SC/68A/SP/03

Cruise Report of the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) in 2018 - Pacific coastal component

Isoda, T., Ito, N., Shimetani, K., Nakamura, G., Kumagai, S., Takahashi, M., Ogihara, M., Hirose, A., Kim, Y., Nishimura, F., Yamamoto, R., Watanabe, H., Koda, N., Yagi, G., Murata, H., Sazawa, R., Ogawa, M., Fukuyoshi, M., Hatanaka, T., Murono N., Takah

INTERNATIONAL WHALING COMMISSION

Cruise Report of the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) in 2018 - Pacific coastal component

TATSUYA ISODA[1)], NOBUYUKI ITO[2)], KAZUTOYO SHIMETANI[2)], GEN NAKAMURA[3)], SAEKO KUMAGAI[2)], MEGUMI TAKAHASHI[1)], MITSUHITO OGIHARA[1)], AYUMI HIROSE[3)], YUJIN KIM[3)], FUTABA NISHIMURA[3)], RYUJI YAMAMOTO[3)], HIKARU WATANABE[3)], NOBORU KODA[3)], GENFU YAGI[3)], HARUNA MURATA[3)], RIKIO SAZAWA[2)], MASAHIRO OGAWA[1)], MAMORU FUKUYOSHI[2)], TORU HATANAKA[2)], NORITSUGU MURONO[2)], TOSHIMASA TAKAHASHI[2)], ATSUHIRO NODA[2)], TOSHIHIRO MOGOE[1)], HIROYUKI OIKAWA[1)], GENTA YASUNAGA[1)] and HIDEHIRO KATO[1)]

[1] *The Institute of Cetacean Research, 4-5 Toyomi-cho, Chuo-ku, Tokyo 104-0055, Japan*
[2] *Association for Community-Based Whaling, Hakata-Kaiseki Building 2F, Hakata-Eki-Higashi, Hakata-ku, Fukuoka 812-0013, Japan*
[3] *Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-0075, Japan*

Contact e-mail: isoda@cetacean.jp

ABSTRACT
The second survey of the NEWREP-NP Pacific coastal component was conducted in sub-areas 7CS and 7CN, which consisted of three surveys based in Ayukawa, Hachinohe and Kushiro ports. The survey in Ayukawa was conducted from 5 to 30 April 2018, using four small-type whaling catcher boats as sighting/sampling vessels. The survey in Hachinohe was conducted from 4 to 31 May 2018, using four small-type and one large-type whaling catcher boats as sighting/sampling vessels. The survey in Kushiro was conducted from 5 September to 4 October 2018, using five small-type whaling catcher boats as sighting/sampling vessels. Searching for common minke whales and sampling took place in coastal waters about 50 n.miles from Ayukawa, Hachinohe and Kushiro Ports. All common minke whales sampled were landed at the NEWREP-NP research stations established in Ayukawa, Hachinohe and Kushiro, where biological examination was conducted. During the survey in Ayukawa, a total of 27 primary sightings (27 individuals) of common minke whale were made during 3,366.3 n.miles of searching distance (337.2 hours). A total of 18 common minke whales (eight males and ten females) were sampled. The dominant prey species was sand lance (adult) and Japanese sardine. During the survey in Hachinohe, a total of 45 primary sightings (45 individuals) of common minke whale were made during 3875.0 n.miles of searching distance (439.9 hours). A total of 33 common minke whales (19 males and 14 females) were sampled. The dominant prey species was Japanese sardine and krill. During the survey in Kushiro, a total of 39 primary sightings (45 individuals) of common minke whale were made during 3,524.1 n.miles of searching distance (355.9 hours). A total of 29 common minke whales (22 males and 7 females) were sampled. The dominant prey species was Japanese sardine. In total 80 common minke whales were successfully collected attaining the planned annual target sample size in the Pacific. Biological samples and data required for Primary Objective I and Ancillary Objectives I and II of NEWREP-NP were obtained from all animals sampled.

KEYWORDS: COMMON MINKE WHALE; NORTH PACIFIC; SCIENTIFIC PERMITS

INTRODUCTION

The research plan for the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) was finalized taking into account recommendations and suggestions from the NEWREP-NP review workshop (IWC, 2017) and the International Whaling Commission Scientific Committee (IWC SC) (IWC, 2018). The NEWREP-NP research plan can be found at http://www.jfa.maff.go.jp/j/whale/attach/pdf/index-6.pdf (GOJ, 2017).

The NEWREP-NP has two primary objectives and three ancillary objectives. Primary Objective I related to common minke whale and the three ancillary objectives are relevant for the field activities of the coastal component of NEWREP-NP reported in this document.

Primary Objective I, which is 'Contribution to optimizing the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan' is composed of four Secondary Objectives as follows: I (i): Investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status; I (ii): Estimate the abundance of the J and O stocks in coastal waters of Japan; I (iii): Verify that there is no structure in the O stock common minke whale in the Pacific side of Japan; and I (iv): Improve RMP trials by incorporating age data in their conditioning (GOJ, 2017).

The three Ancillary Objectives are the following I: 'Investigation of the influence of environmental changes on whale stocks'; II: 'Examination of the effects of pollutants on whales'; and III: 'Study of distribution, movement and stock structure of large whales with particular emphasis on blue and North Pacific right whales' (GOJ, 2017).

The rational for Primary and Ancillary objectives and the required data to fulfill the objectives are given in the

research plan for NEWREP-NP (GOJ, 2017). The most relevant samples and data for Primary Objective I are earplugs for age determination, reproductive organs for determination of sexual maturity, tissue samples for genetic analyses on stock structure, and sighting data for abundance estimates.

The sample size of common minke whale in the Pacific side of Japan was determined in relation to Secondary Objective I (iv) above. The sample size was determined to be 107 O stock animals, of which 43 are to be taken in offshore areas and 64 in the Pacific coastal areas (see details in Annex 11 of GOJ, 2017). Allowing for sampling of some J stock animals, the sample size in the Pacific coastal area was determined to be 80 animals.

This paper reports the results of the second Pacific coastal surveys of NEWREP-NP conducted in 2018 in sub-areas 7CS off Ayukawa and Hachinohe and 7CN off Kushiro. The Institute of Cetacean Research (ICR) conducted these surveys in cooperation with the National Research Institute of Far Seas Fisheries (NRIFSF), the Japan Fisheries Research and Education Agency, Tokyo University of Marine Science and Technology and the Association for Community-Based Whaling.

SURVEY DESIGN

Research area
Sub-areas 7CN and 7CS were the primary research areas (Figure 1). A land-based operation system was incorporated for whale sampling. Land stations with a research head office were established at Ayukawa and Hachinohe (sub-area 7CS) and Kushiro (7CN). The research areas were set approximately within 50 nautical miles from Ayukawa and Hachinohe and Kushiro ports.

Research period
Research period in Ayukawa was set for 26 days, from 5 to 30 April 2018. Research period in Hachinohe was conducted for 28 days, from 4 to 31 May 2018. Research period in Kushiro was set for 30 days, from 5 September to 4 October 2018.

Target species for lethal sampling and sample sizes
The target species was the common minke whale. The sample size in the Pacific side of Japan was 80 animals.

Research vessels and research station
In the Ayukawa survey, four small-type whaling catcher boats were used as sighting/sampling vessels: *Taisho Maru No. 3* (19.0GT), *Koei Maru No. 8* (32.0GT), *Katsu Maru No.7* (32.0GT) and *Sumitomo Maru No.51* (30.0GT).

In the Hachinohe survey four small-type whaling catcher boats were used as sighting/sampling vessels: *Taisho Maru No. 3* (19.0GT), *Koei Maru No. 8* (32.0GT), *Katsu Maru No.7* (32.0GT) and *Sumitomo Maru No.51* (30.0GT). In addition a large-type whaling catcher boat acted as sighting/sampling vessel: *Yushin Maru* (724.0 GT), during 4 to 10 May 2018.

In the Kushiro survey, five small-type whaling catcher boats were used as sighting/sampling vessels: *Taisho Maru No. 3* (19.0GT), *Koei Maru No. 8* (32.0GT), *Katsu Maru No.7* (32.0GT), *Sumitomo Maru No.51* (30.0GT) and *Seiwa Maru* (15.0GT).

Land stations with a research head office were established in Ayukawa and Hachinohe and Kushiro for biological examinations and commanding the operation of the sampling vessels.

Whale sampling survey procedures
The standard survey procedure of searching and sampling for the Pacific coastal component of Ayukawa and Hachinohe and Kushiro was based on Research Plan for NEWREP-NP (GOJ. 2017, see Annex 6).
The research head office established in the research station controlled the sampling vessels during the survey. In order to avoid concentration of searching effort in an area, searching areas and direction of vessels were determined by the office, from weather conditions, whale distribution and information on fishing grounds of coastal fisheries. After vessels left the port, they principally continued to cruise along the predetermined direction until arriving at 30 n.miles from a port, then change their direction chosen by themselves and continued searching within the research area. The vessels were searching in the daytime and returned to the port in everyday. A researcher was on board each of the vessels and recorded sighting and sampling information, *e.g.*, coordinates and time of common minke whale sighting and sampling made, weather conditions and vessel activity. Sighting information was also

recorded for other large whale species. Searching was conducted by crews and researchers from the top barrel and upper bridge of vessels running at around 11 knots. All common minke whales sighted were targeted for sampling, except cow-calf pairs. When a school consisted of more than one animal, an individual was selected randomly from the school and then collected. Once a vessel caught a whale, it returned to the land-station of port, to transport the animal to the research station. While returning to the port, other common minke whales encountered were also targeted for sampling, if the situation allowed. At the port, animals were lifted from the vessel by the crane, using a wire net and then carried to the station by an 11-ton freight trailer.

