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Cruise report of the 2017 IWC-Pacific
Ocean Whale and Ecosystem Research
(IWC-POWER)

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Cruise report of the 2017 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER)

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ABSTRACT

IWC-POWER cruises in the North Pacific follow the series of IWC/IDCR-SOWER (Southern Ocean Whale and Ecosystem Research) cruises that were conducted in the Antarctic since 1978. The 8th annual IWC-POWER cruise was conducted between 03 July and 25 September, 2017 in the eastern part of the Bering Sea. The entire research area was within the US EEZ. The survey was conducted aboard the Japanese R/V *Yushin-Maru No.2*. The cruise was organized as a joint project between the IWC and Japan. The cruise plan was endorsed at the 67a IWC/Scientific Committee (IWC/SC) meeting (IWC, 2017a). Researchers from Japan, the US and IWC participated in the survey. The cruise had five main objectives: (a) information for the in-depth assessments of North Pacific sei, humpback and gray whales in terms of abundance, distribution and stock structure; (b) information on the critically endangered North Pacific right whale population in the eastern Pacific; (c) completion of coverage of the northern range of fin whales following on from the IWC-POWER cruises in 2010-12; (d) baseline information on distribution, stock structure and abundance for a poorly known area for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear; (e) essential information for the development of the medium-long term international programme in the North Pacific in order to meet the Commission's long-term objectives. At the pre-cruise meeting, the Captain and crew of the vessel and international researchers agreed on the procedures and objectives of the survey. The survey was conducted using methods based on the guidelines of the IWC/SC. The acoustic survey was introduced for the first time to acoustically monitor for the presence of marine mammals, with particular importance for detecting and locating North Pacific right whales. Survey trackline coverage was 71.9 % (planned distance of 2,183.7 n.miles) of the original trackline with a total of 1,571.0 n.miles in the Passing with abeam closing mode (NSP) and the Independent Observer passing mode (IO). Additionally, 228.3 n.miles were surveyed during transit between Japan and the research area. Sightings of: fin (145 schools / 198 individuals), humpback (136/165), common minke (17/20), gray (15/22), North Pacific right (9 /18, including 2/3 duplicates), and sperm (25/33) whales were observed during the cruise. Fin and humpback whales were the most frequently sighted large whale species. Gray whales were sighted early in the survey, north of 64°N. There were no sightings of blue or sei whales during the cruise. The Estimated Angle and Distance Training Exercises and Experiments were completed. Photo-identification data were collected for: 15 North Pacific right (12 unique individuals, 3 duplicates), 14 gray (all unique), 55 fin, 34 humpback (32 unique individuals), 1 minke and 56 killer whales. These data are preliminary, pending further processing and photo-identification confirmation. The majority of North Pacific right whales were sighted at the western edge of Bristol Bay and in the middle of the critical habitat. Five of the nine right whale sightings were detected and localised using acoustics. A total of 60 biopsy (skin and blubber) samples was collected from 28 fin, 18 humpback, 9 gray, 3 North Pacific right and 2 killer whales using the Larsen sampling system. A total of 240 sonobuoys were deployed, for a total of 841 monitoring hours. Species detected include fin whales, detected on 46.7% of sonobuoys (112 buoys), killer whales (49 buoys, 20.4%), sperm whales (44 buoys, 18.3%), and right whales (38 buoys 15.8%), followed by humpback whales (23 buoys, 9.6%) and gray whales (4 buoys, 1.7%) and probable Cuvier's beaked whale clicks (1 buoy, 0.4%). A total of 12 objects of marine debris were observed, considerably less than previous cruises. All survey procedures were in accordance with the guidelines set forth and agreed upon by the SC. The 8th annual cruise of this programme was successfully completed and provided important information on cetacean distribution, in particular gray and North Pacific right whales, in an area where limited survey effort had been conducted in recent decades, in a poorly-known and logistically difficult area. These results will contribute to the aforementioned objectives of the IWC/SC.

KEY WORD: NORTH PACIFIC RIGHT WHALE, FIN WHALE, HUMPBACK WHALE, SURVEY VESSEL, NORTH PACIFIC, BERING SEA, IWC-POWER

1. INTRODUCTION

1.1 Research objectives

The cruise was organised as a joint project between the International Whaling Commission (IWC) and Japan (IWC, 2012a, 2012b, 2013, 2014, 2016a, 2016b, 2017a, 2017b, 2017c; Kato *et al.*, 2011, Matsuoka *et al.*, 2011, 2012, 2013, 2014, 2015, 2016, 2017). The 2017 cruise plan was discussed at the Tokyo planning meeting in 2016 and endorsed at the 67a IWC/Scientific Committee (IWC/SC) meeting. The cruise had five main objectives: (a) information for the in-depth assessments of North Pacific sei, humpback and gray whales in terms of abundance, distribution and stock structure; (b) information on the critically endangered North Pacific right whale population in the eastern Pacific; (c) completion of coverage of the northern range of fin whales following on from the IWC-POWER cruises in 2010-12; (d) baseline information on distribution, stock structure and abundance for a poorly known area for several large whale

species/populations, including those that were known to have been depleted in the past but whose status is unclear; (e) essential information for the development of the medium-long term international programme in the North Pacific in order to meet the Commission's long-term objectives (IWC, 2017c).

1.2 Research area, cruise track design and priority of the cruise

The research area was set north of 50°N, south of 66°N between 175°W and 157°W, comprised entirely of the Exclusive Economic Zone of the United States (US EEZ) (Figure 1a). A randomised start point for survey tracks was used based on the IWC/SC survey guidelines (IWC, 2012c). Every location within the study area had an equal probability of being sampled, as calculated by the software "DISTANCE (Ver. 6.2)" (Thomas *et al.*, 2010). The lines were reviewed in the light of the guidelines for good track design included in the Requirements and Guidelines for Surveys under the Revised Management Procedure (RMP) (IWC, 2012c) and in particular the need to take into account the distribution of priority species and the objectives of the survey, the need to ensure that lines did not follow features that might result in a bias (e.g. by following a coastline where the density of whales decreased with distance from the coast), as well as practical considerations such as time that would need to be spent on transit. Figure 1b shows the cruise track design in the designated research area and Table 1c shows Waypoints (WP) for the pre-determined tracklines. Research hours during the cruise were set at a maximum of 12 hours per day (see section 2.5). Primary search effort was conducted only in acceptable weather conditions, as per guidelines for prior cruises; visibility greater than 2.0 nautical miles (n.miles), wind speed <21 knots and sea state <Beaufort 6.

Following advice from the SC and the Technical Advisory Group (TAG), the 2017 survey alternated modes between Normal Closing Mode (NSP) and Independent Observer Mode (IO) (ca every 50 n.miles).

Two primary observers were in the TOP barrel throughout periods of NSP and IO modes (see section 2.5). Sighting survey procedures are detailed in "Information for Researchers" (Anon. 2017a). For encounters of rare species (e.g. right whales), it was decided that the vessel would approach whales immediately in order to avoid losing the sighting due to a delay in closing.

The priority species for biopsy sampling were North Pacific right (highest priority), gray, blue and sei whales, with only the former two encountered during the 2017 cruise. Research time was allocated for biopsy sampling North Pacific right (NPRW), gray, fin, humpback and killer whales. The Larsen system was used to collect samples. Medium-priority species included sperm, fin and killer whales. With respect to humpback whales, the priority was to obtain samples from animals encountered north of 60°N since the origin of the animals in this northern portion of the Bering Sea is unclear. In the southern Bering Sea, humpback whales have been sampled in previous years in large numbers; consequently, the species was considered low priority for biopsy in that area, although (as for other large whale species encountered) opportunistic samples were useful. Priority species for photo-ID were North Pacific right, gray and humpback whales, although photos of all other species, including fin and killer whales were obtained opportunistically.

2. SHORT NARRATIVE OF THE CRUISE

2.1 The 2017 cruise itinerary

Date	Event
01 July 2017	Pre-cruise Meeting at Shimonoseki, Japan
03 July	Vessel departed Shimonoseki
04 July	Started transit survey
08 July	repeated 08 July again to fix Dutch Harbor time
10 July	Passed the dateline at 54-19N (23:25)
13 July	Vessel arrived Dutch Harbor, Unalaska Island, Alaska, USA
15 July	Pre-cruise meeting
16 July	Vessel left Dutch Harbor and started transit survey (60 days in the research area)
19 July	Vessel started the survey from the northern part of the research area
10 September	Vessel completed the research area and moved to Dutch Harbor
13 September	Vessel arrived Dutch Harbor
14 September	Post-cruise meeting
14 September	Vessel left Dutch Harbor and started the transit survey
23 September	Vessel complete the transit survey
25 September	Vessel arrived Yokosuka, Japan

2.2 Research vessel

The R/V *Yushin-Maru No.2* (747GT) was contracted for this cruise. The vessel is a sister ship of the *Yushin-Maru No.3* which was contracted in previous years; 2011, 2012, 2013, 2014, 2015 and 2016. Ship specifications, photo, and the crew list for this cruise are provided in Appendix A.

2.3 Attending scientists and responsibilities

Four international researchers were nominated by the IWC steering group for the POWER programme. Researchers were Koji Matsuoka (The Institute of Cetacean Research, ICR, Cruise Leader), Jessica Crance (US National Oceanic and Atmospheric Administration (NOAA), Alaska Fisheries Science Center (AFSC) researcher), Jessica Taylor (IWC-nominated researcher, UK/USA), and Isamu Yoshimura (IWC-nominated researcher, Japan). Koji Matsuoka and Isamu Yoshimura were on board from Shimonoseki to Yokosuka and therefore participated in transit surveys, whereas Jessica Crance and Jessica Taylor boarded in Dutch Harbor and were not involved in transit surveys.

Koji Matsuoka (Japan) - Cruise Leader /Chief Scientist, sighting, photo-ID
Jessica Crance (USA) – acoustic, photo-ID
Jessica Taylor (UK/USA) – sighting, photo-ID data management
Isamu Yoshimura (Japan) – sighting, sighting and biopsy sample managements, Marine Debris

2.4 Pre-cruise meeting

On 01 July, a pre-cruise meeting was held at the Sansei Dock yard at Shimonoseki, chaired by the convenor of this cruise, Kato. Meeting participants were: Kato (convenor/chair), Miyashita (National Research Institute of Far Seas Fisheries, NRIFSF), Matsuoka (Cruise Leader), Yoshimura (researcher), Kasai (Captain), Ohura (Chief Engineer), Semii (Chief Operator), Takamatsu (Chief Officer), Omura (Bosun) and Sugiyama (Quartermaster), Hosone and Mori (Kyodo-Senpaku). The meeting discussed and confirmed priorities and strategies for the cruise based on the IWC Scientific Committee's planning report (IWC, 2017b), and IWC research manual (Anon, 2017a). The pre-cruise meeting report was distributed to the steering group after review by the Convenor. On 03 July, Matsuoka and Yoshimura boarded the YS2 with all of the necessary equipment and departed from the port of Shimonoseki.

On 15 July, a pre-cruise meeting was held at the Grand Aleutian Hotel in Dutch Harbor, AK, chaired by the Cruise Leader (CL). Meeting participants were: Matsuoka (CL/chair), Crance, Taylor, Yoshimura, Kasai (Captain) and Semii (Chief Operator). The meeting discussed and confirmed priorities and strategies for the cruise based on the IWC Scientific Committee's planning report (IWC, 2017b), and IWC research manual (Anon, 2017a). The pre-cruise meeting report (Anon, 2017b) was distributed to the steering group after review by the Convenor. On 16 July, all researchers boarded the YS2 with all of the necessary equipment and departed from spit dock, Dutch Harbor.

2.5 Research hours, survey mode and number of observers on effort

The schedule for research hours was consistent with previous SOWER (Southern Ocean Whale and Ecosystem Research) and POWER cruises. Research effort began 60 minutes after sunrise and ended 60 minutes before sunset, with a maximum 12-hour research day (approximately 06:00-18:00). There were occasions when it was beneficial to extend the research day beyond the normal research hours. This decision was made with the mutual agreement of the Captain and Cruise Leader. In such cases, there was an allocation of equivalent time-off on the following day for crew and scientists aboard the vessel. Time-zone changes were made in 60-minute increments, effective from 01:00 hrs. Work schedules adhered to local ship time which ranged between -12.0 hours and +12.0 hours GMT throughout the cruise depending on the ship's geographic location (Table 1b). Data collected during the cruise and all associated reporting are provided in local ship time, with the exception of acoustic data, which were collected in Alaska Daylight Time (ADT). Relative GMT has been noted for reference in raw data.

Sighting effort was conducted by the bos'un and topmen from the TOP barrel (crow's nest: always two primary observers) and typically, two primary observers (the helmsman and captain) and four secondary observers from the upper bridge (or officer-on-watch, three researchers, and the chief engineer or deputy). Sighting activities aboard the ship were classified into two principal types: On-effort and Off-effort. On-effort activities were times when full search effort was executed and conditions (such as weather and sea state) were within acceptable parameters to conduct research. Off-effort activities were all activities that were not On-effort when no primary observers were in the TOP barrel (e.g. during drifting, Top down (TD) or steaming on the trackline due to bad weather conditions). All sightings recorded during On-effort were classified as Primary sightings. All other sightings were considered to be Secondary sightings.

Following advice from the SC and TAG (IWC, 2017a), the 2017 survey alternated between NSP and IO modes. It was suggested that at least 50% of effort be in IO mode (see 2.6 for expected versus realised survey effort).

Passing with abeam closing mode (NSP): This was in effect Passing Mode. Two topmen were on effort from 06:00-18:00 from the TOP barrel at all times. There was open communication between the upper bridge and the barrel. The

observers on the upper bridge communicated with the topmen only to clarify sighting information. The upper bridge observers did not distract the topmen from their normal search procedure unless they were directed to do so by the CL (IWC, 2017a, Anon. 2017a).

Independent Observer Mode (IO): This is also in effect Passing Mode. Two topmen were observing from the TOP barrel and two from the IO barrel as recommended by the TAG (IWC, 2017a). Research hours were the same as NSP mode (from 06:00-19:00; with a 30 minute allocated break time for lunch and supper meals). Communications were essentially one-directional, with topmen from the TOP and IO platforms reporting information to the upper bridge in isolation from each other to ensure that no sighting information was exchanged between the TOP and IO barrel observers. The observers on the upper bridge would communicate with the topmen only to clarify sighting information and would not direct the topmen to disrupt their normal search procedure unless directed to do so by the CL.

Immediately after a sighting was detected from the barrel, the topman relayed information to observers on the upper bridge. Details of the estimated distance and angle to the sighting (and when possible, the species and number of animals present) were relayed. After the sighting information was relayed to the upper bridge observers, the topman responsible for the sighting continued his normal searching pattern. Observers on the upper bridge located the sighting made by the topman and decided whether it would be possible to confirm species and conduct a school size count before the sighting passed abeam of the vessel. The topmen gave no further information to the upper bridge unless the whale group resurfaced within their normal searching pattern area. A designated researcher on the upper bridge recorded the species and estimated number of whales in the school when the sighting passed abeam of the vessel; this was in consultation with other upper bridge observers/researchers. When the sighting location was abeam of the vessel, the ship altered course to approach the whale, and speed was increased to 15 knots to hasten the closure. Ship speed was decreased when the group was near, usually within 0.2 to 0.4 n.miles from the initial sighting position. After the sighting was approached, the species, number of animals in the group, estimated length(s), number of calves present, and behaviour were determined and recorded. Following this, other activities would normally be conducted (based on time allowed and at the discretion of the CL), such as photography for natural marking (Photo-ID) studies and biopsy collection experiments. Until the ship resumed full search effort on the trackline, any sightings detected after initial departure from the trackline were classified as secondary sightings (Anon. 2017a).

2.6 Weather conditions and expected versus realised effort

In the research area, sea surface conditions were generally rough. Low-pressure systems resulted in long intervals of poor visibility, rain conditions, and heavy storms. A total of 1,571.0 n.miles (NSP: 826.7 n. miles, IO: 744.3 n.miles) of original trackline were surveyed in the research area. In the research area, 71.9 % of the planned trackline distance of 2,183.7 n.miles was searched, and a total of 130.7 n.miles was surveyed during transit surveys in the research area e.g. transit from Dutch Harbor to the most northern WP and transits between end and start WPs of each trackline). A comparison of weather conditions among past cruises is shown in Appendix B.

2.7 Management Authority Permits for Cetacean Research Activities and International Export and Import of Cetacean Biopsy Tissue Samples.

All research activities (i.e., the approach of cetaceans for species identification, school size estimates, digital photography, and tissue biopsy samples) that were carried out within the US EEZ were permitted under U.S. National Marine Fisheries Service (NMFS) Permit nos. 20465 (issued to the AFSC), and U.S. Bureau of Oceans and International Environmental and Scientific Affairs Permit nos. U2017-012 (issued to the Fisheries Agency of Japan). Researcher Jessica Crance (US, AFSC) was listed as the co-investigator (CI) aboard the research vessel under the Permits.

Cetacean tissue biopsy samples obtained within the US EEZ (i.e., 3 North Pacific right, 28 fin, 13 humpback, 9 gray, 2 killer whale specimens) were legally exported to Southwest Fisheries Science Center (SWFSC/NOAA) after the cruise, under the CITES (Convention on International Trade in Endangered Species) U.S. Management Authority (U.S. Fish and Wildlife Service) Permit. Biopsy samples were imported to Japan (the National Research Institute of Far Seas Fisheries (NRIFSF, Yokohama)) under the CITES Japan Management Authority, the Office of Trade Licensing for Wild Animals and Plants, Ministry of Economy, Trade and Industry (METI).

Cetacean research activities conducted on the high seas in international waters by Japanese researchers aboard the YS2 were authorized under permit SUIKAN 29-749 (dated 28 June, 2017) issued by Fisheries Agency, Government of Japan. A summary of research effort in the US EEZ is provided in Appendix C.

2.8 Photo-ID data collection

As appropriate and decided by the CL, research time was allocated to photo-identification and /or video recording of large whales, with the same priority species as for biopsy sampling (section 1.2). Generally, large whales were approached within 15-20 metres. Adults, juveniles and females accompanied by calves were approached for photo-identification. Photo-ID experiments involved a minimum of one photographer on the bow and a maximum of three,

with additional photographers in the TOP barrel and IO barrel or upper bridge. The main cameras used were 1) IWC Nikon D7000 (with 70-300 mm lens) from the bow, 2) ICR Canon EOS 7D Mark II (with 100-400 mm lens) from the TOP barrel, and 3) a personally-owned Canon EOS 60D (with 100-400 mm lens) from the upper bridge or IO platform.

Images were uploaded to the IWC master photographic database in Adobe Lightroom (LR), backed up and preliminarily analysed at the close of each survey day. Preliminary photo-analysis involved: linking photographic data to relevant sighting information (i.e. sighting number, school size and species) and biopsy records (i.e. sample number, no sample obtained or no attempt to obtain sample); identifying number of individuals photographed in each sighting; and assessment for photo-identification. Photographic data with associated information saved to the metadata were organised into daily folders and sighting subfolders. Copies of photographic data were submitted to the CL and delivered to the IWC Secretariat shortly after the conclusion of the cruise. Low resolution photo-ID images of individual North Pacific right whales sighted during the cruise were emailed to NOAA's Alaska Fisheries Science Center for near real-time matching.

For the purpose of this report, individuals were considered photo-identified if they were documented with one or more image(s) that met species-specific identification criteria and catalogue-quality standards (section 4.1).

2.9 Data entry system and analysis

Research data collected during the survey (weather, effort, sighting and distance experiments data) were entered by researchers using the 'onboard data collecting system' (ICR, 2013).

2.10 Acoustic data collection

Passive acoustic monitoring for marine mammals was conducted using sonobuoys. A sonobuoy is a free-floating, expendable, short-term passive acoustic listening device that transmits signals in real time via VHF radio waves to a receiver on a vessel. Each sonobuoy consists of an outer tube (approx. 14 cm in diameter, 110 cm long), and an inner sonobuoy. Total weight of one sonobuoy (including outer tube) is approximately 30-35 lbs; the weight of one crate of 48 sonobuoys is approximately 1,300 lbs. Prior to the start of the survey, the sonobuoys were removed from their crates, brought on board individually, and stored in the lower hold of the vessel. Two antennas (one omnidirectional and one yagi directional) were installed and tested on the vessel on 04 June 2017 in Shimonoseki prior to the start of the survey. Sonobuoys were deployed approximately every 2-3 hours from 06:00 to 18:00 (ship time) to obtain an evenly-sampled cross-survey census of marine mammal vocalizations. At night, one buoy was deployed and monitored for the full 8-hour life span. Those data were post-processed the following day. When in/near the North Pacific right whale critical habitat, buoys were deployed continuously during daylight hours to maximize the potential for detecting a right whale (IWC, 2017c). Handheld radios allowed the acoustic technician to interact with a member of the visual observation team to groundtruth the acoustic detections with the visual sightings. The acoustic technician did not disclose the species detected on the sonobuoys to avoid biasing the visual surveys, with the exception of North Pacific right whales. When right whale vocalizations were detected, multiple sonobuoys were deployed simultaneously to localize on the calling animal and obtain location and distance estimates.

