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Cruise report of the 2015 IWC-Pacific
Ocean Whale and Ecosystem Research
(IWC-POWER)

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INTERNATIONAL
WHALING COMMISSION

Cruise report of the 2015 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 6th annual IWC-POWER cruise was successfully conducted between 02 July to 30 August, 2015 in the central North Pacific (north of 20°N, south of 30°N, between 170°E and 160°W, with the exception of the Papahānaumokuākea Marine National Monument area, PMNM) using the Japanese Research Vessel *Yushin-Maru No.3*. The cruise was organised as a joint project between the IWC and Japan. The cruise plan was endorsed at the 65b IWC/Scientific Committee (IWC/SC) meeting. Researchers from Japan, US and UK participated in the survey. The cruise had five main objectives, to: (a) provide information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure; (b) provide information relevant to *Implementation Reviews* of whales in terms of both abundance and stock structure; (c) provide baseline information on distribution and abundance for an area of the North Pacific not recently and systematically surveyed for several large whale species/populations, including those that were known to have been depleted in the past, but whose status is unclear; (d) provide biopsy samples and photo-identification data to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear, and; (e) provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific. 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, and predetermined transect lines were completed within the anticipated schedule. Survey coverage was 95.6% and a total of 2,349.8 n.miles was surveyed in the research area in the Passing with abeam closing mode (NSP) and the Independent Observer passing mode (IO). Additionally, 765.2 and 291.9 n.miles were surveyed during transit to and from the research area respectively. Sightings of: Bryde's (46/52), sperm (32/93), pygmy sperm (2/5), dwarf sperm (1/6), Cuvier's beaked (5/9), Longman's beaked (1/110), *Mesoplodon* spp. (3/4), *Ziphiidae* (8/10), killer (1/4) and southern form short-finned pilot (2/60) whales; Risso's (7/85), bottlenose (4/36), rough toothed (3/59), spotted (8/531), striped (5/279), Fraser's (2/233) and spinner (1/13) dolphins were observed during the cruise. Bryde's and sperm whales were the most frequently sighted large whale species and were widely distributed in the research area. The Estimated Angle and Distance Training Exercises and Experiments were completed with improvements following SC suggestions. Photo-identification data for 29 Bryde's whales, 3 sperm whales and 4 killer whales were collected. A total of 37 biopsy (skin and blubber) samples was collected from 34 Bryde's whales, 1 sperm and 2 killer whales using the Larsen-gun system. In the case of Bryde's whale, 22 samples (individuals) were collected from Sub-area 1 (west of 180°E) and 12 samples from Sub-area 2 (180°E- 170°W). These biopsy samples will enable genetic studies on stock structure to be conducted in contribution to the North Pacific Bryde's whale *Implementation Review* to be held at the 2017 SC meeting. A total of 199 objects of marine debris items were observed. The planned survey procedure was in accordance with the guidelines agreed by the SC. The 6th annual cruise of the IWC-POWER programme was completed and provided important information on cetacean distribution in an area where no survey had been conducted in recent decades. These results will contribute to the aforementioned objectives of the IWC/SC.

KEY WORD: BRYDE'S WHALE, SPERM WHALES, SURVEY VESSEL, NORTH PACIFIC, 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, 2014a, 2014b, 2015a, 2015b; Kato *et al.*, 2011, Matsuoka *et al.*, 2011, 2012, 2013, 2014, 2015). The 2015 cruise plan was endorsed at the 65b IWC/Scientific Committee (IWC/SC) meeting. The cruise had five main objectives, to: (a) provide information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure; (b) provide information relevant to Implementation Reviews of whales in terms of both abundance and stock structure; (c) provide baseline information on distribution 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; (d) provide biopsy samples and photo-identification data to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear, and; (e) provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific (IWC, 2015b).

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

The research area was set north of 20°N, south of 30°N between 170°E and 160°W, including areas of the US EEZ except the Papahānaumokuākea Marine National Monument area (PMNM) (Figure 1a). A randomised start point for survey tracks was used based on the IWC/SC survey guidelines (IWC, 2005), as for all previous IWC-POWER cruises. Every location within the study area had an equal probability of being sampled, as calculated by the software “DISTANCE” (Thomas *et al.*, 2010). Figure 1b shows the cruise track design in the research area with a modified course to avoid the PMNM, and Table 1a 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. The sighting survey was conducted using Passing with abeam closing mode (NSP) and the Independent Observer passing mode (IO) based on discussions and suggestions from the Technical Advisory Group (TAG) of SC members (IWC, 2013, 2015a). Two primary observers were in the barrel throughout periods of NSP and IO modes (see section 2.5). Sighting survey procedures are detailed in “Information for Researchers” (Anon. 2015a). For encounters of rare species (e.g. blue and right whales), it was decided that the vessel would approach whales immediately to avoid losing the sighting due to a delay in closing.

The R/V *Yushin-Maru No.3* (YS3) was used during this cruise, which included transits between Japan and the research area. Research time was allocated for biopsy sampling of blue, fin, sei, Bryde’s, common minke, North Pacific right, humpback, sperm and killer whales, with higher priority given to the former seven species. The Larsen-gun system was used to collect samples. Priority species for photo-ID were blue, North Pacific right and humpback whales, although photos of all other species, including fin, sei, Bryde’s, sperm and killer whales would be obtained opportunistically.

2. SHORT NARRATIVE OF THE CRUISE

2.1 The 2015 cruise itinerary

Date	Event
30 June 2015	The whale disentanglement and rescue seminar was held by the IWC, Shiogama, Japan
1 July	Pre-cruise meeting
2 July	Researchers board the <i>Yushin-Maru No. 3</i> . Vessel departed Shiogama
4 July	Started transit survey
11 July	Vessel arrived at the research area (44 days in the research area)
22 August	Vessel completed surveys in the research area at 170°00'E and begins return transit.
28 August	Finished transit survey, Post-cruise meeting
30 August	Vessel arrived Shiogama, Japan

2.2 Research vessel

The R/V *Yushin-Maru No.3* (742GT) was contracted for this cruise. The vessel was also contracted in previous years; 2011, 2012, 2013 and 2014. Ship specifications, photo, and a crew list are provided in Appendix A.

2.3 Attending scientists and responsibilities

Four international researchers were nominated by the steering group of the POWER programme: Koji Matsuoka (Cruise leader/Chief Scientist, sighting, photo-ID and video), James Gilpatrick (sighting, photo-ID and biopsy), Jessica Taylor (sighting, photo database and photo-ID), and Isamu Yoshimura (sighting, biopsy and marine debris

data). Taiki Katsumata (Tokyo University of Marine Science and Technology, TUMSAT) was engaged in data collection photo-ID and marine debris data, as research assistant.

Koji Matsuoka (Japan) - Cruise Leader /Chief Scientist, sighting, photo-ID/video
 James Gilpatrick (USA) - sighting, photo-ID and biopsy
 Jessica Taylor (UK/USA) - sighting, photo database and photo-ID
 Isamu Yoshimura (Japan) – sighting, biopsy and marine debris

2.4 Pre-cruise meeting

On 1 July, a pre-cruise meeting was held at the Tohoku Dock yard, Shiogama, chaired by Kato (Convenor for this cruise) of the Tokyo University of Marine Science and Technology (TUMSAT). Meeting participants were: Miyashita (National Research Institute of Far Seas Fisheries, NRIFS), Matsuoka (The Institute of Cetacean Research, ICR, Cruise Leader), Gilpatrick (National Oceanic and Atmospheric Administration's (NOAA) Southwest Fisheries Science Center, (SWFSC), researcher), Yoshimura (IWC-nominated researcher, Japan), Taylor (IWC-nominated researcher, UK/USA), Ohkoshi (Captain), Oide (Chief Engineer), Shimaoka (Chief Operator), Konagai (Chief Officer), Abe (Bosun), Sugiyama (Quartermaster), Mori (Kyodo-senpaku) and Taiki Katsumata (TUMSAT). The meeting discussed and confirmed priorities and strategies for the cruise based on the IWC Scientific Committee's planning report (IWC, 2015b), and IWC research manual (Anon, 2015a). The pre-cruise meeting report (Anon, 2015b) was distributed to the steering group after review by the Chair. On 2 July, researchers boarded the YS3 with all of the necessary equipment and departed from Shiogama.

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). Time-zone changes were in 30-minute intervals, effective from 01:00. Schedules adhered to local 'ship' time which ranged between +9 and +12.5 GMT throughout the cruise. Data collected during the cruise and all associated reporting were reported in local 'ship' time.

Sighting activities aboard the ship were classified into two principal types: On-effort and Off-effort. In the sightings survey portion of the research, 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. All sightings recorded during On-effort were classified as Primary sightings. All other sightings were considered to be Secondary sightings. Sighting effort was conducted by the bos'un and topmen from the barrel (crow's nest: always two primary observers) and the upper bridge where the helmsman, captain or officer-on-watch, four researchers, and the chief engineer or deputy were also present (always two primary observers and 6 secondary observers). Passing with abeam closing mode (NSP) was used during this cruise. This was in effect Passing Mode. Two topmen were observing from the barrel at all times (maximum 06:00-18:00). There was open communication between the upper bridge and the barrel. The observers on the upper bridge communicated with the topmen only to clarify information and did not distract the topmen from their normal search procedure unless they were directed to do so by the Cruise Leader (Anon. 2015a).

Following advice from the Scientific Committee and the TAG, the 2015 survey alternated between NSP and IO modes (*ca* every 50 n.miles). 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. The topman did not alter his normal searching pattern in order to keep contact with the sighting. Observers on the upper bridge located the sighting made by the topman and decided whether it would be possible to confirm species and count before the sighting passed abeam of the vessel. The topman gave no further information to the upper bridge unless the whale group resurfaced within their normal searching pattern. 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, in consultation with other 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 neared, 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 could commence at the discretion of the Cruise Leader, such as natural marking or biopsy 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. 2015a).

2.6 Weather conditions and expected versus realised effort

In the research area, generally weather conditions were good due to a strong and prevalent high pressure system and high sea surface temperature from the south. A total of 1,198.5 n. miles and 1,151.3 n.miles were surveyed in the

research area in NSP mode and IO mode, respectively. Survey coverage (searching distance/planned distance (2,457.8 n.miles)) was 95.6% in the research area. 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 Exclusive Economic Zone of the United States (US EEZ, along the NW Hawaiian Island Chain) were permitted under U.S. National Marine Fisheries Service (NMFS) Permit nos. 14097-6 (issued to the SWFSC) and 15240 (issued to the Pacific Islands Fisheries Science Center or PIFSC). Researcher James Gilpatrick (from USA) was listed as the co-investigator (CI) aboard the research vessel under both Permits.

Cetacean tissue biopsy samples obtained within the US EEZ (i.e., 16 Bryde's whale and 3 Killer Whale specimens) were legally exported to Japan under the CITES (Convention on International Trade in Endangered Species) U.S. Management Authority (U.S. Fish and Wildlife Service) Permit no. 15US64066B/9. The biopsy samples were then imported to Japan under the CITES Japan Management Authority i.e., the Office of Trade Licensing for Wild Animals and Plants, Ministry of Economy, Trade and Industry (METI): Permit/Cert. No. 15JP000003/TI.

Cetacean research activities conducted on the high seas in international waters by Japanese researchers aboard the YS3 were authorized under permit SUIKAN 27-688 issued by Fisheries Agency, Government of Japan. A summary of research effort in the US EEZ is provided in Appendix C.

2.8 Data entry system and analysis

Researchers input the data collected during the survey (weather, effort, sighting and experiments data) into the computer onboard the vessel using the 'onboard data collecting system' (ICR, 2013).

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, 2015a):

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; this judgement was made only by the Cruise leader 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. 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, 2015a).

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 are 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) should be spent on confirmation, this reduces the potential for confusion with other sightings in the vicinity (Anon, 2015a). Counts of individuals provided in the Sighting summary (section 3.3) represent best estimates of school sizes in the research area, except when indicated otherwise.

3.3 Sighting summary

Tabulations of all track line WPs, the searching effort and the sightings recorded in the research area, by species and by survey modes are presented in Tables 1a, 1b, 2a and 2b, respectively. Table 2c summarises all sightings observed throughout the cruise including transit to and from the research area. Table 2d shows the identification of duplicate sightings observed during survey in IO Mode. Table 3 shows the sea surface temperature (minimum, maximum and

range) for each frequently-sighted species in the research area and provides quartile analysis for the major species observed. Figure 1a illustrates the research area and transit course between Japan and research area. Figure 1b illustrates the track line design and the survey order including a modified course to avoid the PMNM. Figures 2a through 2e illustrate locations of sightings and search effort in the research area. Recorded sea surface temperature (SST) ranged from 24.7 to 31.4°C during sightings observed in the research area (Table 3). Figure 3 shows the breakdown of research time, in hours by effort code in the research area. Appendix B show the breakdown of research time, in hours by wind speed and visibility in the research area, respectively.

Transit survey to the research area

The YS3 departed Shioyama port on schedule (10:30, 02 July) and conducted the transit survey to the research area from 4 July (06:00) through 11 July (12:10) using passing mode. YS3 entered the US EEZ at 30°-14.8N, 178° -26.4E on 9 July 15:42 and arrived at the research area at Waypoint (WP) 125 (27°-N, 173° -45.5W) on 11 July at 12:10. Weather conditions were generally good, with occasional intervals of rain. The safety instruction meeting and emergency drill were conducted on 3 July. Larsen-gun training was conducted on 5 July. Distance and angle estimation exercises were conducted on 9 July.