Biological measurements and sampling procedure

All the whales sampled were biologically examined by researchers at the land station. The items of the biological research are summarized in Table 1.

Morphometric and body weight

After photographing the lateral side of each whale, a series of standard measurements were taken, including body length to the nearest 1 cm and body proportion at 23 different points (to the nearest 1 cm). Skull measurements (length and greatest breadth to the nearest 0.5 cm) were taken for most whales using a large pair of vernier calipers. Measurements of blubber thickness were taken at five points on the lateral side of the body. Girth dimensions are taken from all animals sampled. Body weights of each whale are measured using a crane scale or a track scale.

Definition of sexual maturity

Sexual maturity of females was determined by the presence of at least one corpus luteum or corpus albicans in either ovary. In the case where no corpus luteum or corpus albicans was observed, the female was categorized as immature. Reproductive status of matured female whales was classified into four categories (resting, ovulating, pregnant and pregnant and lactating), based upon observation of the ovary, uterus and mammary gland. Pregnancy of the animal was defined based on conceptus with placental development in the uterus. Body length and weight of fetuses were measured in the same manner as in adult whales. Sexual maturity of males was defined preliminary based on the weight of one testis. If the heavier testis was over 0.29 kg (Bando unpublished data), the whales were determined as sexually mature.

Earplug sampling

Both left and right earplugs were collected for age determination by the routine procedure (Omura, 1963). After removing the mandibles, the proximal part of the earplug was exposed along the surrounding external part of the ear canal from the tympanic bulla using a knife for subsequent incision. The external part of the ear canal was carefully cut open so as not to incise the earplug, and then the earplug was collected with glove-finger using a scalpel. 'Gelatinized Extraction Method' (Maeda *et al.*, 2013) was used to reduce damage at extracting earplugs from small animals (body length < 7 m). Earplugs were fixed and stored in 10 % formalin solution.

Stomach contents

Conventional stomach content records were obtained from all sampled whales. Prey species from the fore- and main-stomach contents were weighed for each whale sampled and a part of stomach contents was stored at −20 °C or in 10 % formalin solution for later examination.

Other biological samples

Ocular lenses were collected from all animals involved in their fetuses with body length less than 10 cm for age estimation purposes, and stored at −80 °C until analysis. Ovary from females were dissected from the uterus and stored at −20 °C for reproductive study. Testis tissue samples were collected from males for the histological observation and fixed using 10 % formalin solution. After measurements of blubber thickness (five points), blubber tissue samples were collected from all animals for the study of feeding ecology and pollutant studies. Muscle and liver tissues were collected for pollutant studies and stored at −20 °C until analysis. Skin tissue samples were collected from all animals for genetic studies and fixed in ethanol solution (99 %).

RESULTS

General narrative of the coastal survey in Ayukawa

Searching effort by sighting/sampling vessels

The survey was conducted for 26 days, from 5 to 30 April 2018. Of the 26 days, vessels conducted searching for 12 days (46.2 %). The remaining days were not suitable for survey, due to bad weather conditions, *e.g.*, low atmospheric pressure and heavy wind. The track-lines are shown in Figure 2, and sighting efforts are shown in Table 2. A total of 3,366.3 n.miles (337.2 hours) was searched. Cruise tracks were mainly distributed within Sendai Bay which was in coastal waters within 30 n.miles from Ayukawa port.

Sightings and sampling
Common minke whales were sighted at the middle part of Sendai Bay. A total of 27 sightings (27 individuals) of common minke whale were made (Table 2, Figure 2). No cow-calf pairs was encountered. A total of 18 common minke whales were sampled. In the sampling process, one common minke whale was struck and lost. Density Index (DI: the number of primary sightings of common minke whale schools per 100 n.miles searching) was 0.77. During the survey, 23 sighting (23 individual) of humpback whale was also made (Table 2, Figure 3).

Biological survey
Samples and data required for Primary Objective I of NEWREP-NP, including body length measurement, earplugs and reproductive organs were obtained from all animals sampled in Ayukawa. The 18 common minke whales sampled consisted of eight males and ten females. Table 3 summarizes the information on their body length. Average body length was 5.66 m (SD = 0.78, range = 4.52-6.75 m) for males and 5.46 m (SD = 0.57, range = 4.46-6.12 m) for females. Body length frequencies of all animals in each sex, compared with results of the previous 2002-2016 JARPNII surveys in Ayukawa are shown in Figure 4a. The dominant body length class was 4.5-6.0 m. Table 4 summarizes the information on sexual maturity composition. Maturity rate of males was low (25.0 %) and no females was sexual maturity. The total biological items collected (items required for Primary Objective I, and Ancillary Objectives I and II), are shown in Table 1.

Table 5 and Figure 5a show the information on forestomach contents. The dominant prey species detected was sand lance (*Ammodytes personatus*) (adult) (frequency of appearance: 66.7 %), followed by Japanese sardine (*Sardinops melanostictus*). After the Great East Japan Earthquake in 2011, proportion of sand lance (adult) tend to be lower than 2000's, however, it was similar to the 2000's, although. No Japanese anchovy (*Engraulis japonicas*) was observed in Ayukawa in this season, whereas it had been observed as the secondary prey species until 2013. Marine debris was observed from stomach of one animal, which had a rubber product.

General narrative of the coastal survey in Hachinohe
Searching effort by sighting/sampling vessels
The survey was conducted for 28 days, from 4 to 31 May 2018. Because of continued unsuitable weather conditions, *e.g*., low atmospheric pressure, heavy wind, high wave and thick fog, and the logistic reasons sighting activity by sighting/sampling vessels was conducted only for 14 days (50.0 %). The track-lines are shown in Figure 6, and sighting efforts are shown in Table 2. A total of 3875.0 n.miles (439.9 hours) was searched (four small-type vessels: 3,363.2 n.miles / 354.3 hours and one large-type vessel: 511.8 n.miles / 85.6 hours). Cruise tracks were mainly distributed in coastal waters within 20 n.miles from Hachinohe port.

Sightings and sampling
Common minke whales were almost sighted at the continental shelf at distances of about 5 to 20 n.miles from Hachinohe. A total of 45 sightings (45 individuals) of common minke whale were made (Table 2, Figure 6). No cow-calf pairs was encountered. A total of 33 common minke whales were sampled. In the sampling process, struck and lost was not occurred. Density Index (DI: the number of primary sightings of common minke whale schools per 100 n.miles searching) was 1.16. During the survey, 3 sighting of fin whale (5 individuals), 74 sighting (83 individuals) of humpback whale, two sightings (seven individuals) of sperm whales, were also made (Table 2, Figure 7).

Biological survey
Samples and data required for Primary Objective I of NEWREP-NP, including body length measurement, earplugs and reproductive organs were obtained from all whales sampled. The 33 common minke whales sampled consisted of 19 males and 14 females. Table 3 summarizes the information on their body length. Average body length was 6.43 m (SD = 1.20, range = 4.33-7.81 m) for males and 5.72m (SD = 0.94, range = 4.84-7.85 m) for females. In males, the dominant body length class was 7.0-7.5 m (Figure 4b). It was 4.5-5.5 m for females. Table 4 summarizes the information on sexual maturity composition. In males, 12 of 19 individuals (63.2 %) were sexually mature. In females, two of 14 individuals (14.3 %) were sexually mature and were pregnant. Body lengths of foetus were 35.7 cm (female) and 40.4 cm (female). The total biological items collected (items required for Primary Objective I, and Ancillary Objectives I and II), are shown in Table 1.

Table 5 and Figure 5b show the information on forestomach contents. The dominant prey species detected was Japanese sardine (frequency of appearance: 60.6 %), followed by krill (frequency of appearance: 36.4 %). Marine debris was observed from stomach of one animal, which had a small piece of glass.

General narrative of the coastal survey in Kushiro

Searching effort by sighting/sampling vessels

The survey was conducted for 30 days, from 5 September to 4 October 2018. Because unsuitable weather conditions, *e.g.*, typhoons, low atmospheric pressure, and the earthquake in Hokkaido, sighting activity by sighting/sampling vessels was conducted only for 15 days (50.0 %). The track-lines are shown in Figure 8, and sighting efforts are shown in Table 2. A total of 3,524.1 n.miles (355.9 hours) was searched. Cruise tracks were distributed in coastal waters within 30 n.miles from Kushiro port.