3. SUMMARY OF SIGHTINGS

3.1 Identification of species

Guidelines for species identification were based on the IWC-SOWER and IWC-POWER methods for classification of identification (Anon, 2017a): Positive identification of species was based on multiple cues and usually required clear observation of the whale's body. Occasionally, repeated observations of the shape of the blow, surfacing and other behavioural patterns were sufficient to identify whales; this judgement was made only by the CL or other designated researcher. Identification of species was recorded as 'probable' based on multiple cues, which were nevertheless insufficient to be absolutely confident of identification (recorded as "like"). This usually occurred when blows and surfacing patterns could be confirmed, but the whale's body could not be clearly seen. Details of recording procedures during sightings can be found in 'Information for Researchers' (Anon, 2017a).

3.2 Determination of group size

The following guidelines were used in determining group size: Schools where the number of animals, or an accurate estimated range of the number of animals was determined, were classified as confirmed schools. Data from the confirmed schools can be used to determine a mean school size. Therefore, it is critical that the confirmed schools accurately represent the size of schools in the survey area. Normally, schools believed to be confirmed for school size were approached to within 1 n. mile for large whales and to within 0.3 n. miles for minke whales. Allowing for context-specific differences (i.e. environmental conditions and animal behaviour), every effort was made to be consistent with regard to the maximum time spent on identification of species and confirmation of numbers. Normally, if the sighting was thought to be minke whales, no more than 20 minutes (after closure has been completed) was spent on confirmation,

this reduces the potential for confusion with other whale sightings in the vicinity (Anon, 2017a). Counts of individual cetaceans found for each sighting are provided in the Sighting summary (section 3.3). The summary provides best estimates of school sizes in the research area, except when indicated otherwise.

3.3 Sighting summary

Tabulations of cruise itinerary, ship time, trackline WPs, area codes, leg number codes, search effort and sightings recorded in the research area, by species and by survey modes are presented in Tables 1a-1e and 2a. Table 2b summarises all sightings observed throughout the cruise including those recorded during transit to and from the research area. Table 2c shows the identification of duplicate sightings observed during survey in the IO mode. Table 3 shows the sea surface temperature (minimum, maximum and range) for species sighted in the research area and provides quartile analysis for species sighted on multiple occasions. Recorded sea surface temperature (SST) ranged from 5.9 to 12.3°C during sightings observed in the research area (Table 3). Table 4a show the summary of the number of biopsy samples collected by each species. Tables 4b to 4f summarises NPRW, gray, humpback, fin and killer whale sightings, photography and biopsy effort during the cruise. Table 4g shows the summary of photographed sightings with Photo-ID results for individuals and biopsy results for each sighting. Tables 5a to 5e provide sighting-specific details for NPRW, gray, humpback, fin and killer whale sightings respectively, including photo-ID and biopsy information. Table 6 show the summary of all sonobuoy deployments, recording hours, and species detected. Table 7 show the summary of marine debris observations during the cruise.

Figure 1a illustrates the research area and transit course between Japan and the research area. Figure 1b illustrates the pre-determined trackline design and start/end points of tracklines in the research area. Figure 1c illustrates the waypoint number of the original trackline. Figures 2a through 2g illustrate locations of the main species sighted and search effort in the research area. Figure 3 shows the breakdown of research time, in hours by effort code in the research area. Figure 4 shows the location of all sonobuoy deployments and species detected. Figure 5 shows the breakdown of water depth (m) at the sighting position for the main species sighted in the research area. Appendix B compares weather conditions (wind speed / visibility) in the research area among past cruises.

Transit survey to the research area

The YS2 departed the port of Shimonoseki on schedule at 09:25 hrs, 03 July 2017. A safety instruction meeting and an emergency abandon ship drill were conducted on 04 July. Transit survey commenced using the passing mode at 07:20 on 05 July under acceptable weather conditions. Whale biopsy collection training using the Larsen darts system was conducted on 05 July. YS2 passed the dateline on 08 July at 54°-19'N when local ship time was adjusted from +12h to -12h GMT, therefore repeating several survey hours on 08 July. Total searching distance between 05 and 12 July was 288.3 n.miles (High Sea: 211.1 n.miles, US-EEZ: 77.2 n.miles). Total transit sightings included fin (2 schools/ 3 individuals), humpback (7/8) including one mother-calf pair, sperm (10/18) and killer (4/36) whales, and several dolphins and porpoises (Table 2c). Humpback (3 schools/ 3 individuals) and killer (2/14) whale sightings were approached for photo-ID experiments, with two humpback and four killer whales photo-identified. Two humpback whales were biopsy sampled in the high sea (Tables 4a and 4d). Six types of marine debris were recorded during observations which were restricted to the first 15 minutes of every hour during On-effort (Table 7). YS2 arrived at the Crowley dock at Captain's Bay in Dutch Harbor, Alaska, USA at 08:00 hrs, 13 July.

The research area

On 16 July, the YS2 departed Dutch Harbor from Spit dock and started the transit survey in the research area progressing northward. The YS2 arrived at the first WP in the northern part of the research area, finishing the transit survey on 18 July. YS2 started designated trackline surveys in the research area on 19 July at WP101: 65-27.4N, 167-45.2W. For the period between 16 to 22 July inclusive, a high pressure system resulted in good weather conditions. The water depths along the trackline were shallow (generally 20-50 meters) and the number of observed navigation ships and fishing boats was very low. Air temperature ranged from 7.4°C to 17.4°C, and sea temperature ranged between 4.9°C and 13.4°C. The exercise of distance and angle estimation was conducted on 19 July. Sightings consisted of: 13 schools (19 individuals) of gray whale, 6 schools (6 individuals) of common minke whale and one humpback whale. Eight gray whales were biopsy sampled.

During 23 to 29 July, the YS2 continued surveying southward in the research area mainly north and west of Nunivak Island. Overall during the week, low pressure systems resulted in poor visibility conditions. Water depths along the trackline were shallow (generally 20-70 meters) and the number of observed navigation ships and fishing boats was low. Air temperature ranged from 7.3°C to 14.5°C, and sea temperature ranged between 7.5°C and 11.8°C.

During 30 July to 05 August, the YS2 continued surveying southward in the research area mainly to the west and south of Nunivak Island. Overall during the week, low pressure systems resulted in poor visibility and rain conditions. Water depths along the trackline were shallow (generally 25-75 meters) and the number of observed navigation ships and

fishing boats was low. Air temperature ranged from 8.4°C to 13.6°C, and sea temperature ranged between 7.6°C and 10.3°C.

During 06 to 12 August, the YS2 continued surveying south-eastward in the research area, mainly east of Bristol Bay, and turned to the southwest almost on schedule. Overall during the week, low pressure systems resulted in intervals of poor visibility and rain conditions. Water depths along the trackline were shallow (generally 30-80 meters) and the number of observed navigation ships and fishing boats were few. Air temperature ranged from 10.1°C to 16.9°C, and sea temperature ranged between 9.7°C and 13.4°C. Sightings included 5 schools (11 individuals) of NPRWs. The majority of sightings were outside of the designated critical habitat for right whales in the Bering Sea, to the east (only 1 of the 11 individuals sighted inside the critical habitat). A total of 8 individuals were photographed and photo-identified and biopsy samples were collected from 3 individuals, including one suspected juvenile. A high-density area of fin and humpback whales was also observed. Biopsy attempts were abandoned for several fin whale sightings due to long dive times (15 to 20 minutes). Furthermore, due to shallow water depth (less than 20 meters), biopsy attempts were not conducted for one gray (mother-calf pair) and one fin (single individual) whale sighting due to safety considerations.

During 13 to 19 August, the YS2 continued surveying south-westward in the research area, crossing the designated critical habitat area for right whales, mainly north of St. Paul Island, and turned to the southeast almost on schedule. Overall during the week, low pressure systems resulted in poor visibility, rain conditions and storms. Water depths along the trackline were shallow until the western end of the trackline reached the shelf break, where they became deep (generally 70- 2,300 meters), and the number of observed navigation ships and fishing boats was low. Air temperature ranged from 8.2°C to 12.7°C, and sea temperature ranged between 9.1°C and 11.5°C. A fin whale high-density area was encountered to the north of St George Island, south of St. Paul Island.

During 20 to 26 August, the YS2 continued surveying south-eastward in the research area, mainly south of St. George Island and west of Unimak Island, and turned to the south-west near Unimak Pass almost on schedule. Overall during the week, low pressure systems resulted in long intervals of poor visibility, rain conditions, and heavy storms. Water depths along the trackline were generally deep, becoming shallow near Unimak Is. (generally 130-1,300 meters) and the number of observed navigation ships and fishing boats were high later in the week (maximum 10 fishing boats observed within a 24 n.miles range on 25 and 26 August). Air temperature ranged from 7.9°C to 16.1°C, and sea temperature ranged between 8.1°C and 11.0°C. 37 schools (46 individuals) of fin whales were sighted, from which biopsy samples were collected from 6 individuals.

During 27 August to 02 September, the YS2 continued surveying south-westward in the research area, mainly north of Unalaska Island and north of Bogoslof Island, an active volcano, and continued to the south-west near the Aleutian Islands almost on schedule. Overall during the week, low pressure systems resulted in long intervals of poor visibility, rain conditions, and heavy storms. Water depths along the trackline were generally deep, becoming shallow near Akutan Is. and Unalaska Is. (generally 85- 2,800 meters). Air temperature ranged from 7.4°C to 11.7°C, and sea temperature ranged between 6.8°C and 10.0°C.

During 03 to 10 September, the YS2 continued surveying south-westward in the research area, and completed the pre-designated trackline on 07 September, three days ahead of schedule due to low whale density in the first half of this week. Following the successful completion of on-track survey effort in the research area, efforts were redirected to a dedicated search for NPRW in the critical habitat using passive acoustic survey with no pre-determined trackline (therefore all NPRW sightings including duplicates sightings after 08 September were secondary sightings)..

On the night of 07 September YS2 headed for the northeast corner of the right whale critical habitat; a decision based on high density of sightings in that area in previous years as well as earlier during the 2017 POWER cruise. During 08 to 10 September, YS2 documented 4 schools of 7 individual NPRW, 3 of which were duplicates from earlier in the same week therefore adding 4 unique NPRW for a total of 12 photo-documented individuals during the cruise. NPRW were located acoustically after a dedicated search in the right whale habitat, therefore all NPRW sightings were secondary sightings. Overall during the week, low pressure systems resulted in short intervals of poor visibility and rain conditions. During this week, air temperature ranged from 7.6°C to 13.8°C, and sea temperature ranged between 5.9°C and 11.1°C.

During the 2017 POWER cruise, in the research area weather conditions were generally poor for the sighting survey. Low pressure weather systems resulted in long intervals of poor visibility, rain conditions, and heavy storms. Wind speed generally ranged between 15 to 20 knots, visibility was usually poor and swells reached over 3 meters (Appendix B).

A total of 1,571.0 n.miles of pre-designated, original trackline (NSP: 826.7 n. miles, IO: 744.3 n.miles) was surveyed in the research area, 71.9% of the planned distance of 2,183.7 n.miles. A total of 130.7 n.miles was surveyed during transit surveys in the research area e.g. transit from Dutch Harbor to the most northern WP and transit between end and start WPs between tracklines (Table 1e).

Sightings in the research area consist of: NPRW (9 schools /18 individuals, including 2 schools /3 individuals that were duplicates), gray (15/22), fin (143/195), common minke (23/23), humpback (129/157) and sperm (15/15) whales. Fin and humpback whales were the most frequently sighted large whale species. Gray whales were sighted early in the survey, north of 64°N. There were no sightings of blue or sei whales during the cruise.

On 10 September, YS2 completed surveys in the Bering Sea and arrived at Dutch Harbor on 13 September on schedule. US/UK researchers, Crance and Taylor disembarked at Dutch Harbor and Japanese researchers, Matsuoka and Yoshimura remained onboard for the completion of the transit back to Japan.

Transit survey to Yokosuka

YS2 departed Dutch Harbor at 15:15 on 14 September, two days earlier than scheduled at the recommendation of the local harbor authorities and ship agent, due to expected strong winds (>50 knots sustained). YS2 experienced heavy storm conditions during the transit survey to Japan (the port of Yokosuka) on 16 and 17 September (maximum wind speed was 62 knots and swell height was over 5 meters). The YS2 passed the dateline at 20:25 on 16 September (at 53°-30.0'N) and the ship date and time were changed from 16 September to 18 September (Tables 1a and 1b). YS2 departed US EEZ at 01:18 on 19 September at 50°-59.7'N, 168°-03.1'E and continued the transit survey until 23 September at 12:00 under heavy wind and/or rain conditions (Table 1e). There was no sighting survey effort during the transit from Dutch Harbor to Japan due to poor weather conditions, and no sightings in the US EEZ or high seas during the transit.

Detailed sightings by each species during the 2017 cruise are as follows:

North Pacific right whale (*Eubalaena japonica*)

A total of 9 schools (18 individuals) including 2 duplicate schools (3 individuals) of NPRW were sighted in the research area (Table 2a). Excluding known duplicates, 12 of the 15 individuals were photographed and photo-identified. Seven of the 12 unique NPRW, plus an additional three unphotographed individuals were sighted in Bristol Bay, approximately 50 n.miles east of their designated critical habitat. Five of the 12 unique individuals were sighted in the critical habitat area (Figure 2a). All whales were sighted in shallow water, with depth between 31 and 85 meters (Figure 5). Sea temperatures ranged from 11.6°C to 12.1°C (25th to 75th Quartile: 11.9 °C -12.0 °C) (Table 3). A total of 5 schools of 9 individuals (including 2 duplicate schools of 3 individuals) were detected by acoustics. Of these, all but one school (2 individuals) were detected during 08-10 September during the dedicated right whale acoustic survey. Biopsy samples were obtained from 3 individuals. Generally, long diving behaviours (from 12 to 18 minutes) were often observed. Details of each sighting are as follows:

A school of two NPRW on 06 August was detected approximately 32 n.miles from the trackline by acoustics (sighting number 017). Time taken to close after initial acoustic detection was approximately 4.5 hours. Photo-ID images were collected for both whales A and B and have been matched to whales in the NMML catalogue (Tables 4b and 5a). Whale A was biopsied (S/No 17081016), sex was previously unknown for this whale. One attempt was made to biopsy whale B, a known male, but no sample was obtained. Divots on both whales were documented, presumably from NMML tagging events in 2004. In general, whales were maintaining a consistent direction of travel during long, coordinated surfacings. Feeding was not observed although there were large numbers of shearwaters feeding in surface waters surrounding the whales. It was not possible to obtain a biopsy sample of whale B, or better photo-identification images of whale A due to failing light conditions and evasive whale behaviour. Acoustic data were collected from these individuals.

A school of six individuals (sighting number 015) on 08 August was detected by visual observations from the trackline. The school was initially sighted approximately 3 n.miles away surfacing within 0.1 n.miles of each other. During observations the whales dispersed to between 0.5 n.miles and 1.5 n.miles apart. Several fin whales were also observed (2 schools 5 individuals) during this sighting. Three of the right whales (whales A-C) were approached for photo-identification and have been matched to whales in the NMML catalogue (Tables 4b and 5a). Whale B was biopsied (S/No 17081019); NMML 84, whose sex was previously unknown. Two attempts were made to biopsy whale C but no sample was obtained due to inclement weather conditions (seastate 4 to 5, rain) and whale behavior (long dives, evasive). Whale A was observed feeding; surfacing with mouth closing and water being expelled. No right whale acoustic detections occurred prior to the sighting despite continuous monitoring; however, acoustic data were collected from the school after biopsy and photo-ID experiments concluded.

A single NPRW (sighting number 021) was detected by visual observations on 08 August during closing on a fin whale sighting. Photo-ID images were obtained. Attempts were made to collect a biopsy sample, but there was no opportunity to take a shot due to inclement weather and evasive whale behaviour. Based on time lapsed, location and distance of blows observed during sighting 015 on the same day, it is possible that this was one of the unphotographed whales from

sighting 015. Acoustic data were collected during this encounter.

A single NPRW (sighting number 047) was detected on 08 August by visual observations from the trackline. Photo-ID images were collected. The whale was not evasive and two attempts were made to collect a biopsy sample. However, no sample was obtained and biopsy attempts were abandoned due to inclement weather (seastate 4 to 5, rain). The whale was observed with mud on its head, presumably feeding close to the seafloor. Water depth during this sighting was 62 metres. Acoustics data collected during this sighting can confirm that this individual was not vocalizing during biopsy and photo-ID experiments.

During all three sightings on 08 August there were many other baleen whales in close proximity; (humpback, fin and minke whales), that were apparently feeding, based on short dive and surfacing times. Large, dense flocks of birds were also feeding in the area.

A single NPRW (sighting number 082) was detected on 09 August by visual observations from the trackline. Photo-ID images and a biopsy sample (S/No 17081020) were obtained. The suspected juvenile (estimated length 13.3m) was not evasive and was spending the majority of sighting time at the surface or in the shallow subsurface. The whale was observed briefly stalling at the surface and shaking its rostrum forward and back, possibly flushing its baleen although the mouth was not seen open during the sighting. Only a few calls were detected from this individual.

A school of two adult NPRW was detected on 08 September (sighting number 001). At 10:15, gunshots were detected, with a bearing of approx. 62° from the sonobuoy. A second sonobuoy was deployed, and at 11:21 an approximate location and distance to the calling animal was obtained. The position was 16 n.miles, at a bearing of 97° from the vessel's position. At 12:57 the two right whales were sighted 1 n.mile away from the acoustic localisation position. Biopsy attempts were made, but due to elusive whale behaviour and inclement weather, biopsy samples were not obtained. Photo-ID images were collected for both whales A (sex unknown) and B (female) and have been matched to whales in the NMML catalogue (Tables 4b and 5a). At initial sighting, the two whales were between 0.5 to 0.8 n.miles apart. The whales joined approximately 23 minutes into the sighting and brief surface active behaviour was observed, belly-to-back (belly of whale A to back of whale B). Following this, the whales were observed surfacing together within one body length, with the same heading. A divot scar was documented on the right lateral of whale B, presumably from the 2009 NMML tagging event.

A school of two adult NPRW was detected on 09 September (sighting number 001). Many calls were detected throughout the morning, indicating multiple callers at various locations. After radar indicated rain and fog for the other localisation positions, the decision was made to attempt to locate the whale in the area of least rain, whose position was approximately 7 n.miles southeast at 140° from the vessel's position. While transiting to that position, updated acoustic localisations at 09:57 showed a right whale approximately 5 n.miles to the west. The vessel redirected toward this location, and sighted the school at 12:08. Weather conditions were not suitable for biopsy attempts but photo-identification was obtained between periods of rain and reduced visibility. At the time of this report, one of the two whales has been matched to the NMML catalogue. Calls were again detected later in the afternoon, leading to a re-sighting of the whales (same sighting number).

A school of two NPRW was detected (sighting number 004 of one whale and re-sighting number 005 of both whales, duplicates of sighting number 001 on 09 September) on 10 September. Several NPRW calls were detected in the morning, indicating at least two callers. The position of one calling whale indicated that it was likely the whales from the previous day (09 September). In an attempt to locate new individuals, the vessel opted to search for the second calling animal approximately 8 n.miles to the east. Although weather conditions were ideal, the calling NPRW was not located. At 10:05 the decision was made to abandon the search for this animal and redirect back to the west, toward the calling animal. While transiting west, three different acoustic localisations indicated multiple calling animals in the vicinity. At 12:41 one NPRW was sighted (sighting number 004 singleton) and confirmed to be whale A from the previous day (sighting number 001 on 09 Sept). Additional photo-ID photographs were collected and biopsy attempts were made but due to long dive times (10 to 17 minutes) and evasive behaviour, biopsy attempts were unsuccessful. After localizing on another caller to the southeast, the vessel transited towards that direction. Two NPRW were sighted at 14:18 (sighting number 005) and confirmed to be whales A and B from the previous day (sighting number 001 on 09 Sept). Since the whales were not evasive during initial approaches, additional photo-ID photographs were collected and biopsy attempts were made. However, the whales' dive time increased and behaviour became more evasive, and biopsy attempts were unsuccessful. Efforts were abandoned around 15:50 and the vessel headed towards more localisations, approximately 11 n.miles to the southeast. No additional NPRW were sighted after this and due to failing light conditions and numerous whales of different species (humpback and fin whales) in the area, the survey was concluded at 18:00.

Photographs of NPRWs have been intermatched within and between sightings when there was a possibility of duplication. Preliminary results are given in Table 4b and sightings are summarized in Table 5a.

Fin whale (*Balaenoptera physalus*)

Fin whales were the most frequently encountered baleen whale species in the research area. Sightings were widely distributed in the southern part of the research area south of 58°N, and there were areas of high concentrations to the north and south of St. George Island, as well as north of Unimak Island (Figure 2b). A total of 143 schools (195 individuals including 3 calves) of fin whales were observed in the research area (Table 2a). Approximately 50 % of fin whales were sighted in shallow waters (depth between 31 and 200 meters); the rest were in deep water of depths over 1,000 meters (Figure 5). Sea temperatures ranged from 7.0°C to 12.2°C (25th to 75th Quartile: 9.4 °C -10.8 °C) (Table 3). Biopsy samples were obtained from 28 fin whales, including both individuals in a mother calf pair. In the high density area north of St. George Island, red colored faeces were observed on a few occasions while photographing sightings on 14 Aug. In the research area, long diving behaviours (from 10 to 18 minutes) were often observed. A total of 79 individuals from 63 schools (combined school size of 88) were photographed, of these 55 were photo-identified. Individuals have not been intermatched to check for duplicates (Tables 4e and 4g).