Total searching distance was 765.2 n. miles. Total transit sightings included Bryde's whales (17 schools/18 individuals), like Bryde's (10/12), sperm whales (21/43), pygmy sperm (2/5), Cuvier's beaked (2/3), *Mesoplodon* (2/2), Ziphiidae (4/6), southern-form short finned pilot whales (1/28), Risso's dolphins (6/82), spinner (1/13) and spotted (4/341) dolphins (Table 2c). Biopsy experiments were successfully conducted for 4 Bryde's whales on 9 and 10 July (Table 4a,c).

The research area

The YS3 finished the transit survey and started the research area survey at Waypoint 125 (Table 1a) position 27°08.6'N 175°23.4'W, on 11 July 12:10. The research vessel followed a north-east course (35°) towards latitude 30°N, with a south-east course change (146°) towards latitude 20 °N under acceptable searching conditions. The YS3 arrived at the most easterly WP (WP130), position 25°25.1'N 160°00'W, on 20 July, almost on schedule.

Generally, weather conditions were good for the sighting survey allowing for a good portion of passing mode searching. Wind speed generally ranged between 15 to 20 knots and visibility was usually over 7.0 n.miles (Appendix B). There were no strong ocean currents in the research area or during the research period.

A total of 2,349.8 n. miles was surveyed in the research area (original trackline) in the Passing with abeam closing (NSP) mode and Independent Observer (IO) mode. Survey coverage (searching distance/planned distance (2,457.8 n.miles)) was 95.6% in the research area. Additionally, a total of 898.7 n.miles was surveyed on the modified course to avoid the PMNM (Table 1b). Sightings recorded in the research area by species, by survey mode, are presented in Tables 2a and 2b.

The dominant, and only large whale species sighted in the research area were Bryde's (27 schools/32 individuals) and sperm (11/50) whales. Total sightings of other species sighted in the research area include: dwarf sperm (1/6), Cuvier's beaked (3/6), Longman's beaked (1/110), *Mesoplodon* (1/2), Ziphiidae (4/4), southern-form short finned pilot (1/32), killer (1/4) whales; Risso's (1/3), bottlenose (4/36), rough toothed (2/54), spotted (3/162), striped (5/279) and Fraser's (2/233) dolphins. Bryde's whales and sperm whales were widely sighted in the research area (Figures 2a to 2e). 29 Bryde's, 2 killer and one sperm whale were biopsy sampled in the research area between 11 July and 22 Aug (Tables 4 a and 4c).

Details of sightings by each species; results of photo-identification and biopsy experiments; and marine debris observations are provided in the following paragraphs.

Transit survey to Shioyama

The YS3 departed the research area (15:23, 22 August) and started the transit survey to Japan (Shioyama port) using the passing mode until 28 August (12:00) under intervals of heavy wind and/or rain (Table 1b). Total searching distance was 291.9 n. miles. Sightings recorded during the transit sighting survey, by species are presented in Table 2c. One Bryde's whale was biopsy sampled on 23 August during transit from the research area (Tables 4a and 4c).

Detailed sightings by each species are as follows:

(Note: see Tables 2c and 3 for summary data on general sighting locations and sea surface temperatures, SST)

Bryde's whale (*Balaenoptera edeni*)

Bryde's whales were the most frequently encountered whale species during the survey with 46 sightings; a total of 52 individuals were counted including 5 mother/calf pairs (Figure 2a). Seventeen of these sightings (18 individuals) were made during the survey transit from Japan to the main research area. Twenty-seven sightings (32 individuals; including 5 mother/calf pairs) were made within the research area; including sightings along the track line that was modified to avoid the PMNM area. Two sightings (2 individuals) were recorded during the return transit survey from the research area to Japan (Table 2c).

Biopsy samples were obtained from 34 Bryde's whales throughout the cruise. Within the research area biopsy samples were obtained from 29 Bryde's whales (including 11 whales (16 specimens) within the US EEZ). Biopsy samples were collected from 5 Bryde's whales outside of the main research area. Five mother/calf pairs were biopsied during the survey.

In general, Bryde's whales were found to be distributed throughout the research area with the majority of sightings occurring north of the 21°N Latitude and west of the 170°W Longitude (Figure 2a). Bryde's whales were found in SST ranging between 25.1° - 31.4°C with most whales sighted in SST ranging between 28.0-29.5°C (using 25th to 75th quartiles of the observed SST data for this species).

Sperm whale (*Physeter macrocephalus*)

Sperm whales were the most frequently encountered toothed whale sighted during the survey with 32 sperm whale sightings comprised of 93 whales (including 8 calves). Twenty-one sperm whale sightings were recorded during the transit to the survey area (43 whales, including 2 calves) and 11 other sightings comprised of 50 individuals (including 6 calves) were recorded in the main research area. Sightings were located over a relatively wide area with most sightings occurring north of 24°N Latitude and west of 171°W Longitude (Figure 2b).

Sperm whales were recorded in waters with SST ranging from 24.9° - 30.3°C with most individuals found in SST waters between 28.3-30.0°C (using 25th to 75th quartiles of the SST data observed for this species).

Pygmy sperm whale (*Kogia breviceps*)

Two sightings of the pygmy sperm whale (5 individuals total) were made during transit to the research area (Figure 2b).

Dwarf sperm whale (*Kogia simus*)

One sighting of the dwarf sperm whale (6 individuals including 1 calf) was recorded in the research area (Figure 2b); the SST was 30°C.

Cuvier's beaked whale (*Ziphius cavirostris*)

There were 5 Cuvier's beaked whale sightings (9 individuals total) during the survey. Two sightings (3 individuals) were recorded on transit to the research area and 3 sightings (6 individuals) were recorded in the research area (Figure 2c). Cuvier's beaked whales occurred in SST ranging between 27.6°-28.9°C.

Longman's beaked whale (*Indopacetus pacificus*)

One sighting of Longman's beaked whales was recorded in the research area (110 individuals, including 10 calves). The SST was 28.3°C. These whales were located just outside of the PMNM (due south of Nihoa Island and approx. 200 n.miles west of Oahu Island, Hawaii) in approximately 4,500 m water depth (Figure 2c).

Mesoplodon spp.

Three sightings of *Mesoplodon spp.* beaked whales (not identified to species; 4 individuals) were recorded. One sighting (2 individuals) was made in the research area and 2 sightings (2 individuals) were recorded during transit to the research area (Figure 2c) in SST of 25.8°C.

Ziphiidae

Eight sightings of beaked whales (10 individuals; no calves observed) belonging to the Family *Ziphiidae* were recorded. Four sightings (4 individuals) were recorded in the research area and 4 sightings (6 individuals) were documented during transit to the research area (Figure 2c). SST ranged between 27.4°-29.5°C.

Short-finned pilot whale (*Globicephala macrorhynchus*)

Two sightings of the southern form of the short-finned pilot whale were observed during the survey (60 individuals including 2 calves). A school of 28 individuals was observed during transit to the research area and a school of 60 individuals (including 2 calves) was observed in the research area (Figure 2d). The pilot whales recorded along the transit line were located in SST of 25°C.

Killer whale (*Orcinus orca*)

One killer whale pod (4 individuals including a large male) was observed within the research area (Figure 2d). The SST at the time of the sighting was 27.0° C. Biopsy samples were collected from the large male and another whale that was most likely a female.

Risso's dolphin (*Grampus griseus*)

Seven schools of Risso's dolphins (85 individuals including 1 calf) were observed. Six schools containing approximately 82 animals (including 1 calf) were located along the transit line to the research area. One school (3 individuals) were recorded in the research area (Figure 2d) and SST was 28.4° C.

Bottlenosed dolphin (*Tursiops truncatus*)

Four schools of bottlenosed dolphins (36 individuals including 8 calves) were observed during the survey, all within the research area. Two schools (26 individuals including 2 calves) were recorded along designated tracklines and 2 schools (10 individuals including 3 calves) were recorded along a track line modified to avoid the PMNM. These 10 dolphins were located approx. 20 nmi ESE of Nihoa Island and were associated with a sea mount with water depth between approx. 35-100 m; the other 2 schools were sighted in deep pelagic waters (Figure 2e). The bottlenosed dolphins were found in SST ranging between 27.8°-29.1°C.

Pantropical spotted dolphin (*Stenella attenuata*)

Eight schools of pantropical spotted dolphins (531 individuals including 74 calves) were observed during the survey. Four of the schools (341 individuals including 46 calves) were observed along the transit line to the research area. Three schools were recorded within the research area (162 individuals including 25 calves) and 1 school (28 individuals including 3 calves) was recorded along the transit line from the research area (Figure 2e). Pantropical spotted dolphins were found generally north of the 25°N Latitude and west of the 176°E Longitude and in SST ranging between 24.8°-30.3°C.

Striped dolphin (*Stenella coeruleoalba*)

Five schools of striped dolphins (279 individuals including 16 calves) were observed during the survey, all within the research area. Three schools were observed (168 dolphins including 16 calves) along designated tracklines; another 2 schools (111 individuals; no calves) were recorded along track lines modified to avoid the PMNM. Striped dolphins were located north of the 20°N Latitude and west of the 162°W Longitude (Figure 2e) in areas with SST ranging between 24.7°- 28.3°C. Within this range, most of the dolphins were located in waters 26.6°-28.3°C (using the 25th to 75th quartiles of the SST data observed for this species).

Spinner dolphin (*Stenella longirostris*)

One spinner dolphin school (13 individuals; no calves) was sighted during the survey (at 33°55.07'N Latitude/161°52.49' E Longitude). The school was sighted along the transit line eastward to the research area.

Fraser's dolphin (*Lagenodelphis hosei*)

Two schools of Fraser's dolphins (233 individuals including 20 calves) were recorded within the research area (Figure 2e). The SST ranged between 28.6°-30.2°C.

Rough-toothed dolphin (*Steno bredanensis*)

Two schools of Rough-toothed dolphins (estimated 54 dolphins including 7 calves) were recorded within the main research area (Figure 2e). The SST ranged between 28.8°C-29.0°C.

3.4 Resighting During IO Mode

Resighting data were recorded for a total of 9 sightings during IO Mode. Table 2d shows the identification of duplicate sightings observed during survey in IO Mode.

4. PHOTOGRAPHIC DATABASE

Sixteen different species (or family when species unknown) were photographed during the 2015 IWC-POWER cruise: Bryde's (43 schools / 49 individuals), sperm (10/37), killer (1/4), pilot (2/60), dwarf sperm (1/6), pygmy sperm (1/4) whales; Longman's (1/110) Cuvier's (4/8), unidentified Mesoplodon (2/3), unidentified Ziphiidae (1/1) beaked whales; Risso's (3/28), rough-toothed (3/59), bottlenose (4/36), spotted (7/485), striped (5/279) and Fraser's (2/233) dolphins (Tables 4a and 4c). Note that numbers are given for total individuals in photographed schools, not all individuals were photographed.

Images collected during the 2015 IWC-POWER cruise were uploaded to the SOWER-POWER IWC Lightroom (LR) database. Preliminary coding was completed for all images (18,120), including the allocation of species, sighting number and school size. A more thorough photo analysis was conducted for Bryde's, sperm, killer and beaked whale sightings. Time permitting, various health, behaviour and unique identification parameters were coded when evident in images. The majority of small odontocete images were marked for coding at a later date. Images of non-cetaceans were archived.

4.1 Individual Identification

Photo-identification results are **preliminary** and subject to change at the discretion of catalogue curators. Images useful for individual identification were collected for Bryde's, sperm, killer, pilot whales, Risso's and bottlenose dolphins. Individuals provisionally identified include 29 Bryde's, four killer and three sperm whales. Of the total 46 sightings of 52 individual Bryde's whales sighted during the 2015 IWC-POWER cruise, 43 sightings were photo-documented and 29 individuals were photo-identified (Table 4c). Of the 34 biopsy sampled Bryde's whales, 23 were photo-identified including four of the five mum-calf pairs one of which included an entangled calf. Both of the two killer whales that were biopsy sampled were also photo-identified, including one male. The sperm whale calf that was biopsy sampled was also photo-identified. Images will be available for incorporation into their respective catalogues.

5. BIOPSY SAMPLING

A total of 37 biopsy samples (individuals) were successfully collected, including 34 Bryde's whales, 1 sperm whale, and 2 killer whales (Table 4a). Every biopsy encounter was documented photographically. All samples for molecular genetic analysis were frozen. All biopsy samples will be sent to NRIFS after arrival in Shioyama. Samples are to be divided in half, with one half of the sample for IWC and the other half for Japan. All dividing work will be conducted by NRIFS, after conclusion of the cruise, before export is arranged. Summary of number of Bryde's whale biopsied individuals during this cruise is shown in Table 4c.

In the case of Bryde's whales, 22 samples (individuals) were collected from Sub-area 1 (west of 180°E) and 12 samples from Sub-area 2 (180°E- 170°W, in Figure 2a). These biopsy samples will enable genetic studies on stock structure to be conducted in contribution for the North Pacific Bryde's whale *Implementation Review* to be held in the 2017 SC meeting.

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 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 Bryde's whales for sampling was very high and similar to the success rate from the 2014 cruise. Of the 39, encounters with Bryde's whales where biopsy sampling was attempted, a sample was obtained in 34 of those encounters (87.3% success rate). Median time from setup to sample retrieval when sampling single Bryde's whales was 21 minutes. When sampling groups of 2 Bryde's whales (mothers and calves), the median time from setup to sample retrieval was 14 minutes.

One biopsy sample was collected from a sperm whale calf that was part of a group of 6 individuals (biopsy effort duration: 70 minutes). Biopsy specimens were collected from 2 killer whales (part of a pod of 4 killer whales) and average time for the encounter and collection of the samples was 54 minutes. During the five encounters with Bryde's whales where the biopsy experiment was initiated but samples were not collected, the whales were surfacing in erratic (not predictable) patterns and the whales exhibited exceptional speed in staying ahead of the research vessel. Biopsy sampling was attempted as often as permitted under acceptable environmental conditions.