Sightings and sampling by vessels

Sightings of common minke whales were made mainly on the continental slope southwest to southeast of Kushiro. A total of 39 sightings (45 individuals) of common minke whale were made (Table 2, Figure 8). No cow-calf pairs was encountered. 29 common minke whales were sampled. In the sampling process, struck and lost was not occurred. DI was calculated at 0.94. During the survey, 12 sightings (26 individuals) of sei whales, 10 sightings (16 individuals) of fin whales, five sightings (seven individuals) of humpback whales and six sightings (eight individuals) of sperm whales were also made (Table 2, Figure 9).

Biological survey

Samples and data required for Primary Objective I of NEWREP-NP, including body length measurement, earplugs and reproductive organs were obtained from all whales sampled. The 29 common minke whales sampled consisted of 22 males and 7 females. Table 3 summarizes the information on their body length. Average body length was 6.51 m (SD = 0.90, range = 4.84-7.75 m) for males and 5.73 m (SD = 1.20, range = 4.62-8.10 m) for females. Body length frequencies of common minke whales sampled in Kushiro, compared with results of the previous 2003-2016 JARPNII surveys in Kushiro are shown in Figure 4c. The dominant body length class was 7.0-7.5 m for males and 4.5-6.0m for females (Figure 4c). Table 4 summarizes the information on sexual maturity composition. Sex ratio of males was 75.9 %. In males, 11 of 22 individuals (50.0 %) were sexually mature. In females, one of 7 individuals (14.3 %) were sexually mature and were pregnant. Body lengths of fetus was 123.6 cm (male). The total biological items collected (items required for Primary Objective I and Ancillary Objectives I and II) are shown in Table 1.

Table 5 and Figure 5c show the information on forestomach contents. The dominant prey species detected was Japanese sardine (frequency of appearance: 93.1 %), followed by mackerels (*Scomber japonicas*) and/or (*S. australasicus*) (frequency of appearance: 3.4 %) and Japanese common squid *Todarodes Pacificus* (frequency of appearance: 3.4 %). No Japanese anchovy or Pacific saury (*Cololabis saira*) were observed, which were the main prey species during the 2000's JARPNII surveys. Marine debris was observed from stomach of four animals. Three animals had a small plastic sheet and one animal had a small piece of plastic.

DISCUSSION

The second coastal survey of NEWREP-NP in the Pacific side of Japan was conducted in three research areas, Ayukawa, Hachinohe and Kushiro. While surveys have been conducted previously in Ayukawa and Kushiro, this was the second time the survey was conducted in Hachinohe in sub-area 7CS and it is the first time to conduct a survey in May. In total 80 common minke whales were successfully collected attaining the planned annual target sample size in the Pacific. All data and samples identified in the NEWREP-NP research plan as required for Primary Objective I and Ancillary Objectives I and II were obtained from the common minke whales sampled.

In each survey area, the characteristics of composition in common minke whale were confirmed (Table 4, Figures 4a-c). In Ayukawa, it was composed mainly of small individuals (immature), and sex ratio was more than 40 % in males. In Kushiro, it has a wide composition from small to large individuals (immature to mature) and sex ratio exceeds 70 % for males. In Hachinohe, composition was shown like the middle between Ayukawa and the Kushiro in the body length and sex ratio (males are less than 60 %). By conducting the survey at three locations on the Pacific side coastal area, it was confirmed that there is a difference in the distribution / migration composition in such sea areas and seasons.

Sighting number of humpback whales gradually increased in Ayukawa and Kushiro after the middle of the period of JARPNII (Yoshida *et al*., 2015; Kishiro *et al*., 2016; Yoshida *et al*., 2017; Yasunaga *et al*., 2017; Isoda *et al*., 2018). Also in this season of Ayukawa and Hachinohe, sighting number of humpback whales was almost the same or to exceed sighting number of common minke whale. In this season of Kushiro, it was characteristic that sighting number of humpback and sei whales were decreased and increased, respectively. In the sighting survey of JARPNII from 2002 to 2013, sei whale was no sighted in 7 CN from May to August and sighted a few on east side of 7 CN in September (Murase *et al*. 2016). It seems that the distribution of sei whales in Kushiro has seasonality and

frequently migrated in autumn.

The proportion of Japanese sardine has increased in the stomach contents in Ayukawa since 2012 and Kushiro since 2014 (Figures 5a and c), which coincided with increased catches of this species in commercial fisheries in the same area (Yukami *et al.*, 2017). These observations suggest replacement of fish species in the research area, because the dominant prey species of common minke whales had been alternately replaced among Japanese anchovy, Japanese sardine and sand lance (*Ammodytes personatus*) in waters off Sanriku from every five to ten years for 1960's -1980's (Kasamatsu and Tanaka, 1992). Differences in feeding habits of common minke whale in Kushiro might be explained by the trade-offs of cost of foraging activity for prey and/or energy demands between immature and mature whales (Kishiro *et al.*, 2009, Watanabe *et al.* 2009). However, these differences were not observed in 2017 and this year. Therefore, at this time, Japanese sardine was probably the most available and prey adapted to energy demand for either mature stage.

Data and samples obtained from this survey will be validated and stored at the Institute of Cetacean Research (ICR), Japan, and are available to national (Japan) and international scientists under established guidelines (see http://www.icrwhale.org/pdf/NEWREP-NP and A Protocol.pdf). Catch data record will be submitted to the IWC secretary, as in the previous surveys.

ACKNOWLEDGMENTS

We thank the following persons and organizations: the Fisheries Agency of Japan, the Institute of Cetacean Research and National Research Institute of Far Seas Fisheries and Tokyo University of Marine Science and Technology, for their support and guidance in the survey design; crew of research vessels, staff of the research stations in Ayukawa, Hachinohe and Kushiro, and the Association for Community-Based Whaling for logistical assistance.

REFERENCES

Government of Japan. 2017. Research Plan for New Scientific Whale Research Program in the western North Pacific (NEWREP-NP). http://www.jfa.maff.go.jp/j/whale/attach/pdf/index-6.pdf.

International Whaling Commission. 2017. Report of the Scientific Committee. Report of the Expert Panel Workshop on the Proposed Research Plan for New Scientific Whale Research Programme in the western North Pacific (NEWREP-NP). *J. Cetacean Res. Manage*. (*Suppl*.) 19.

International Whaling Commission. 2018. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 19: *in press*.

Isoda, T., Yasunaga, G., Yoshida H., Mogoe, T., Ito, N., Shimetani, K., Nakamura, G., Maeda, H., Inoue, S., Kumagai, S., Goto, M., Nishimura, F., Kim, Y., Asano, Y., Akagi, M., Nakajo, K., Yamamoto, R., Watanabe, H., Sonobe, N., Shibata, C., Agari, T., Katsumata, T., Sazawa, R., Hatanaka, T., Takahasi, T., Hatsuse, A., Inoue, T., Kobata, M., Takeuchi, A., Matsumoto, S., Miyoshi. M., Seko. H., Monguchi., Y., and Kato., H. 2018. Cruise Report of the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) in 2017- Pacific coastal component off Hachinohe and Kushiro. Paper SC/67b/SCSP/02 presented to the 67bth IWC Scientific Committee, (unpublished). 14pp.

Kasamatsu, F. and Tanaka, S. 1992. Annual changes in prey species of minke whales taken off Japan 1948-87. *Nippon Suisan Gakkaishi*. 58: 637-51.

Kishiro, T., Yoshida, H., Tamura, T., Konishi, K., Kanda, N., Okamoto, R. and Kato, H. 2009. Relationship between body size, maturity, and feeding habit of common minke whales off Kushiro in autumn season, from 2002-2007 whale sampling surveys under the JARPNII coastal components off Kushiro. Paper SC/J09/JR13 presented to the JARPNII Review Workshop, Tokyo, January 2009 (unpublished). 25pp.

Kishiro, T., Yoshida, H., Ito, N., Mogoe, T., Nakamura, G., Maeda, H., Miyakawa, N., Hirose, A., Ota, M., Kato, K., Hayashi, R., Yoshii, K., Kim, Y., Miyashita, T., Kumagai, S., Hitomi, S., Kimura, Y., Hiruda, H., Katsumata, T., Nakai, K., and Kato, H. 2016. Cruise report of the Second phase of the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN II) in 2015 (Part III) - Coastal component off Kushiro. Paper SC/66b/SP03 presented to the 66bth IWC Scientific Committee, (unpublished). 13pp.

Maeda H., Kawamoto T. and Kato H. 2013. A study on the improvement of age estimation in common minke whales using the method of gelatinized extraction of earplug. *NAMMCO Sci Publ* 10. 17pp.

Murase, H., Hakamada, T., Sasaki, H., Matsuoka, K. and Kitakado, T. Seasonal spatial distributions of common minke, sei and Bryde's whales in the JARPNII survey area from 2002 to 2013. 2016. Paper SC/F16/JR/7 presented to the Expert Panel Workshop of the final review on the western North Pacific Japanese Special Permit Programme (JARPNII). 17pp.

Omura, H. 1963. An improved method for collection of ear plugs from baleen whales. *Norsk Hvalfangst-Tidende*. 10: 279–83.