Humpback whale (*Megaptera novaengliae*)

Humpback whales were the second most frequently encountered baleen whale species in the research area. Sightings ranged from 53°N to 58°N. There were some areas of high concentration in Bristol Bay and west of Unimak Island, as well as north of Unalaska Island (Figure 2d). A total of 129 schools (157 individuals) were observed in the research area. No mother-calf pairs were observed. Sea temperatures ranged from 8.1°C to 12.3°C (25th to 75th Quartile: 10.1 °C -11.8 °C) (Table 3). Biopsy samples were obtained from 16 humpback whales (Table 4a). A total of 48 individuals from 38 schools (combined school size of 50) were photographed. Of these, 34 individuals were photo-identified for a total of 32 unique individuals since two were duplicates from previous days (Tables 4d and 4g).

Common minke whale (*Balaenoptera acutrostrata*)

Common minke whales were widely distributed in the northern part of the research area, between 55°N and 65°N with some areas of high concentrations in Bristol Bay (Figure 2c). A total of 23 schools (23 individuals) were observed. All whales were sighted in the shallow water depth less than 70 meters (Figure 5). Minke whales were observed at sea temperature from 9.7°C to 12.2°C (Table 3). Because of the difficulty in seeing their blow and small body, observations of this species were more difficult than in Antarctic waters. Common minke whale blows are very small, and are difficult to spot in rough sea surface conditions. During this survey, sea states averaged 4-5 on the Beaufort scale, which is assumed to be too rough for sighting common minke whales. A total of 6 individuals from 6 schools were photographed, one of which was photo-identified.

Gray whale (*Eschrichtius robustus*)

Gray whales were the second least frequently encountered baleen whale species in the research area and sightings ranged from 53°N to 58°N. There were some areas of high concentration in Bristol Bay and west of Unimak Island, as well as north of Unalaska Island (Figure 2d). A total of 15 schools (22 individuals, including one mother and calf pair) were seen in the research area. All whales were sighted in shallow water depths between 31 and 60 meters (Figure 5). Sea temperatures ranged from 9.6°C to 11.4°C. Biopsy samples were obtained from 9 gray whales (Table 4b). A total of 16 individuals from 13 schools (combined school size of 17) were photographed, of these 14 individuals were photo-identified and were all unique individuals (Tables 4c and 4g).

Sperm whale (*Physeter macrocephalus*)

Sperm whales were sighted in the southern part of the research area, south of 57°N where the water depth was over 200 meters (Figure 2f). A total of 15 schools (15 individuals) were recorded (Table 2c). Almost all whales were sighted in deep waters over 1,000 meters (Figure 5). Sperm whales were recorded in waters with SST ranging from 6.1° - 10.8°C with most individuals found in SST waters between 10.1-10.5°C (25th to 75th Quartile) (Table 3). No photographs or biopsy samples were collected from any sperm whales sighted.

Killer whale (*Orcinus Orca*)

Killer whales were sighted in the southern part of the research area, south of 59°N. There were some areas of high concentrations near Unimak Is., and west of Seguam Is. (Figure 2g). A total of 28 schools (98 individuals, including 6 calves) were sighted (Table 2a). Killer whales were sighted in waters with SST ranging from 5.9° - 11.5°C (25th to 75th Quartile: 6.0 °C -9.8 °C) (Table 3). Biopsy samples were obtained from 2 killer whale individuals (Table 4a). A total of 84 individuals from 22 schools (combined school size of 94) were photographed, of these 56 were photo-identified (Tables 4f and 4g). Individuals have not been intermatched to check for duplicates

3.4 Resighting During IO Mode

Resighting data were recorded for a total of 123 sightings during IO Mode. Table 2c shows the identification of duplicate sightings observed during survey in IO mode. Duplicate status was based on the number of sightings made by the Independent Observer Platform (IOP) that were observed also by the Topmen in the Standard TOP Barrel. For fin whales, there were 77 school sightings made by TOP or IOP and 31 schools made by IOP. Breakdown numbers of the 31 schools were 14 for “Definite duplicate” and 17 for “Not duplicate”. For humpback whales, there were 75 school sightings made by TOP or IOP and 31 schools made by IOP. Breakdown numbers of the 31 were 13 for “Definite duplicate” and 18 for “Not duplicate”. During this cruise, long diving behaviours (10 to 18 minutes) were often observed for fin and humpback whales, and visibility was not always clearly during the research area. These may have resulted in lower numbers of duplicates for these species.

3.5 Whale carcasses

Three whale carcasses were observed and photographed. One severely decomposed baleen whale carcass was documented on 18 July (64-08.3N, 168-08.6W). It appeared to be a female, although species could not be determined. One moderately decomposed male humpback whale carcass was documented on 04 August (58-32.9N, 163-45.4W). One severely decomposed common minke whale carcass was documented on 10 August (57-13.3N, 164-29.6W). No biopsy samples were collected due to heavy state of decomposition.

4. PHOTOGRAPHIC DATABASE

Six different photo-ID species were photographed during the 2017 IWC-POWER cruise. A total of 273 individuals in 151 schools were approached close enough to obtain photo-identification images. Of those, 248 individuals were photographed and 175 were photo-identified within schools, not all have been intermatched to check for duplicates (see 4.1). Photo-ID species encountered included: Fin (88 individuals approached / 79 photographed), humpback (50 / 48), gray (17 / 16), North Pacific right (18 / 15), killer (94 / at least 84) and common minke (6 / 6) whales (Table 4a). Harbour (5 individuals) and Dall’s (15) porpoises were also photographed but not analysed for unique individuals.

Images collected during the cruise were uploaded to the IWC master photographic database in Adobe Lightroom (LR). Preliminary coding was completed for all cetacean images (20,239), including the allocation of species name, sighting number, school size and biopsy effort. Full coding involved analysing each image in LR for various health, behaviour and unique identification parameters, which were written to the image metadata as keywords. Star ratings were allocated for image quality and colours were assigned for photo-identification purposes. This thorough image-by-image analysis was conducted for all sightings up to and including 15 August, as well as all gray whale images (2,162) and the majority of NPRW (3,484 of 5,511 images), humpback (1,362 of 3,621) and fin (2,602 of 5,394) whale images. Photographs of low priority species and carcasses were marked to be fully coded at a later date, time permitting. This included the majority of killer whale, around half of minke whale and all porpoise photographs. Images of non-cetaceans were archived.

4.1 Individual Identification

Sighting rates were high for five photo-ID species encountered during the 2017 POWER survey; NPRW, gray, fin, humpback and killer whales. Images of photo-ID species were reviewed at the end of each survey day to confirm number of unique individuals per sighting. Individuals were reviewed for images that documented identification features and met catalogue-quality criteria e.g. perpendicular angle for dorsal fins. Primary ID features were species-specific: ventral flukes for humpbacks; left or right head for right whales; laterals (left or right) or flukes (dorsal or ventral) for gray whales; dorsal fin or right head blazed chevron for fin whales; and dorsal fin or saddle patch for killer whales. Individuals that had one or more image(s) of a Primary ID feature that adhered to catalogue-quality criteria, were considered photo-identified for the purpose of this report (Tables 4a, c-g). Secondary ID features were useful for photo-identification but not sufficient alone e.g. humpback whale dorsal fins or scars anywhere on the body.

The IWC LR database is not a photo-identification catalogue but is designed to categorise images for contribution to various research interests, including photo-identification. During the 2017 POWER cruise, the best primary ID feature image(s) and the best secondary feature image(s) of individuals were coded ‘Photo-identification’ in LR. If no images of primary features met the criteria, the individual was not considered photo-identified for the purpose of this report, and no images were coded ‘Photo-identification’ in LR, not even excellent-quality secondaries.

The logic: species-specific catalogues are based on primary ID features, therefore even if a secondary feature e.g. scar, is well documented making the whale easy to match, this whale could potentially never be matched to catalogue

primaries that do not show the distinct mark (or to images of the whale prior to acquiring the scar). All images ‘useful for photo-identification’ are labelled green in LR, regardless of whether the whale is photo-identified or not.

Photo-identification results are **preliminary** and subject to change after further processing by catalogue curators. Individuals that were documented to catalogue-quality standards were provisionally identified, including: 15 right (12 unique individuals), 14 gray (all unique; including one calf of a mother-calf pair), 34 humpback (32 unique individuals), 55 fin (not yet intermatched for duplicates; including 2 mother-calf pairs), 1 minke and 56 killer whales (not yet intermatched for duplicates; including 1 calf) (Table 4a, c-g). Images will be made available for incorporation into respective catalogues.

5. BIOPSY SAMPLING

Biopsy samples were collected for 60 individual whales: 3 North Pacific right, 28 fin, 18 humpback, 9 gray and 2 killer whales (Table 4b). Every biopsy encounter was documented photographically. All biopsy samples were catalogued and stored in cryo-vials frozen at a temperature of -30°C on the vessel. These samples will be used for molecular genetics analyses. All biopsy samples collected in the US EEZ were sent to SWFSC post cruise after arrival at Dutch Harbor, Alaska, USA under the responsibility of the CL and US researcher, Crance. So that replicate genetic analyses can take place for the biopsy collection (i.e., an IWC study to take place at the SWFSC genetics laboratory in the USA and a separate, concurrent study to be conducted by the Japanese Fisheries Agency at the NRIFSF laboratory), all individual biopsies were cut in half on board. This provided two equivalent biological samples for separate analysis at the respective laboratories noted above. Samples for Japan will be sent to the NRIFSF laboratory as soon as possible from SWFSC under the responsibility of the SWFSC genetic scientist. A summary of the number of individuals biopsied during this cruise is shown in Table 4b. These biopsy skin samples will enable genetic studies on stock structure to be conducted and samples of blubber will be analysed for contaminants, hormones and fatty acids.

5.1 Biopsy data management

As in past years, biopsy darts were numbered and color-coded and each biopsy shooter used either red or black labelled darts. This allowed us to track which whale was sampled. At the commencement of each biopsy sampling encounter, effort code “BX” was recorded and after a sample was collected, effort code “EX” was recorded by the researcher on the upper bridge. The time of each biopsy hit was captured photographically, and the exact biopsy time of each biopsy hit was written on the foil wrap for each sample before it was taken to the biopsy lab.

5.2 Biopsy efficiency

Biopsy duration times were evaluated to examine biopsy efficiency (Table 4a). Biopsy success rate when approaching NPRW for sampling was very low compared to other species during this cruise. Success rates for each species were 18.8% (n=16) for NPRW, 69.2% (n=13) for gray, 43.8% (n=64) for fin, 60.0% (n=30) for humpback and 22.2% (n=9) for killer whales. The main cause of low success rates of NPRW and fin whales was long diving behaviour instead of fast, surface swimming (approx. 10-18 min. diving). Median time of biopsy effort duration from setup to sample retrieval when sampling each species was 49.0 minutes for NPRW, 44.0 minutes for gray, 13.5 minutes for fin, 19.5 minutes for humpback and 26.0 minutes for killer whales. Biopsy sampling was attempted as often as time permitted under acceptable environmental conditions.

6. VIDEO-RECORDING

A digital video camera recorder, Sony HDR-PJ800, AVCHD progressive was used to conduct opportunistic video recording. 17 separate video clips (8 schools) were recorded for a total time of 00:19:38, including 00:11:06 of fin whale surfacing and biopsy events, 00:04:49 of gray whale surfacing and biopsy events and 00:03:43 of humpback whale surfacing and biopsy events.

7. ACOUSTIC DATA COLLECTION

A total of 240 sonobuoys were deployed during the cruise (Appendix 5). Of these, 219 deployed and transmitted successfully for an overall success rate of 91.3% (Table 6). A total of over 841 hours of acoustic monitoring occurred during the survey. The location of sonobuoy deployments and species detected are shown in Figure 4. The most common species detected were fin whales, detected on 46.7% of sonobuoys (112 buoys), followed by killer whales (49 buoys, 20.4%), sperm whales (44 buoys, 18.3%), right whales (38 buoys 15.8%), and humpback whales (23 buoys, 9.6%). Other species detected include walrus (9 buoys, 3.8%), probable fish grunts (6 buoys, 2.5%), gray whales (4

buoys, 1.7%), unknown detections (4 buoys, 1.7%), seismic airguns (2 buoys, 0.8%), and probable Cuvier's beaked whale clicks (1 buoy, 0.4%).

Of the 9 total right whale sightings, 5 were localized using sonobuoys. Maximum detection distance for right whales was approximately 40 n.miles. In-air reception range averaged 17 nm for the yagi antenna (maximum 19 nm), and 13 nm (maximum 14 nm) for the omni antenna. In addition to spatial distribution data of all marine mammals, valuable acoustic data on gunshot pattern production by NPRW were collected during this survey. These data, along with data from other surveys and long-term acoustic recorders, will contribute to a manuscript on stereotyped gunshot pattern production by the NPRW, to be submitted by Crance et al.

8. OTHER EXPERIMENTS

8.1 Estimated Angle and Distance Training Exercise

The Estimated Angle and Distance Training Exercises were conducted on the afternoon of 18 and 19 July for a total duration of 2 hours 42 minutes. During the exercise observers familiarised themselves with distance estimates from the top barrel and upper bridge. Following advice from the SC and the TAG, the 2017 survey adopted several improvements for this experiment (IWC, 2017a). The improvements were: (1) use of relatively inexpensive GPS technology (a durable waterproof model) on the buoy to improve detectability (a) at greater distances and (b) in more realistic sea/weather conditions than may be possible using the present radar system; (2) use of two buoys which can (a) reduce the potential lack of independence while using only one buoy with the correct experimental protocols and (b) allow increased efficiency which will assist when having a greater distance range and when including researchers as well as the crew in the experiment using the recommended buoy (to simulate a whale's body rather than the blow).

8.2 Estimated Angle and Distance Experiment

The Estimated Angle and Distance Experiments were conducted on 06 August for 6 hours 10 minutes whilst in the research area. A total of 84 trials were conducted for each platform (top and IO barrels and upper bridge). Both of the estimated Angle and Distance Training Exercises and Estimated Angle and Distance Experiments were performed using the improved protocol (IWC, 2017b). Details of the results will be analysed and reported to the TAG after the conclusion of the cruise.

8.3 Marine debris observations

During this cruise as in past years, data on floating marine debris were collected to document the type and extent of marine debris present in the North Pacific. As agreed during the pre-cruise meeting in Shimonoseki, systematic data collection of marine debris was limited to the first 15 minutes of each hour, as time permitted (not to interfere with marine mammal observations). In addition, opportunistic marine debris data were recorded and photographed if items were particularly large and/or could potentially lead to large whale entanglements. For all recorded marine debris items, observers recorded angle, distance and time of initial sighting, IWC code and a description. Photographed items were archived and will be available to those interested in these data.

Marine debris was very few and sparsely distributed during this cruise compared to previous years (Matsuoka *et al.* 2013; Matsuoka *et al.*, 2014). A total of 12 marine debris objects were observed. 9 of 12 were recorded "on effort" (i.e., during the first 15 minutes of each hour) and 3 of 12 were recorded during "off effort" (Table 5). A total of 6 objects were recorded in the US EEZ (Appendix Table C7).

9. TECHNICAL MATTERS OF DATA AND RECOMMENDATIONS

9.1 Photography equipment

All camera equipment was successfully tested prior to departure from Japan. However, the Nikon D7000 developed two faults that were not possible to fix in Dutch Harbor: a small spot on the sensor and a faulty GPS port. Nikon images collected during the 2017 cruise are not georeferenced (Canon EOS 7D images are georeferenced as usual). GPS data will be added to the metadata after conclusion of the cruise by synching with location data. The image sensor and mirror were cleaned, improving performance but not completely removing dirt on the sensor. Image quality was still better than the backup Canon EOS 20D and therefore the Nikon D7000 remained the primary photo-ID camera. It is **recommended** that the Nikon body is sent for Nikon-authorized servicing after return to Japan. It is **recommended** that all cameras, including backup Canon cameras also undergo servicing and routine maintenance. If the faults with the Nikon D7000 cannot be repaired, it is **recommended** that a replacement camera be purchased.

9.2 Photographic data collection

Previously it has been recommended that VHF marine radios be purchased for use by photographers. On the 2017 cruise, photographers used radios on loan from NOAA. During photo-ID experiments of killer whales with large school sizes that were dispersed, radio communications were particularly useful. It was possible to coordinate between researchers on separate platforms in order to maximise the number of individuals that were photographed, rather than have three isolated photographers all focusing on the closest animal. It is **recommended** that VHF radios are available for future cruises.

9.3 Photographic database processing in Lightroom (LR)

Images collected during the cruise were uploaded to LR and preliminarily coded. By processing images directly in LR, post-cruise processing time is greatly reduced. Furthermore, it allows for real-time photo-analysis summaries and expedites image access/sharing. It is **recommended** that researchers on future cruises continue LR processing. It is recommended that guidance documents specific for photo-processing during the cruise and the IWC LR Photographic Database Manual are kept up-to-date and that hard and electronic copies are made available on future cruises. A new IWC-POWER laptop with fast processor, high resolution wide screen and ample memory and drive storage was available on the 2017 cruise for digital photography processing. This was a welcomed upgrade and considerably improved the efficiency of photographic data processing. It is **recommended** that LR is installed on the IWC-POWER laptop with an up-to-date catalogue prior to the 2018 POWER cruise.

9.4 Acoustic equipment

At the start of the cruise, the acoustic technician ran into difficulties with the monitoring equipment. The ship's power is 100 V/50 Hz. Although the US-based equipment had converters that would accept power in the range of 100 – 240 V and 50-60 Hz, it seemed as though there were power issues with the soundcard. The primary soundcard would lose power and drop the audio input randomly, multiple times throughout the course of one sonobuoy deployment. One theory was that due to the large number of electronic equipment all plugged into the outlets at the monitoring station desk, perhaps it was drawing too much power and the interface was not receiving the required amount. It remains unknown whether this caused the failure in the soundcard or not. However, switching to the backup soundcard, and plugging it into a separate outlet of 220 V did not cause a repeat of the issue, and the soundcard operated well for the remainder of the cruise. Therefore, it is **recommended** that at least one plug of a secondary power source of greater than 100 V (but not exceeding 240 V) be provided at the acoustic monitoring station. Additionally, due to the sensitivity of the acoustic equipment to power surges, drops in power, or the interference of electronic signals (manifesting in the form of frequency bands in the recordings), it is **recommended** that a Universal Power Supply (UPS) be provided to allow for clean power to the equipment. A VHF marine radio is essential for cruises that include acoustic monitoring. Because acoustic monitoring is occurring in the acoustic technician's cabin, a VHF radio allows the acoustic technician to communicate with the visual observers and groundtruth the acoustic detections with the sightings and species information. It is **recommended** that handheld VHF radios be provided in future cruises.

10. CONCLUSIONS

The 8th annual IWC-POWER cruise was successfully conducted using the Japanese R/V *Yushin-Maru No.2* under approved international status. Dutch Harbor was used for shipping, refuelling and boarding international researchers. The inclusion of acoustic data collection was successfully conducted and detected numerous marine mammal species, in addition to localizing on 5 of the 9 North Pacific right whale sightings. All equipment and survey methods were consistent with previous IWC international cetacean sighting surveys. Sighting procedures were in accordance with guidelines agreed upon by the SC (IWC, 2012). Survey objectives, methods and procedures were discussed and agreed upon by the Captain, officers, crew and international researchers prior to survey operations. Throughout the cruise, all participants worked collaboratively to meet overall research objectives. Data collected, including sighting records, photographic, video data, acoustic and biopsy samples have been submitted to the IWC secretariat by the cruise leader and confirmed on xx 2017. The 8th cruise of this programme provides critical information on the distribution, abundance and stock structure of baleen whale species, in particular gray and North Pacific right whales, in a poorly-known and logistically difficult area. Additional information on other cetacean species in particular fin, humpback and sperm whales, found to be widely distributed in the southern part of the research area will contribute to an improved understanding of species/population movements in areas of the North Pacific where there has been little to no survey effort in recent decades. These results contribute to the objectives of the IWC/SC.

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TABLES AND FIGURES

Table 1a. The 2017 cruise itinerary. Area code and no. of trackline were used for the effort record for this cruise.