6. VIDEO-RECORDING

A digital video camera recorder, Sony HDR-PJ800, AVCHD was used to conduct opportunistic video recording. Eight separate video clips were recorded, for a total time of 00:11:35, including 00:04:10 of Longman's beaked whale surfacing, 00:00:39 of killer whale biopsy event, 00:00:43 of Fraser's dolphin large group, 00:00:35 of sperm whale calf surfacing and 00:05:28 of Bryde's mother and calf pair (entangled calf).

7. OTHER EXPERIMENTS

7.1 Estimated Angle and Distance Training Exercise

The Estimated Angle and Distance Training Exercises were conducted on the afternoon of 9 July for 2 hour 54 minutes. During the exercise observers familiarised themselves with distance estimates from the top barrel and upper bridge. Following advice from the Scientific Committee and the TAG, the 2015 survey conducted several improvements for this experiment (SC/66a/Rep01). The improvements were: (1) use of relatively inexpensive GPS technology (a waterproof tough 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 with 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 recommended buoy (to simulate a whale's body rather than the blow) had provided on the vessel.

7.2 Estimated Angle and Distance Experiment

The Estimated Angle and Distance Experiments were conducted on 3 August for 7 hours 38 minutes during the latter half of the research period whilst in the research area. A total of 60 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. Details of the results will be analysed and reported to the TAG after the conclusion of the cruise.

7.3 Marine debris observations

During this cruise as in past years, data on floating marine debris were collected to document type and extent of marine debris presence in the North Pacific. As agreed during the pre-cruise meeting in Shioyama, 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 sparsely distributed during this cruise, unlike during the 2012 POWER cruise (Matsuoka *et al.* 2013) and especially during the 2013 POWER cruise (Matsuoka *et al.* 2014). A total of 199 marine debris objects were observed, of which 173 were recorded "on effort" (i.e., during the first 15 minutes of each hour) (Table 5). A total of 64 objects were recorded in the US EEZ (Appendix Table C7). A total of 32 objects were photographed.

8. TECHNICAL MATTERS OF DATA AND RECOMMENDATIONS

8.1 Photographic database processing in Lightroom

Images collected during the cruise were uploaded to Adobe Lightroom (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. It is **recommended** that researchers on future cruises continue the Adobe Lightroom processing to make the photographic database a more valuable and readily available resource. A guidance document specific for during-cruise processing has been developed and added to the 'Information for Researchers' (Anon 2015a). It is recommended that hard copies of this document and the LR IWC Photographic Database Manual be made available during the cruise. Upgrades are **recommended** for the IWC laptop and software programs in order to handle image processing.

8.2 Datasheets: Natural Marking and Biopsy

It is **recommended** that the Natural Marking Record sheet and Biopsy Sampling Record sheet be amended to include the alternate's Form Number so that the two can be easily linked. It is **recommended** that the minimum information required for daily image processing be recorded on the Natural Marking Record sheet, and that every photographed sighting has a corresponding form. It is **recommended** that every individual in a school be allocated a whale letter (referenced in Nat. Mark. Record sheet) and each biopsied whale in a school be allocated a sequential whale number (referenced in Biopsy Record sheet). Biopsied whales should be linked to corresponding whale letters when possible. Recommended updates to record sheets have been included in the 'Information for Researchers' (Anon 2015a).

8.3 Large-whale Entanglement cases

An entanglement response data form was completed for the Bryde's whale calf observed entangled in rope on 18-August during this 2015 cruise. It is **recommended** that specific protocols, data forms and data submission for cases of entanglement (and carcasses if sighted) be agreed upon.

9. CONCLUSIONS

The 6th annual IWC-POWER cruise was successfully conducted using the Japanese Research Vessel *Yushin-Maru No.3*. Equipment and survey methods were consistent with previous IWC international sighting surveys. Sighting procedures were in accordance with guidelines agreed upon by the SC (IWC, 2005). Survey objectives, methods and procedures were understood 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 photographic, sighting records, biopsy samples and video, will be sent to the IWC secretariat after arriving at the home port, under the responsibility of the cruise leader. The 6th cruise of this programme provides critical information on the distribution, abundance and stock structure of baleen whale species, in particular the Bryde's whale, in a poorly-known area. Additional information on other cetacean species found to be widely distributed in 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. Way Points (WP) and each survey mode in the research area. The planned original cruise track line distance in the research area was 2,457.8 n.miles (except a modified course to avoid the PMNM, see Figure 1b).

WP	Latitude	Longitude	Co.	Distance	Mode
101	25°25.1'N	170°00.0'E	34°	54.9	IO
102	26°11.0'N	170°33.8'E	34°	55.0	NSP
103	26°57.0'N	171°07.9'E	34°	55.1	IO
104	27°43.0'N	171°42.3'E	34°	55.0	NSP
105	28°29.0'N	172°16.9'E	34°	53.9	IO
106	29°14.0'N	172°51.1'E	34°	55.1	NSP
107	30°00.0'N	173°26.2'E	146°	72.3	IO
108	29°00.0'N	174°13.0'E	146°	72.3	NSP
109	28°00.0'N	174°59.3'E	146°	72.3	IO
110	27°00.0'N	175°45.2'E	146°	72.3	NSP
111	26°00.0'N	176°30.7'E	146°	72.3	IO
112	25°00.0'N	177°15.8'E	146°	72.3	NSP
113	24°00.0'N	178°00.6'E	145°	72.7	IO
114	23°00.0'N	178°45.8'E	146°	71.8	NSP
115	22°00.0'N	179°29.0'E	146°	51.2	IO
116	21°17.5'N	180°00.0'W	146°	21.1	IO
117	21°00.0'N	179°47.2'W	146°	72.2	NSP
118	20°00.0'N	179°03.8'W	34°	72.2	IO
119	21°00.0'N	178°20.4'W	34°	72.3	NSP
120	22°00.0'N	177°36.6'W	34°	72.2	IO
121	23°00.0'N	176°52.6'W	34°	72.3	NSP
122	24°00.0'N	176°08.2'W	34°	72.3	IO
123	25°00.0'N	175°23.4'W	34°	48.7	NSP
124	25°40.4'N	174°53.0'W	-	-	-
125	27°08.6'N	173°46.2'W	35°	62.3	NSP
126	28°00.0'N	173°06.2'W	35°	71.9	IO
127	29°00.0'N	172°20.6'W	34°	72.3	NSP
128	30°00.0'N	171°33.8'W	146°	72.3	IO
129	29°00.0'N	170°47.0'W	146°	72.3	NSP
130	28°00.0'N	170°00.7'W	146°	72.3	IO
131	27°00.0'N	169°14.8'W	146°	72.3	NSP
132	26°00.0'N	168°29.3'W	146°	3.8	IO
133	25°56.8'N	168°26.9'W	-	-	-
134	22°52.8'N	166°09.8'W	146°	63.6	NSP
135	22°00.0'N	165°31.0'W	146°	72.3	IO
136	21°00.0'N	164°47.2'W	146°	72.2	NSP
137	20°00.0'N	164°03.8'W	35°	65.4	IO
138	20°54.0'N	163°24.0'W	35°	65.4	NSP
139	21°48.0'N	162°43.9'W	35°	33.6	IO
140	22°15.7'N	162°23.2'W	-	-	-
141	23°42.8'N	161°17.9'W	35°	57.2	IO
142	24°30.0'N	160°42.1'W	35°	66.8	NSP
143	25°25.1'N	160°00.0'W	-	-	-
-	-	-	-	-	-

Table 1b. Summary of search effort (time and distance) and experimental time (hours) conducted during the 2015 IWC- POWER 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								
Shiogama to research area	4-Jul.	11-Jul.	66:23:12	765.16	0:00:00	0.00	66:23:12	765.16	2:01:10	2:54:30
	6:00	12:09								
Research area (original track line)	11-Jul.	22-Aug.	104:23:21	1,198.51	100:08:35	1,151.25	204:31:56	2,349.76	32:12:00	7:37:59
	12:09	13:05								
Research area (a modified course to avoid the PMNM)	17-Jul	31-Jul	78:51:04	898.69	0:00:00	0.00	78:51:04	898.69	2:58:04	0:00:00
	11:37	7:19								
Research area to Shiogama	22-Aug.	28-Aug.	25:27:39	291.93	0:00:00	0.00	25:27:39	291.93	1:03:00	0:00:00
	13:05	12:00								
Total	4-Jul	28-Aug.	275:05:16	3,154.29	100:08:35	1,151.25	375:13:51	4,305.54	38:14:14	10:32:29
	6:00	12:00								

Table 2a. Number of sightings for all species observed in the research area (Original trackline) 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
Bryde's whale	13	15	2	11	14	3	0	0	0	24	29	5
Like Bryde's whale	0	0	0	2	2	0	0	0	0	2	2	0
Sperm whale	3	14	3	5	17	3	0	0	0	8	31	6
Dwarf sperm whale	0	0	0	1	6	1	0	0	0	1	6	1
Cuvier's beaked whale	3	6	0	0	0	0	0	0	0	3	6	0
<i>Mesoplodon</i> spp.	0	0	0	1	2	0	0	0	0	1	2	0
<i>Ziphiidae</i>	0	0	0	4	4	0	0	0	0	4	4	0
Southern form short-finned pilot whale	1	32	2	0	0	0	0	0	0	1	32	2
Bottlenose dolphin	0	0	0	2	26	5	0	0	0	2	26	5
Rough toothed dolphin	0	0	0	2	54	7	0	0	0	2	54	7
Spotted dolphin	1	46	8	2	116	17	0	0	0	3	162	25
Striped dolphin	3	168	16	0	0	0	0	0	0	3	168	16
Fraser's dolphin	1	53	0	1	180	20	0	0	0	2	233	20
Unidentified large baleen whale	1	1	0	0	0	0	0	0	0	1	1	0
Unidentified large cetacean	0	0	0	3	3	0	0	0	0	3	3	0
Unidentified Kogia	0	0	0	2	3	0	1	1	0	3	4	0
Unidentified small cetacean	0	0	0	1	1	0	0	0	0	1	1	0
Unidentified dolphin/porpoise	0	0	0	4	84	0	0	0	0	4	84	0
Unidentified cetacean	2	2	0	0	0	0	0	0	0	2	2	0
Total	28	337	31	41	512	56	1	1	0	70	850	87

Table 2b. Number of sightings for all species observed in the research area (Original trackline and a modified course to avoid the PMNM). Numbers of Individuals include number of calves.

Species	Research area (Original track line) (area code 61+62)			Research Area (a modified course to avoid the PMNM) (area code 63)			Research area Total		
	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf
Bryde's whale	24	29	5	3	3	0	27	32	5
Like Bryde's whale	2	2	0	0	0	0	2	2	0
Sperm whale	8	31	6	3	19	0	11	50	6
Dwarf sperm whale	1	6	1	0	0	0	1	6	1
Cuvier's beaked whale	3	6	0	0	0	0	3	6	0
Longman's beaked whale	0	0	0	1	110	10	1	110	10
<i>Mesoplodon</i> spp.	1	2	0	0	0	0	1	2	0
<i>Ziphiidae</i>	4	4	0	0	0	0	4	4	0
Southern form short-finned pilot whale	1	32	2	0	0	0	1	32	2
Killer whale	0	0	0	1	4	0	1	4	0
Risso's dolphin	0	0	0	1	3	0	1	3	0
Bottlenose dolphin	2	26	5	2	10	3	4	36	8
Rough toothed dolphin	2	54	7	0	0	0	2	54	7
Spotted dolphin	3	162	25	0	0	0	3	162	25
Striped dolphin	3	168	16	2	111	0	5	279	16
Fraser's dolphin	2	233	20	0	0	0	2	233	20
Unid. large baleen whale	1	1	0	0	0	0	1	1	0
Unid. large cetacean	3	3	0	0	0	0	3	3	0
Unid. Kogia	3	4	0	0	0	0	3	4	0
Unid. small cetacean	1	1	0	3	3	0	4	4	0
Unid. dolphin/porpoise	4	84	0	2	30	0	6	114	0
Unid. cetacean	2	2	0	0	0	0	2	2	0
Total	70	850	87	18	293	13	88	1,143	100

Table 2c. Number of sightings for all species observed in 2015, including sightings during transits and in the research area (R.A.).