Yasunaga, G., Ito, N., Isoda, T., Nakamura, G., Hirose, A., Hayashi, R., Yoshii, K., Kim, Y., Akagi, M., Nakajo, K., Nishimura, F., Asano, Y., Ozaki, R., Katsumata, T., Yamada, R., Koizumi, C., Kumagai, S., Sato, H., Sakaguchi, M., Kanbayashi, J. and Kato, H. 2017. Cruise Report

of the Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPNII) in 2016 - (Part II) - Coastal component off Sanriku. 2017. Paper SC/67a/SCSP/03 presented to the 67ath IWC Scientific Committee, (unpublished). 23pp.

Yoshida, H., Ito, N., Kishiro, T., Miyashita, T., Nakai, K., Nakamura, G., Maeda, H., Ishida, K., Takahasi, M., Ota, M., Furuyama, Y., Kato, K., Hayashi, R., Hiruda, H., Kumagai, S., Kasamoto, N., Kimura, Y., Teshima, I. and Kato, H. 2015. Cruise report of the Second phase of the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN II) in 2014 (Part III) - Coastal component off Kushiro. Paper SC/66a/SP7 presented to the 66ath IWC Scientific Committee, (unpublished). 13pp.

Yoshida, H., Shimetani, K., Maeda, H., Nakamura, G., Nakai, K., Inoue, S., Hriose, A., Hayashi, R., Akagi, M., Nakajyo, K., Nishimura, F., Asano, Y., Fukami, A., Kumagai, S., Kanbayashi, J., Kuwagaki. A., Miyashita, T., Minamikawa, S., Kanaji, Y., Sasaki, H., Yamada, R., Kakinuma, A. and Kato, H. 2017. Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific (JARPN II) in 2016 (Part III) - Coastal component off Kushiro -. 2017. Paper SC/67a/SCSP/07 presented to the 67ath IWC Scientific Committee, (unpublished). 14pp.

Yukami, R., Watanabe, C., Kamimura, Y., Furuichi, S. Akamine, T. and Kishida, T. 2017. Stock assessment and evaluation for Pacific stock of Japanese sardine, *Sardinops melanostictus*, (fiscal year 2016), pp 15-52. In: *Marine fisheries stock assessment and evaluation for Japanese waters (fiscal year 2016/2017)*. Fisheres Agency and Fisheries Research and Education Agency of Japan.

Watanabe, H., Yonezaki, S., Kiwada, H., Kumagai, S., Kishiro, T., Yoshida, H. and Kawahara, S. 2009. Distribution and abundance of prey species and prey preference of common minke whale Balaenoptera acutorostrata in the coastal component of JARPNII off Kushiro from 2002 to 2007. Paper SC/J09/JR11 presented to the JARPNII Review Workshop, Tokyo, January 2009 (unpublished) 37pp.

Table 1.
Summary of biological data and samples collected during the 2018 NEWREP-NP Pacific coastal component off Ayukawa, off Hachinohe and off Kushiro.

Data or samples	Number of animals						
	Off Ayukawa		Off Hachinohe		Off Kushiro		Total
	Male	Female	Male	Female	Male	Female	
Catching date and location[1,2,3]	8	10	19	14	22	7	80
Photographic record and external body character[1]	8	10	19	14	22	7	80
Sex and body length[1,2,3]	8	10	19	14	22	7	80
External body proportion[1,2,3]	8	10	19	14	22	7	80
Diatom film record[1]	8	10	19	14	22	7	80
Body scar record[1]	8	10	19	14	22	7	80
Record of external parasites[1]	8	10	19	14	22	7	80
Measurements of blubber thickness (five points)[2,3]	8	10	19	14	22	7	80
Body weight[2,3]	8	10	19	14	22	7	80
Skin tissues for DNA analysis[1,3]	8	10	19	14	22	7	80
Muscle, liver, kidney and blubber for chemical study[1,2,3]	8	10	19	14	22	7	80
Muscle, liver, kidney, spleen, blubber and heart for various analysis[1,2,3]	8	10	19	14	22	7	80
Urine for various analysis	0	0	5	0	5	0	10
Collection of blood plasma[3]	7	6	13	9	19	5	59
Mammary grand; lactation status, measurement and histological sample[1,2,3]	-	10	-	14	-	7	31
Uterine horn; measurements and endometrium sample[1,2,3]	-	10	-	14	-	7	31
Collection of ovary[1,2,3]	-	10	-	14	-	7	31
Photographic record of foetus[1]	0	0	0	2	1	0	3
Foetal length and weight[1]	0	0	0	2	1	0	3
External body measurements of foetus[1]	0	0	0	2	1	0	3
Skin tissues for DNA study of foetus[1,3]	0	0	0	2	1	0	3
Muscle, liver, kidney, heart, blubber and skin tissues of foetus[1,2,3]	0	0	0	2	1	0	3
Ocular lens of foetus for age determination[1,3]	0	0	0	1	1	0	2
Collection of whole body of foetus[1]	0	0	0	0	0	0	0
Testis and epididymis; weight and histological sample[1,2,3]	8	-	19	-	22	-	49
Stomach contents, convenient record[2,3]	8	10	19	14	22	7	80
Volume and weight of stomach content in each compartment[2,3]	8	10	19	14	22	7	80
Observation of marine debris in stomach[3]	8	10	19	14	22	7	80
Collection of stomach contents for feeding study[2,3]	7	10	18	12	21	6	74
Earplug for age determination[1,3]	8	9*	19	14	22	7	79
Ocular lens for age determination[1,3]	8	10	19	14	22	7	80
Collection of Baleen plate[1,2,3]	8	10	19	14	22	7	80
Baleen plate measurements (length and breadth)[1,2]	8	10	19	14	22	7	80
Photographic record of baleen plate series	8	10	19	14	22	7	80
Length of baleen series	8	10	19	14	22	7	80
Vertebral epiphyses sample	2	3	13	4	14	2	38
Number of ribs	8	10	19	14	22	7	80
Skull measurement (length and breadth)[1]	8	10	19	14	22	7	80
Measurement of flipper white patch [1]	8	10	14	12	4	2	50

*Earplug of one animal could not collected for harpoon damege.
[1]: Data or samples to be used for Primary Objective I
[2]: Data or samples to be used for Ancillary Objective I
[3]: Data or samples to be used for Ancillary Objective II

Table 2.
Searching days, distances, hours and number of cetacean sightings made during the 2018 NEWREP-NP Pacific coastal component off Ayukawa, off Hachinohe and off Kushiro. The numbers probably includes some duplicated sightings.

Off Ayukawa

Period	Days	Distance (n.miles)	Hours	Number of sightings			
				Species	Primary (Sch/Ind)	Secondary (Sch/Ind)	Total (Sch/Ind)
5 Apr. - 30 Apr.	26	3,366.3	337.2	Common minke whale	26/26	1/1	27/27
				Like minke	5/5	0/0	5/5
				Humpback whale	22/22	1/1	23/23

Density Index (DI: the number of primary sightings of common minke whale schools per 100 n. miles searching): 0.77

Off Hachinohe

Period	Days	Distance (n.miles)	Hours	Number of sightings			
				Species	Primary (Sch/Ind)	Secondary (Sch/Ind)	Total (Sch/Ind)
4 May - 31 May	28	3,875.0	439.9	Common minke whale	33/33	12/12	45/45
				Like minke	6/6	3/3	9/9
				Fin whale	2/4	1/1	3/5
				Humpback whale	52/59	22/24	74/83
				Sperm whale	2/7	0/0	2/7

Density Index (DI: the number of primary sightings of common minke whale schools per 100 n. miles searching): 1.16

Off Kushiro

Period	Days	Distance (n.miles)	Hours	Number of sightings			
				Species	Primary (Sch/Ind)	Secondary (Sch/Ind)	Total (Sch/Ind)
5 Sept. - 4 Oct.	30	3,524.1	355.9	Common minke whale	33/38	6/7	39/45
				Like minke	19/19	1/1	20/20
				Sei whale	9/19	3/7	12/26
				Fin whale	9/14	1/2	10/16
				Humpback whale	5/7	0/0	5/7
				Sperm whale	6/8	0/0	6/8

Density Index (DI: the number of primary sightings of common minke whale schools per 100 n. miles searching): 0.94

Table 3.
Body length (m) of common minke whales collected in the 2018 NEWREP-NP Pacific coastal component off Ayukawa, off Hachinohe and off Kushiro.