Date (GMT) y/m/d	Time (GMT)	Date (SMT) y/m/d	Time (SMT)	Area code	Ttack Line	Leg No	Position		Remark
2017/7/3	0:25	2017/7/3	9:25	-	-	-	-	-	Departed Shimonoseki, Japan
2017/7/3	20:50	2017/7/4	6:50	1	1	001	37° 18.7'N	134° 24.0'E	Started transit survey to Dutch Harbor (D. H.)
2017/7/8	12:00	2017/7/8	1:00	1	1	001	47° 38.3'N	162° 28.7'E	Adjusted ship's Time, repeated date of 8 th July
2017/7/9	13:25	2017/7/9	3:25	11	1	001	50° 55.5'N	168° 07.9'E	US EEZ in
2017/7/11	8:25	2017/7/10	23:25	11	1	001	54° 19.0'N	180° 00.0'	Crossed the meridian of 180° (Date Line)
2017/7/13	2:00	2017/7/12	18:00	11	1	001	54° 20.8'N	168° 34.6'W	Finished Transit survey
2017/7/13	16:00	2017/7/13	8:00	-	-	-	-	-	Arrived D. H.
2017/7/16	18:00	2017/7/16	10:00	70	1	801	53° 54.3'N	166° 30.7'E	Departed D. H. and started transit to WP101
2017/7/19	3:00	2017/7/18	18:00	70	1	803	64° 47.8'N	167° 55.8'W	Finished Transit to WP101
2017/7/19	15:00	2017/7/19	6:00	71	1	101	65° 27.3'N	167° 45.4'W	Started R.A
2017/9/8	2:08	2017/9/7	14:08	71	1	134	53° 31.9'N	170° 36.4'W	Finished R.A
2017/9/8	2:08	2017/9/7	14:08	70	1	811	53° 31.9'N	170° 36.4'W	Started transit survey to D. H.
2017/9/12	20:00	2017/9/12	12:00	70	1	811	54° 56.3'N	165° 55.9'W	Finished Transit survey to D. H.
2017/9/13	17:40	2017/9/13	9:40	-	-	-	-	-	Arrived D. H.
2017/9/14	23:15	2017/9/14	15:15	12	1	002	53° 51.1'N	166° 34.4'W	Departed D. H. and started transit to Shioyama
2017/9/17	6:25	2017/9/16	20:25	12	1	002	53° 30.0'N	180° 00.0'	Crossed the meridian of 180° (Date Line)
2017/9/17	11:00	2017/9/17	1:00	12	1	002	53° 24.7'N	178° 04.5'E	Adjusted ship's Time, skipped date of 17 th Sep.
2017/9/18	13:18	2017/9/19	1:18	2	1	002	50° 59.7'N	168° 03.1'E	US EEZ out
2017/9/24	3:00	2017/9/23	12:00	-	-	-	36° 09.0'N	139° 01.4'E	Finished Transit
2017/9/24	23:00	2017/9/25	8:00	-	-	-	-	-	Arrived Yokosuka, Japan

Table 1b. Summary of the “Ship's Time Adjustment” Schedule during 2017 Cruise. JST: Japan time.

Date	Ah'd/Ab'k	Balance	Ship's time	Remarks
2017/7/3	-	GMT+9.0h	JST	Depart Shimonoseki, Japan
2017/7/4	Ah'd 60min	GMT+10.0h	JST+1.0h	Transit to Dutch Harbor (D.H.)
2017/7/5	Ah'd 60min	GMT+11.0h	JST+2.0h	-
2017/7/6	Ah'd 60min	GMT+12.0h	JST+3.0h	-
2017/7/8	Ah'd 60min	GMT-11.0h	JST-20.0h	Repeated date of 8th July
2017/7/9	Ah'd 60min	GMT-10.0h	JST-19.0h	-
2017/7/10	Ah'd 60min	GMT-9.0h	JST-18.0h	-
2017/7/11	Ah'd 60min	GMT-8.0h	JST-17.0h	-
2017/7/17	Ab'k 60min	GMT-9.0h	JST-18.0h	Transit from D. H. to WP101
2017/7/22	Ab'k 60min	GMT-10.0h	JST-19.0h	-
2017/8/12	Ab'k 60min	GMT-11.0h	JST-20.0h	-
2017/8/29	Ab'k 60min	GMT-12.0h	JST-21.0h	-
2017/9/8	Ah'd 60min	GMT-11.0h	JST-20.0h	-
2017/9/9	Ah'd 60min	GMT-10.0h	JST-19.0h	-
2017/9/11	Ah'd 60min	GMT-9.0h	JST-18.0h	-
2017/9/12	Ah'd 60min	GMT-8.0h	JST-17.0h	-
2017/9/16	Ab'k 120min	GMT-10.0h	JST-19.0h	-
2017/9/17	Ab'k 60min	GMT-11.0h	JST-20.0h	Skipped date of 17th September
2017/9/19	Ab'k 60min	GMT+12.0h	JST+3.0h	-
2017/9/20	Ab'k 60min	GMT+11.0h	JST+2.0h	-
2017/9/21	Ab'k 60min	GMT+10.0h	JST+1.0h	-
2017/9/22	Ab'k 60min	GMT+9.0h	JST	Arrived Yokosuka, Japan

Table 1c. Way Points (WP) and each survey mode in the research area. The planned original cruise track line distance in the research area was 2,183.7 n.miles (original trackline, see Figure1c).

WP	Latitude	Longitude	Co.	Distance	Mode	WP	Latitude	Longitude	Co.	Distance	Mode
101	65°27.4'N	167°45.2'W	234°	17.8	NSP	121	57°38.8'N	160°17.5'W	259°	83.0	IO
102	65°16.9'N	168°19.6'W	234°	17.8	IO	122	57°23.5'N	162°49.0'W	259°	83.0	NSP
103	65°06.4'N	168°53.8'W	-	-	-	123	57°08.2'N	165°19.5'W	259°	83.0	IO
104	64°45.2'N	168°50.0'W	117°	56.1	NSP	124	56°52.9'N	167°49.0'W	259°	83.0	NSP
105	64°19.7'N	166°54.1'W	117°	56.1	IO	125	56°37.6'N	170°17.5'W	259°	83.0	IO
106	63°54.3'N	165°00.0'W	-	-	-	126	56°22.3'N	172°44.9'W	-	-	-
107	63°24.2'N	165°00.0'W	247°	59.4	NSP	127	56°12.5'N	172°50.2'W	107°	73.0	NSP
108	63°01.4'N	167°01.3'W	247°	59.3	IO	128	55°51.0'N	170°45.6'W	107°	72.9	IO
109	62°38.6'N	169°00.8'W	-	-	-	129	55°29.5'N	168°42.4'W	107°	72.9	NSP
110	62°06.2'N	169°21.8'W	106°	45.9	NSP	130	55°08.1'N	166°40.2'W	107°	72.9	IO
111	61°53.9'N	167°47.9'W	106°	45.9	IO	131	54°46.6'N	164°39.1'W	-	-	-
112	61°41.6'N	166°14.6'W	-	-	-	132	54°27.3'N	165°00.0'W	255°	88.0	NSP
113	60°16.5'N	165°21.9'W	256°	86.3	NSP	133	54°04.3'N	167°25.1'W	255°	88.1	IO
114	59°55.7'N	168°09.5'W	256°	86.3	IO	134	53°41.2'N	169°49.0'W	255°	88.0	NSP
115	59°34.9'N	170°55.4'W	-	-	-	135	53°18.2'N	172°11.5'W	255°	88.1	IO
116	59°19.4'N	171°04.6'W	102°	106.5	NSP	136	52°55.1'N	174°32.8'W	-	-	-
117	58°58.1'N	167°41.6'W	102°	106.6	IO	137	52°51.9'N	174°34.4'W	115°	42.3	NSP
118	58°36.7'N	164°20.6'W	102°	106.5	NSP	138	52°33.7'N	173°31.5'W	115°	42.3	IO
119	58°15.4'N	161°01.7'W	102°	106.6	IO	139	52°15.5'N	172°29.1'W	-	-	-
120	58°54.1'N	157°44.7'W	259°	83.1	NSP						

Table 1d. List of area code and leg number code used for the effort record during 2017 cruise.

Area Code	Definition
1	Transit survey from Shimonoseki to Dutch Harbor (High Sea)
11	Transit survey from Shimonoseki to Dutch Harbor (US-EEZ)
70	Research area (Transit survey from Dutch Harbor to WP101 and Leg 802-811, US-EEZ)
71	Research area (original track line WP101-WP139, US-EEZ)
12	Transit survey from Dutch Harbor to Shioyama (US EEZ)
2	Transit survey from Dutch Harbor to Shioyama (High Sea)

Leg.No code	Definition
801	Transit survey from Dutch Harbor to WP101
802	Transit survey from WP106 to WP107
803	Transit survey from WP109 to WP110
804	Transit survey from WP112 to WP113
805	Transit survey from WP115 to WP 116
806	Transit survey around WP120
807	Transit survey from WP126 to WP127
808	Transit survey from WP131 to WP132
809	Transit survey to WP139
810	Transit survey from WP137 to WP136
811	Transit survey to Dutch Harbor

Table 1e. Summary of the searching effort (time and distance) and experimental time (hours) by each survey with the area code conducted during 2017 Cruise.

Area	Start	End	NSP		IO		NSP+IO		Photo-ID, Biopsy	Estimated angle and distance training / experiment
	Date	Date	Time	Dist. (n.m.)	Time	Dist. (n.m.)	Time	Dist. (n.m.)	Time	Time
	Time	Time								
Shimonoseki to Dutch Harbor (High Sea) (1)	4-Jul.	8-Jul.	17:31:06	211.11	0:00:00	0.00	17:31:06	211.11	1:19:52	0:00:00
	6:50	18:00								
Shimonoseki to Dutch Harbor (US EEZ) (11)	9-Jul.	12-Jul.	6:26:29	77.17	0:00:00	0.00	6:26:29	77.17	0:19:22	0:00:00
	7:40	18:00								
Research area (Leg 801-811, US EEZ) (70)	16-Jul.	12-Sep.	11:07:55	130.71	0:00:00	0.00	11:07:55	130.71	7:56:08	1:50:07
	10:00	12:00								
Research area (WP101-139, US EEZ) (71)	19-Jul.	7-Sep.	71:46:24	826.66	64:22:23	744.26	136:08:47	1,570.92	44:20:44	8:52:24
	6:00	14:08								
Dutch Harbor to Yokosuka (US EEZ) (12)	14-Sep.	18-Sep.	0:00:00	0.00	0:00:00	0.00	0:00:00	0.00	0:00:00	0:00:00
	15:15	18:00								
Dutch Harbor to Yokosuka (High Sea) (2)	19-Sep.	24-Sep.	0:00:00	0.00	0:00:00	0.00	0:00:00	0.00	0:00:00	0:00:00
	7:35	12:00								
Total	4-Jul.	24-Sep.	106:51:54	1,245.65	64:22:23	744.26	171:14:17	1,989.91	53:56:06	10:42:31
	6:50	12:00								

Table 2a. Number of sightings for all species observed in the research area (Original trackline and transit tracklines) by effort mode. NSP: Normal Passing with abeam closing Mode; IO: Independent Observer Mode (IO), OE: Top down (TD) and drifting (DR). Numbers of Individuals are included the number of calves.

Species	NSP			IO			OE			Total		
	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf
Fin whale	52	69	1	79	114	2	12	12	0	143	195	3
Like fin	4	5	0	8	8	0	5	7	0	17	20	0
Common minke whale	7	7	0	6	6	0	10	10	0	23	23	0
Like minke	1	1	0	0	0	0	0	0	0	1	1	0
Humpback whale	29	36	0	76	95	0	24	26	0	129	157	0
Like humpback	0	0	0	7	10	0	2	2	0	9	12	0
North pacific right whale	1	1	0	2	7	0	4	7	0	7	15	0
Like right whale	0	0	0	0	0	0	2	2	0	2	2	0
Gray whale	7	12	0	8	10	1	0	0	0	15	22	1
Sperm whale	3	3	0	12	12	0	0	0	0	15	15	0
<i>Ziphiidae</i>	2	3	0	0	0	0	0	0	0	2	3	0
Killer whale	8	29	1	17	60	3	3	9	2	28	98	6
Habour porpoise	5	9	0	1	2	0	0	0	0	6	11	0
Dalli type Dall's porpoise	3	18	0	8	39	0	10	57	0	21	114	0
Unid. type Dall's porpoise	3	10	0	7	37	0	0	0	0	10	47	0
Unid. large baleen whale	0	0	0	1	1	0	0	0	0	1	1	0
Unid. small cetacean	2	2	0	0	0	0	0	0	0	2	2	0
Unid. cetacean	3	3	0	2	2	0	0	0	0	5	5	0

Table 2b. Number of sightings for all species observed during 2017 cruise. Numbers of Individuals include number of calves.

Species	Transit to Dutch Harbor (High Sea, area code 1)			Transit to Dutch Harbor (US EEZ, area code 11)			Research area (US EEZ, area codes 70, 71)			Transit to Shioyama (US EEZ, area code 12)			Transit to Shioyama (High Sea, area code 2)			Total		
	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf
Fin whale	0	0	0	2	3	0	143	195	3	0	0	0	0	0	0	145	198	3
Like fin	0	0	0	0	0	0	17	20	0	0	0	0	0	0	0	17	20	0
Common minke whale	0	0	0	0	0	0	23	23	0	0	0	0	0	0	0	23	23	0
Like minke	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	2	2	0
Humpback whale	2	2	0	5	6	1	129	157	0	0	0	0	0	0	0	136	165	1
Like humpback	0	0	0	0	0	0	9	12	0	0	0	0	0	0	0	9	12	0
North Pacific Right whale	0	0	0	0	0	0	7	15	0	0	0	0	0	0	0	7	15	0
Like right	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	2	0
Gray whale	0	0	0	0	0	0	15	22	1	0	0	0	0	0	0	15	22	1
Sperm whale	9	17	0	1	1	0	15	15	0	0	0	0	0	0	0	25	33	0
<i>Ziphiidae</i>	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	2	3	0
Killer whale	2	14	0	2	22	1	28	98	6	0	0	0	0	0	0	32	134	7
Pacific white-sided dolphin	7	168	6	0	0	0	0	0	0	0	0	0	0	0	0	7	168	6
Northern right whale dolphin	1	210	10	0	0	0	0	0	0	0	0	0	0	0	0	1	210	10
Harbour porpoise	0	0	0	0	0	0	6	11	0	0	0	0	0	0	0	6	11	0
Dall's type Dall's porpoise	8	35	0	0	0	0	21	114	0	0	0	0	0	0	0	29	149	0
Unid. type Dall's porpoise	3	12	0	1	3	0	10	47	0	0	0	0	0	0	0	14	62	0
Unid. large baleen whale	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0
Unid. small cetacean	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	2	0
Unid. dolphin	3	67	0	0	0	0	0	0	0	0	0	0	0	0	0	3	67	0
Unid. cetacean	1	1	0	0	0	0	5	5	0	0	0	0	0	0	0	6	6	0

Table 2c. Identification of duplicate sightings (main species) observed during survey in Independent Observer (IO) mode. Duplicate status was based on the number of sightings made by the Independent Observer Platform (IOP) that were observed also by the Topmen in the Standard TOP Barrel. Status codes: D - Definite duplicate, P - Possible duplicate, R - Remote duplicate, N - Not duplicate.

Species	Number of all schools sighted made by TOP & IOP	Number of schools made by IOP	Duplicate Status			
			D	P	R	N
Fin whale	77	31	14	0	0	17
Like fin	8	1	0	0	0	1
Humpback whale	75	31	13	0	0	18
Like humpback	7	4	2	0	0	2
North Pacific right whale	2	1	1	0	0	0
Gray whale	8	3	1	0	0	2
Common minke whale	3	1	0	0	0	1
Sperm whale	12	3	3	0	0	0

Table 3. Minimum, maximum and range of sea surface temperatures in degrees Celsius for each species sighted during the research area (original trackline). Also noted are the number of sightings for each species. Range of 25th to 75th quartiles are presented for our most frequently encountered cetaceans.

Species	Number of sightings	Minimum SST	Maximum SST	Temperature range	25 th to 75 th Quartile
Fin whale	140	7.0	12.2	5.2	9.4-10.8
Common minke whale	23	9.7	12.2	2.5	10.4-11.7
Humpback whale	124	8.1	12.3	4.2	10.1-11.8
North Pacific right whale	5	11.6	12.1	0.5	11.9-12.0
Gray whale	15	9.6	11.4	1.8	10.1-11.1
Sperm whale	15	6.1	10.8	4.7	10.2-10.5
<i>Ziphiidae</i>	2	10.3	11.5	1.2	10.6-11.2
Killer whale	26	5.9	11.5	5.6	6.0-9.8
Harbour porpoise	6	7.5	9.7	2.2	7.8-8.3
Dalli type Dall's porpoise	16	8.8	11.6	2.8	9.9-11.1

Table 4a. Summary of the number of biopsy samples collected by each species. *: includes samples from one mother-calf pair and one mother (calf not sampled).

Biopsy samples	N.P. Right	Fin	Humpback	Gray	Killer	Total
Transit to Dutch Harbor (High Sea, area code 1)	0	0	2	0	0	2
RA (US EEZ, area codes 70, 71)	3	28*	16	9	2	58
Transit to Shioyama (High Sea, area code 2)	0	0	0	0	0	0
Total	3	28	18	9	2	60

Table 4b. Summary of North Pacific right whale sightings, photography and biopsy effort during the cruise (see table 5a for detailed sighting summary). R.A.: Research Area. *: include 2 duplicates (schools), **: includes 3 duplicates, total of 12 unique individuals

N.P. right	Total Sightings		Ind. Biopsy	Sch. Photo-graphed	Sch size of Photo'd Schools	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch.	Ind.					
Transit from Shimonoseki to Dutch Harbor (High Sea)	0	0	0	0	0	0	0
Transit from Shimonoseki to Dutch Harbor (US-EEZ)	0	0	0	0	0	0	0
Research area (All US-EEZ)	9*	18**	3	9	18	15	15**
Transit from D. H. to Shioyama (US EEZ)	0	0	0	0	0	0	0
Transit from D.H. to Shioyama (High Sea)	0	0	0	0	0	0	0
Total	9	18	3	9	18	15	15

Table 4c. Summary of gray whale sightings, photography and biopsy effort during the cruise (see table 5b for detailed sighting summary). *: Includes one calf (mother not photo-identified).

Gray whale	Total Sightings		Ind. Biopsy	Sch. Photo-graphed	Sch size of Photo'd Schools	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch.	Ind.					
Transit from Shimonoseki to Dutch Harbor (High Sea)	0	0	0	0	0	0	0
Transit from Shimonoseki to Dutch Harbor (US-EEZ)	0	0	0	0	0	0	0
Research area (All US-EEZ)	15	22	9	13	17	16	14*
Transit from D. H. to Shioyama (US EEZ)	0	0	0	0	0	0	0
Transit from D.H. to Shioyama (High Sea)	0	0	0	0	0	0	0
Total	15	22	9	13	17	16	14

Table 4d. Summary of humpback whale sightings, photography and biopsy effort during the cruise (see table 5c for detailed sighting summary).

Humpback whale	Total Sightings		Ind. Biopsy	Sch. Photo-graphed	Sch size of Photo'd Schools	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch.	ind.					
Transit from Shimonoseki to Dutch Harbor (High Sea)	2	2	2	2	2	2	1
Transit from Shimonoseki to Dutch Harbor (US-EEZ)	5	6	0	1	1	1	1
Research area (All US-EEZ)	129	157	16	35	47	45	32
Transit from D. H. to Shiogama (US EEZ)	0	0	0	0	0	0	0
Transit from D.H. to Shiogama (High Sea)	0	0	0	0	0	0	0
Total	136	165	18	38	50	48	34

Table 4e. Summary of fin whale sightings, photography and biopsy effort during the cruise (see table 5d for detailed sighting summary).

Fin whale	Total Sightings		Ind. Biopsy	Sch. Photo-graphed	Sch size of Photo'd Schools	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch.	ind.					
Transit from Shimonoseki to Dutch Harbor (High Sea)	0	0	0	0	0	0	0
Transit from Shimonoseki to Dutch Harbor (US-EEZ)	2	3	0	0	0	0	0
Research area (All US-EEZ)	143	195	28	63	88	79	55
Transit from D. H. to Shiogama (US EEZ)	0	0	0	0	0	0	0
Transit from D.H. to Shiogama (High Sea)	0	0	0	0	0	0	0
Total	145	198	28	63	88	79	55

Table 4f. Summary of killer whale sightings, photography and biopsy effort during the cruise (see table 5e for detailed sighting summary).

Killer whale	Total Sightings		Ind. Biopsy	Sch. Photo-graphed	Sch size of Photo'd Schools	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch.	ind.					
Transit from Shimonoseki to Dutch Harbor (High Sea)	2	14	0	2	14	10	4
Transit from Shimonoseki to Dutch Harbor (US-EEZ)	2	22	0	0	0	0	0
Research area (All US-EEZ)	28	98	2	20	80	74	52
Transit from D. H. to Shiogama (US EEZ)	0	0	0	0	0	0	0
Transit from D.H. to Shiogama (High Sea)	0	0	0	0	0	0	0
Total	32	134	2	22	94	84	56

Table 4g. Summary of Photographed Sightings with Photo-ID results for Individuals and Biopsy results for Sightings. Primary ID features are main, species-specific identification characteristics. Secondary ID features, and features in brackets, are useful but not enough alone for identification. Body part codes: FL = Flukes, LD = Left dorsal fin, RD = Right dorsal fin, LL = Left lateral, RL = Right lateral, HD = Head, DM = Distinctive marking, OT = Other e.g. ped = peduncle, PBH = post blowhole callosity. View direction codes: D = Dorsal, V = Ventral, L = Left, R = Right. Body part codes always precede view direction codes. ID Form No = natural marking datasheet form number. BY Form No = Biopsy datasheet form number. S/No = Biopsy sample number is concatenated: Year (17) | Species code (e.g. Gray whale 01) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired). Biopsy sampling encounter duration was calculated using effort code "BX" (on standby with equipment) and "EX" (darts collected time).