Species	Transit to research area			Research area (Original track line)			Research Area (a modified course to avoid the PMNM)			Transit from research area			Total		
	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf
Bryde's whale	17	18	0	24	29	5	3	3	0	2	2	0	46	52	5
Like Bryde's whale	10	12	0	2	2	0	0	0	0	0	0	0	12	14	0
Sperm whale	21	43	2	8	31	6	3	19	0	0	0	0	32	93	8
Pygmy sperm whale	2	5	0	0	0	0	0	0	0	0	0	0	2	5	0
Dwarf sperm whale	0	0	0	1	6	1	0	0	0	0	0	0	1	6	1
Cuvier's beaked whale	2	3	0	3	6	0	0	0	0	0	0	0	5	9	0
Longman's beaked whale	0	0	0	0	0	0	1	110	10	0	0	0	1	110	10
<i>Mesoplodon</i> spp.	2	2	0	1	2	0	0	0	0	0	0	0	3	4	0
<i>Ziphiidae</i>	4	6	0	4	4	0	0	0	0	0	0	0	8	10	0
Southern form short-finned pilot whale	1	28	0	1	32	2	0	0	0	0	0	0	2	60	2
Killer whale	0	0	0	0	0	0	1	4	0	0	0	0	1	4	0
Risso's dolphin	6	82	1	0	0	0	1	3	0	0	0	0	7	85	1
Bottlenose dolphin	0	0	0	2	26	5	2	10	3	0	0	0	4	36	8
Rough toothed dolphin	0	0	0	2	54	7	0	0	0	1	5	0	3	59	7
Spinner dolphin	1	13	0	0	0	0	0	0	0	0	0	0	1	13	0
Spotted dolphin	4	341	46	3	162	25	0	0	0	1	28	3	8	531	74
Striped dolphin	0	0	0	3	168	16	2	111	0	0	0	0	5	279	16
Fraser's dolphin	0	0	0	2	233	20	0	0	0	0	0	0	2	233	20
Unid. large baleen whale	13	15	0	1	1	0	0	0	0	1	1	0	15	17	0
Unid. large cetacean	0	0	0	3	3	0	0	0	0	0	0	0	3	3	0
Unid. Kogia	0	0	0	3	4	0	0	0	0	0	0	0	3	4	0
Unid. pilot whale	2	36	0	0	0	0	0	0	0	0	0	0	2	36	0
Unid. small cetacean	5	71	0	1	1	0	3	3	0	0	0	0	9	75	0
Unid. dolphin/porpoise	11	266	0	4	84	0	2	30	0	0	0	0	17	380	0
Unid. cetacean	0	0	0	2	2	0	0	0	0	0	0	0	2	2	0
Total	101	941	49	70	850	87	18	293	13	5	36	3	194	2,120	152

Table 2d. Identification of duplicate sightings 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 sightings made by IOP	Duplicate Status			
		D	P	R	N
Bryde's whale	16	10	0	0	6
Like Bryde's whale	2	0	0	0	2
Sperm whale	6	2	0	0	4
<i>Mesoplodon</i> spp.	1	0	0	0	1
<i>Ziphiidae</i>	4	0	0	0	4
Dwarf sperm whale	1	0	0	0	1
Unidentified large cetacean	3	0	0	0	3

Table 3. Minimum, maximum and range of sea surface temperatures in degrees Celsius for each species sighted during the cruise (including transit survey), sorted in order of frequency of sightings. Range of 25th to 75th quartiles are presented for our most frequently encountered cetaceans: Bryde's whales, sperm whales and common dolphins.

Species	Number of sightings	Minimum SST	Maximum SST	Temperature range	25 th to 75 th Quartile
Bryde's whale	27	25.1	31.4	6.3	28.0-29.5
Sperm whale	11	24.9	30.3	5.4	28.3-30.0
Dwarf sperm whale	1	30.0	-	-	-
Cuvier's beaked whale	3	27.6	28.9	1.3	-
Longman's beaked whale	1	28.3	-	-	-
<i>Mesoplodon</i> spp.	1	25.8	-	-	-
<i>Ziphiidae</i>	4	27.4	29.5	2.1	28.4-29.4
Southern form short-finned pilot whale	1	25.1	-	-	-
Killer whale	1	27.0	-	-	-
Risso's dolphin	1	28.4	-	-	-
Bottlenose dolphin	4	27.8	29.1	1.3	27.9-29.0
Rough toothed dolphin	2	28.8	29.0	0.2	-
Spotted dolphin	3	24.8	30.3	5.5	-
Striped dolphin	5	24.7	28.3	3.6	26.6-28.3
Fraser's dolphin	2	28.6	30.2	1.6	-

Table 4a. Summary of Photographed Sightings with Photo-ID and Biopsy results. For species where biopsy / photo-ID is not attempted Whale ID and Biopsy Sample No. are blank (-). All Bryde's whale images were assessed for photo-ID. When images were not sufficient for unique identification, Whale ID states 'No ID'. For all Bryde's whale sightings that were not sampled, Biopsy Sample No. states 'No Sample', this includes sightings where attempts were unsuccessful and sightings where no biopsy attempt was made. For sightings where no biopsy attempt was made Encounter duration is blank (-). Biopsy sampling encounter duration was calculated using effort code "BX" (standby the equipment) and "EX" (darts collected time).

Sighting Date (SMT)	Sight No.	Species	School Size	Number Photo-ID'd	Number Biopsied	Nat Mark Form No.	Whale ID	Biopsy Sample No.	Biopsy Form No.	Encounter duration (min)	Notes
05/07/2015	002	Spotted dolphin	128	0	0	ID001	-	-	-	-	
05/07/2015	003	Bryde's whale	1	0	0	ID002	No ID	No Sample	-	-	
05/07/2015	005	Bryde's whale	1	1	0	ID003	ID003_A	No Sample	-	-	
05/07/2015	008	Bryde's whale	1	0	0	ID005	No ID	No Sample	-	-	
05/07/2015	009	Bryde's whale	1	1	0	ID004	ID004_A	No Sample	-	-	
05/07/2015	011	Sperm whale	3	0	0	ID006	-	-	-	-	
05/07/2015	012	Sperm whale	1	0	0	ID007	-	-	-	-	
06/07/2015	001	Bryde's whale	1	0	0	ID008	No ID	No Sample	-	-	
06/07/2015	009	Short-finned pilot whale	28	0	0	ID009	-	-	-	-	
06/07/2015	012	Bryde's whale	2	1	0	ID010	ID010_B	No Sample	-	-	adult-juvenile pair
06/07/2015	029	Bryde's whale	1	0	0	ID011	No ID	No Sample	-	-	
07/07/2015	004	Risso's dolphin	12	0	0	ID012	-	-	-	-	
07/07/2015	006	Sperm whale	4	0	0	ID014	-	-	-	-	
07/07/2015	007	Sperm whale	2	0	0	ID013	-	-	-	-	

Sighting Date (SMT)	Sight No.	Species	School Size	Number Photo-ID'd	Number Biopsied	Nat Mark Form No.	Whale ID	Biopsy Sample No.	Biopsy Form No.	Encounter duration (min)	Notes
08/07/2015	003	Sperm whale	5	1	0	ID015	ID015_A	-	-	-	
08/07/2015	004	Spotted dolphin	62	0	0	ID016	-	-	-	-	
08/07/2015	016	Cuvier's beaked	2	0	0	ID017	-	-	-	-	
08/07/2015	017	Risso's dolphin	13	0	0	ID018	-	-	-	-	
08/07/2015	020	Unid Mesoplodon	1	0	0	ID019	-	-	-	-	
08/07/2015	021	Spotted dolphin	46	0	0	ID020	-	-	-	-	
08/07/2015	023	Spotted dolphin	105	0	0	ID021	-	-	-	-	
08/07/2015	025	Bryde's whale	1	0	0	ID022	No ID	No Sample	-	-	
09/07/2015	001	Bryde's whale	1	1	1	ID023	ID023_A	15031001	BY001	44	
09/07/2015	004	Bryde's whale	1	1	1	ID024	ID024_A	15031002	BY002	13	
09/07/2015	005	Bryde's whale	1	0	1	ID025	No ID	15031003	BY003	18	
10/07/2015	002	Pygmy sperm whale	4	0	0	ID026	-	-	-	-	
10/07/2015	005	Bryde's whale	1	1	1	ID027	ID027_A	15031004	BY004	10	
10/07/2015	007	Bryde's whale	1	0	0	ID028	No ID	No Sample	-	36	
10/07/2015	008	Bryde's whale	1	0	0	ID029	ID029_A	No Sample	-	-	
11/07/2015	001	Bryde's whale	1	0	0	ID030	ID030_A	No Sample	-	20	
12/07/2015	001	Bryde's whale	1	1	1	ID031	ID031_A	15031005	BY005	38	
12/07/2015	002	Unid Mesoplodon	2	0	0	ID032	-	-	-	-	
12/07/2015	003	Bryde's whale	1	0	0	ID033	No ID	No Sample	-	37	
13/07/2015	002	Bryde's whale	1	0	1	ID034	No ID	15031006	BY006	20	
13/07/2015	004	Striped dolphin	88	0	0	ID035	-	-	-	-	
14/07/2015	001	Short-finned pilot whale	32	0	0	ID036	-	-	-	-	
18/07/2015	002	Striped dolphin	24	0	0	ID037			-	-	
18/07/2015	004	Striped dolphin	87	0	0	ID038			-	-	
19/07/2015	001	Bryde's whale	1	0	1	ID039	No ID	15031007	BY007	17	Skinny
19/07/2015	002	Killer whale	4	4	2	ID040	ID040_A	15271008_A	BY008	59	Male. Video taken
19/07/2015	002	Killer whale	4	4	2	ID040	ID040_B	15271009_B	BY008	49	Video taken
19/07/2015	002	Killer whale	4	4	2	ID040	ID040_C	No Sample	-	-	Video taken
19/07/2015	002	Killer whale	4	4	2	ID040	ID040_D	No Sample	-	-	Video taken
22/07/2015	001	Bottlenose dolphin	5	2	0	ID041	ID041_A	-	-	-	
22/07/2015	001	Bottlenose dolphin	5	2	0	ID041	ID041_B	-	-	-	
22/07/2015	002	Bottlenose dolphin	5	0	0	ID042	-	-	-	-	
22/07/2015	003	Risso's dolphin	3	0	0	ID043	-	-	-	-	
22/07/2015	004	Longman's beaked	110	0	0	ID044	-	-	-	-	Video taken
23/07/2015	001	Striped dolphin	62	0	0	ID045	-	-	-	-	
25/07/2015	001	Bryde's whale	2	2	2	ID046	ID046_A	15031010_A	BY009	25	Mother
25/07/2015	001	Bryde's whale	2	2	2	ID046	ID046_B	15031011_B	BY009	54	Calf
26/07/2015	001	Cuvier's beaked	2	0	0	ID047	-	-	-	-	
26/07/2015	002	Bryde's whale	1	0	1	ID048	No ID	15031012	BY010	12	
28/07/2015	002	Bryde's whale	1	1	1	ID049	ID049_A	15031013	BY011	41	
29/07/2015	001	Sperm whale	1	1	0	ID050	ID050_A	-	-	-	

Sighting Date (SMT)	Sight No.	Species	School Size	Number Photo-ID'd	Number Biopsied	Nat Mark Form No.	Whale ID	Biopsy Sample No.	Biopsy Form No.	Encounter duration (min)	Notes
29/07/2015	002	Sperm whale	2	0	0	ID051	-	-	-	-	
31/07/2015	001	Striped dolphin	18	0	0	ID052	-	-	-	-	
31/07/2015	002	Fraser's dolphin	180	0	0	ID053	-	-	-	-	Video taken
31/07/2015	003	Bryde's whale	2	2	2	ID054	ID054_B	15031014_B	BY012	5	Calf
31/07/2015	003	Bryde's whale	2	2	2	ID054	ID054_A	15031015_A	BY012	13	Mother
02/08/2015	001	Bryde's whale	1	1	1	ID055	ID055_A	15031016	BY013	23	
03/08/2015	001	Bryde's whale	1	0	1	ID056	No ID	15031017	BY014	18	
04/08/2015	002	Rough toothed dolphin	18	0	0	ID057	-	-	-	-	
09/08/2015	001	Bryde's whale	1	1	1	ID058	ID058_A	15031018	BY015	31	
10/08/2015	001	Bryde's whale	1	1	1	ID059	ID059_A	15031019	BY016	11	
10/08/2015	005	Bryde's whale	1	1	1	ID060	ID060_A	15031020	BY017	53	
11/08/2015	001	Bryde's whale	1	1	1	ID061	ID061_A	15031021	BY018	22	
12/08/2015	001	Bottlenose dolphin	23	0	0	ID062	-	-	-	-	
12/08/2015	002	Bottlenose dolphin	3	0	0	ID063	-	-	-	-	
12/08/2015	006	Bryde's whale	1	1	1	ID064	ID064_A	15031022	BY019	13	
13/08/2015	001	Dwarf sperm whale	6	0	0	ID065	-	-	-	-	
13/08/2015	002	Spotted dolphin	48	0	0	ID066	-	-	-	-	
13/08/2015	004	Bryde's whale	2	2	2	ID067	ID067_B	15031023_B	BY020	15	Calf
13/08/2015	004	Bryde's whale	2	2	2	ID067	ID067_A	15031024_A	BY020	15	Mother
14/08/2015	003	Sperm whale	6	1	1	ID068	ID068_B	15101025_B	BY021	70	Calf. Video taken.
14/08/2015	008	Sperm whale	8	0	0	ID069	-	-	-	-	
14/08/2015	009	Sperm whale	5	0	0	ID071	-	-	-	-	
14/08/2015	010	Fraser's dolphin	53	0	0	ID070	-	-	-	-	
14/08/2015	011	Bryde's whale	1	1	1	ID072	ID072_A	15031026	BY022	24	
14/08/2015	012	Bryde's whale	1	0	1	ID073	No ID	15031027	BY023	40	
15/08/2015	001	Spotted dolphin	68	0	0	ID074	-	-	-	-	
15/08/2015	002	Rough toothed dolphin	36	0	0	ID075	-	-	-	-	
15/08/2015	005	Bryde's whale	1	0	1	ID076	No ID	15031028	BY024	40	
15/08/2015	008	Unid Ziphiidae	1	0	0	ID077	-	-	-	-	
18/08/2015	001	Bryde's whale	1	0	1	ID078	No ID	15031029	BY025	19	
18/08/2015	002	Cuvier's beaked	1	0	0	ID079	-	-	-	-	
18/08/2015	003	Cuvier's beaked	3	0	0	ID080	-	-	-	-	
18/08/2015	004	Bryde's whale	2	2	2	ID081	ID081_B	15031030_B	BY026	11	Entangled calf
18/08/2015	004	Bryde's whale	2	2	2	ID081	ID081_A	15031031_A	BY026	21	Mother
19/08/2015	002	Bryde's whale	1	0	1	ID082	No ID	15031032	BY027	9	
19/08/2015	004	Bryde's whale	1	1	1	ID083	ID083_A	15031033	BY028	12	
19/08/2015	005	Bryde's whale	1	0	0	ID084	No ID	No Sample	-	74	
22/08/2015	001	Bryde's whale	1	1	1	ID085	ID085_A	15031034	BY029	23	
22/08/2015	003	Bryde's whale	2	0	2	ID086	No ID	15031035_B	BY030	11	Calf
22/08/2015	003	Bryde's whale	2	0	2	ID086	No ID	15031036_A	BY030	8	Mother
22/08/2015	006	Bryde's whale	1	1	0	ID087	ID087_A	No Sample	-	33	

