SC/67B/SCSP/07

# Cruise Report of the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) in 2017 -Coastal component off Abashiri in the southern Okhotsk Sea-

Yoshida, H., Ito, N., Maeda, H., Nakamura, G., Inoue, S., Hirose, A., Nishimura, F., Asano, Y., Yamamoto, R., Watanabe H., Agari T., Sonobe N., Kumagai S., Sazawa R., Takahashi, T., Hatsuse A., Sato, S., Higa, H., Hiruda, H., Miyashita. T., Kato, H.

INTERNATIONAL WHALING COMMISSION

# Cruise Report of the New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) in 2017 -Coastal component off Abashiri in the southern Okhotsk Sea-

HIDEYOSHI YOSHIDA[1], NOBUYUKI ITO[2], HIKARI MAEDA[1], GEN NAKAMURA[3], SATOKO INOUE[4], AYUMI HIROSE[3], FUTABA NISHIMURA[3], YUKO ASANO[3], RYUJI YAMAMOTO[3], HIKARU WATANABE[3], TOMOKO AGARI[3], NOZOMI SONOBE[3], SAEKO KUMAGAI[2], RIKIO SAZAWA[2], TOSHIMASA TAKAHASHI[2], AKIHIDE HATSUSE[2], SHUICHI SATO[2], HIROMI HIGA[2], HISOKA HIRUDA[2], TOMIO MIYASHITA[1], HIROKO SASAKI[1], KEN NAKAJYO[3], AND HIDEHIRO KATO[4].

[1] *National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, Kanagawa 236-8648, 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*
[4] *The Institute of Cetacean Research, 4-5, Toyomi-cho, Chuo-ku, Tokyo, 104-0055, Japan.*

*Contact e-mail:hideka@fra.affrc.go.jp*

ABSTRACT
The NEWREP-NP coastal component off Abashiri, northern Japan (southwestern part of the sub-area 11), was conducted in the southern Okhotsk Sea, from 11 June to 6 July 2017. The survey was carried out using five small-type whaling catcher boats as sampling vessels, in coastal waters mainly within about 40 nautical miles from Abashiri port. Common minke whales collected were landed at the NEWREP-NP research station for biological examination. During the survey, a total of 2,449.9 nautical miles (243.4 hours) was searched and the 128 schools (132 individuals) of common minke whales were encountered. Sightings of 39 schools (55 animals) of fin whales, of 4 schools (10 individuals) of humpback whales, of two blue whales, and of a sperm whale were also made. Of 132 common minke whales encountered, 47 animals were collected. Ear plugs and eye lenses for age determination and gonad for reproductive study were collected from all the whales. Sex of animals caught was biased towards the female (9 males and 38 females). Average body length of males was 6.92m (SD=0.55, Range=5.62-7.55m) and 7.35m (SD=0.85, Range=4.96-8.18m) for females. Of 9 males, 8 were sexually mature (88.9%) and 30 of 38 females attained to sexual maturity (78.9%). The 25 mature females were pregnant. Stock assignment was conducted from nuclear microsatellite data. Of 47 animals collected, 28 were assigned to J stock and 17 were identified as O stock. The remaining two animals could not be assigned. Proportion of J stock animals increased from June (53.6%) to July (76.5%). Sex ratio of males was higher in J stock animals (28.6%) than in O stock animals (5.9%). In females, proportion of mature animals was higher in O stock (93.8%) than in J stock (65.0%). From foetus body length, conception date was estimated using the growth formula. Results indicate that animals migrating to the Okhotsk Sea possess separate two breeding seasons, i.e., autumn breeding season and winter breeding season prolonged to spring. Females pregnant with foetus estimated to be conception in autumn were assigned to J stock. All females assigned to O stock conceived in a period from winter to spring. Dominant prey species detected from whale forestomach was Krill (89.4%), followed by Copepoda (4.3%) and only one animal feed on walleye pollock (2.1%). Animals feeding on copepods were assigned to O stock. An individual taking walleye pollock was identified as J stock.

KEYWORDS: COMMON MINKE WHALE; OKHOTSK SEA; COASTAL WATERS OF JAPAN; STOCK ASSIGNMENT; REPRODUCTIVE STATUS, SCIENTIFIC PERMITS.

## INTRODUCTION

The New Scientific Whale Research Program in the western North Pacific (NEWREP-NP) was started in 2017. The Primary Objective I of the program is 'Contribution to optimizing the establishment of a sustainable catch limit for common minke whales in the coastal waters of Japan', with four Secondary Objectives i) investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status, ii) estimate the abundance of the J and O stocks in coastal waters of Japan, iii) verify that there is no structure in the O stock in the Pacific side of Japan, and iv) improve RMP trials by incorporating age data in their conditioning (Government of Japan, 2017).