Off Ayukawa

Period	Male					Female				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
5 Apr. - 10 Apr.	5.99	-	-	-	1	4.80	-	-	-	1
11 Apr. - 20 Apr.	5.43	0.75	4.52	6.75	6	5.65	0.61	4.46	6.12	5
21 Apr. - 30 Apr.	6.70	-	-	-	1	5.38	0.43	4.98	6.10	4
Total	5.66	0.78	4.52	6.75	8	5.46	0.57	4.46	6.12	10

Off Hachinohe

Period	Male					Female				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
4 May. - 10 May.	6.73	1.00	4.60	7.52	6	5.45	0.48	4.90	6.50	9
11 May. - 20 May.	6.07	1.24	4.42	7.81	8	5.15	0.36	4.84	5.66	3
21 May. - 31 May.	6.65	1.19	4.33	7.55	5	7.76	0.10	7.66	7.85	2
Total	6.43	1.20	4.33	7.81	19	5.72	0.94	4.84	7.85	14

Table 3. (continued)

Off Kushiro

Period	Male					Female				
	Mean	S.D.	Min.	Max.	n	Mean	S.D.	Min.	Max.	n
5 Sept. - 14 Sept.	7.14	0.76	5.50	7.75	6	5.75	1.13	4.62	6.88	2
15 Sept. - 24 Sept.	6.23	0.95	4.84	7.63	8	6.06	1.45	4.99	8.10	3
25 Sept. - 4 Oct.	6.31	0.69	5.32	7.22	8	5.22	0.46	4.76	5.67	2
Total	6.51	0.90	4.84	7.75	22	5.73	1.20	4.62	8.10	7

Table 4.
Sexual maturity composition of common minke whales collected in the 2018 NEWREP-NP Pacific coastal component off Ayukawa, off Hachinohe and off Kushiro. Im: Immature; M: Mature; R: Resting; P: Pregnant; *: %.

Off Ayukawa

Period	Male				Female						Sex ratio
	Im	M	Total	Maturity*	Im	R	P	Total	Pregnancy*	Maturity*	(%males)
5 Apr. - 10 Apr.	1	0	1	0.0	1	0	0	1	0.0	0.0	50.0
11 Apr. - 20 Apr.	5	1	6	16.7	5	0	0	5	0.0	0.0	54.5
21 Apr. - 30 Apr.	0	1	1	100.0	4	0	0	4	0.0	0.0	20.0
Total	6	2	8	25.0	10	0	0	10	0.0	0.0	44.4

Off Hachinohe

Period	Male				Female						Sex ratio
	Im	M	Total	Maturity*	Im	R	P	Total	Pregnancy*	Maturity*	(%males)
4 May. - 10 May.	1	5	6	83.3	9	0	0	9	0.0	0.0	40.0
11 May. - 20 May.	5	3	8	37.5	3	0	0	3	0.0	0.0	72.7
21 May. - 31 May.	1	4	5	80.0	0	0	2	2	100.0	100.0	71.4
Total	7	12	19	63.2	12	0	2	14	14.3	14.3	57.6

Off Kushiro

Period	Male				Female						Sex ratio
	Im	M	Total	Maturity*	Im	R	P	Total	Pregnancy*	Maturity*	(%males)
5 Sept. - 14 Sept.	1	5	6	83.3	2	0	0	2	0.0	0.0	75.0
15 Sept. - 24 Sept.	5	3	8	37.5	2	0	1	3	33.3	33.3	72.7
25 Sept. - 4 Oct.	5	3	8	37.5	2	0	0	2	0.0	0.0	80.0
Total	11	11	22	50.0	6	0	1	7	14.3	14.3	75.9

Table 5.
Number of common minke whales with major prey species found in forestomach, collected in the 2018 NEWREP-NP Pacific coastal component off Ayukawa, off Hachinohe and off Kushiro.

Off Ayukawa

Period	Number of whales (%)		All
	Sand lance (adult)	Japanese sardine	
5 Apr. - 10 Apr.	2 (100.0)	0 (0.0)	2
11 Apr. - 20 Apr.	7 (63.6)	4 (36.4)	11
21 Apr. - 30 Apr.	3 (60.0)	2 (40.0)	5
Total	12 (66.7)	6 (33.3)	18

Table 5. (continued)

Off Hachinohe

Period	Number of whales (%)			All
	Japanese sardine	Krill	Unknown*	
4 May - 10 May	3 (20.0)	11 (73.3)	1 (6.7)	15
11 May - 20 May	11 (100.0)	0 (0.0)	0 (0.0)	11
21 May - 31 May	6 (85.7)	1 (14.3)	0 (0.0)	7
Total	20 (60.6)	12 (36.4)	1 (3.0)	33

*Stomach was broken by harpoon.

Off Kushiro

Period	Number of whales (%)			All
	Japanese sardine	Mackerels	Common squid	
5 Sept. - 14 Sept.	7 (87.5)	0 (0.0)	1 (12.5)	8
15 Sept. - 24 Sept.	10 (90.9)	1 (9.1)	0 (0.0)	11
25 Sept. - 4 Oct.	10 (100.0)	0 (0.0)	0 (0.0)	10
Total	27 (93.1)	1 (3.4)	1 (3.4)	29

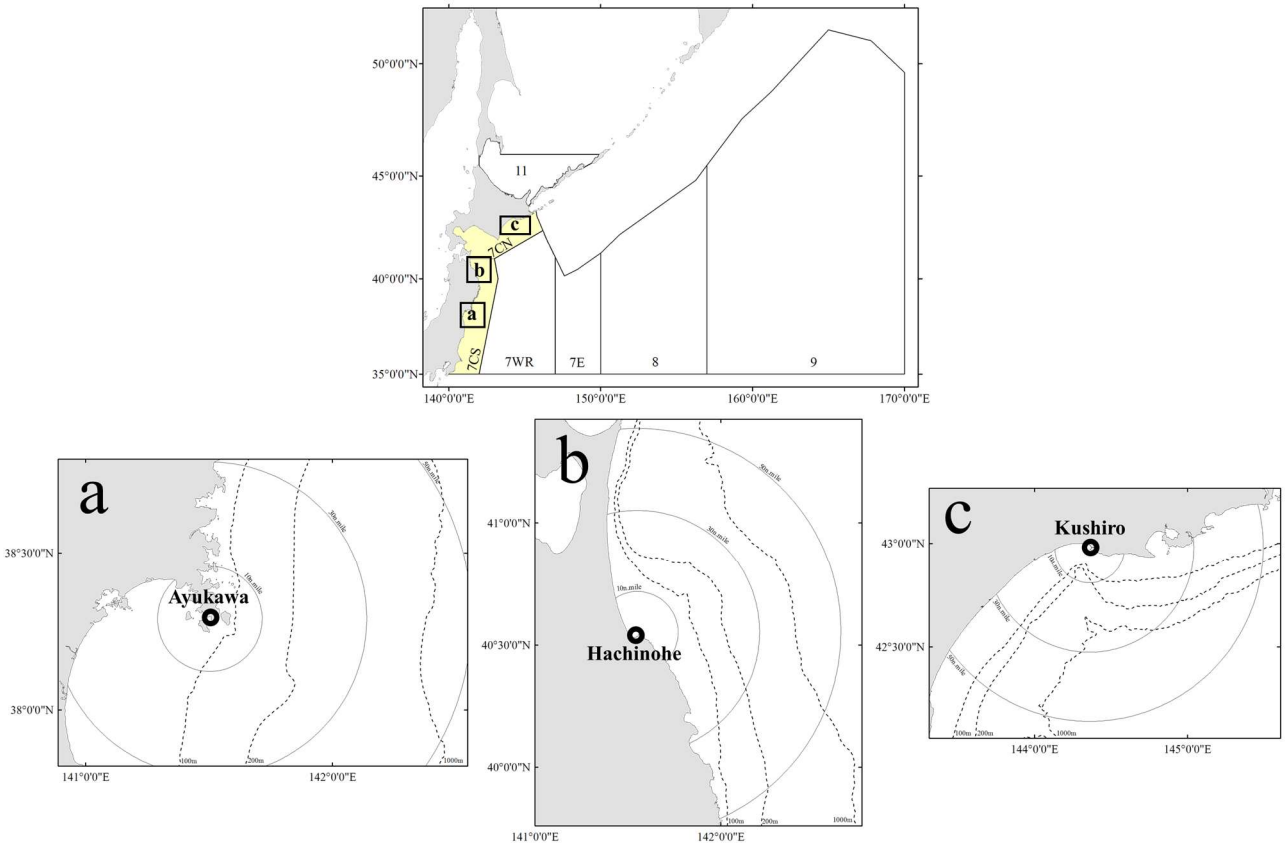


Figure 1. Research area set for the 2018 NEWREP-NP Pacific coastal component (a) off Ayukawa, (b) off Hachinohe and (c) off Kushiro.