Sighting Date (SMT)	Sight No.	Species	School Size	Number Photo-ID'd	Number Biopsied	Nat Mark Form No.	Whale ID	Biopsy Sample No.	Biopsy Form No.	Encounter duration (min)	Notes
23/08/2015	001	Rough toothed dolphin	5	0	0	ID088	-	-	-	-	
23/08/2015	002	Bryde's whale	1	1	1	ID089	ID089_A	15031037	BY031	30	
24/08/2015	001	Spotted dolphin	28	0	0	ID090	-	-	-	-	

Table 4b. Summary of Photographed Species with Photo-ID Results

Species Photographed	Total Sightings		Photo-ID		
	Sch.	Ind.	Sch. Photo'd	No. images useful for Photo-ID*	Ind. Photo-ID'd [†]
Bryde's whale	46	52	43	1,554	29
Sperm whale	32	93	10	200	3
Dwarf sperm whale	1	6	1	40 [‡]	NA
Pygmy sperm whale	2	5	1	10 [‡]	NA
Killer whale	1	4	1	329	4
Short-finned pilot whale	2	60	2	29	NA
Longman's beaked whale	1	110	1	63 [‡]	NA
Cuvier's beaked whale	5	9	4	8 [‡]	NA
Unid Mesoplodon	3	4	2	21 [‡]	NA
Unid <i>Ziphiidae</i>	8	10	1	0	NA
Risso's dolphin	7	85	3	22	NA
Bottlenose dolphin	4	36	4	52	2
Rough-toothed dolphin	3	59	3	21 [‡]	NA
Spotted dolphin	8	531	7	NA	NA
Striped dolphin	5	279	5	NA	NA
Fraser's dolphin	2	233	2	21 [‡]	NA
Total	-	-	90	2,370	38

* Images useful for photo-ID may not be sufficient to catalogue the individual, but show useful identification characteristics such as dorsal fin shape, nick in dorsal, scars etc. These images are coded Green in the IWC Lightroom database.

[†] Photo-ID images are sufficient to catalogue the individual. These images are coded with the keyword 'Photo-identification' in the IWC Lightroom database and will be contributed to cataloguing efforts.

[‡] Images of species where individual photo-identification is not feasible have been coded 'useful for species identification'. These images are coded Purple in the IWC Lightroom database.

Table 4c. Summary of Bryde's whale sightings, photography and biopsy effort during the cruise.

Bryde's whale	Total Sightings		Ind. Biopsied	Sch. Photo-graphed	Ind. Photo-graphed	Ind. Photo-ID'd
	Sch	Ind				
Transit to RA	17	18	4	14	15	7
RA	27	32	29	27	32	20
Transit from RA	2	2	1	2	2	2
Total	46	52	34	43	49	29

Table 5. Summary of marine debris observations. On-effort observations were during the first 15 minutes each hour while on survey. Off-effort observations were strictly opportunistic.

IWC code	Description	ON Effort	OFF Effort	Total
119	Trawl net, large mesh, large piece	0	1	1
120	Unidentified net	0	2	2
123	Unidentified net, small mesh, large piece	0	2	2
124	Unidentified net, medium mesh, small fragment	1	0	1
126	Unidentified net, medium mesh, large piece	1	2	3
129	Unidentified net, large mesh, large piece	2	2	4
130	Long line, small piece	1	0	1
132	Long line, large piece	1	2	3
134	Single fishing float	70	3	73
135	Clustered fishing floats(2-10 floats together)	6	2	8
136	Wood plank	2	0	2
137	Wood crate, 1 side only	2	0	2
139	Wood structure	1	1	2
144	Metal can, 50-150 litres	1	0	1
147	Styrofoam, unidentified	2	0	2
148	Styrofoam board, less than 1 square metre	8	0	8
149	Styrofoam board, 1-3 square metres	1	0	1
151	Styrofoam box (at least 2 sides)	1	0	1
153	Cardboard board, less than 1 square metre	1	0	1
161	Plastic, unidentified	3	0	3
162	Plastic, less than 1 square metre	21	0	21
163	Plastic, 1-3 square metre	4	0	4
164	Plastic, greater than 3 square metres	1	1	2
165	Plastic bag, small	1	0	1
166	Plastic garbage bag, empty	2	0	2
168	Garbage, unidentified	2	0	2
169	Garbage, 1-10 pieces	26	0	26
199	Other	12	8	20
	Total	173	26	199

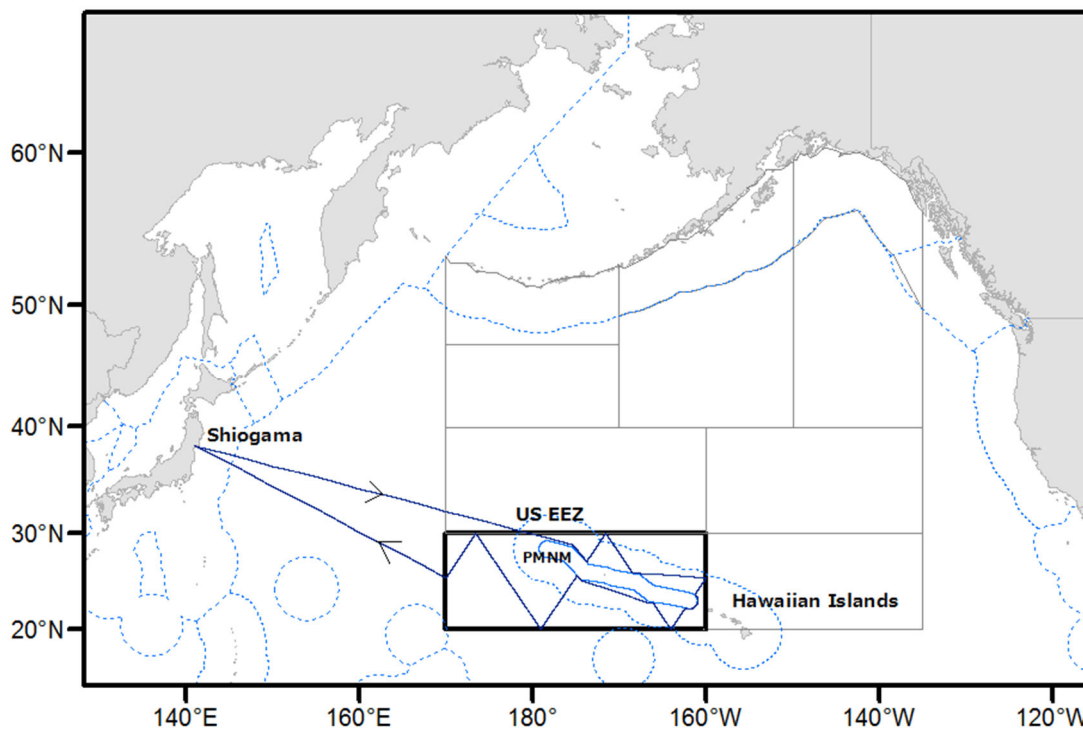


Figure 1a. Research area, transit and survey track lines for the 2015 IWC-POWER cruise.

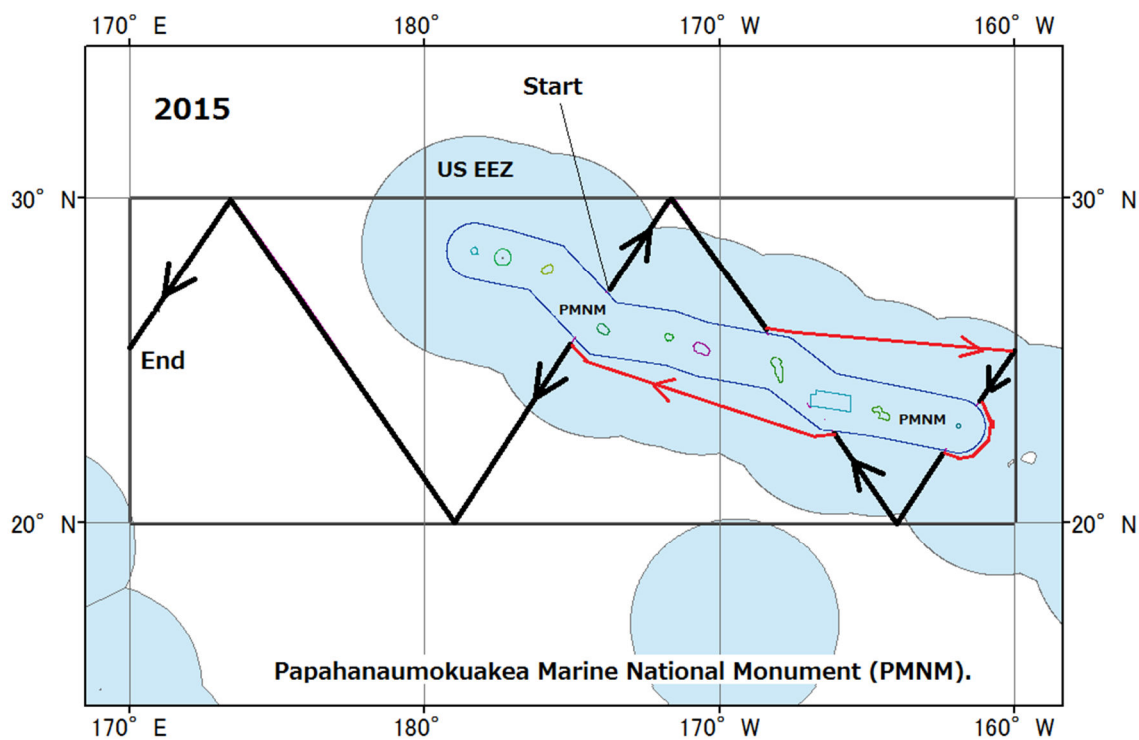


Figure 1b. Cruise track lines and course directions taken within the main survey area for the 2015 IWC POWER cruise survey. Red lines indicate track line adjustments made to avoid the PMNM.

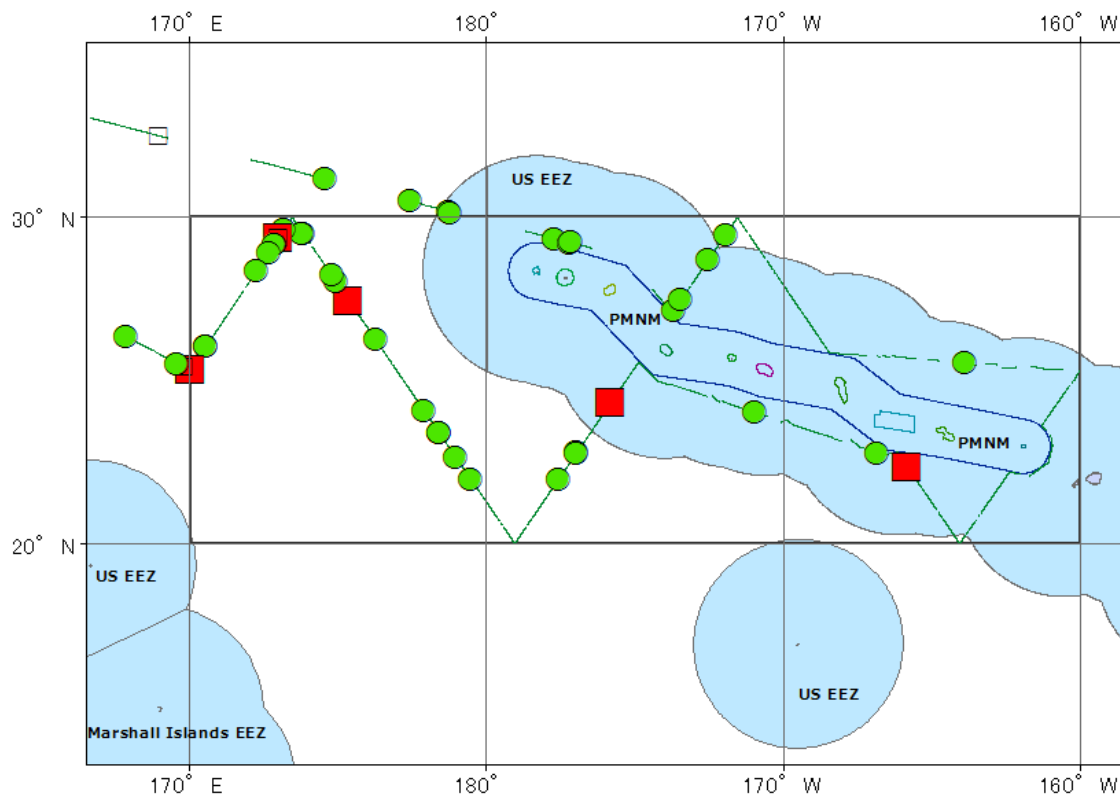


Figure 2a. The searching effort (thin line) and sighting positions of Bryde's whales (green circle), including five mother and calf pairs (red Square) and unid. baleen whale (white square) during the 2015 POWER cruise.