The common minke whale is widely distributed in the North Pacific, from the equator to the Chukchi Sea (Perrin and Brownell, 2002). Two stocks of the common minke whales have been reported for the western North Pacific, i.e., the Sea of Japan - Yellow Sea - East China Sea stock (J stock) and the Okhotsk Sea – West Pacific stock (O stock) (Hatanaka, 1997). Morphological (external body proportions and colouration of flippers and baleens; Kato *et al*., 1992; Nakamura *et al*., 2016), genetic (mtDNA haplotype frequencies; Goto

and Pastene, 1997; 1998 and microsatellites allele frequencies; Pastene *et al*., 2016), and biological (conception dates; Kato, 1992) differences have been reported between the two stocks. In feeding season from spring to autumn, they migrate to the northern productive waters from their winter southern breeding/calving ground. It is known that common minke whales of both stocks migrate to the Okhotsk Sea and mix there (Hatanaka and Miyashita, 1997; Pastene *et al*., 1998).

Unlike the case of sub-areas 7CS and 7CN, there are only limited and dated data on mixing proportion between the J and O stocks in northern Hokkaido (Abashiri, sub-area 11). Therefore, under NEWREP-NP, the priority sub-area for addressing Objective I (i) (investigate the spatial and temporal occurrence of J stock common minke whales around Japan, by sex, age and reproductive status) is sub-area 11 (GOJ, 2017). Segregation by sex, age and reproductive status occurs during migration of common minke whales along the Japanese coast (Hatanaka and Miyashita, 1997). Therefore, information on genetics alone is not sufficient and simultaneous collection of both genetics and biological information including age and sexual maturity data is essential to evaluate the spatial and temporal migration pattern of this species, and to estimate patterns of stock mixing by age and sexual maturity stages (GOJ, 2017).

The estimate of sample size for sub-area 11 in NEWREP-NP is preliminary, and it was calculated to estimate the J stock proportion with sufficient precision. The estimated samples size was 47 animals (see details in Annex 11 of GOJ, 2017).

The NEWREP-NP's coastal component survey off Abashiri was conducted in early summer of 2017 in the southern Okhotsk Sea (part of sub-area 11). This paper outlines the results of the survey. The National Research Institute of Far Seas Fisheries (NRIFSF) of Japan Fisheries Research and Education Agency planned and conducted the survey, under cooperation with the Institute of Cetacean Research (ICR), Tokyo University of Marine Science and Technology, and the Association for Community-Based Whaling. The present survey was the first coastal survey in the Okhotsk Sea under the NEWREP-NP.

## MATERIALS AND METHODS

### Research area

Research area was set in coastal waters around Abashiri, northeastern Hokkaido (southwestern part of sub-area 11 (Figure 1).

### Target Species and sample size

The target species and sample size for lethal sampling was 47 common minke whales (GOJ, 2017).

### Research vessels, station, and period

Five small-type whaling catcher boats were used as 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). All the common minke whales collected were landed at the NEWREP-NP research station established in the Abashiri port, for biological examination. Research period was set for 30 days, from 11 June to 10 July 2017.

### Searching and sampling methods

Searching and sampling methods were almost the same as those adopted at the JARPNII coastal component (Kishiro *et al*. 2016). 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. After vessels left the port, they principally continued to cruise along the predetermined direction until arriving at around 40 n. miles from the port, then change their direction chosen by themselves and continued searching within the research area. Searching was carried out in the daytime and vessels returned to the port every night. A researcher was on board of each vessel and recorded sighting and sampling information, e.g., coordinates and time when common minke whale sighting and sampling were made, weather conditions, and vessel activity. Sighting information was also recorded for other baleen whales and sperm whales. Searching was conducted by crews and researchers from the top barrel and upper bridge of vessels running at around 11 knots. Whale sampling was not conducted in coastal zone within about 10 n. miles from the shoreline for safety, because many fishing boats and nets operated there. In the coastal zone, only observation of common minke whales encountered was made. All common minke whales sighted outside the zone were targeted for sampling, except cow-calf pair. 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 transported the whale to the research station in the Abashiri port. 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 trailer. At that time, body weight of animals was measured using the truck scale. At the survey, biopsy sampling was not conducted, because new sampling equipment was under redesign.

**Biological research on common minke whales collected**

All the whales collected were examined by biological researchers at the research station. Research items are listed in Table 2. These items were required for Objective I (i) and other Ancillary Objectives of NEWREP-NP.

Females having at least one corpus luteum or albicans in their ovaries were identified as sexually mature. In the case where no corpus luteum or corpus albicans was observed, the female was categorized as immature. Sexual maturity of males was defined preliminary from the weight of a single testis. Animals with a single testis weight of 290g or more were determined as sexually mature. Reproductive status of females was classified into four categories (ovulating, pregnant, resting, and pregnant and lactating), from observation of the ovary, uterus, and mammary gland. Pregnancy of animals was defined on conceptus with placental development in the uterus. Body length and weight of foetus was measured in the same manner as in adult animals. Sex of foetus was classified into three categories (female, male or sex unidentified).

From foetus body length, conception date was estimated using the growth formula given by Kato and Miyashita (1991). They estimated conception date of Antarctic common minke whales from the following formula, i.e.:

$L < 15$ cm $\quad t = 0.0655L2.676$
$L \geqq 15$ cm $\quad t = 1.6220L0.892 + 74$

where $L$ is the foetal body length in cm and $t$ is the number of days since conception.