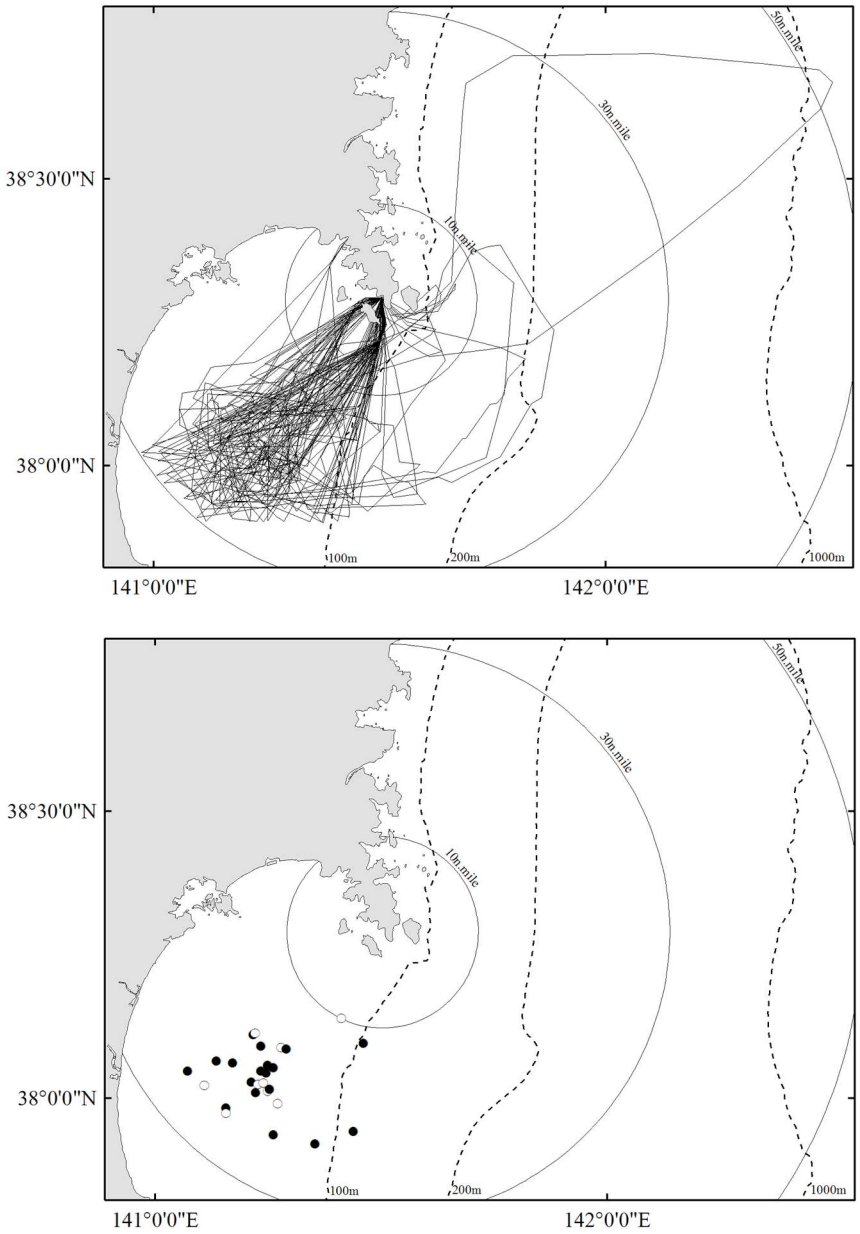


Figure 2. Cruise tracks (upper) and sighting position (lower) of common minke whales made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Ayukawa. Black circles are sighting position of common minke whales sampled.

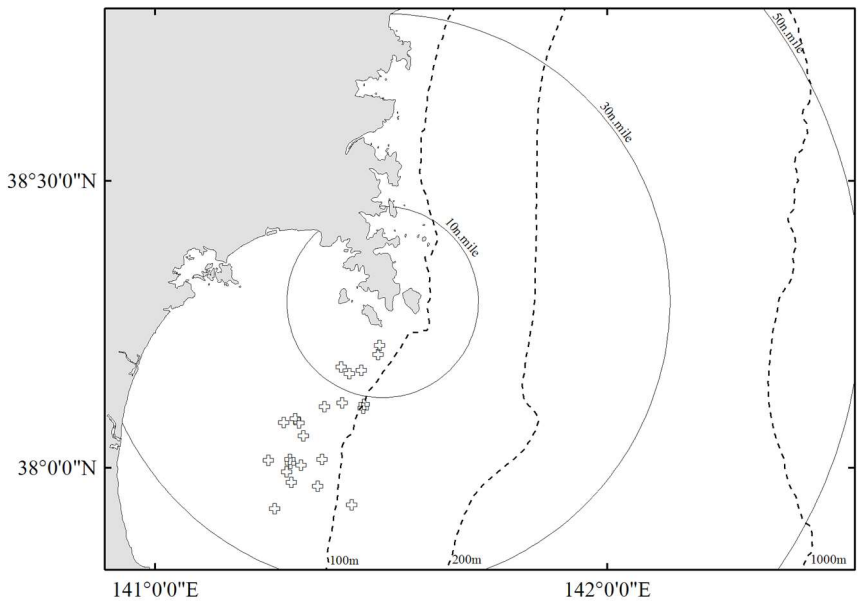


Figure 3. Sighting positions of humpback (cross) whale made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Ayukawa.

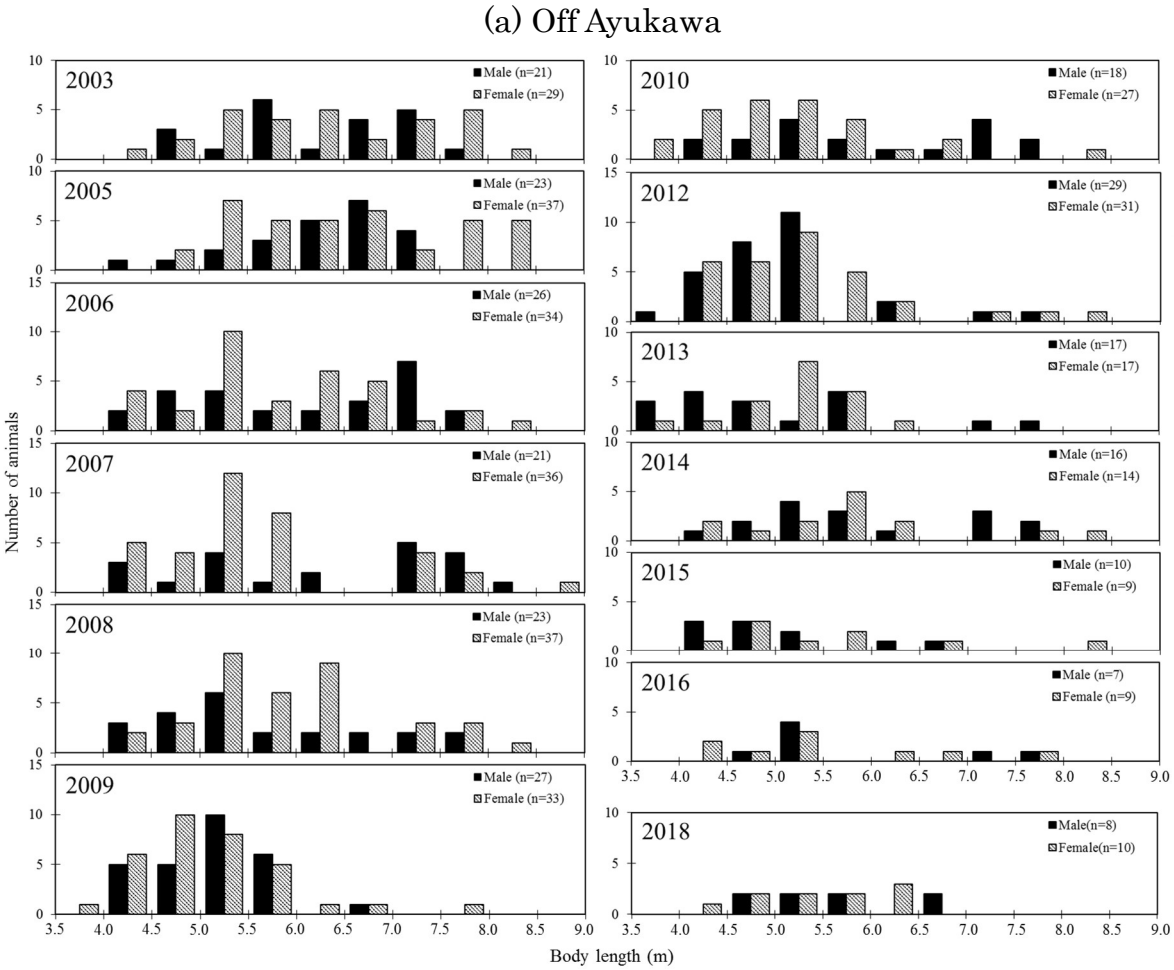
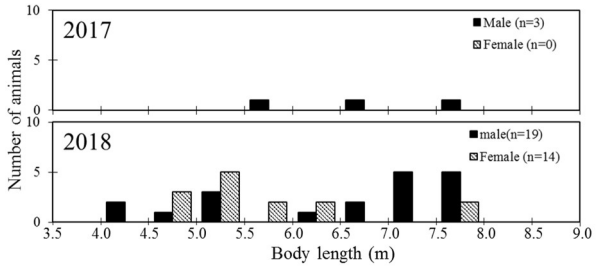


Figure 4. Body length frequency of common minke whales sampled during the 2018 NEWREP-NP Pacific coastal component (a) off Ayukawa, (b) off Hachinohe and (c) off Kushiro compared with results of the previous surveys in Ayukawa , Hachinohe and Kushiro, respectively.