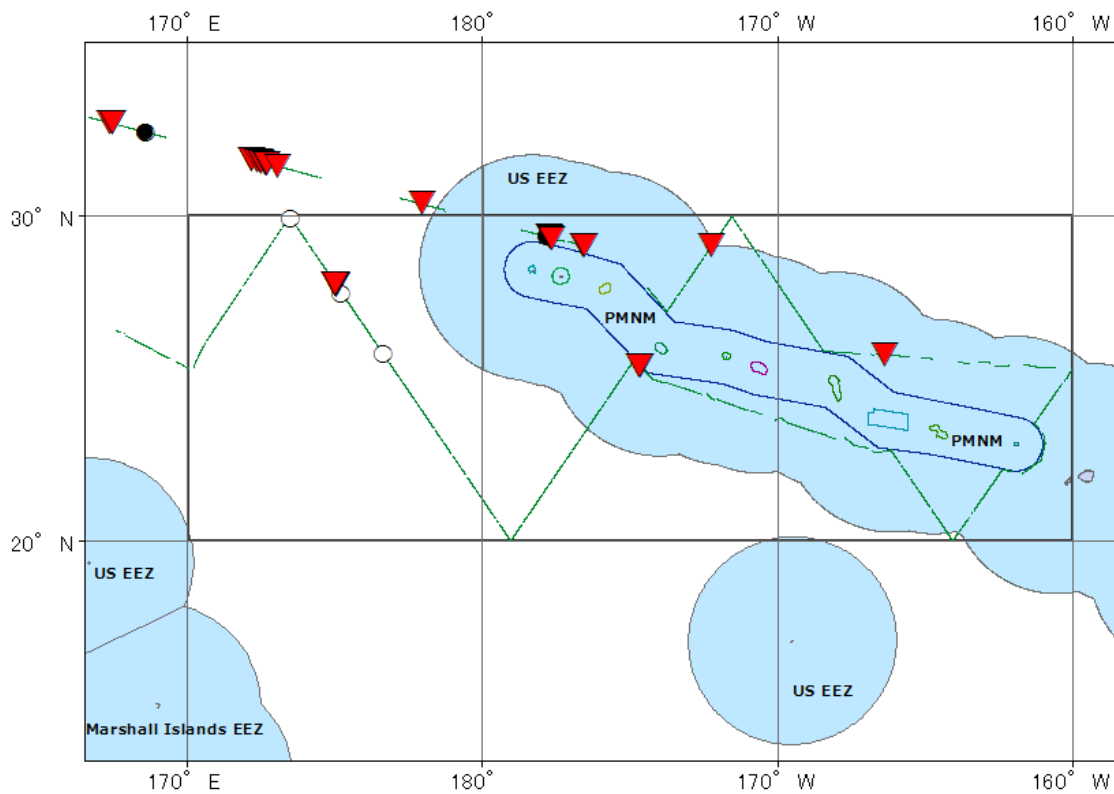


Figure 2b. The searching effort (thin line) and sighting positions of sperm whales (red triangle), pygmy sperm (white circle) and dwarf sperm (black circle) during the 2015 POWER cruise.

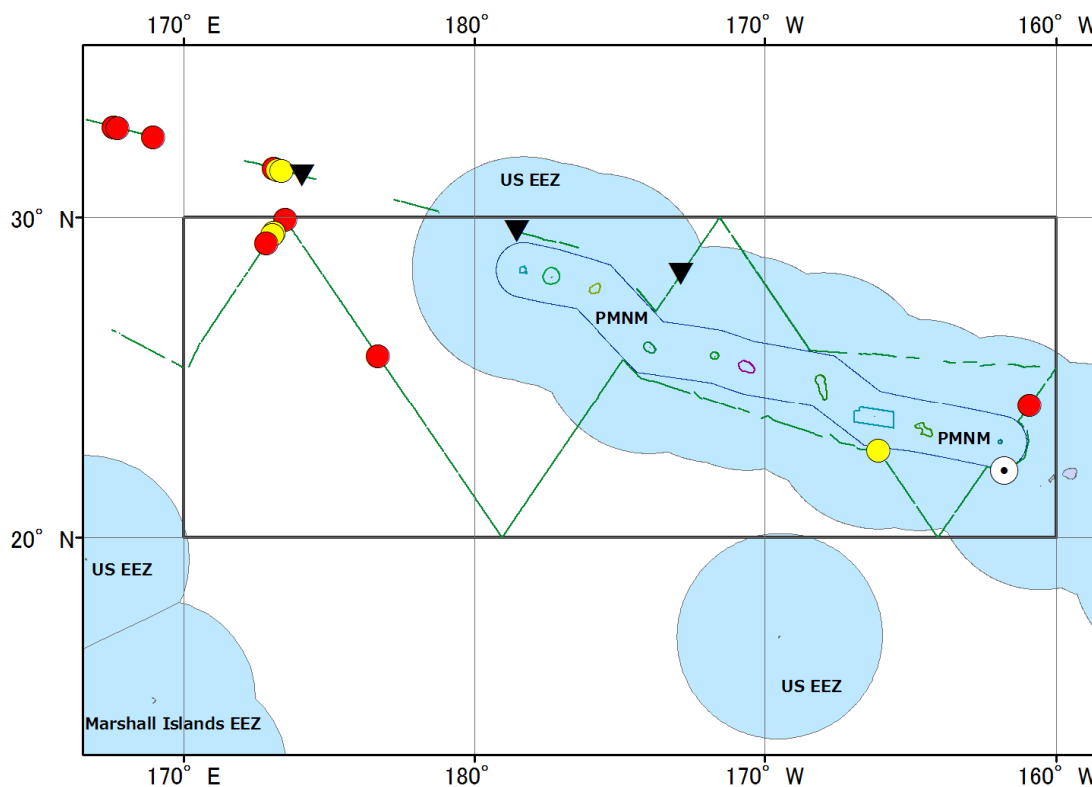


Figure 2c. The searching effort (thin line) and sighting positions of Cuvier's beaked whale (yellow circle), Longman's beaked whale (white point circle), unidentified *Mesoplodon* (black triangle) and unidentified *Ziphiidae* (red circle) during the 2015 POWER cruise.

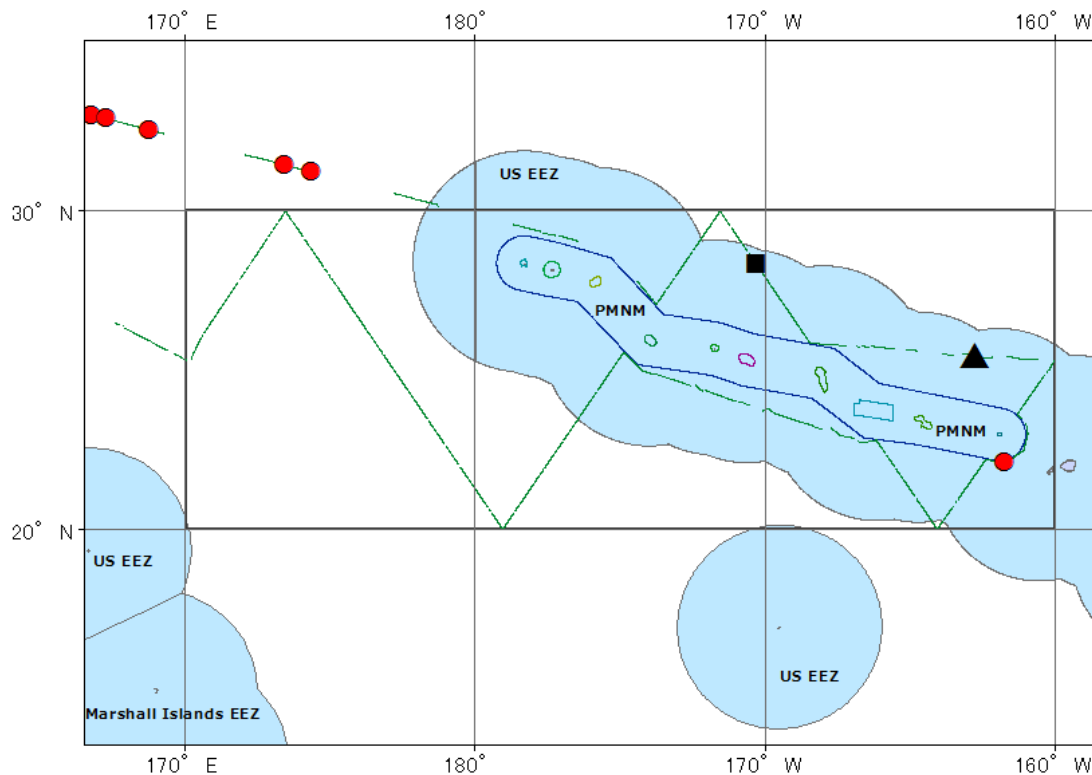


Figure 2d. The searching effort (thin line) and sighting positions of killer whales (black triangle), southern form short-finned pilot whales (black square) and Risso's dolphins (red circle) during the 2015 POWER cruise.

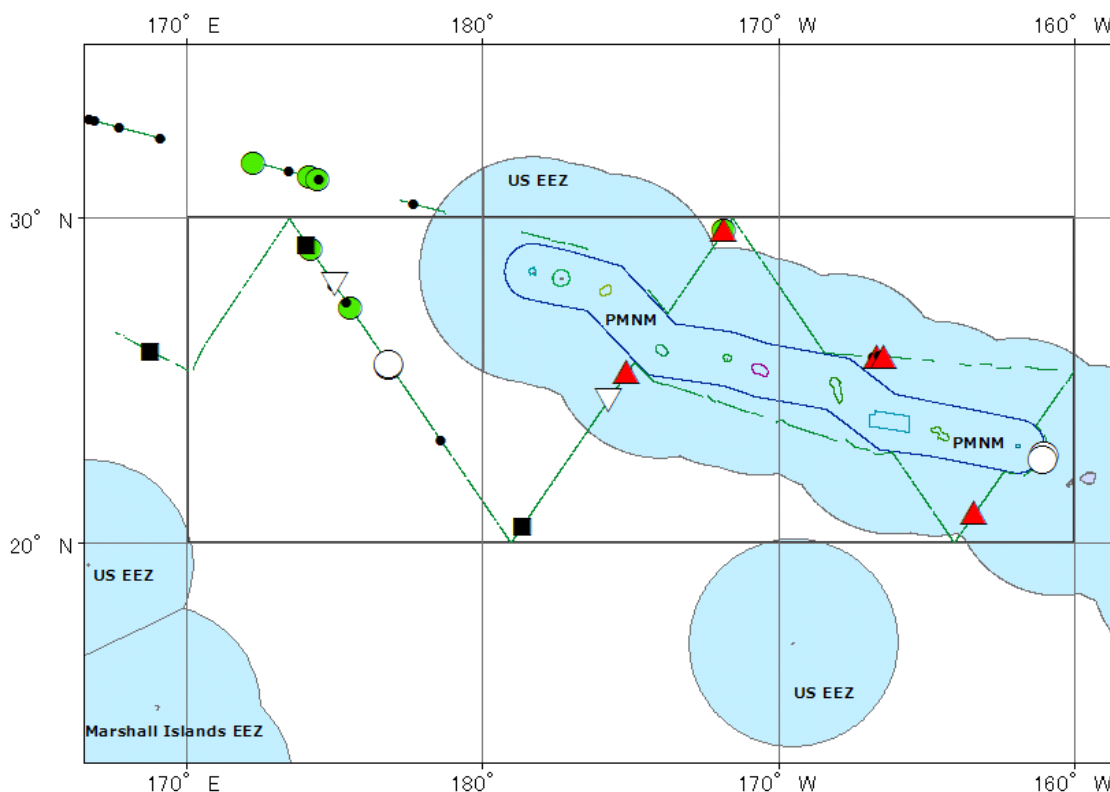


Figure 2e. The searching effort (thin line) and sighting positions of bottlenose (white circle), pantropical spotted dolphin (green circle), striped (red triangle), Fraser’s (white triangle), rough toothed (black square) and unidentified (black circle) dolphins during the 2015 POWER cruise.

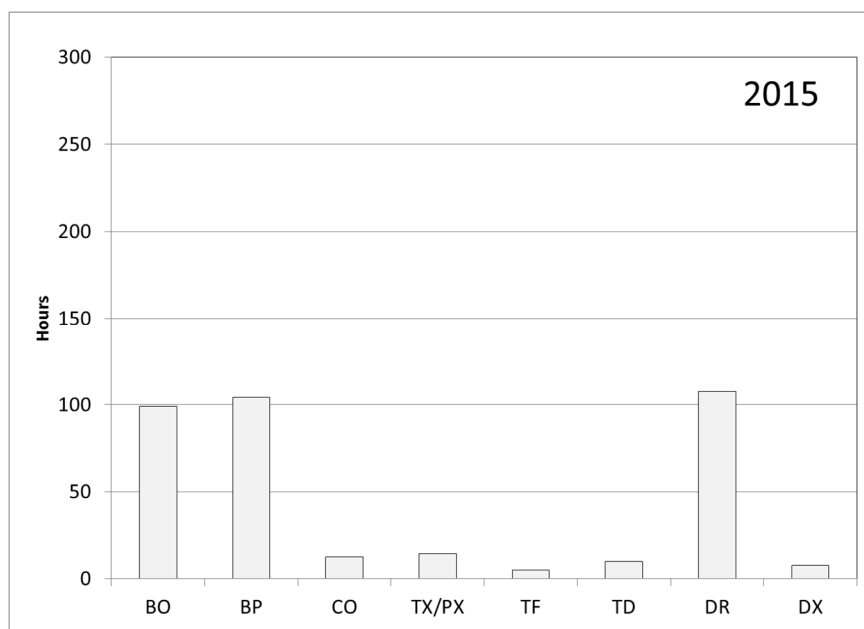


Figure 3. Breakdown of research time in hours, by effort code in the research area during the 2015 POWER cruise. BP: Passing mode searching, BO: Independent Observer mode, CO: Confirmation of school, TX/PX: Biopsy / Photo-ID experiments, TF: Time back to trackline, TD: Top down steaming, DR: Drifting, DX: Distance and angle estimate experiment.