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
07/07/2017	016	Humpback whale	1	1	1	A	FLV	RD	1	A	ID001	BY001	17071001	44	
07/07/2017	018	Humpback whale	1	1	0	N/A	N/A	N/A	1	A	ID002	BY002	17071002	10	
08/07/2017	001	Killer whale	7	4	2	B	LD,LL	OT: eye patch L	0	N/A	ID003	N/A	N/A	0	
						C	LD	N/A							
08/07/2017	003	Killer whale	7	6	2	A	LL	N/A	0	N/A	ID004	N/A	N/A	0	
						C	RD,RL	N/A							
09/07/2017	005	Humpback whale	1	1	1	A	FLV	LD	0	N/A	ID005	N/A	N/A	0	
19/07/2017	001	Gray whale	1	1	1	A	RL,FLV,FLD,(LL)	HDR	1	A	ID011	BY003	17011003	22	Feeding
19/07/2017	003	Gray whale	1	1	1	A	RL,LL,FLV,FLD	DM: Scar RL	1	A	ID012	BY004	17011004	55	Feeding
19/07/2017	004	Gray whale	1	1	1	A	RL,LL,FLV,FLD	N/A	1	A	ID013	BY005	17011005	17	
19/07/2017	006	Gray whale	2	1	1	A	RL,LL	HDR	0	N/A	ID014	BY006	No sample	23	
19/07/2017	008	Gray whale	1	1	0	N/A	N/A	N/A	0	N/A	ID015	N/A	N/A	0	
19/07/2017	010	Gray whale	1	1	1	A	RL,LL,FLV,FLD	HDR	1	A	ID016	BY007	17011006	48	Feeding
19/07/2017	009	Gray whale	1	1	1	A	FLV	N/A	0	N/A	ID017	N/A	N/A	0	
20/07/2017	001	Gray whale	3	3	3	A	RL,LL,FLV,FLD	HDR, DM: Scar	1	A	ID018	BY008	17011007	44	
						B	RL,LL,FLV,FLD	HDR DM: Scar							
						C	RL,LL,FLV,FLD	HDR							
20/07/2017	002	Gray whale	1	1	1	A	RL,LL,FLV,FLD	DM: Scar HDR	1	A	ID019	BY009	17011008	55	Video taken
20/07/2017	005	Gray whale	1	1	1	A	RL,(LL)	N/A	1	A	ID020	BY010	17011009	23	Reaction to dart
21/07/2017	001	Gray whale	1	1	1	A	RL	OT: Unusual hump	1	A	ID021	BY011	17011010	15	Reaction to dart. Unusual hunched back. Video taken

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
21/07/2017	003	Common minke whale	1	1	0	N/A	N/A	N/A	0	N/A	ID022	BY012	No sample	24	Breaching
21/07/2017	004	Common minke whale	1	1	0	N/A	N/A	N/A	0	N/A	ID023	N/A	N/A	0	
21/07/2017	008	Common minke whale	1	1	0	N/A	N/A	N/A	0	N/A	ID024	N/A	N/A	0	
22/07/2017	002	Humpback whale	1	1	0	N/A	N/A	N/A	1	A	ID025	BY013	17071011	40	
25/07/2017	001	Gray whale	2	2	1	B	RL	N/A	0	N/A	ID026	N/A	N/A	0	Mother (A, No photo-ID) calf (B) pair. Mother DM: scar HDR
25/07/2017	002	Fin whale	1	1	1	A	RL,RD	N/A	0	N/A	ID027	BY014	No sample	30	
26/07/2017	002	Harbour porpoise	1	1	0	N/A	N/A	N/A	0	N/A	ID028	N/A	N/A	0	
26/07/2017	003	Harbour porpoise	1	1	0	N/A	N/A	N/A	0	N/A	ID029	N/A	N/A	0	
26/07/2017	007	Harbour porpoise	3	?	0	N/A	N/A	N/A	0	N/A	ID030	N/A	N/A	0	
29/07/2017	001	Fin whale	2	2	2	A	RL,(RD)	N/A	1	A	ID031	BY015	17051012	66	Mother
						B	RL,RD,LD	LL,DM: scar LD							Calf
29/07/2017	006	Fin whale	1	1	1	A	RD	N/A	0	N/A	ID032	BY016	No sample	59	
29/07/2017	007	Gray whale	1	1	1	A	RL,LL	N/A	1	A	ID033	BY017	17011013	46	Feeding
29/07/2017	008	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID034	BY018	No sample	28	
29/07/2017	009	Common minke whale	1	1	0	N/A	N/A	N/A	0	N/A	ID035	N/A	N/A	0	
03/08/2017	001	Killer whale	3	3	2	A	LL,RD	OT: belly patch L	1	A	ID036	BY019	17271014	31	
						B	RL,LL,RD	OT: eye patch L+R							
04/08/2017	Carcass 01	Humpback whale	N/A	1	0	N/A	N/A	N/A	0	N/A	ID037	N/A	N/A	0	Male
05/08/2017	001	Killer whale	4	4	3	A	LD, (LL,RL)	OT: eye patch L	1	A	ID038	BY020	17271015	21	Coordinated surfacings with whale D
						B	LL,LD, (RL,RD)	OT: eye patch L							Male
						D	RL	OT: eye patch R							Juvenile. Coordinated surfacings with whale A
05/08/2017	003	Common minke whale	1	1	1	A	RD	N/A	0	N/A	ID039	N/A	N/A	0	
06/08/2017	001	Killer whale	6	6	3	C	LD,LL	OT: eye patch L	0	N/A	ID040	N/A	N/A	0	Male
						E	LD,LL	OT: eye patch L							Male
						F	LD	OT: eye patch L							
06/08/2017	003	Killer whale	8	8	3	D	LL,(LD)	OT: eye patch L	0	N/A	ID041	N/A	N/A	0	Whale B male.

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
						E	LL,LD	OT: eye patch L							
						H	RL,(RD)	OT: eye patch R							
06/08/2017	017	North Pacific right whale	2	2	2	A	HDL,HDD	DM: divot LL, white fluke tips	1	A	ID042	BY021	17081016	49	Whale A (no lips): NMML 28 tagged 2004, sex unknown. Only year sighted, 2004. Estimated body length 15.3m.
						B	HDL,HDR	DM: divot tail stock R							Whale B (big lips): NMML 27, Male tagged 2004. First sighted 1997. Estimated body length 16.0m
07/08/2017	002	Humpback whale	1	1	1	A	FLV	FLD, DM: fresh wound ped+FL trail edge L	1	A	ID043	BY022	17071017	9	
07/08/2017	003	Humpback whale	1	1	1	A	FLV	RD,FLD,(LD)	1	A	ID044	BY023	17071018	31	Reaction to dart - tail flick. Unusual - scarring LD
07/08/2017	004	Humpback whale	1	1	0	N/A	N/A	N/A	0	N/A	ID045	BY024	No sample	28	
08/08/2017	004	Humpback whale	1	1	0	N/A	N/A	N/A	0	N/A	ID046	N/A	N/A	0	
08/08/2017	006	Fin whale	1	1	1	A	RD,(RL)	N/A	0	N/A	ID047	BY025	No sample	20	
08/08/2017	014	Fin whale	4	2	1	B	LD	N/A	0	N/A	ID048	N/A	N/A	0	
08/08/2017	015	North Pacific right whale	6	3	3	A	HDL,HDR	FLD, OT:FL nicks L+R	1	B	ID049	BY026	17081019	196	Whale A: NMML 78, seen 2008, sex unknown. Feeding - mouth closing expelling water. Body length estimate 14.0m.
						B	HDL,HDR	FLD,FLV, OT: FL nick, DM: scar ped, scar HDR							Whale B: NMML 84, "Quatro", seen 2009, sex unknown. Scar across coaming, right. Tooth decay in bonnet. Small nicks: left FL tip and right FL trailing edge. Body length estimate 14.6m. Possibly feeding - mouth closing
						C	HDL	FLD,FLV, DM: scar FLD, scar FL tip RV, scar around blowhole R, OT: FL nick							Whale C: NMML 85, "Spot", seen 2009+2011, male. Small dot scar right blowhole. Body length estimate 17.0m
08/08/2017	021	North Pacific right whale	1	1	1	A	HDL,HDR, HDD	DM: scar ped D, rake FL tip R, rake trailing edge RV+LV	0	N/A	ID050	BY027	No sample	117	Possible relocation of one of the 3 not photographed in sighting 015 based on time lapsed and positions of first / last photos. Body length estimate 14.3m.
08/08/2017	022	Fin whale	1	1	1	A	RL	N/A	0	N/A	ID051	N/A	N/A	0	Opportunistically photo'd during sight #021
08/08/2017	023	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID052	N/A	N/A	0	Opportunistically photo'd during sight #021
08/08/2017	025	Humpback whale	1	1	0	N/A	N/A	N/A	0	N/A	ID053	N/A	N/A	0	

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
08/08/2017	047	North Pacific right whale	1	1	1	A	HDL,HDR	FLD	0	N/A	ID054	BY028	No sample	29	Possible feeding close to bottom - mud on head. Water depth 62.1m. Slight tooth decay front of bonnet. Body length estimate 14.3m.
09/08/2017	082	North Pacific right whale	1	1	1	A	HDL,HDR, HDD	N/A	1	A	ID055	BY029	17081020	16	Possible juvenile - body length estimate 13.3m. Possibly flushing baleen at surface. Not fluking, close to surface duration of sighting.
10/08/2017	001	Humpback whale	1	1	0	N/A	N/A	N/A	0	N/A	ID056	BY030	No sample	19	
10/08/2017	003	Humpback whale	1	1	0	N/A	N/A	N/A	0	N/A	ID057	BY031	No sample	16	
10/08/2017	Carcass 01	Unidentified	N/A	1	0	N/A	N/A	N/A	0	N/A	ID058	N/A	N/A	0	Minke?
10/08/2017	004	Fin whale	2	2	2	A	RD,RL	N/A	2	A,B	ID059	BY032	17051021+ 17051022	71	Mother
						B	RD,RL, (LD)	LL							Calf
11/08/2017	001	Humpback whale	1	1	0	N/A	N/A	N/A	1	A	ID060	BY033	17071023	11	
11/08/2017	003	Fin whale	1	1	1	A	RD,(RL)	N/A	1	A	ID061	BY034	17051024	14	
14/08/2017	001	Fin whale	1	1	1	A	RL,RD	DM:scar RD	1	A	ID062	BY035	17051025	34	
14/08/2017	002	Fin whale	2	2	2	A	LD	N/A	2	A,B	ID063	BY036	17051026+ 17051027	5	
						B	LD	N/A							
14/08/2017	004	Fin whale	3	1	0	N/A	N/A	N/A	0	N/A	ID064	N/A	N/A	0	
14/08/2017	007	Fin whale	1	1	1	A	LD	N/A	0	N/A	ID065	N/A	N/A	0	
14/08/2017	005	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID066	BY037	No sample	28	
14/08/2017	008	Fin whale	2	1	1	A	RD	N/A	0	N/A	ID067	N/A	N/A	0	
14/08/2017	009+011	Fin whale	4	4	3	B	RL	N/A	0	N/A	ID068	BY038	No sample	38	
						C	LD	N/A							
						D	LD	N/A							
14/08/2017	013	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID069	BY039	No sample	33	
14/08/2017	014	Humpback whale	1	1	1	A	FLV	RD,(LD)	1	A	ID070	BY040	17071028	11	
14/08/2017	015	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID071	N/A	N/A	0	
14/08/2017	017	Humpback whale	1	1	1	A	FLV	LD,RD, DM:scar FLD,scar ped D+V	1	A	ID072	BY041	17071029	11	DM: Entanglement scars FLD and ped D+V
14/08/2017	018	Fin whale	2	2	2	A	RL,RD,LD	LL,OT:ped R	1	B	ID073	BY042	17051030	28	
						B	RL,RD,LD	LL							
15/08/2017	007	Fin whale	1	1	1	A	LD,RD	N/A	0	N/A	ID074	BY043	No sample	37	
15/08/2017	008	Humpback whale	2	2	0	N/A	N/A	N/A	1	B	ID075	BY044	17071031	44	
15/08/2017	011	Killer whale	1	1	1	A	RD,(RL)	OT: eye patch R	0	N/A	ID076	N/A	N/A	0	Male

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
15/08/2017	009	Killer whale	2	1	1	A	RD, RL,(LL)	OT: eye patch L+R	0	N/A	ID077	BY045	No sample	32	
15/08/2017	013	Fin whale	1	1	1	A	RL,(RD)	N/A	1	A	ID078	BY046	17051032	40	
15/08/2017	015	Fin whale	1	1	1	A	RD,(RL)	N/A	1	A	ID079	BY047	17051033	10	
18/08/2017	003	Fin whale	1	1	1	A	RL,LD	LL	1	A	ID080	BY048	17051034	23	
18/08/2017	006	Fin whale	1	1	1	A	RL,RD,LD	N/A	0	N/A	ID081	BY049	No sample	50	
19/08/2017	001	Fin whale	1	1	1	A	LD	N/A	0	N/A	ID082	BY050	No sample	23	
19/08/2017	003	Fin whale	2	1	1	A	LD,RD	N/A	0	N/A	ID083	BY051	No sample	13	
19/08/2017	004	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID084	N/A	N/A	0	
19/08/2017	007	Fin whale	1	1	1	A	RL,RD	N/A	1	A	ID085	BY052	17051035	4	
19/08/2017	011	Humpback whale	4	3	2	A	FLV	RD,FLD,(LD)	1	A	ID086	BY053	17071036	42	Whale A match 21/8/2017 #019. Whale B: (No photo-ID) healed wound from serious, embedded body wrap entanglement. Gear apparently shed – only right body documented and no fluke shots.
						C	FLV	LD,RD							Whale C match whale B on 21/8/2017 sight #025
20/08/2017	002	Humpback whale	1	1	1	A	FLV	LD,RD	0	N/A	ID087	BY054	No sample	29	
20/08/2017	003	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID088	BY055	No sample	13	
20/08/2017	006	Fin whale	1	1	1	A	LD	LL	0	N/A	ID089	BY056	No sample	18	
20/08/2017	008	Fin whale	1	1	1	A	RL,RD	N/A	1	A	ID090	BY057	17051037	29	
20/08/2017	012	Fin whale	1	1	1	A	RD,LD	N/A	1	A	ID091	BY058	17051038	6	
20/08/2017	014	Fin whale	1	1	1	A	RL,(RD)	N/A	1	A	ID092	BY059	17051039	34	
20/08/2017	015	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID093	BY060	No sample	18	
21/08/2017	001	Fin whale	2	2	1	A	LD	LL	1	A	ID094	BY061	17051040	7	
21/08/2017	013	Humpback whale	1	1	1	A	FLV	LD,RD	0	N/A	ID095	BY062	No sample	20	
21/08/2017	017	Humpback whale	1	1	1	A	FLV	LD	0	N/A	ID096	BY063	No sample	11	
21/08/2017	019	Humpback whale	1	1	1	A	FLV	LD	0	N/A	ID097	N/A	N/A	0	Match whale A on 19/8/2017 sight #011
21/08/2017	025	Humpback whale	3	3	3	A	FLV	N/A	0	N/A	ID098	N/A	N/A	0	Whale B match whale C 19/8/2017 sight #011
						B	FLV	N/A							
						C	FLV	N/A							
21/08/2017	029	Fin whale	1	1	1	A	RL,RD	N/A	0	N/A	ID099	BY064	No sample	43	
22/08/2017	001+005+009+013	Fin whale	8	7	3	A	RL,(RD)	N/A	1	A	ID100	BY065	17051041	12 14 0	Video taken
						D	LD	N/A							
						E	LD	LL							
22/08/2017	015	Common minke whale	1	1	0	N/A	N/A	N/A	0	N/A	ID101	N/A	N/A	0	
22/08/2017	016	Fin whale	1	1	1	A	RL,RD,(LD)	N/A	0	N/A	ID102	BY066	No sample	39	Video taken
22/08/2017	020	Fin whale	1	1	1	A	RL	N/A	1	A	ID103	BY067	17051042	8	
22/08/2017	025	Fin whale	1	1	1	A	RD,RL	LL	0	N/A	ID104	BY068	No sample	51	

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
26/08/2017	001	Humpback whale	2	2	1	A	FLV	RD,LD	0	N/A	ID105	N/A	N/A	0	
26/08/2017	005	Humpback whale	2	1	0	N/A	N/A	N/A	0	N/A	ID106	N/A	N/A	0	
26/08/2017	010	Killer whale	1	1	1	A	LD,RD,RL	OT:eye patch R	0	N/A	ID107	N/A	N/A	0	
26/08/2017	011	Humpback whale	3	3	3	A	FLV	FLD	0	N/A	ID108	N/A	N/A	0	Feeding.
						B	FLV	N/A							
						C	FLV	LD							
26/08/2017	014	Humpback whale	1	1	1	A	FLV	N/A	1	A	ID109	BY069	17071043	16	
26/08/2017	021	Humpback whale	1	1	1	A	FLV	LD,RD	1	A	ID110	BY070	17071044	13	
26/08/2017	023	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID111	N/A	N/A	0	
26/08/2017	022	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID112	N/A	N/A	0	
27/08/2017	001	Killer whale	4	4	4	A	LD,RD,RL	OT:eye patch L+R	0	N/A	ID113	N/A	N/A	0	Breaching and fluke slapping.
						B	LD,LL,RD,RL	OT:eye patch R							
						C	LD,RD,RL	OT:eye patch L+R							
						D	LD,RD	N/A							
27/08/2017	003+004	Killer whale	11	11	11	A-L	TBD	TBD	0	N/A	ID113	N/A	N/A	0	At least 11 photo'd and photo ID'd. Further photo analysis required
27/08/2017	002	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID114	N/A	N/A	0	
27/08/2017	005	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID115	N/A	N/A	0	
27/08/2017	006	Humpback whale	1	1	1	A	FLV	N/A	0	N/A	ID116	N/A	N/A	0	
27/08/2017	007	Killer whale	5	4	4	A	LD,LL,RD,RL	OT:eye patch R	0	N/A	ID117	N/A	N/A	0	Male
						B	RD,(LD)	N/A							
						C	LD,LL,RD,RL	OT:eye patch L+R							
						D	LD,LL,RD,RL	OT:eye patch L							
27/08/2017	010	Killer whale	2	1	0	N/A	N/A	N/A	0	N/A	ID118	N/A	N/A	0	Fluke slapping
27/08/2017	009	Killer whale	3	3	3	A	LD,LL	N/A	0	N/A	ID119	N/A	N/A	0	Mother
						B	LD,LL	OT:eye patch L							
						C	LD,(LL)	OT:eye patch L							
27/08/2017	011	Humpback whale	2	2	1	B	FLV	RD,LD	2	A,B	ID120	BY071	17071045+17071046	42	
28/08/2017	001	Humpback whale	1	1	1	A	FLV	FLD,(RD,LD)	0	N/A	ID121	BY072	No sample	41	
28/08/2017	002	Fin whale	2	2	1	A	RD	N/A	1	A	ID122	BY073	17051047	14	With Dall's porpoise

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
28/08/2017	003	Fin whale	2	2	2	A	LD	LL	1	B	ID123	BY074	17051048	7	
						B	LD	LL							
28/08/2017	006	Fin whale	1	1	0	N/A	N/A	N/A	1	A	ID124	BY075	17051049	8	Video taken
28/08/2017	007	Humpback whale	2	2	2	A	FLV	RD,FLD	1	B	ID125	BY076	17071050	22	Video taken
						B	FLV	RD							
28/08/2017	008	Humpback whale	1	1	1	A	FLV	LD	1	A	ID126	BY077	17071051	14	
28/08/2017	012	Humpback whale	1	1	1	A	FLV	RD,LD,FLD	1	A	ID127	BY079	17071053	26	
28/08/2017	011	Fin whale	1	1	1	A	RD,RL	N/A	1	A	ID128	BY078	17051052	7	
28/08/2017	014	Humpback whale	1	1	1	A	FLV	RD	1	A	ID129	BY080	17071054	23	
28/08/2017	015	Fin whale	1	1	0	N/A	N/A	N/A	1	A	ID130	BY081	17051055	12	Video taken
28/08/2017	018	Fin whale	2	2	2	A	LD,(RD)	N/A	0	N/A	ID131	BY082	No sample	12	
						B	LD,(RD)	N/A							
28/08/2017	017	Fin whale	1	1	1	A	RL,RD	N/A	1	A	ID132	BY083	17051056	4	Video taken
31/08/2017	003	Fin whale	1	1	1	A	RD,LD,(RL)	N/A	0	N/A	ID133	BY084	No sample	14	
31/08/2017	022	Fin whale	1	1	1	A	LD	N/A	0	N/A	ID133	N/A	N/A	0	
31/08/2017	038	Fin whale	4	2	1	A	RL,RD	N/A	0	N/A	ID134	BY085	No sample	47	
01/09/2017	001	Fin whale	1	1	1	A	RL	N/A	1	A	ID135	BY086	17051057	13	
01/09/2017	005	Fin whale	1	1	1	A	LD	LL	0	N/A	ID136	BY087	No sample	49	
01/09/2017	009	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID137	BY088	No sample	13	Second whale found in PA of sight no 007. Assumed to be nearby sight no 009.
01/09/2017	007	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID137	BY088	No sample	20	Second whale found in PA of sight no 007. Assumed to be nearby sight no 009.
01/09/2017	010	Fin whale	2	2	0	N/A	N/A	N/A	0	N/A	ID138	N/A	N/A	0	
04/09/2017	001-003+005-008	Killer whale	30	27	16	A	LD,LL	N/A	0	N/A	ID139	N/A	N/A	0	Male
						C	LD	N/A							
						D	LD,LL	OT:eye patch L							
						H	LL,(LD)	N/A							
						I	LD	N/A							
						J	LD	N/A							
						K	RL,(LD)	OT:eye patch L							
						L	LD,(LD, RD)	N/A							
						N	LL,(LD)	N/A							
						O	LD,(LL)	N/A							
						P	LD,LL	N/A							
						Q	LD,LL	N/A							
						S	LD,LL	N/A							
T	LD,LL	N/A													
V	RD	N/A													
														Male	

Survey Date (D/M/Y)	Sighting Number	Species	School Size	Photographed	Photo Identified	Letters of ID'd	Results of Primary ID features	Results of Secondary ID features	Biopsied	Letter of Biopsied	ID Form Number	BY Form Number	S/No	Encounter Duration (min)	Photo-ID Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
						Z	RD	N/A							
04/09/2017	020	Fin whale	1	1	0	N/A	N/A	N/A	0	N/A	ID140	BY089	No sample	29	
04/09/2017	021	Fin whale	1	1	1	A	LD	LL	1	A	ID141	BY090	17051058	33	
07/09/2017	003	Fin whale	1	1	1	A	RL,RD	N/A	1	A	ID142	BY091	17051059	50	
07/09/2017	004	Fin whale	1	1	1	A	RD,(RL)	N/A	1	A	ID143	BY092	17051060	36	
08/09/2017	001	Right whale	2	2	2	A	HDL, HDR	DM: scar back	0	N/A	ID144	BY093	No sample	280	Whale A: NMML 09, "Notchy", seen 1996, 2000, 2009, 2010, tagged in 2009, sex unknown. DM raised line scars along rear dorsal ridge. Brief SAG with whale B, belly-to-back. Estimated body length 14.8m.
						B	HDL, HDR	DM: divot RL, white dot scar LL							Whale B: NMML 24, seen 2004 and 2009, tagged in 2009, female. DM multiple small dot scars: HDR, bonnet, right lip. Brief SAG with whale A, belly-to-back. Estimated body length 14.3m.
09/09/2017	001	Right whale	2	2	2	A	HDL, HDR	FLV,DM:scar FLV+ped V	0	N/A	ID145	N/A	N/A	0	Whale A: NMML 15, seen 2000, 2004, 2008, 2009. Dupe of sight no 004 10/9/17 and whale A sight no 005 10/9/17. DM: white blotch scar FLV and faint black horizontal ped scars. Estimated body length 16.1m.
						B	HDL, (HDR)	N/A							Whale B: Dupe of whale B sight no 005 10/9/17. Estimated body length 14.7m
10/09/2017	004	Right whale	1	1	1	A	HDL, HDR	FLD,OT:ped D	0		ID146	BY094	No sample	27	Dupe of whale A sight no 001 9/9/17 and whale A sight no 005 10/9/17. DM:small dot scars leading fluke edge and faint black horizontal ped scars.
10/09/2017	005	Right whale	2	2	2	A	HDL, HDR	FLD+V,RL ,LL,OT:ped D,PBH	0		ID147	BY095	No sample	73	Whale A: Dupe of whale A sight no 001 9/9/17 and sight no 004 10/9/17.
						B	HDL	LL,FLD+V							Whale B: Dupe of whale B sight no 001 9/9/17 DM:small dot scars leading fluke edge, white fluke tip L, mottled skin.

