



# Employing Active Aerial Acoustics to Increase Detections of the Critically Endangered North Pacific Right Whale

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## THE NORTH PACIFIC RIGHT WHALE

(*Eubalaena japonica*) was once abundant and widely distributed throughout the North Pacific Ocean. Little is known about the current distribution, movements, migrations or habitat use of this species, but the limited existing data suggest that it now occupies a reduced range compared to historical times. Recent estimates of abundance in the eastern portion of the range suggest the population there numbers only about 30 individuals. During a multi-year study conducted in the southeastern Bering Sea, the

efficacy of aircraft-based acoustic operations for increasing sighting opportunities was explored. Forty-seven successful sonobuoy deployments recorded over 90 h of acoustic data, wherein both right whale “gunshot” and “up” calls were identified (Fig. 1). There were a total of 21 visual sightings of 7 unique individuals, of which 5 sightings were located using acoustic operations; these included 4 animals acoustically located and subsequently visually observed in high sea states. “Gunshot” calls were documented 75

times more frequently than “up” calls, with an in-flight calling rate for each call type of 1.66 calls/min versus 0.04 calls/min, respectively (Fig. 4). Although the higher calling rate makes “gunshot” calls the best signal for locating animals in real-time, both call types proved valuable for identifying areas of right whale presence. Results demonstrate that incorporating active acoustic sampling into aerial visual surveys provides an effective strategy for increasing encounters of this critically endangered species.

## METHODS

Aerial surveys were conducted within the Bering Sea critical habitat from 14 July to 25 August 2009 in an Aero Commander 690A at a target speed of 110 knots and an altitude of 230 m, weather permitting. Visual and acoustic operations were conducted simultaneously to increase probability of right whale encounters. Prior to sonobuoy deployment, a brief survey of the area was conducted to document animals and vessel traffic to ensure safe deployment. AN/SSQ-53E and AN/SSQ-77C sonobuoys were deployed through the aircraft belly port with hydrophones programmed to operate at a depth of 27 m and 60 m respectively for 8 hours, although operational time was contingent on radio reception range and aircraft endurance.

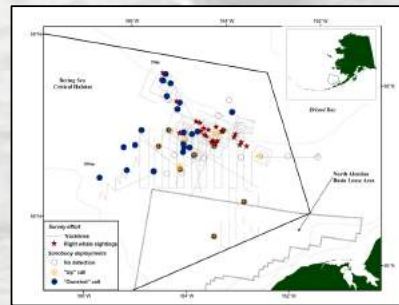


Fig. 1. Study area in the southeastern Bering Sea (inset) within the Bering Sea critical habitat and the North Aleutian Basin oil and gas lease area. Represented aerial survey results include tracklines, sonobuoy deployments, and North Pacific right whale sightings and acoustic detections from the 2009 aerial survey.

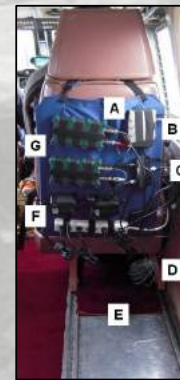


Fig. 2. In the aircraft, an acoustic gear harness (A) secured the sound card (B), antenna splitter (C), antenna cable (D), power supplies (F) and two WinNRADIO receivers (G) for safety and to maximize the limited space. Sonobuoys were deployed out the belly port (E).

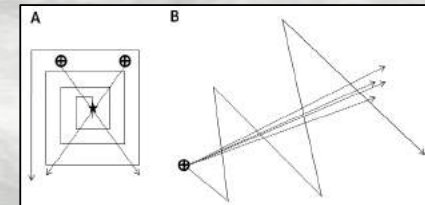


Fig. 3. (A) Once consistent bearings (dotted) to gunshot detections of a North Pacific right whale were established from sonobuoys (circle), a crossfix (star) was calculated, and transects (solid) were flown in a fine-scale expanding search pattern around the crossfix, typically at a 9 km spacing. (B) When a crossfix was unattainable but a consistent bearing was established (dotted) from a sonobuoy (circle) to gunshot detections from a North Pacific right whale, transects (solid) were flown in a sawtooth pattern at approximately 45° angles starting from the sonobuoy and surveying out in the direction of the bearing.

## RESULTS

Date	Number of NPRW (located acoustically)	Number of sonobuoys	Total recording time (min)	Total recording time (cont.) with NPRW calls	Number of “gunshot” calls	Number of “up” calls	Sea State
14 Jul	0	1	185	0	0	0	2-3
15 Jul	0	0	0	0	0	0	1-2
19 Jul	0	3	242	169	0	3	5-6
22 Jul	0	1	230	230	28	0	3-4
23 Jul	0	2	260	0	0	0	3
25 Jul	0	4	380	106	1	0	3-5
31 Jul	3	0	0	0	0	0	2-4
01 Aug	3(2)	4	685	222	229	11	4-5
04 Aug	0	4	389	149	51	8	3-6
07 Aug	2(2)	2	343	164	629	10	5-7
08 Aug	0	3	318	318	29	1	5
12 Aug	0	3	198	198	39	0	3
14 Aug	3	0	0	0	0	0	3
15 Aug	4(1)	3	466	466	495	0	1-2
16 Aug	0	5	176	176	151	0	6
18 Aug	0	2	210	210	19	2	4-5
19 Aug	0	2	372	372	90	16	4-5
22 Aug	4	2	378	378	2232	0	2-6
23 Aug	4	0	0	0	0	0	0
24 Aug	3(1)	2	278	278	703	0	2-3
25 Aug	2(2)	4	356	356	952	0	7

Table 1. Aerial survey effort in 2009 including successful sonobuoy deployments, recordings and visual and acoustic North Pacific right whale detections.

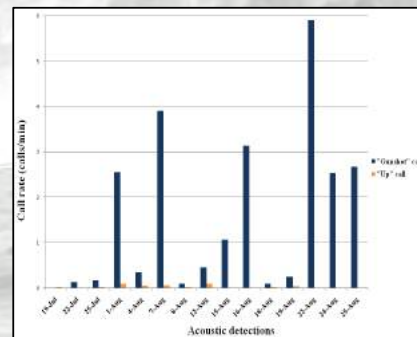


Fig. 4. Average in-flight call rates for North Pacific right whale “gunshot” and “up” calls recorded from sonobuoys deployed during the 2009 aerial survey. This figure represents flights where calls were detected and right whales were encountered, as well as, flights in which only acoustic detections were documented.

- Average reception range was 37 km (n=17; Range = 17 – 96 km; Median = 35 km).
- Average acoustic detection range was 23 km (n = 8; Range = 4 – 63 km; Median =13 km).
- Calls detected every time sonobuoys were deployed and right whales were encountered (Table 1).
- Calls detected on 16 flights including 9 flights without visual encounters (Table 1).
- Only “up” calls detected on one day (Table 1).

## DISCUSSION

- Nine flights would have been aborted or curtailed if the survey had relied on acceptable visual conditions alone (i.e. visibility ≥ 4 km and/or Beaufort sea state ≤ 5). Acoustic sampling provided an opportunity to collect data despite unacceptable visual survey conditions, thereby maximizing survey resources.
- Four animals were located and photo-documented in a Beaufort sea state 7 (Table 1), conditions near impossible to detect animals by visual observations alone.
- “Gunshot” and/or “up” calls detected on 9 flights without visual sightings. Information was relayed to the vessel, thereby establishing areas to focus vessel survey effort.
- Potential for nighttime operations (with deployments achieved during daylight hours), thereby further expanding opportunities for data collection.

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