APPENDICES

Appendix A. Ship specifications and crew list of *Yushin-Maru No.3*.

Ship photo:



Ship specifications:

	<i>Yushin-Maru No.3</i>
Call sign	7JCH
Length overall [m]	69.61
Molded breadth [m]	10.80
Gross tonnage (GT)	742
Barrel height [m]	19.5
Upper bridge height [m]	11.5
Bow height [m]	6.5
Engine power [PS / kW]	5280 / 3900

Crew list:

	<i>Yushin-Maru No.3</i>
Captain	Chikamasa Okoshi
Chief Officer	Takahiro Konagai
Second Officer	Hiroya Mure
Chief Engineer	Akihide Oide
First Engineer	Ryuta Miyamoto
Second Engineer	Kenji Kawamoto
Third Engineer	Hiroshi Ohsawa
Chief Operator/Purser	Hitoshi Shimaoka
Boatswain	Masahiko Abe
Quartermaster	Kazuyuki Sugiyama
Quartermaster	Takato Sawabe
Sailor	Takashi Kominami
Sailor	Naoto Nomakawauchi
Sailor	Shinya Torihara
Sailor	Yuto Yamagata
Chief Steward	Hironobu Hodokuma
Steward	Tadashi Abe

Appendix B. Comparison of weather conditions (wind speed / visibility) among past cruises (2010-2015).

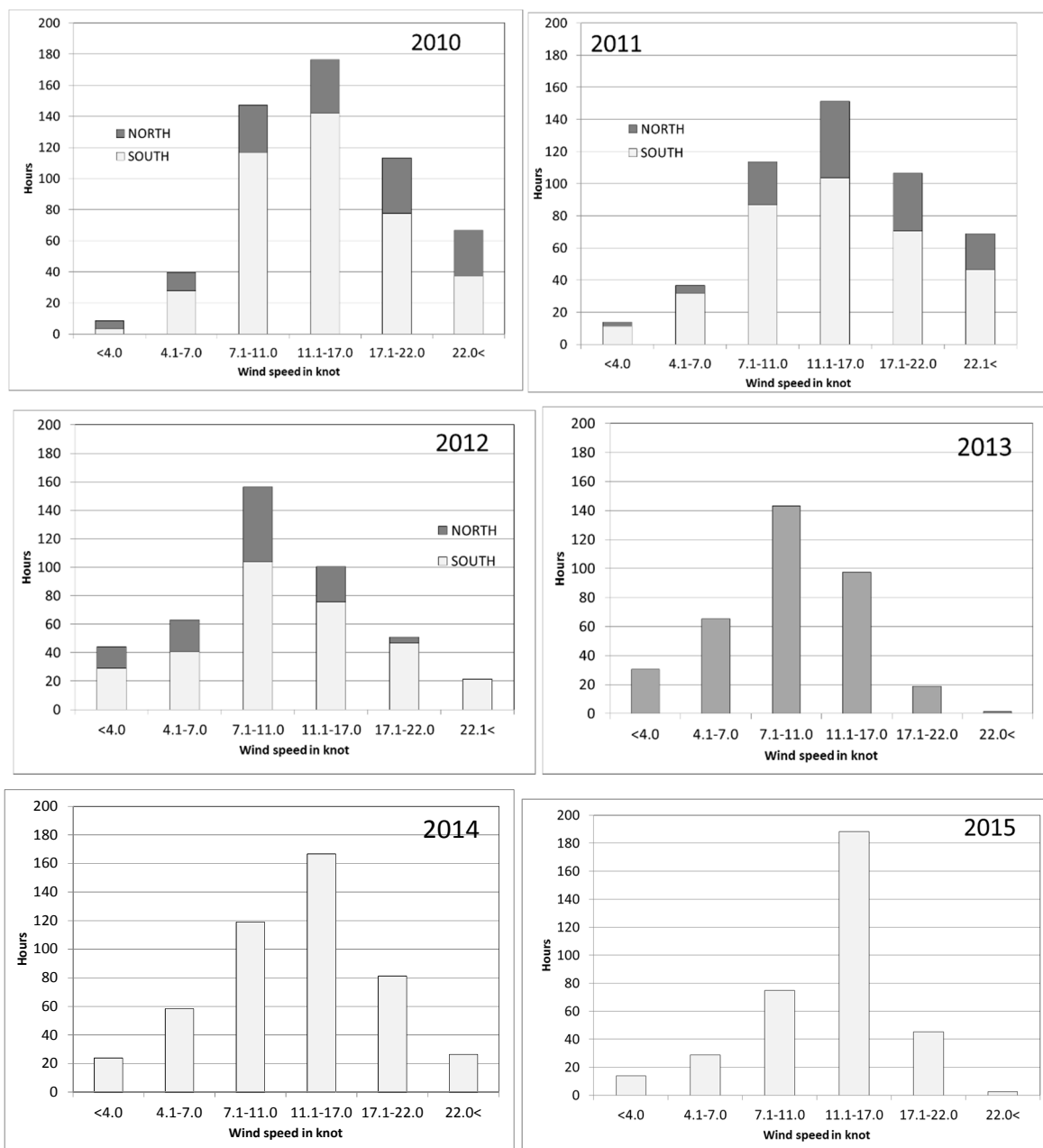


Figure B1. Breakdown of research time in hours during 2010 to 2015 surveys in research area by wind speed.

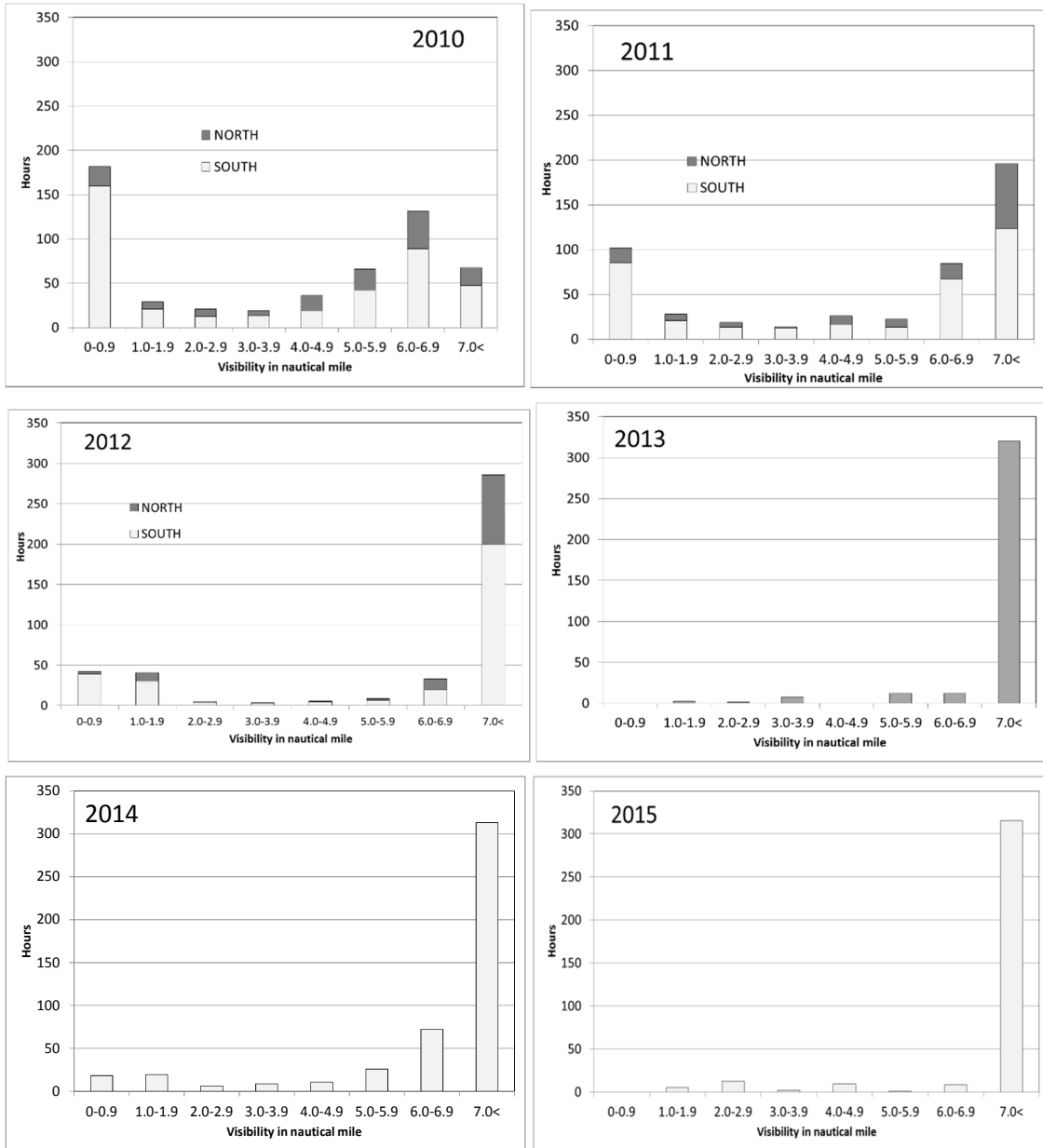


Figure B2. Breakdown of research time in hours during 2010 to 2015 surveys in research area by visibility in nautical mile.

Appendix C. Sightings in the US EEZ

1. Dates and Locations of Survey Effort in US waters

The ship first entered the US EEZ at location 30° 14.8' N, 178° 26.4' E on 9 July 2015 at 04:12 (GMT) and final departure from the US EEZ was at location 23° 32.3' N, 176° 28.6' W, on 1 August 2015 at 02:04 GMT. Total searching distance in the US EEZ was 2,029.6 n. miles.

Appendix Table C1. Summary of dates and locations in the US EEZ.

Date (y/m/d) (GMT)	Time (GMT)	Date (y/m/d) (SMT)	Time (SMT)	Position		Remark
2015/7/9	04:12	2015/7/9	15:42	30° 14.8'N	178° 26.4'E	US EEZ in
2015/7/12	20:23	2015/7/13	8:23	29° 12.3'N	172° 11.1'W	US EEZ out
2015/7/13	19:36	2015/7/14	8:06	29° 04.1'N	170° 50.2'W	US EEZ in
2015/7/23	20:32	2015/7/24	9:02	20° 15.0'N	163° 52.7'W	US EEZ out
2015/7/23	23:43	2015/7/24	12:13	20° 15.2'N	164° 14.8'W	US EEZ in
2015/8/1	02:04	2015/8/1	13:34	23° 32.3'N	176° 28.6'W	US EEZ out

2. Sightings

Appendix Table C2 shows total sightings in the US EEZ. All Bryde's and killer whales sighted were approached for species confirmation and biopsy sampling. The group of sperm, beaked whales and dolphins were approached briefly to within 0.1 miles for long distance species confirmation.

Appendix Table C2. Summary of all sightings in the US-EEZ.

Species	Transit to the research area (US-EEZ)			Research area, original trackline (US-EEZ)			Rresearch area, (a modified course to avoid the PMNM) (US-EEZ)			Total		
	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf	Sch.	Ind.	Calf
Bryde's whale	5	5	0	5	7	2	3	3	0	13	15	2
Sperm whale	5	7	0	1	1	0	3	19	0	9	27	0
Pygmy sperm whale	1	4	0	0	0	0	0	0	0	1	4	0
Cuvier's beaked whale	0	0	0	1	2	0	0	0	0	1	2	0
Longman's beaked whale	0	0	0	0	0	0	1	110	10	1	110	10
<i>Mesoplodon</i> spp.	1	1	0	1	2	0	0	0	0	2	3	0
<i>Ziphiidae</i>	0	0	0	1	1	0	0	0	0	1	1	0
Killer whale	0	0	0	0	0	0	1	4	0	1	4	0
Southern form short-finned pilot whale	0	0	0	1	32	2	0	0	0	1	32	2
Risso's dolphin	0	0	0	0	0	0	1	3	0	1	3	0
Fraser's dolphin	0	0	0	1	180	20	0	0	0	1	180	20
Bottlenose dolphin	0	0	0	0	0	0	2	10	3	2	10	3
Striped dolphin	0	0	0	2	80	10	2	111	0	4	191	10
Unid. small cetacean	0	0	0	0	0	0	3	3	0	3	3	0
Unid. dolphin/porpoise	0	0	0	0	0	0	2	30	0	2	30	0
Total	12	17	0	13	305	34	18	293	13	43	615	47

Appendix Table C3. Sightings in the US-EEZ with locations and sea surface temperature (SST).