Table 5a. Summary of North Pacific right whale sightings. ID Form No: natural marking datasheet form number. BY Form No: Biopsy datasheet form number. S/No: Biopsy sample number is concatenated Year (17) | Species code (e.g. NP right whale 08) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired).*: includes 3 duplicates, total of 12 unique individuals

Survey Date	Sight No	School Size	Photographed	Photo IDd	Biopsied	ID Form No	BY Form No	S/No	North Pacific right whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
06/08/2017	017	2	2	2	1	ID042	BY021	17081016	Found by Acoustics. NMML IDs 28 (A) and 27 (B). Dense flocks of shearwaters in surrounding waters.
08/08/2017	015	6	3	3	1	ID049	BY026	17081019	NMML IDs 78 (A), 84 (B) and 85 (C). Many humpbacks, fin and minke whales and dense flocks of shearwaters in close proximity.
08/08/2017	021	1	1	1	0	ID050	BY027	No sample	Possible relocation of one of the 3 not photographed in sighting 015 based on time lapsed and positions of first / last photos. Humpback within 0.1nm. Many shearwaters in surrounding waters.
08/08/2017	047	1	1	1	0	ID054	BY028	No sample	Possible feeding close to bottom - mud on head. Water depth 62.1m. Many humpbacks, fin and minke whales and dense flocks of shearwaters in close proximity. Humpback within 0.1nm.
09/08/2017	082	1	1	1	1	ID055	BY029	17081020	Possible juvenile - body length estimate 13.3m. Possibly flushing baleen at surface. Not fluking, close to surface duration of sighting.
08/09/2017	001	2	2	2	0	ID144	BY093	No sample	Found by Acoustics. NMML IDs 09 (A) and 24 (B). Brief belly-to-back SAG.
09/09/2017	001	2	2	2	0	ID145	N/A	N/A	Found by Acoustics. NMML 15 (A). Dupes of whales A+B sight no 005 on 10/9/17. Whale A dupe of sight no 004 on 10/9/17.
10/09/2017	004	1	1	1	0	ID146	BY094	No sample	Found by Acoustics. Dupe of A sight no 001 on 9/9/17 and A sight no 005 on 10/09/17.
10/09/2017	005	2	2	2	0	ID147	BY095	No sample	Found by Acoustics. Whale A dupe of A sight no 001 9/9/17 and sight no 004 on 10/9/17. Whale B dupe of B sight no 001 9/9/17.
Total	9	18	15	15*	3				

Table 5b. Summary of gray whale sightings. ID Form No: natural marking datasheet form number. BY Form No: Biopsy datasheet form number. S/No: Biopsy sample number is concatenated Year (17) | Species code (e.g. Gray whale 01) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired).

Survey Date	Sight No	School Size	Photographed	Photo IDd	Biopsied	ID Form No	BY Form No	S/No	Gray whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
19/07/2017	001	1	1	1	1	ID011	BY003	17011003	Feeding.
19/07/2017	003	1	1	1	1	ID012	BY004	17011004	Feeding
19/07/2017	004	1	1	1	1	ID013	BY005	17011005	
19/07/2017	006	2	1	1	0	ID014	BY006	No sample	
19/07/2017	008	1	1	0	0	ID015	N/A	N/A	
19/07/2017	010	1	1	1	1	ID016	BY007	17011006	Feeding
19/07/2017	009	1	1	1	0	ID017	N/A	N/A	

Survey Date	Sight No	School Size	Photographed	Photo IDd	Biopsied	ID Form No	BY Form No	S/No	Gray whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
20/07/2017	001	3	3	3	1	ID018	BY008	17011007	
20/07/2017	002	1	1	1	1	ID019	BY009	17011008	Video taken
20/07/2017	005	1	1	1	1	ID020	BY010	17011009	Reaction to dart
21/07/2017	001	1	1	1	1	ID021	BY011	17011010	Reaction to dart. Unusual hunched back. Video taken
25/07/2017	001	2	2	1	0	ID026	N/A	N/A	Mother (A) calf (B) pair. Mother DM: scar HDR. No biopsy effort due to shallow water depth.
29/07/2017	007	1	1	1	1	ID033	BY017	17011013	Feeding
Total	13	17	16	14	9				

Table 5c. Summary of humpback whale sightings. ID Form No: natural marking datasheet form number. BY Form No: Biopsy datasheet form number. S/No: Biopsy sample number is concatenated Year (17) | Species code (e.g. humpback whale 07) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired).

Survey Date	Sight No	School Size	Photographed	Photo IDd	Biopsied	ID Form Number	BY Form Number	S/No	Humpback whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
07/07/2017	016	1	1	1	1	ID001	BY001	17071001	
07/07/2017	018	1	1	0	1	ID002	BY002	17071002	
09/07/2017	005	1	1	1	0	ID005	N/A	N/A	
22/07/2017	002	1	1	0	1	ID025	BY013	17071011	
07/08/2017	002	1	1	1	1	ID043	BY022	17071017	
07/08/2017	003	1	1	1	1	ID044	BY023	17071018	Reaction to dart - tail flick. Unusual - scarring left dorsal
07/08/2017	004	1	1	0	0	ID045	BY024	No sample	
08/08/2017	004	1	1	0	0	ID046	N/A	N/A	
08/08/2017	023	1	1	1	0	ID052	N/A	N/A	Opportunistically photo'd during sight #021
08/08/2017	025	1	1	0	0	ID053	N/A	N/A	
10/08/2017	001	1	1	0	0	ID056	BY030	No sample	
10/08/2017	003	1	1	0	0	ID057	BY031	No sample	
11/08/2017	001	1	1	0	1	ID060	BY033	17071023	
14/08/2017	014	1	1	1	1	ID070	BY040	17071028	
14/08/2017	017	1	1	1	1	ID072	BY041	17071029	Entanglement scars documented on flukes and peduncle (dorsal and ventral)
15/08/2017	008	2	2	0	1	ID075	BY044	17071031	
19/08/2017	011	4	3	2	1	ID086	BY053	17071036	A match 21/8/2017 #019. C match B 21/8/2017 #025. Healed wound documented from serious, embedded body wrap entanglement. Gear apparently shed -only right body documented and no fluke shots.
20/08/2017	002	1	1	1	0	ID087	BY054	No sample	
21/08/2017	013	1	1	1	0	ID095	BY062	No sample	
21/08/2017	017	1	1	1	0	ID096	BY063	No sample	
21/08/2017	019	1	1	1	0	ID097	N/A	N/A	Match A 19/8/2017 #011
21/08/2017	025	3	3	3	0	ID098	N/A	N/A	B match C 19/8/2017 #011
26/08/2017	001	2	2	1	0	ID105	N/A	N/A	
26/08/2017	005	2	1	0	0	ID106	N/A	N/A	
26/08/2017	011	3	3	3	0	ID108	N/A	N/A	Feeding.
26/08/2017	014	1	1	1	1	ID109	BY069	17071043	

Survey Date	Sight No	School Size	Photographed	PhotoIDd	Biopsied	ID Form Number	BY Form Number	S/No	Humpback whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
26/08/2017	021	1	1	1	1	ID110	BY070	17071044	
26/08/2017	023	1	1	1	0	ID111	N/A	N/A	
26/08/2017	022	1	1	1	0	ID112	N/A	N/A	
27/08/2017	002	1	1	1	0	ID114	N/A	N/A	
27/08/2017	005	1	1	1	0	ID115	N/A	N/A	
27/08/2017	006	1	1	1	0	ID116	N/A	N/A	
27/08/2017	011	2	2	1	2	ID120	BY071	17071045 + 17071046	
28/08/2017	001	1	1	1	0	ID121	BY072	No sample	
28/08/2017	007	2	2	2	1	ID125	BY076	17071050	Video taken
28/08/2017	008	1	1	1	1	ID126	BY077	17071051	
28/08/2017	012	1	1	1	1	ID127	BY079	17071053	
28/08/2017	014	1	1	1	1	ID129	BY080	17071054	
Total	38	50	48	34	18				

Table 5d. Summary of fin whale sightings. ID Form No: natural marking datasheet form number. BY Form No: Biopsy datasheet form number. S/No: Biopsy sample number is concatenated Year (17) | Species code (e.g. fin whale 05) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired).

Survey Date	Sight No	School Size	Photographed	Photo Identified	Biopsied	ID Form Number	BY Form Number	S/No	Fin whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
25/07/2017	002	1	1	1	0	ID027	BY014	No sample	
29/07/2017	001	2	2	2	1	ID031	BY015	17051012	Whale A mother. Whale B calf
29/07/2017	006	1	1	1	0	ID032	BY016	No sample	
29/07/2017	008	1	1	0	0	ID034	BY018	No sample	
08/08/2017	006	1	1	1	0	ID047	BY025	No sample	
08/08/2017	014	4	2	1	0	ID048	N/A	N/A	
08/08/2017	022	1	1	1	0	ID051	N/A	N/A	Opportunistically photo'd during sight #021
10/08/2017	004	2	2	2	2	ID059	BY032	17051021 + 17051022	Whale A mother. Whale B calf
11/08/2017	003	1	1	1	1	ID061	BY034	17051024	
14/08/2017	001	1	1	1	1	ID062	BY035	17051025	
14/08/2017	002	2	2	2	2	ID063	BY036	17051026 + 17051027	
14/08/2017	004	3	1	0	0	ID064	N/A	N/A	
14/08/2017	007	1	1	1	0	ID065	N/A	N/A	
14/08/2017	005	1	1	0	0	ID066	BY037	No sample	
14/08/2017	008	2	1	1	0	ID067	N/A	N/A	
14/08/2017	009 + 011	4	4	3	0	ID068	BY038	No sample	Photographed both schools in close proximity. Defecation.
14/08/2017	013	1	1	0	0	ID069	BY039	No sample	
14/08/2017	015	1	1	0	0	ID071	N/A	N/A	
14/08/2017	018	2	2	2	1	ID073	BY042	17051030	
15/08/2017	007	1	1	1	0	ID074	BY043	No sample	
15/08/2017	013	1	1	1	1	ID078	BY046	17051032	
15/08/2017	015	1	1	1	1	ID079	BY047	17051033	
18/08/2017	003	1	1	1	1	ID080	BY048	17051034	
18/08/2017	006	1	1	1	0	ID081	BY049	No sample	

Survey Date	Sight No	School Size	Photographed	Photo Identified	Biopsied	ID Form Number	BY Form Number	S/No	Fin whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
19/08/2017	001	1	1	1	0	ID082	BY050	No sample	
19/08/2017	003	2	1	1	0	ID083	BY051	No sample	
19/08/2017	004	1	1	0	0	ID084	N/A	N/A	
19/08/2017	007	1	1	1	1	ID085	BY052	17051035	
20/08/2017	003	1	1	0	0	ID088	BY055	No sample	
20/08/2017	006	1	1	1	0	ID089	BY056	No sample	
20/08/2017	008	1	1	1	1	ID090	BY057	17051037	
20/08/2017	012	1	1	1	1	ID091	BY058	17051038	
20/08/2017	014	1	1	1	1	ID092	BY059	17051039	
20/08/2017	015	1	1	0	0	ID093	BY060	No sample	
21/08/2017	001	2	2	1	1	ID094	BY061	17051040	
21/08/2017	029	1	1	1	0	ID099	BY064	No sample	
22/08/2017	001+ 005+ 009+ 013	8	7	3	1	ID100	BY065	17051041	Estimated 20 fin whales in area. Video taken.
22/08/2017	016	1	1	1	0	ID102	BY066	No sample	Video taken.
22/08/2017	020	1	1	1	1	ID103	BY067	17051042	
22/08/2017	025	1	1	1	0	ID104	BY068	No sample	
28/08/2017	002	2	2	1	1	ID122	BY073	17051047	With Dall's porpoise
28/08/2017	003	2	2	2	1	ID123	BY074	17051048	
28/08/2017	006	1	1	0	1	ID124	BY075	17051049	Video taken
28/08/2017	011	1	1	1	1	ID128	BY078	17051052	
28/08/2017	015	1	1	0	1	ID130	BY081	17051055	Video taken
28/08/2017	018	2	2	2	0	ID131	BY082	No sample	
28/08/2017	017	1	1	1	1	ID132	BY083	17051056	Video taken
31/08/2017	003	1	1	1	0	ID133	BY084	No sample	
31/08/2017	022	1	1	1	0	ID133	N/A	N/A	
31/08/2017	038	4	2	1	0	ID134	BY085	No sample	
01/09/2017	001	1	1	1	1	ID135	BY086	17051057	
01/09/2017	005	1	1	1	0	ID136	BY087	No sample	
01/09/2017	009	1	1	0	0	ID137	BY088	No sample	Second whale found in PA of sight no 007. Assumed to be nearby sight no 009.
01/09/2017	007	1	1	0	0	ID137	BY088	No sample	Second whale found in PA of sight no 007. Assumed to be nearby sight no 009.
01/09/2017	010	2	2	0	0	ID138	N/A	N/A	
04/09/2017	020	1	1	0	0	ID140	BY089	No sample	
04/09/2017	021	1	1	1	1	ID141	BY090	17051058	
07/09/2017	003	1	1	1	1	ID142	BY091	17051059	
07/09/2017	004	1	1	1	1	ID143	BY092	17051060	
Total	63	88	79	55	28				

Table 5e. Summary of killer whale sightings. ID Form No: natural marking datasheet form number. BY Form No: Biopsy datasheet form number. S/No: Biopsy sample number is concatenated Year (17) | Species code (e.g. killer whale 27) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001). If S/No is N/A no biopsy attempt was made. If S/No is 'No Sample' a biopsy attempt was made i.e. shooters were on standby, but no sample was collected (shots may or may not have been fired).

Survey Date	Sight No	School Size	Photographed	Photo IDd	Biopsied	ID Form No	BY Form No	S/No	Killer whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
08/07/2017	001	7	4	2	0	ID003	N/A	N/A	
08/07/2017	003	7	6	2	0	ID004	N/A	N/A	

Survey Date	Sight No	School Size	Photographed	Photo ID'd	Biopsied	ID Form No	BY Form No	S/No	Killer whale Sighting Notes e.g. Behavs, Assocs, Reaction to dart, Unusual
03/08/2017	001	3	3	2	1	ID036	BY019	17271014	
05/08/2017	001	4	4	3	1	ID038	BY020	17271015	Whale B male. Whale D juvenile. whales A+D coordinating surfacings
06/08/2017	001	6	6	3	0	ID040	N/A	N/A	Whales C+E males. At least 3 males photographed in group. Probable mixing with sight #003
06/08/2017	003	8	8	3	0	ID041	N/A	N/A	Whale B male. At least 1 male in gp. Probable mixing with sight #001
15/08/2017	011	1	1	1	0	ID076	N/A	N/A	Resident male
15/08/2017	009	2	1	1	0	ID077	BY045	No sample	
26/08/2017	010	1	1	1	0	ID107	N/A	N/A	
27/08/2017	001	4	4	4	0	ID113	N/A	N/A	Breaching and fluke slapping.
27/08/2017	003 + 004	11	11	11	0	ID113	N/A	N/A	At least 11 photo'd and photo ID'd. Further photo analysis required
27/08/2017	007	5	4	4	0	ID117	N/A	N/A	Whales A+B males. Whale D breaching.
27/08/2017	010	2	1	0	0	ID118	N/A	N/A	Fluke slapping
27/08/2017	009	3	3	3	0	ID119	N/A	N/A	Whale A (mum), whale B (calf), whale C (young)
04/09/2017	001-003 + 005-008	30	27	16	0	ID139	N/A	N/A	Residents. Whales A,K+Q males. At least 5 males+1 calf photographed in group. 3 calves recorded in the sighting.
Total	22	94	84	56	2				

Table 6. Weekly summary of successful sonobuoy deployments (# deployed sonobuoys), recording hours, and species detected (on # of buoys).

Dates	# successful (# deployed)	Recording time (hh:mm:ss)	Fin	NP RW	Hump	Gray	Killer	Sperm	Walrus	Other
16-22 July	23 (27)	36:12:20*	2	0	1	4	(1)	0	0	0
23-29 July	21 (24)	83:08:42	9	0	3	0	4	0	0	Fish - 2
30 July – 5 Aug	28 (30)	110:33:37	6	0	1	0	5	0	1	Fish - 3
6-12 Aug	45 (46)	168:51:01**	20	21	9	0	7	0	7	Fish - 1
13-19 Aug	21 (24)	86:48:45	9	0	2	0	7	7	0	Seismic airguns - 1 Cuvier's beaked - 1
20-26 Aug	22 (24)	84:31:19	21	0	3	0	6	10	1	0
27 Aug – 2 Sept	20 (20)	117:00:13	18	0	(1)	0	9	10	0	Seismic airguns - 1 Unknown - 2
3-11 Sept	39 (45)	153:59:49**	27	17	4	0	11	17	0	0
TOTAL	219 (240)	841:05:06	112	38	23	4	49	44	9	13

*Much of this first week was spent troubleshooting antenna and equipment issues.

**The overly inflated recording hours are a result of multiple buoys deployed and monitored at once while in the right whale critical habitat.

Table 7. Summary of marine debris observations during whole cruise. On-effort observations were during the first 15 minutes each hour while on survey. Off-effort observations were strictly opportunistic.