(b) Off Hachinohe



(c) Off Kushiro

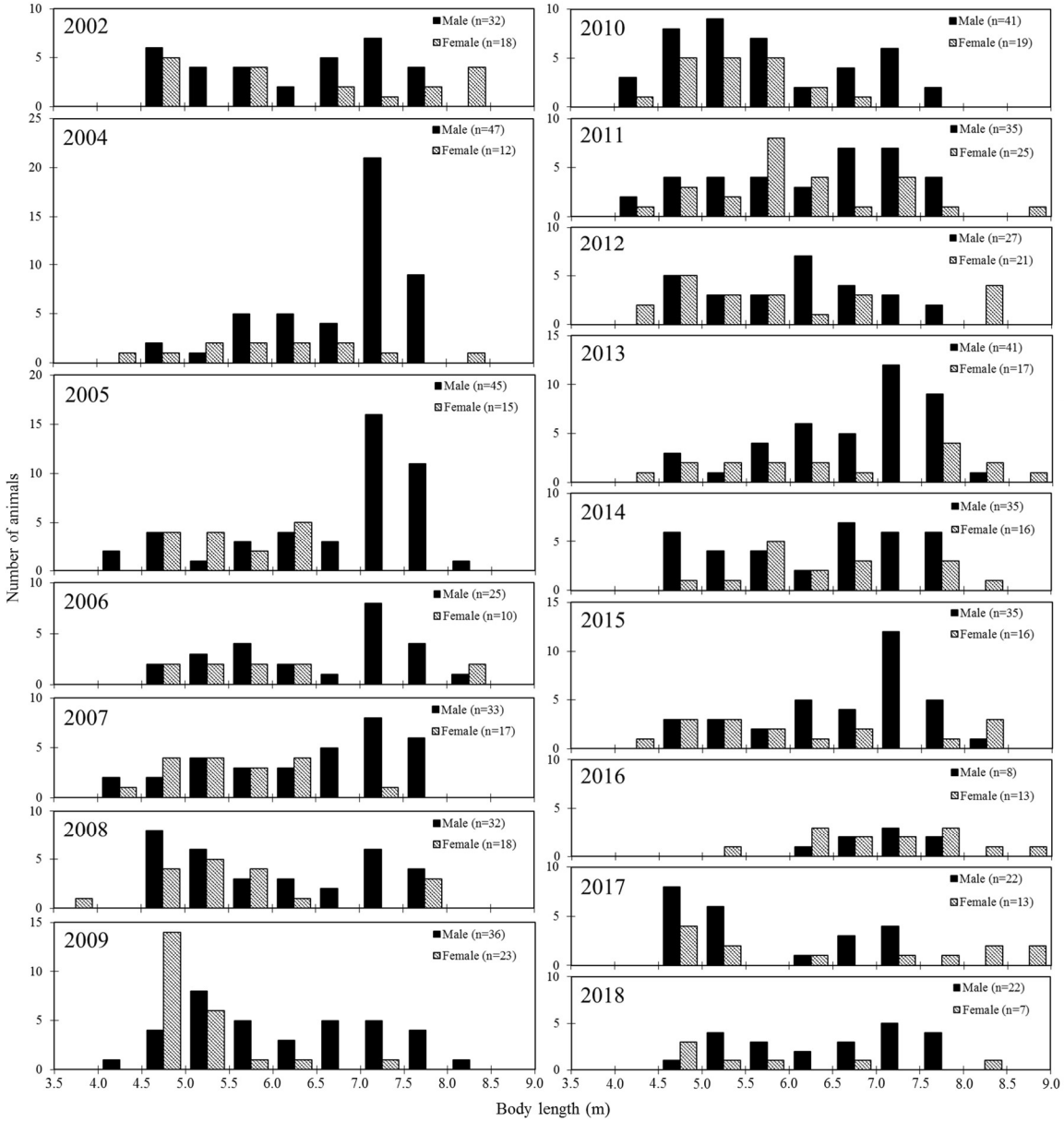


Figure 4 (continued)

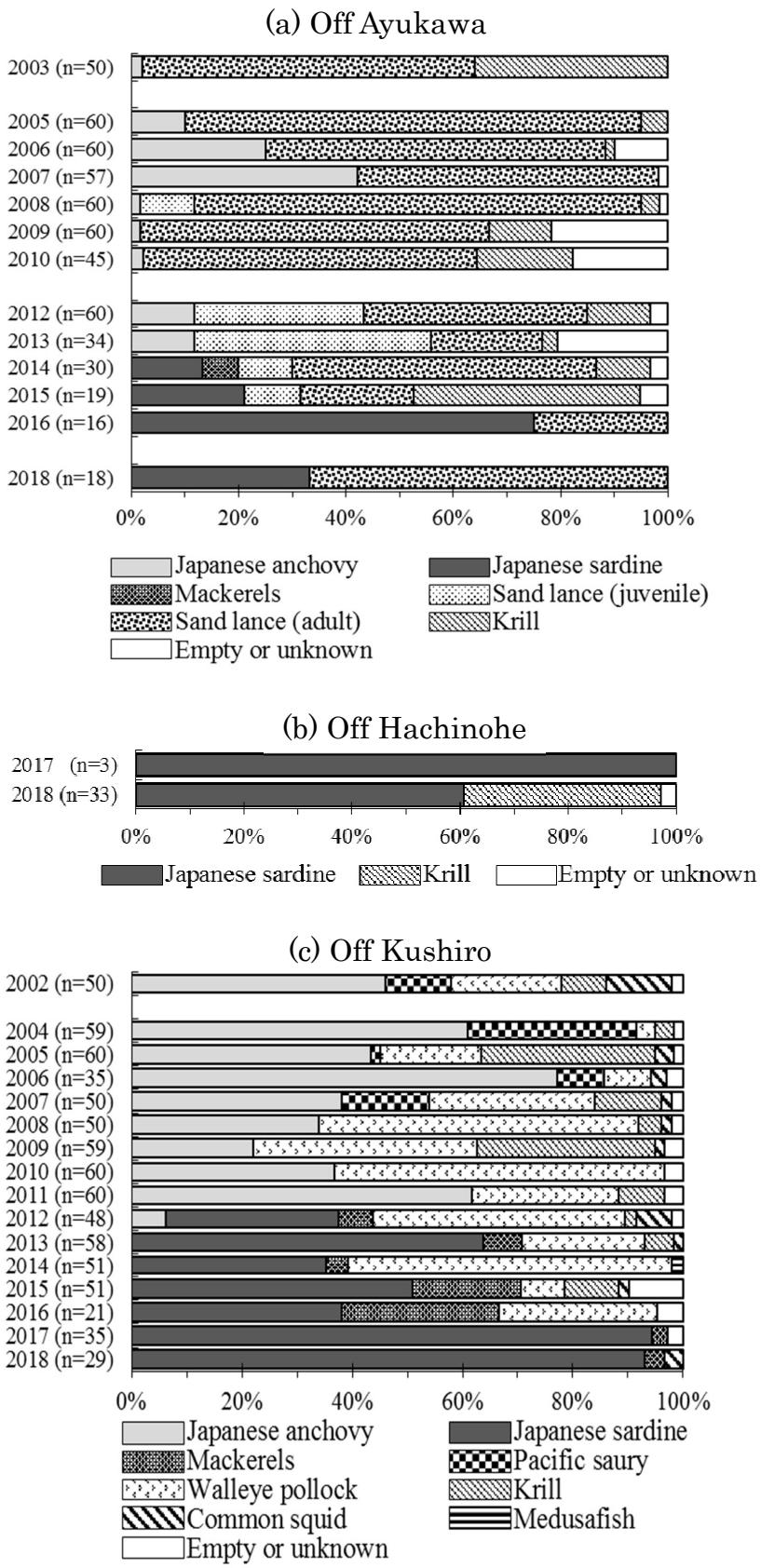


Figure 5. Composition of prey species of common minke whales sampled during the 2018 NEWREP-NP Pacific coastal component (a) off Ayukawa, (b) off Hachinohe and (c) off Kushiro, compared with results of the previous surveys in Ayukawa, Hachinohe and Kushiro, respectively.

