02		
090715	733	N53:41.93	W151:35.48	41.5	2
	1820	N53:58.73	W152:48.59		
090815	734	N54:29.63	W151:27.47	60.3	3.5
	1840	N55:22.10	W150:35.91		
090915	755	N57:59.30	W151:29.95	50.7	4.9
	1334	N58:54.06	W152:27.01		
091015	941	N58:58.01	W152:14.03	70.3	5.5
	1844	N58:59.10	W149:46.04		
091115	738	N59:05.00	W146:17.80	94.8	5.3
	1840	N59:33.36	W143:20.56		
091215	734	N59:49.60	W141:52.24	38.7	2.8
	1232	N59:37.52	W140:34.16		
091315	733	N59:35.23	W139:55.66	66.6	1.7
	1840	N59:13.68	W139:23.24		
091415	731	N59:12.99	W139:20.02	45.8	3.9
	1704	N58:22.95	W136:59.76		
091515	731	N58:09.92	W136:43.80	43.8	3.2
	1742	N57:13.25	W136:03.72		
091615	728	N57:06.49	W135:31.77	57.2	3.1
	1840	N57:33.23	W137:09.22		
091715	734	N57:35.51	W137:12.30	56.7	6
	1846	N57:05.73	W135:31.49		
091815	802	N57:03.33	W135:31.00	76.5	2.7
	1820	N56:01.76	W134:37.73		
091915	729	N55:03.89	W133:23.84	32	2.1
	1550	N54:37.28	W132:29.23		

Biopsy Sampling

Although collecting biopsy samples from gray whales in the waters off Kodiak was difficult, we successfully obtained six samples as part of small boat operations during the first week of Leg 3. These samples will contribute to ongoing SWFSC genetic analyses of gray whales in the North Pacific and will also be valuable in any future studies looking at stable isotopes, contaminants, and/or hormones in these whales.

In addition, we were able to collect five biopsy samples from one of the two Pacific white-sided dolphin groups that were photographed while surveying aboard the *Rueben Lasker*. The final three samples were collected from fin whales as we neared the end of the Leg 3 survey area in the waters on the U.S. side of the Dixon Entrance. Two of these samples were obtained during small boat operations, while the final sample was collected from the bow of the ship while working with the last sighting of Leg 3. This sample was temporarily lost at sea when the line tethering the bolt snapped and was only retrieved due to the collaborative efforts of both science and crew.

Table 11. Biopsy samples collected during Leg 3.

Species	No. samples collected	Comments
Gray whale	6	
Fin whale	3	
Pacific white-sided dolphin	5	All from same group

Photo-identification

Most of the effort to collect photo-identification data during Leg 3 was focused on gray whales and fin whales. In addition, photos were also collected from two large groups of Pacific white-sided dolphins, two groups of killer whales, and opportunistically from humpback whales. These photographs will be compared to the existing photo-identification catalogues maintained at SWFSC and by other groups.

Figure 27. Gray whale photographed off of Ugak Bay, Kodiak Island.

Table 12. Photo-identification data collected during Leg 3.

Species	No. Sightings	No. Photos
Pacific white-sided dolphin	2	905
Killer whale	2	94
Gray whale	4	3821
Fin whale	12	3295
Humpback whale	5	118

Acknowledgements

The CLaWS 2015 project is funded by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NMFS Office of Science and Technology, NMFS Office of Protected Resources, NMFS Alaska Regional Office and the Marine Mammal Commission. Doug DeMaster was instrumental in securing funding for this survey. John Ford and Annely Greene generously assisted with Canadian research permits. Chris Gabriele and Lewis Sharman provided support for obtaining Glacier Bay National Park research permits. Shore-side support in preparation for this cruise was provided in large part by Annette Henry. Additional support, both conceptual and physical, was provided by: Eric Archer, Lisa Ballance, John Bengtson, Jim Carretta, Phil Clapham, John Durban, Lynn Evans, Paul Fiedler, Terry Henry, Roger Hewitt, Robert Holland, Al Jackson, Kelly Jacovino, Jennifer Keating, Kristen Koch, Jeff Laake, Karen Martien, Jeff Moore, Shannon Rankin, Kelly Robertson, Brenda Rone, Jeremy Rusin, Gaby Serra-Valente, Barb Taylor, Wayne Perryman, Mridula Srinivasan and Cisco Werner. Regional scientific advice was generously offered by: John Calambokidis, Jim Darling, John Ford, Pat Gearin, Dawn Goley, Jeff Jacobsen, Sue Moore, Jan Straley and Bree Witteveen. The crew of the NOAA Ship *Reuben Lasker* were extraordinarily helpful and a pleasure to sail with. Daryl Jordan of the Marine Mammal Commission was exceptional in facilitating last minute travel and logistics for Leg 3 scientists.

Leg 3 Scientific Party. Front Row: L to R: E. Watford, N. Vollmer, C. Boyd, and A. Baldo. Back Row: L to R: E. Archer, A. Lang, B. Alps.