IWC code	Discription	ON Effort	OFF Effort	Total
134	Single fishing float	1	-	1
148	Styrofoam board, less than 1 square metre	2	-	2
162	Plastic, less than 1 square metres	3	-	3
165	Plastic bag, small	1	-	1
199	Metal box, 0.6metre×0.6metre×0.15metre	-	1	1
199	Plastic bottle, green color, 2.0 litres	1	-	1
199	Plastic bottle, clear color, 2.0 litres	-	1	1
199	Styrofoam ball with bamboo, ball size 0.6 metres	1	-	1
199	Life ring from St. Laguna	-	1	1
Total		9	3	12

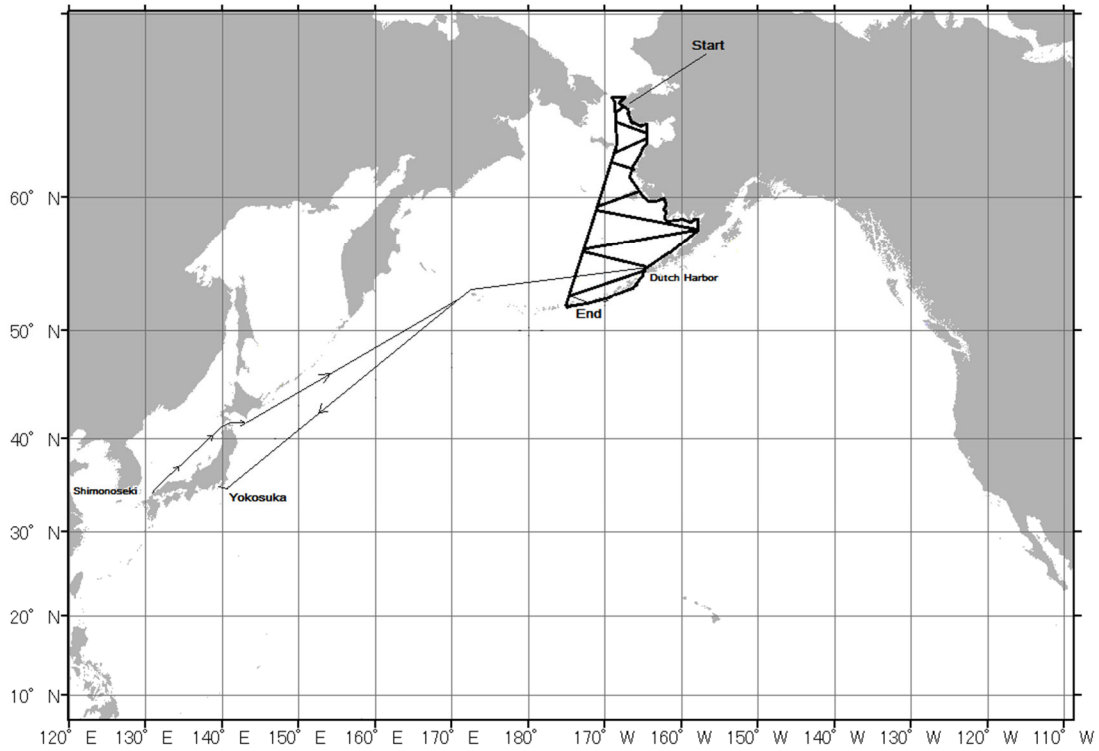


Figure 1a. Research area, transit and survey track lines with start and end points for the 2017 IWC-POWER cruise.

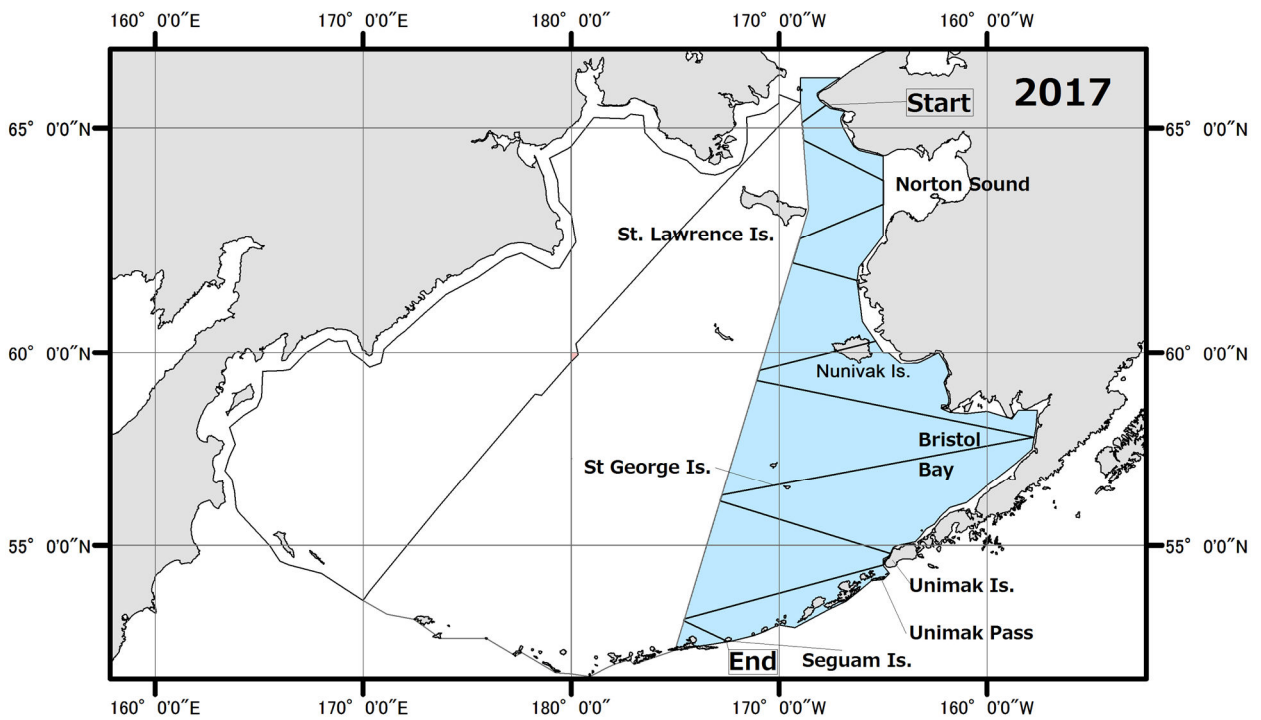


Figure 1b. Predetermined cruise track lines and course directions taken within the main survey area for the 2017 IWC POWER cruise survey.

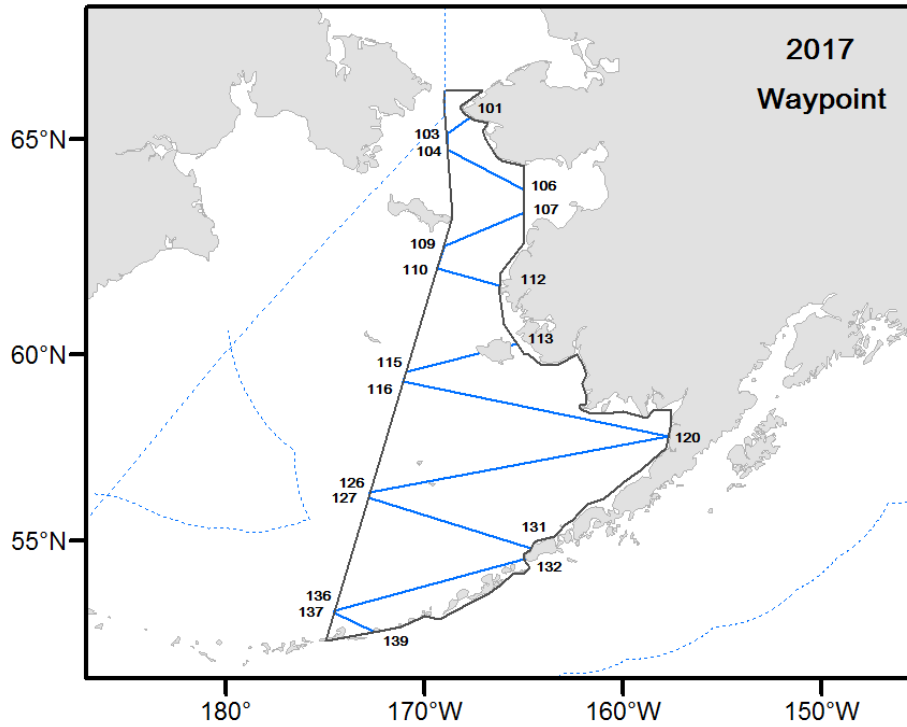


Figure 1c. The waypoint number and course directions (from 101 to 139) taken within the main survey area for the 2017 IWC POWER cruise survey.

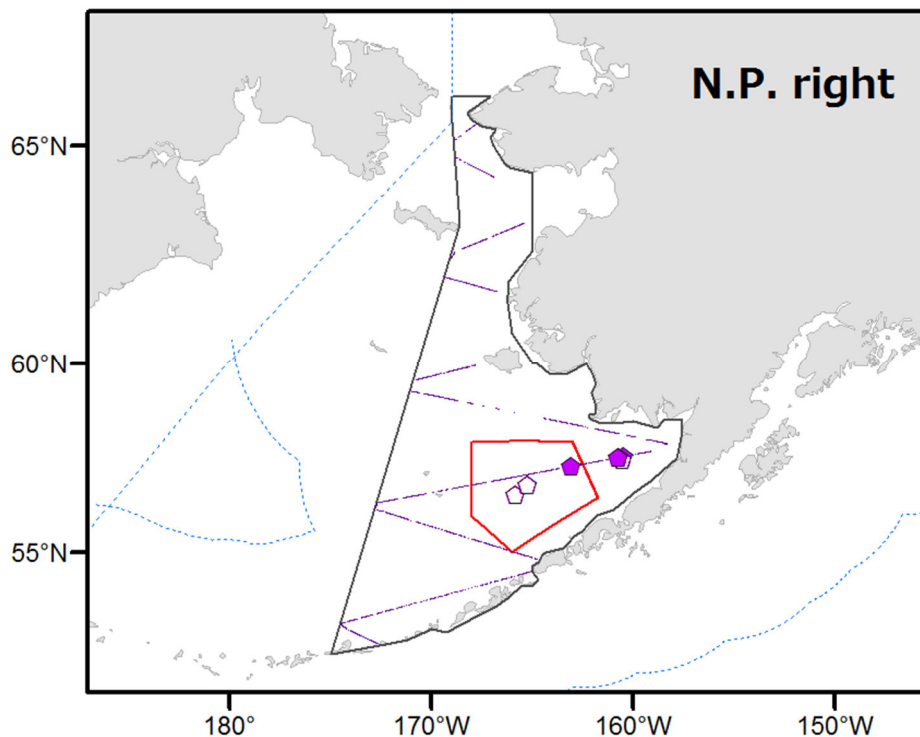


Figure 2a. The searching effort (thin line) and sighting positions of North Pacific right whale (7 schools (15 individuals, except 2 duplicate schools)) during the 2017 POWER cruise. Purple pentagon (n=4) show the right whale sighted on the trackline. White pentagon (n=3) show the right whale which detected by acoustic and then sighted. A pentagon (red line) area shows the critical habitat area for the N.P. right whale (NOAA, 2016). Two white pentagon plots in the central part of the critical habitat area were detected by acoustic and confirmed during 08-10 September.

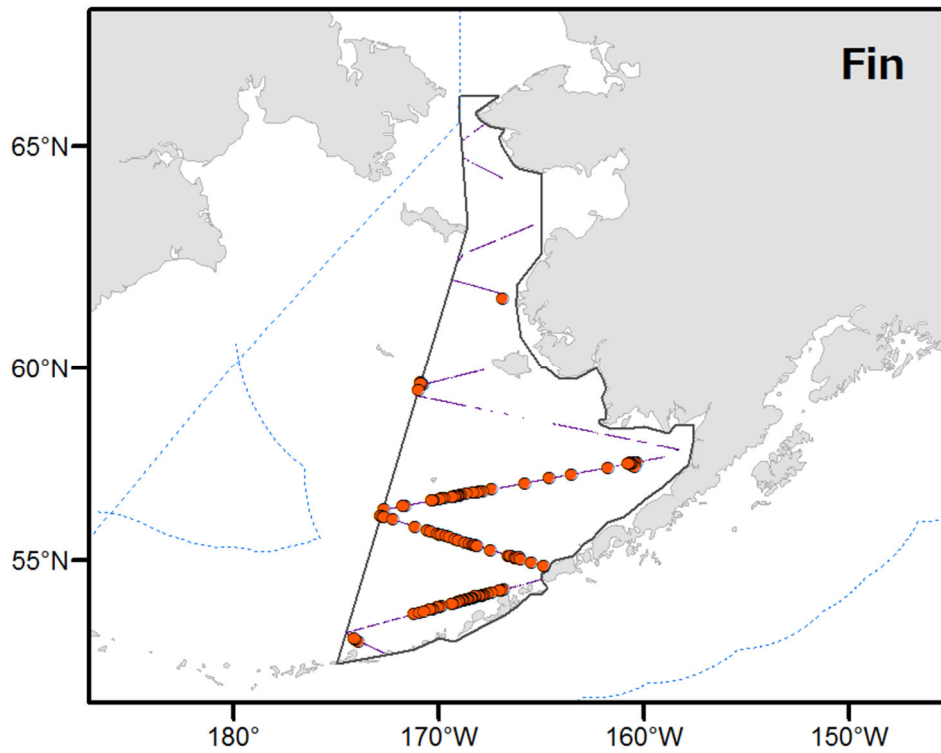


Figure 2b. The searching effort (thin line) and sighting positions of fin whales (red circle) during the 2017 POWER cruise.

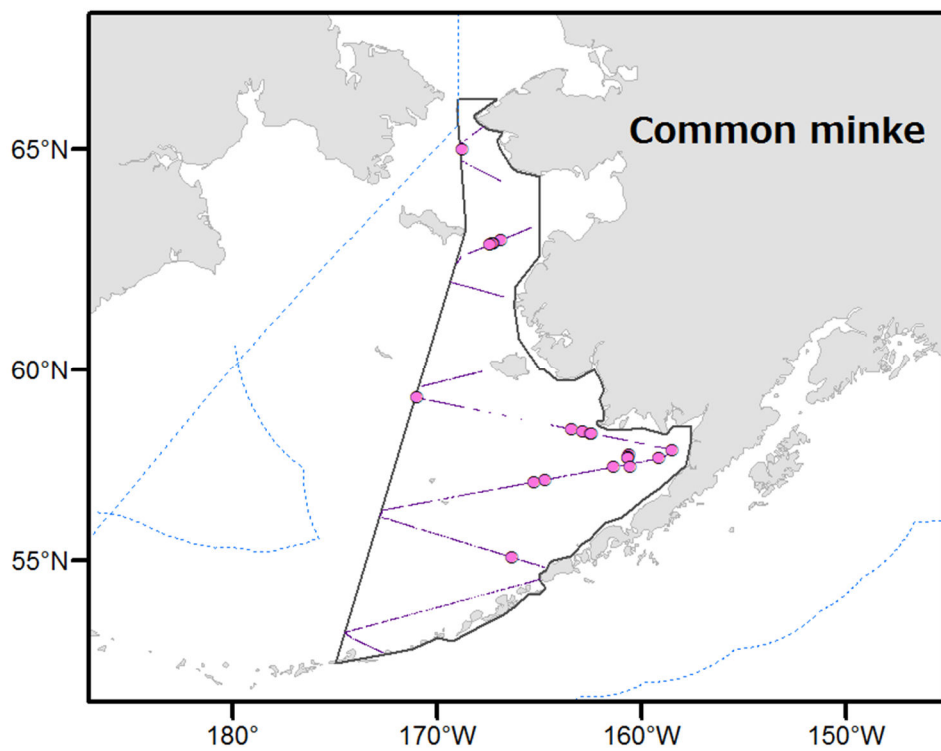


Figure 2c. The searching effort (thin line) and sighting positions of common minke whales (pink circle) during the 2017 POWER cruise.

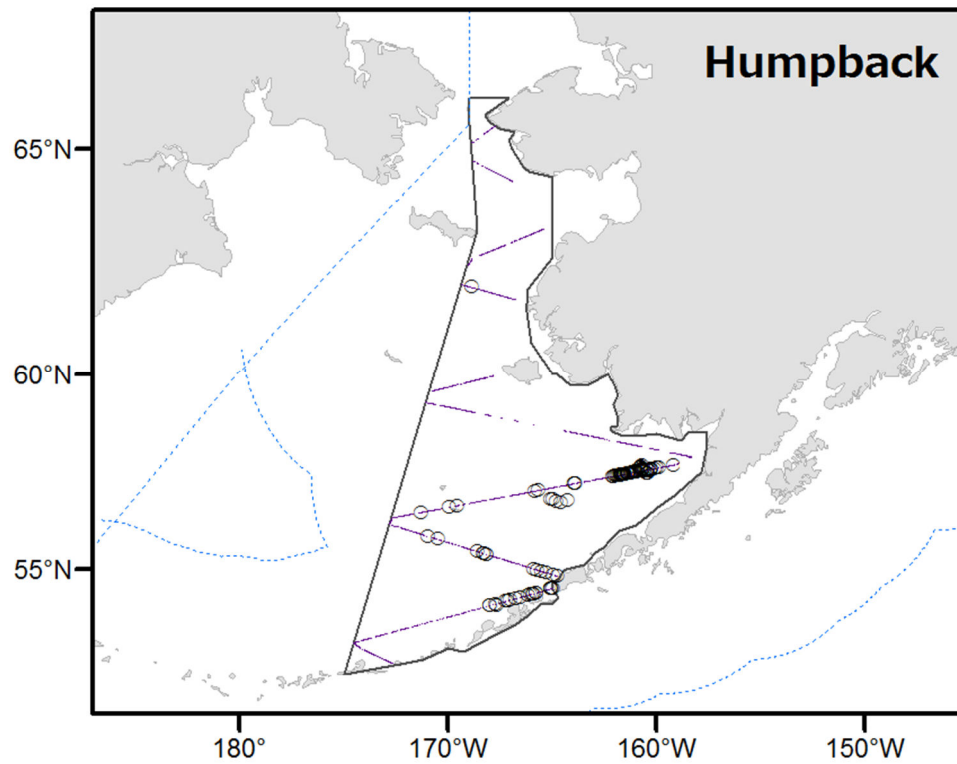


Figure 2d. The searching effort (thin line) and sighting positions of humpback whales (white circle) during the 2017 POWER cruise.

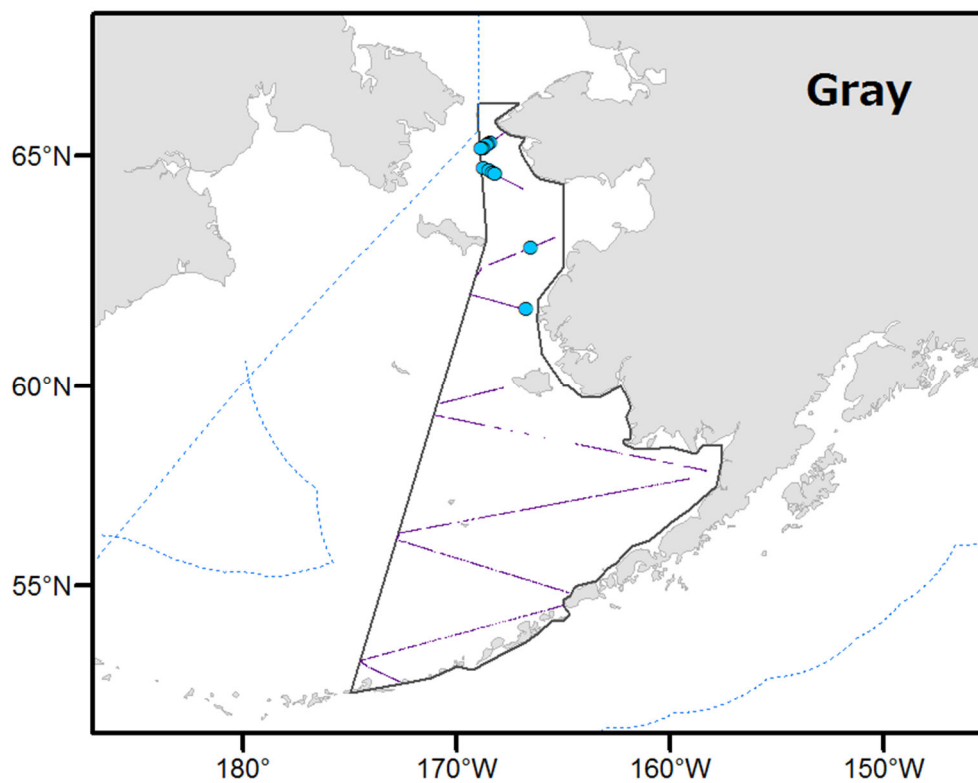


Figure 2e. The searching effort (thin line) and sighting positions of gray whales (blue circle) during the 2017 POWER cruise.

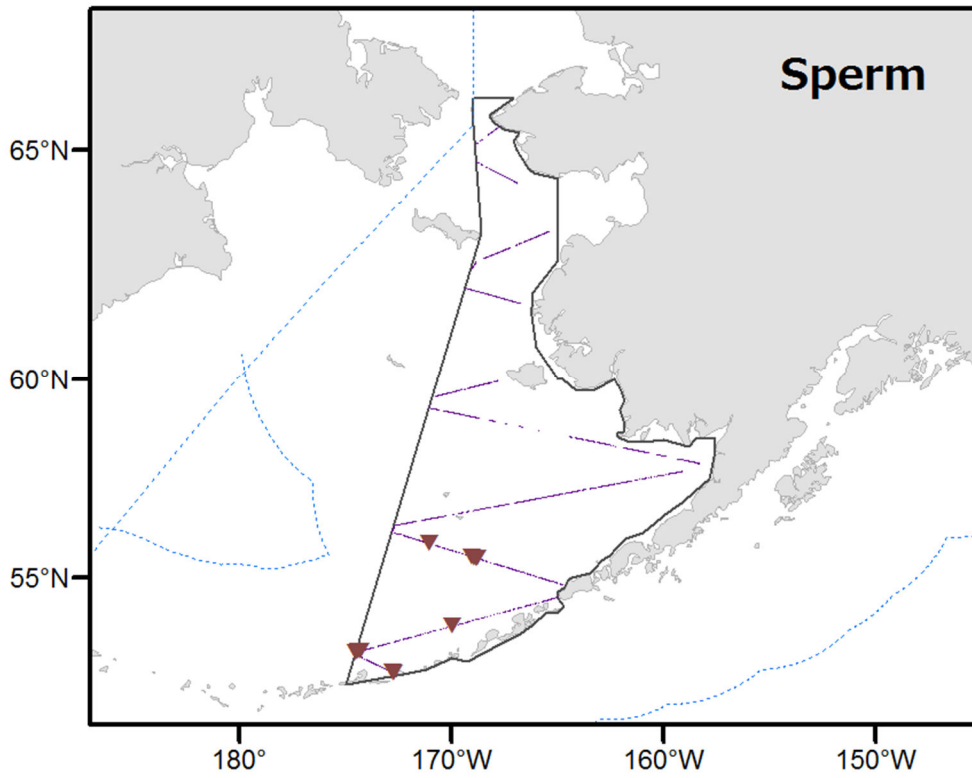


Figure 2f. The searching effort (thin line) and sighting positions of sperm whales during the 2017 POWER cruise.