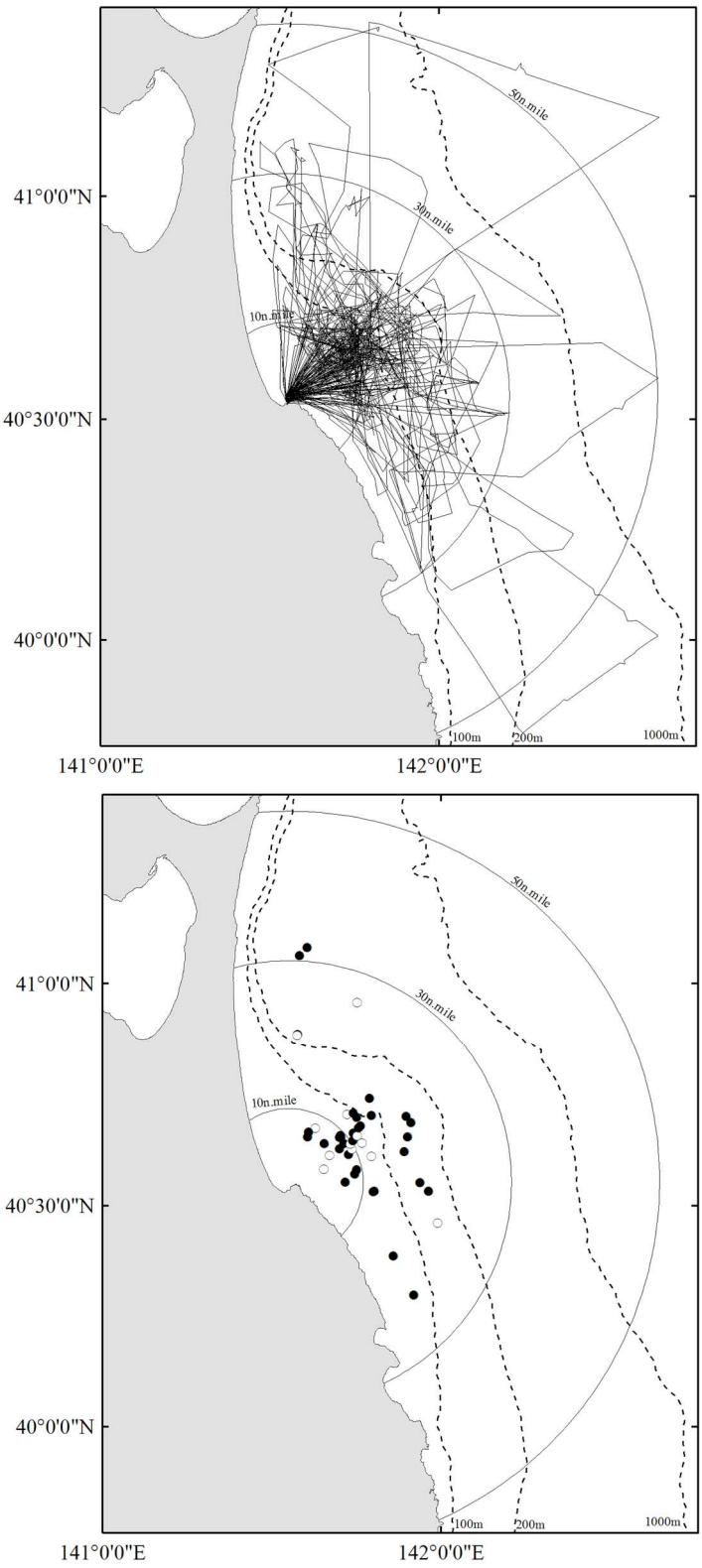


Figure 6. Cruise tracks (upper) and sighting position (lower) of common minke whales made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Hachinohe. Black circles are sighting position of common minke whales sampled.

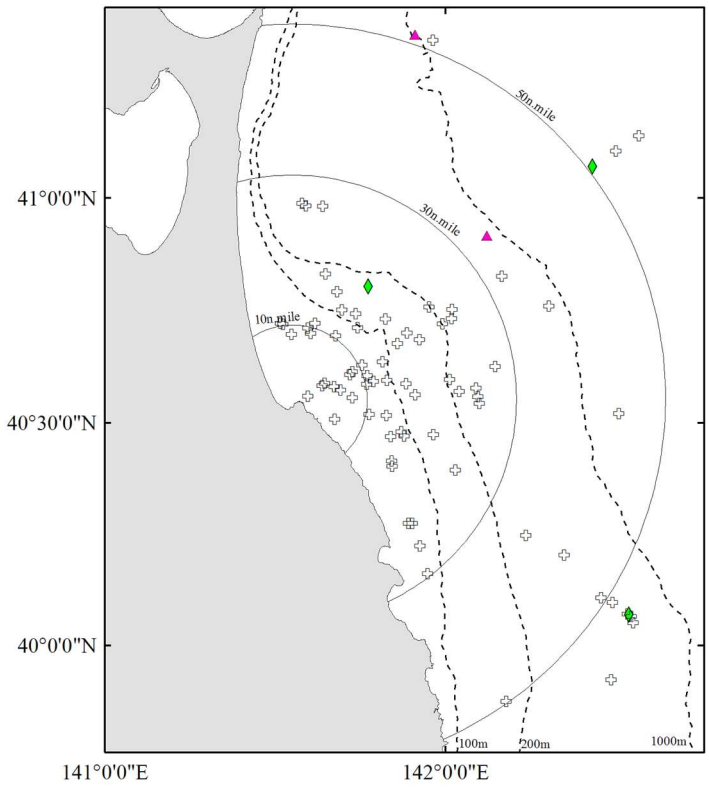


Figure 7. Sighting positions of fin (rhombus), humpback (cross) and sperm whales (triangle) made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Hachinohe.

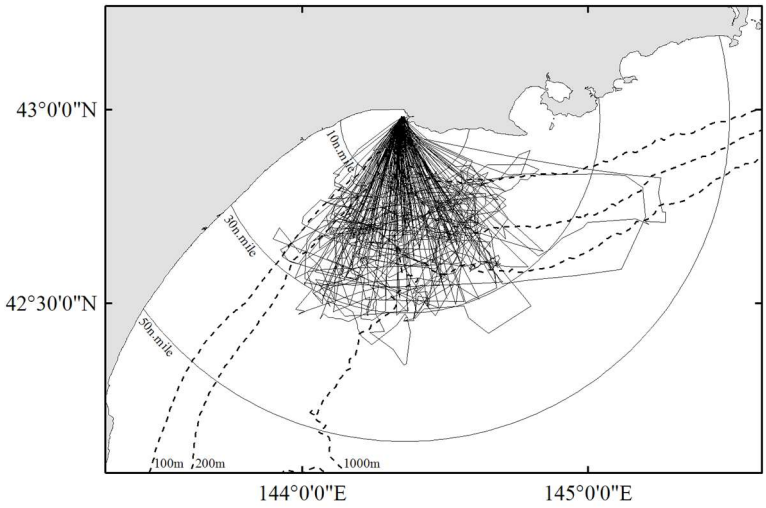


Figure 8. Cruise tracks (upper) and sighting position (lower) of common minke whales made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Kushiro. Black circles are sighting position of common minke whales sampled.

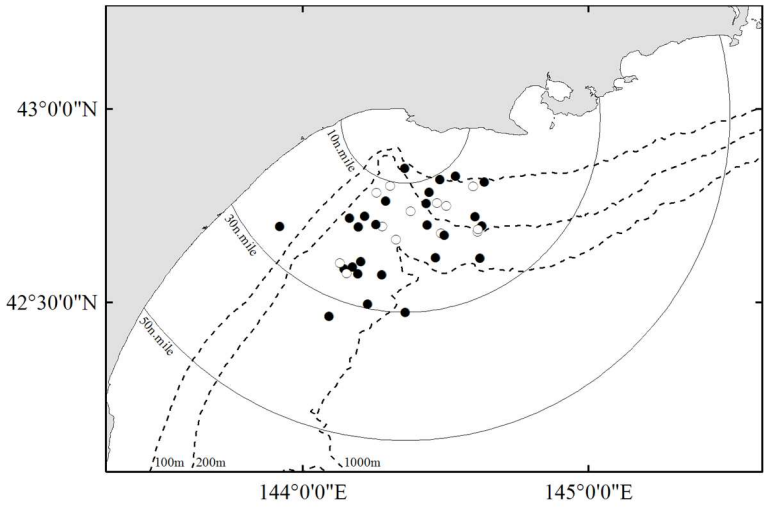


Figure 8. (continued)

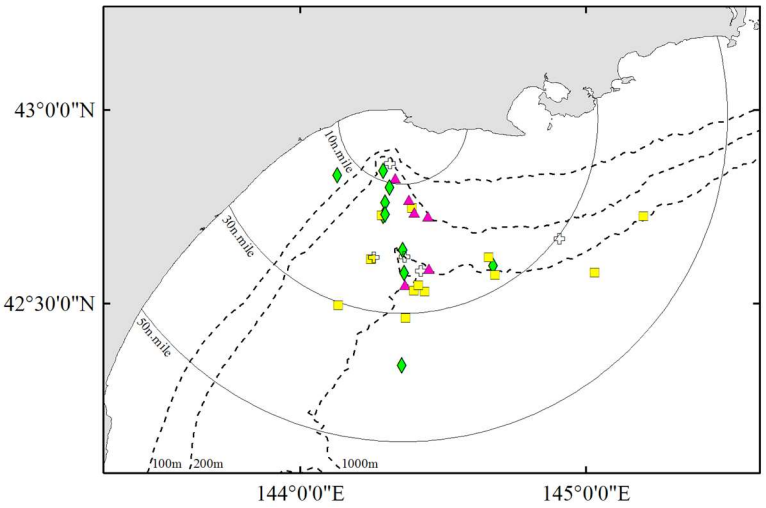


Figure 9. Sighting positions of sei (square), fin (rhombus), humpback (cross) and sperm whales (triangle) made by sighting/sampling vessels during the 2018 NEWREP-NP Pacific coastal component off Kushiro.