Date (y/m/d)	Sighting No.	Species	School size	Calf	Lat.	Long.	SST (°C)
2015/7/9	004	Bryde's whale	1	0	30°10.8'N	178°43.5'E	26.8
2015/7/9	005	Bryde's whale	1	0	30°08.2'N	178°46.4'E	26.9
2015/7/10	001	<i>Mesoplodon</i> spp.	1	-	29°34.1'N	178°33.6'W	25.8
2015/7/10	002	Pygmy sperm whale	4	-	29°24.0'N	177°49.5'W	25.8
2015/7/10	003	Sperm whale	2	0	29°23.2'N	177°45.5'W	25.8
2015/7/10	004	Sperm whale	1	0	29°22.4'N	177°43.9'W	25.8
2015/7/10	005	Bryde's whale	1	0	29°22.1'N	177°42.4'W	25.7
2015/7/10	006	Sperm whale	2	0	29°20.1'N	177°39.3'W	25.9
2015/7/10	007	Bryde's whale	1	0	29°15.9'N	177°13.6'W	26.3
2015/7/10	008	Bryde's whale	1	0	29°16.0'N	177°10.7'W	26.2
2015/7/10	009	Sperm whale	1	0	29°07.7'N	176°37.3'W	26.3
2015/7/10	010	Sperm whale	1	0	29°06.4'N	176°32.2'W	25.8
2015/7/11	001	Bryde's whale	1	0	27°13.5'N	173°42.6'W	26.2
2015/7/12	001	Bryde's whale	1	0	27°33.0'N	173°27.5'W	25.4
2015/7/12	002	<i>Mesoplodon</i> spp.	2	0	28°17.6'N	172°53.4'W	25.8
2015/7/12	003	Bryde's whale	1	0	28°46.0'N	172°31.4'W	25.6
2015/7/13	001	Sperm whale	1	0	29°07.5'N	172°14.6'W	24.9
2015/7/14	001	Southern form short-finned pilot whale	32	2	28°24.2'N	170°19.4'W	25.1
2015/7/18	001	Unid. dolphin	18	-	25°50.6'N	166°48.1'W	26.4
2015/7/18	002	Striped dolphin	24	0	25°50.2'N	166°40.9'W	26.6
2015/7/18	003	Unid. dolphin	12	-	25°51.1'N	166°36.9'W	26.4
2015/7/18	004	Striped dolphin	87	0	25°49.6'N	166°24.4'W	26.7
2015/7/18	005	Sperm whale	16	0	25°50.0'N	166°21.8'W	26.7
2015/7/19	001	Bryde's whale	1	0	25°39.7'N	163°53.0'W	25.8
2015/7/19	002	Killer whale	4	0	25°35.5'N	162°45.6'W	27.0
2015/7/21	001	<i>Ziphiidae</i>	1	-	24°14.3'N	160°54.0'W	27.4
2015/7/22	001	Bottlenose dolphin	5	1	22°46.5'N	161°01.2'W	27.8
2015/7/22	002	Bottlenose dolphin	5	2	22°39.3'N	161°02.9'W	27.9
2015/7/22	003	Risso's dolphin	3	0	22°09.2'N	161°45.4'W	28.4
2015/7/22	004	Longman's beaked whale	110	10	22°09.5'N	161°46.4'W	28.3
2015/7/23	001	Striped dolphin	62	10	20°56.9'N	163°21.8'W	28.3
2015/7/25	001	Bryde's whale	2	1	22°26.6'N	165°50.5'W	28.1
2015/7/26	001	Cuvier's beaked whale	2	0	22°47.5'N	166°05.9'W	27.6
2015/7/26	002	Bryde's whale	1	0	22°51.5'N	166°51.4'W	27.8
2015/7/27	001	Unid. small cetacean	1	-	23°18.4'N	168°18.3'W	27.2
2015/7/28	001	Unid. small cetacean	1	-	24°03.8'N	170°46.1'W	27.9
2015/7/28	002	Bryde's whale	1	0	24°07.0'N	170°56.1'W	27.9
2015/7/28	003	Unid. small cetacean	1	-	24°28.7'N	172°07.3'W	28.3
2015/7/29	001	Sperm whale	1	0	25°28.7'N	174°40.7'W	28.3
2015/7/29	002	Sperm whale	2	0	25°28.6'N	174°42.9'W	28.3
2015/7/31	001	Striped dolphin	18	0	25°22.6'N	175°06.5'W	28.3
2015/7/31	002	Fraser's dolphin	180	20	24°29.6'N	175°46.0'W	28.6
2015/7/31	003	Bryde's whale	2	1	24°27.2'N	175°47.9'W	28.7

3. Photo-ID

Photo-ID effort was dedicated to all 13 Brydes whale sightings encountered in the US EEZ. Sufficient photographs for assigning photo-ID catalogue numbers were collected for 10 of the 15 individual of Bryde's whales sighted including both mother and calf of two mum-calf pairs. In addition, one sperm whale, four killer whales and two bottlenose dolphins were sufficiently photographed for individual identification (Appendix Table C5).

Appendix Table C4. Summary of Photo-ID effort in the US EEZ by Sighting.

Sighting Date (SMT)	Sight. No.	Species	School Size	Number Photo-ID'd	Number Biopsied	Whale ID / Nat. Mark. Form No.	Biopsy Sample No.	Biopsy Form No.	Encounter Duration (min)	Notes
09/07/2015	004	Bryde's whale	1	1	1	ID024_A	15031002	BY002	13	
09/07/2015	005	Bryde's whale	1	0	1	ID025	15031003	BY003	18	
10/07/2015	002	Pygmy sperm whale	4	0	0	ID026	-	-	-	
10/07/2015	005	Bryde's whale	1	1	1	ID027_A	15031004	BY004	9	
10/07/2015	007	Bryde's whale	1	0	0	ID028	No sample	-	-	
10/07/2015	008	Bryde's whale	1	1	0	ID029_A	No sample	-	-	
11/07/2015	001	Bryde's whale	1	1	0	ID030_A	No sample	-	-	
12/07/2015	001	Bryde's whale	1	1	1	ID031_A	15031005	BY005	37	
12/07/2015	002	<i>Mesoplodon</i> spp.	2	0	0	ID032	-	-	-	
12/07/2015	003	Bryde's whale	1	0	0	ID033	No sample	-	-	
14/07/2015	001	Short-finned pilot whale	32	0	0	ID036	-	-	-	
18/07/2015	001	Striped dolphin	24	0	0	ID037	-	-	-	
18/07/2015	004	Striped dolphin	87	0	0	ID038	-	-	-	
19/07/2015	001	Bryde's whale	1	0	1	ID039	15031007	BY007	17	Thin.
19/07/2015	002	Killer whale	4	4	2	ID040_A	15271008	BY008	107	Male. Video taken
19/07/2015	002	Killer whale	4	4	2	ID040_B	15271009	BY008		Video taken
19/07/2015	002	Killer whale	4	4	2	ID040_C	No sample	-		Video taken
19/07/2015	002	Killer whale	4	4	2	ID040_D	No sample	-		Video taken
22/07/2015	001	Bottlenose dolphin	5	2	0	ID041_A	-	-	-	
22/07/2015	001	Bottlenose dolphin	5	2	0	ID041_B	-	-	-	
22/07/2015	002	Bottlenose dolphin	5	0	0	ID042	-	-	-	
22/07/2015	003	Risso's dolphin	3	0	0	ID043	-	-	-	
22/07/2015	004	Longman's beaked whale	110	0	0	ID044	-	-	-	Video taken.
23/07/2015	001	Striped dolphin	62	0	0	ID045	-	-	-	
25/07/2015	001	Bryde's whale	2	2	2	ID046_A	15031010	BY009	78	Mother
25/07/2015	001	Bryde's whale	2	2	2	ID046_B	15031011	BY009		Calf
26/07/2015	001	Cuvier's beaked whale	2	0	0	ID047	-	-	-	
26/07/2015	002	Bryde's whale	1	0	1	ID048	15031012	BY010	12	
28/07/2015	002	Bryde's whale	1	1	1	ID049_A	15031013	BY011	40	
29/07/2015	001	Sperm whale	1	1	0	ID050_A	-	-	-	
29/07/2015	002	Sperm whale	2	0	0	ID051	-	-	-	
31/07/2015	001	Striped dolphin	18	0	0	ID052	-	-	-	
31/07/2015	002	Fraser's dolphin	180	0	0	ID053	-	-	-	Video taken
31/07/2015	003	Bryde's whale	2	2	2	ID054_B	15031014	BY012	4	Calf
31/07/2015	003	Bryde's whale	2	2	2	ID054_A	15031015	BY012	13	Mother

Appendix Table C5. Summary of photo-ID effort in the US EEZ by Species.

Species Photographed	Total Sightings		Photo-ID		
	Sch.	Ind.	Sch. Photo'd	No. images useful for Photo-ID ¹	Ind. Photo-ID'd
Bryde's whale	13	15	13	442	10 ²
Sperm whale	9	27	2	80	1
Killer whale	1	4	1	328	4
Pygmy sperm whale	1	4	1	NA	NA
Longman's beaked whale	1	110	1	63 ³	NA
Cuvier's beaked whale	1	2	1	6 ³	NA
<i>Mesoplodon</i> spp.	2	3	1	14	NA
Short-finned pilot whale	1	32	1	27	NA
Risso's dolphin	1	3	1	NA	NA
Bottlenose dolphin	2	10	2	47	2
Fraser's dolphin	1	180	1	21 ³	NA
Striped dolphin	4	191	4	NA	NA
Total	37	581	29	1,028	17

4. Biopsy

Biopsy samples were collected from 11 Bryde's whales within the boundaries of the US EEZ, including samples from two mother-calf pairs. In addition, biopsy samples were collected from 2 killer whales within the US EEZ (Appendix Table C4).

Appendix Table C6. Summary of biopsy samples in the US EEZ.

Sighting Date	Species	Sighting No.	School Size	Biopsy Sample No.*	Natural Markings Form No.**	Whale No.***	Photo ID	Remarks
09-Jul-15	Brydes whale	004	1	15031002	ID024	A	Yes	US_EEZ
09-Jul-15	Brydes whale	005	1	15031003	ID025	A	No	US_EEZ
10-Jul-15	Brydes whale	005	1	15031004	ID027	A	Yes	US_EEZ
12-Jul-15	Bryde's whale	001	1	15031005	ID031	A	Yes	US EEZ
19-Jul-15	Bryde's whale	001	1	15031007	ID039	A	No	US-EEZ, thin whale
19-Jul-15	Killer whale	002	4	15271008	ID040	A	Yes	US-EEZ, Large male.
19-Jul-15	Killer whale	002	4	15271009	ID040	B	Yes	US-EEZ,
25-Jul-15	Bryde's whale	001	2	15031010	ID046	A	Yes	US-EEZ, Mother.
25-Jul-15	Bryde's whale	001	2	15031011	ID046	B	Yes	US-EEZ, Calf.
26-Jul-15	Bryde's whale	002	1	15031012	ID048	A	No	US EEZ
28-Jul-15	Bryde's whale	002	1	15031013	ID049	A	Yes	US EEZ
31-Jul-15	Bryde's whale	003	2	15031014	ID054	B	Yes	US EEZ, Calf
31-Jul-15	Bryde's whale	003	2	15031015	ID054	A	Yes	US EEZ, Mother.

* Sample Number = Year (15) | Species code (e.g. Bryde's 03) | Boat code (1) | Serial number (consecutive number for all samples throughout the cruise starting at 001)

** A natural marking record sheet is completed for every school photographed. Forms are numbered consecutively throughout the cruise starting at ID001.

*** Each individual in a school is designated a letter starting with 'A'. Mother within a cow/calf pair is 'A', calf is 'B'

¹ Images useful for photo-ID may not be sufficient to catalogue the individual, but show useful identification characteristics such as dorsal fin shape, nick in dorsal, scars etc. These images are coded Green in the IWC Lightroom database.

² Includes two mother-calf pairs

³ Images of species where individual photo-identification is not feasible have been coded 'useful for species identification'. These images are coded Purple in the IWC Lightroom database.

5. Marine Debris

A total of 65 objects of marine debris were recorded during surveys in the US EEZ (Appendix Table C7) and 9 of those were photographed.

Appendix Table C7. Summary of all marine debris observations in the US EEZ.

IWC code	Description	Remarks	Number
120	Unidentified net	Large cluster of rope, net >24 fishing buoys	1
124	Unidentified net, medium mesh, small fragment	A scrap pile of orange net 0.5m×0.5m	1
129	Unidentified net, large mesh, large piece	Rolled large net 3m width	1
134	Single fishing float	Diameter:0.6m×1. 0.4m×11(with rope×1). 0.3m×7(with rope×1). 0.25m×1. 0.2m×4. Square×1. Unknown×2	27
135	Clustered fishing floats(2-10 floats together)	0.4m×2	2
137	Wood crate, 1 side only	Wooden pallet. Wood board(0.4m×0.2m)	2
148	Styrofoam board, less than 1 square metre	Size:(0.3m×0.3)×1. (0.3×0.2)×1. (0.15m×0.15m)×1 (0.1×0.1)×3	6
151	Styrofoam box (at least 2 sides)	Small styrofoam(0.3m×0.2m)	1
162	Plastic, less than 1 square metre	Tank×2(0.5m×0.3m×0.2m)(0.4m×0.4m) Crate×2(0.2m×0.3m)(0.45m×0.45m) Small piece×2(0.3m×0.3m) Board×2(1m×0.5m) Bottle×1(0.15m). Cool box(0.4×0.6×0.5) container × 1	11
168	Garbage, unidentified	Appeared to be red ball not buoy 0.15m(diameter)	1
169	Garbage, 1-10 pieces	Plastic rod 1.5m	1
199	Other	Rope 2m-3m	1
199	Other	Net & poss. Boat mixed 3m-5m	1
199	Other	Marker buoy (white) 0.75m (diameter)	1
199	Other	Clump of rope	1
199	Other	Rope 2m	1
199	Other	Tire 0.6m(diameter)	1
199	Other	Single tire 0.6m(diameter)	1
199	Other	2 white fishing buoys(0.25m diameter) with tangled fishing net; 10feet long	1
199	Other	Gas cylinder 0.25m(diameter)×0.6m(tall)	1
199	Other	Vase 0.25m	1
Total			64