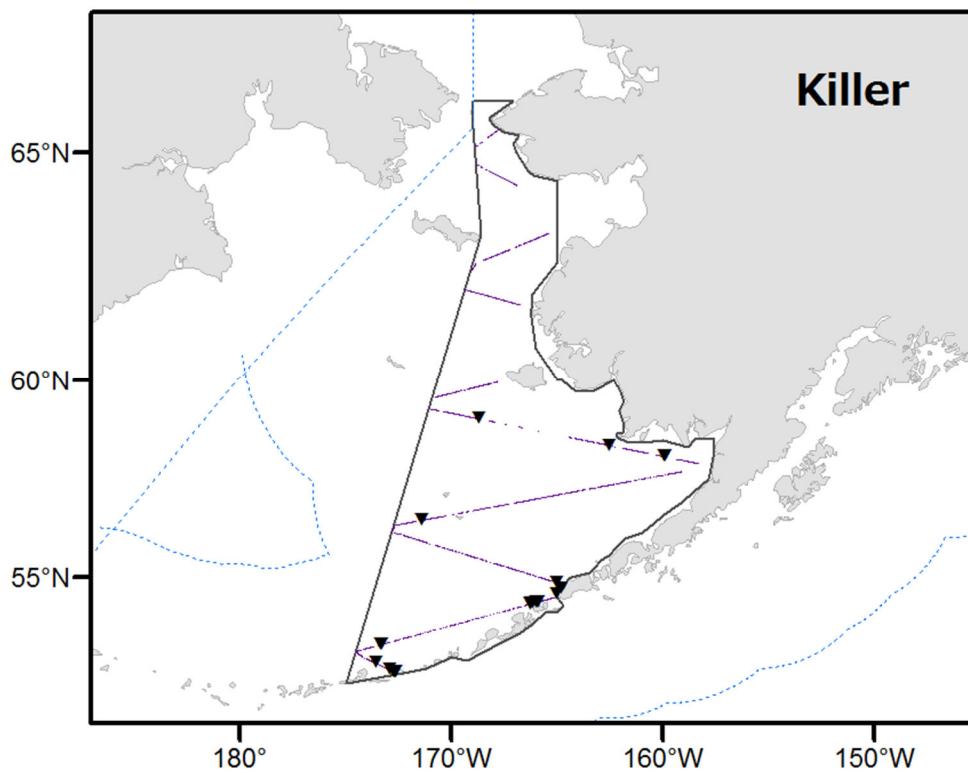


Figure 2g. The searching effort (thin line) and sighting positions of killer whales during the 2017 POWER cruise.

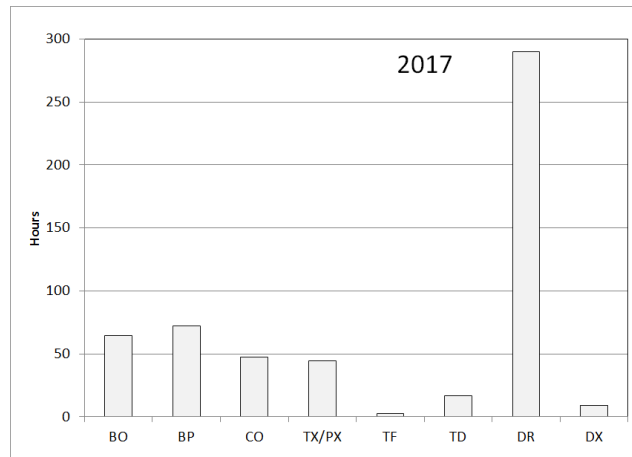


Figure 3. Breakdown of research time in hours, by effort code in the research area during the 2017 POWER cruise (Original trackline, Area code: 71). BO: Independent Observer mode, BP: Passing mode searching, CO: Confirmation of school, TX/PX: Biopsy / Photo-ID experiments, TF: Time back to trackline, TD: Top down steaming, DR: Drifting, DX: Distance and angle estimate experiment.

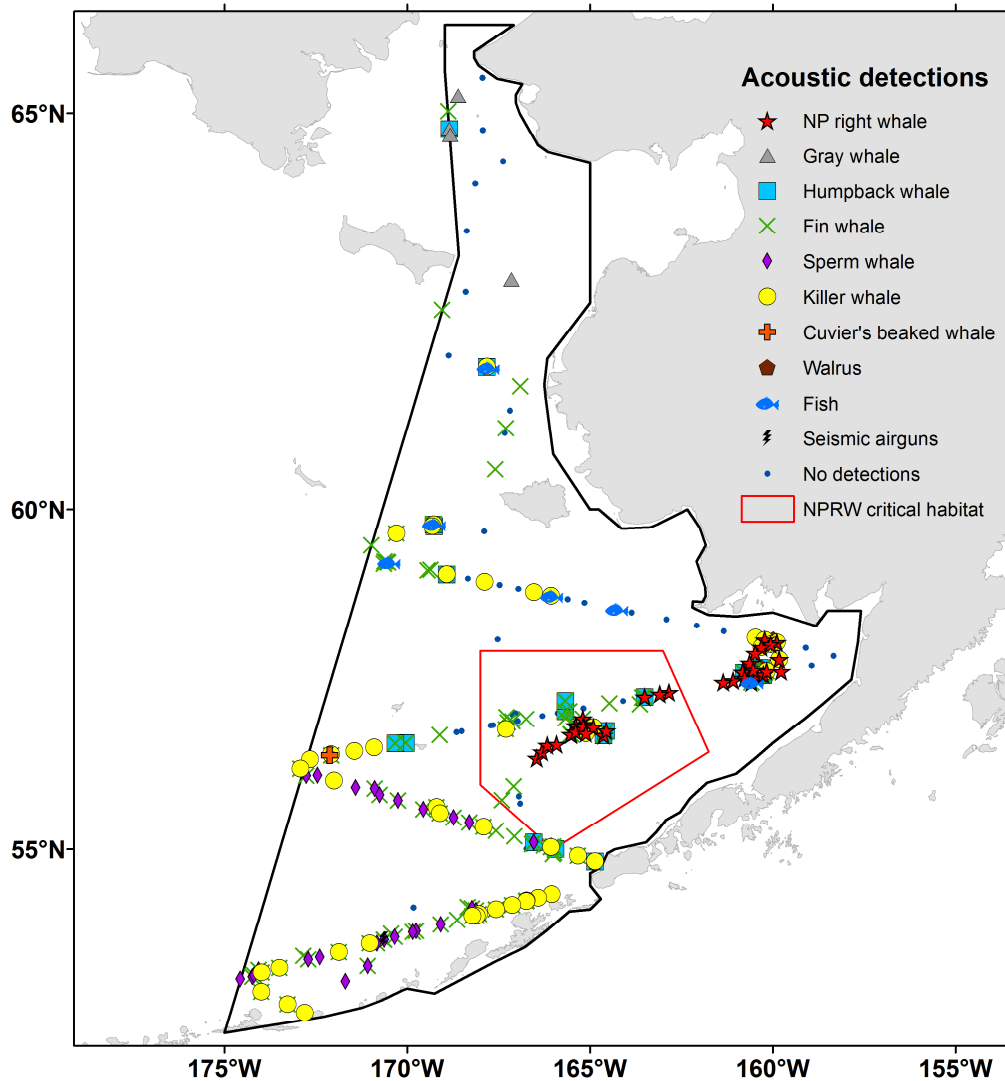


Figure 4. Location and species detected on all sonobuoy deployments during the 2017 POWER cruise.

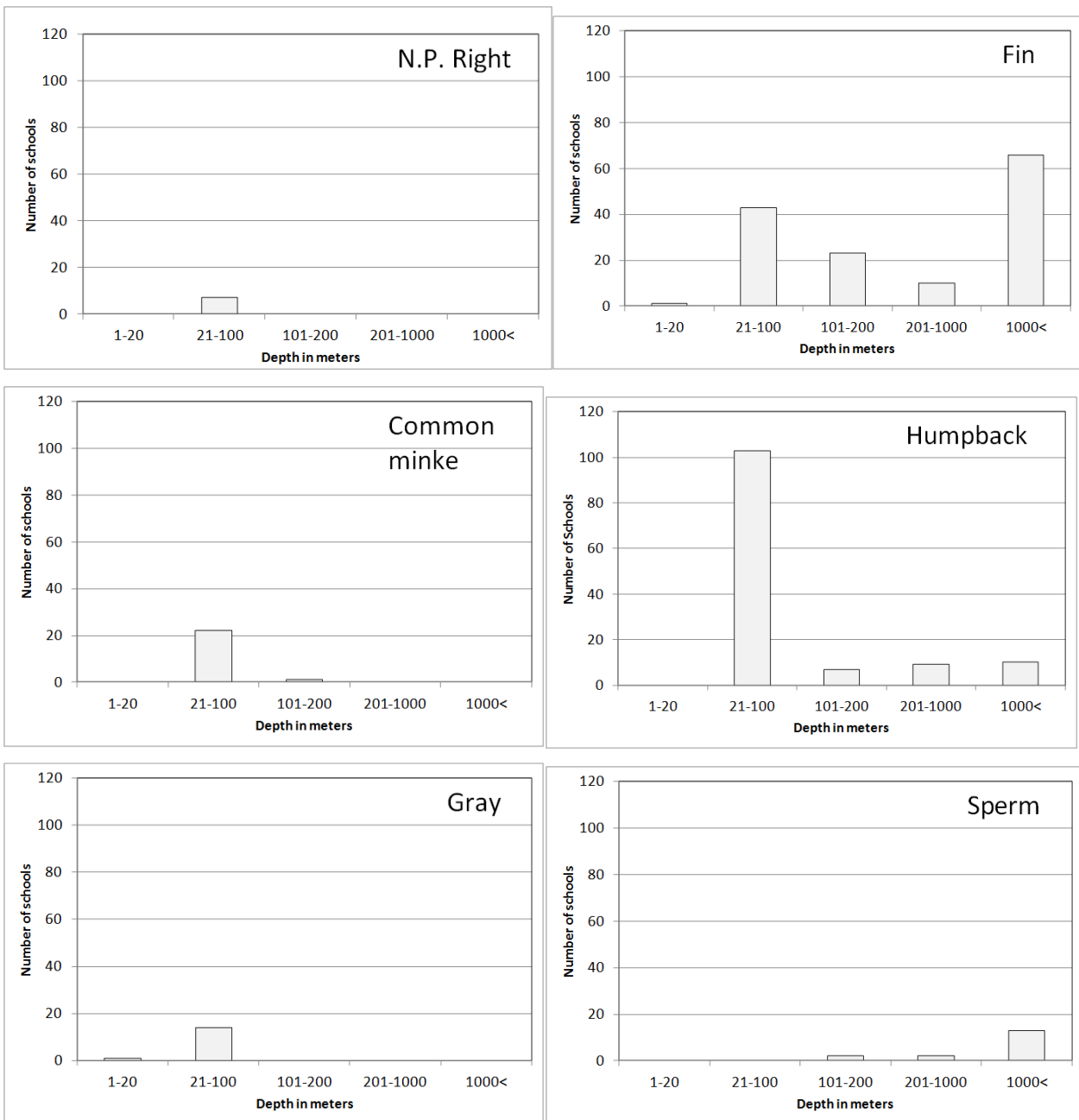


Figure 5. Breakdown of the water depth (m) at the sighting position for the main species sighted in the research area.

APPENDICES

Appendix A. Ship specifications and crew list of *Yushin-Maru No.2*.

Ship photo:



Ship specifications:

	<i>Yushin-Maru No.2</i>
Call sign	JPPV
Length overall [m]	69.61m
Molded breadth [m]	11.5m
Gross tonnage (GT)	747
Barrel height [m]	19.5m
IO barrel height [m]	13.5m
Upper bridge height [m]	11.5m
Bow height [m]	6.5m
Engine power [PS / kW]	5303/3900 (PS/kW)

Crew list:

Title	<i>Yushin-Maru No.2</i>
Captain	Hidenori Kasai
Chief Officer	Tohru Takamatsu
Second Officer	Ryuichiro Moriyama
Chief Engineer	Yoshihiro Ooura
First Engineer	Fumiyoshi Shimoda
Second Engineer	Koji Takamatsu
Third Engineer	Yasuhisa Nitta
Chief Operator/Purser	Takeshi Semii
Boatswain	Takao Ohmura
Quartermaster	Kazuyuki Sugiyama
Quartermaster	Takato Sawabe
Quartermaster	Akihiko Tsuji
Sailor	Naoto Suzuki
Sailor	Kazuki Fujiwara
Sailor	Toshikazu Takahashi
Chief Steward	Seichi Hamashita
Steward	Masanobu Abe

Appendix B. Comparison of weather conditions (wind speed / visibility) among past cruises (2010-2017).

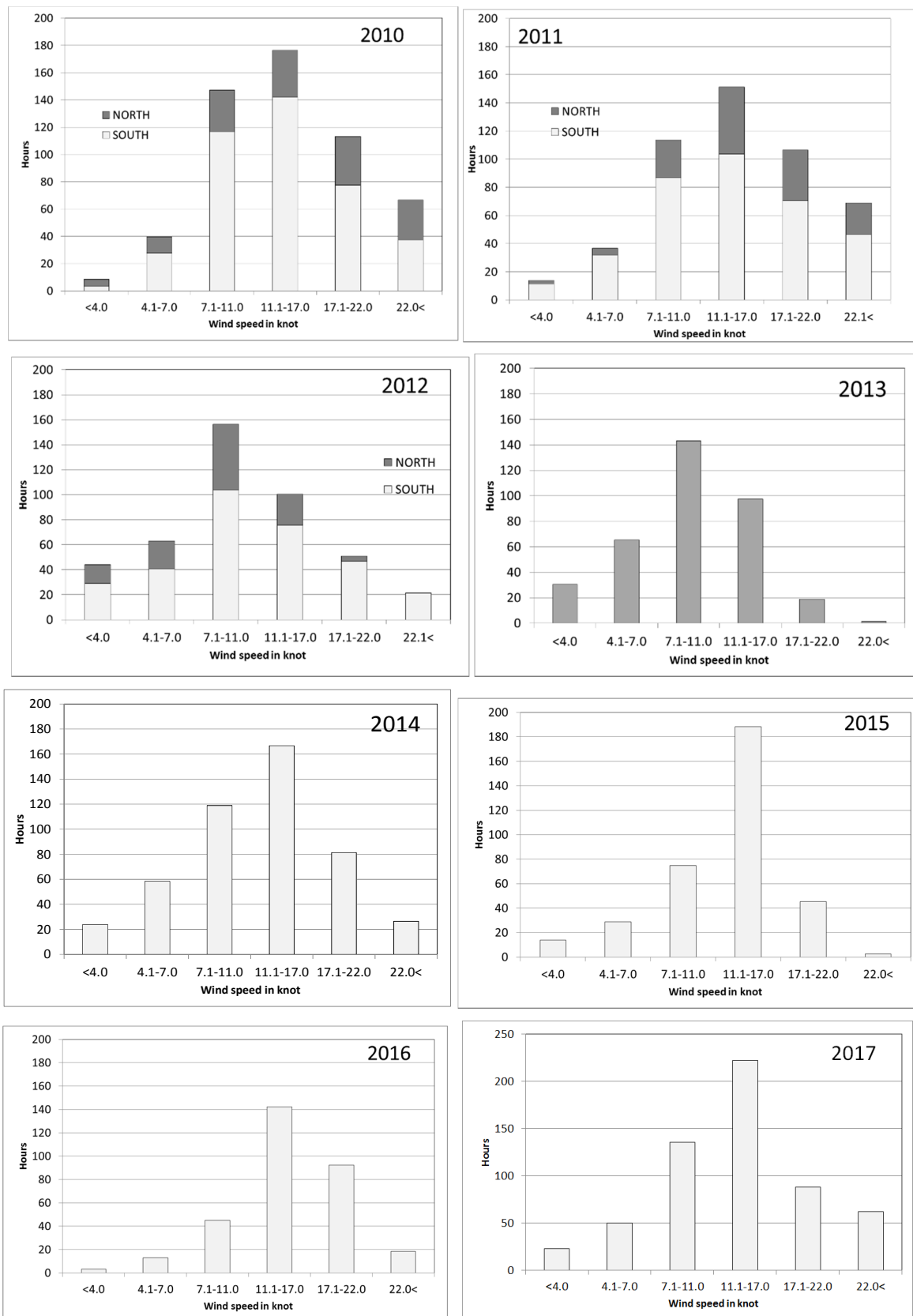


Figure B1. Breakdown of research time in hours during 2010 to 2017 surveys in research area by wind speed.

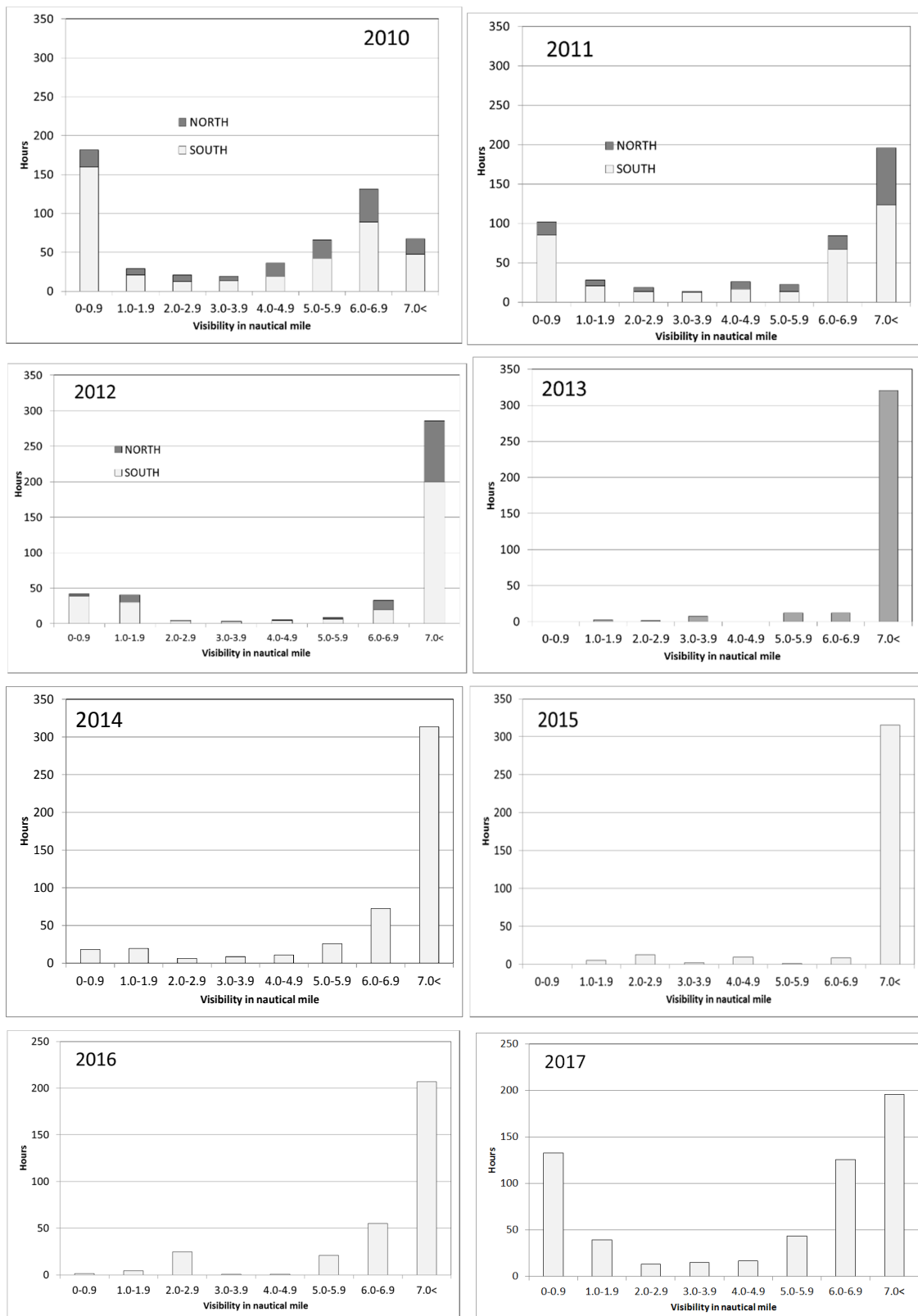


Figure B2. Breakdown of research time in hours during 2010 to 2017 surveys in research area by visibility in nautical mile.