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 the 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. Eye lenses of each animal and, if possible, eye balls from fetus were collected and stored in polyethylene bags at -80°C for age estimation.

Assignment of J and O stocks was conducted from sixteen nuclear microsatellite loci extracted from animal skin tissues, using the program STRUCTURE (see details in the Appendix).

## RESULTS

**Searching effort**

The survey was started on 11 June, and finished on 6 July, after the 47 common minke whales were collected. Of the 26 days, vessels conducted searching for 13 days (50.0%). The remaining days were not suitable for survey, due to bad weather conditions, e.g., low atmospheric pressure and thick fog. Survey tracklines are shown in Figure 1. Searching distance and time (distance and time recorded under searching activity conducted by crews from the top barrel of the vessels) are given in Table 1. During the survey, a total of 2449.9 nautical miles (243.4 hours) was searched.

**Sightings**

A total of 128 schools (132 individuals) of common minke whales were sighted during the searching (Table 1, Figure 2). No cow-calf pairs were encountered. Track lines were widely distributed in coastal waters within around 40 n. miles from the Abashiri port. Sightings of common minke whales were concentrated along 200m isobath north of Abashiri. Density index (DI, the number of primary sightings of schools per 100 nautical miles searching) of common minke whales was calculated as 4.00. The SPUE (the number of primary

sightings of schools per 1 hour searching) was calculated as 4.00. At the survey, 39 schools (55 animals) of fin whales, four schools (10 individuals) of humpback whales, two blue whales, and a sperm whale were also encountered (Table 1, Figure 2).

**Sampling of common minke whales**
Of the 132 common minke whales encountered, 47 animals were collected for biological examination. Sighting positions of animals collected are shown in Figure 2.

**Stock assignment of animals caught**
The program STRUCTURE assigned 28 animals to J stock and 17 individuals to O stock. Two animals could not be assigned (see details in the Appendix). Mixing proportion of J and O stock animals was calculated by sex and month. Proportion of J stock animals increased from June (53.6%) to July (76.5%)(Figure 2, Appendix).

**Body length, sex ratio, maturity of animals, and foetus conception date**
Biological items collected from the 47 animals collected are summarized in Table 2. Earplugs and eye lenses for age determination and reproductive organs for determination of sexual maturity were collected from all whales.

Individuals consisted of nine males and 38 females (Table 3). Sex ratio of males to all animals was 19.1% (Table 4). Of nine males, eight were assigned to J stock and only one male was assigned to O stock (Table 1, Appendix). Sex ratio of males was higher in J stock animals (28.6%) than in O stock animals (5.9%). Average body length of males and females were 6.92m (SD=0.55, range=5.62-7.55m) and 7.35m (SD=0.85, range=4.96-8.18m), respectively (Table 3). In males, the most dominant body length class was 6.5 m (Figure 3). The most dominant body length class of females was 7.5 m (Figure. 3). Body length of females assigned to J stock ranged from 4.96 to 8.10 m, which was broader than O stock females with range from 6.70 to 8.18 m (see, Appendix). Eight of nine males (88.9%) and 30 of 38 females (78.9%) were sexually mature (Table 4). The 25 mature females were pregnant. Three females were resting and two were ovulating. Pregnant and lactating females were not observed. Proportion of mature females was higher in O stock (93.8%) than in J stock (65.0%)(Figure 4, Appendix). For each of J and O stocks, 12 females were pregnant. The remaining one pregnant female could not be assigned. Ovulating female was observed only in O stock animals (Table 1, Appendix). Body length of the largest foetus was 223.0cm. A female pregnant with the largest foetus was assigned to J stock. A female was pregnant with twin foetuses (195.2cm male and 178.0cm female), which was also assigned to J stock.

From foetus body length, conception date was estimated. At the present survey, fetuses of 10 cm or less body length was judged as 'very small foetus'. Their body length was assume to be 10 cm and conception date was estimated. Regarding twin foetus, body length of larger one was used for calculation. Conception date was divided in two seasons, i.e., autumn breeding season and winter breeding season prolonged to spring, as noted Kato (1992)(Figure 4).

**Prey species found from common minke whale forestomach**
Stomach contents of the 47 animals were examined following the same methods adopted in the JARPNII feasibility survey conducted in 2001 (Fujise *et al*., 2002). Stomach contents were weighed to the nearest 0.1 kg, by each of four chambers. Weights were recorded both including and excluding liquid contents. A small quantity of stomach contents was collected and frozen for laboratory analysis. Weight of forestomach contents including liquid ranged from 2.7 kg to 49.8 kg. Forestomach contents found from the whales are listed in Table 5 and shown in Figure 5. Two animals had empty stomach. Dominant prey species was krill (*Euphausia pacifica*). Krill was major prey species of 42 whales (89.4%). Two individuals mainly feed on copepods (*Neocalanus* sp., 4.3%). Fish, walleye pollock (*Theragra chalcogramma*), was found from forestomach of one animal as major prey (2.1%). Two animals feeding on copepods were assigned to O stock. An individual taking walleye pollock was identified as J stock.

**Observation of marine debris**
Marine debris was detected from stomach of four animals. These were five small pieces of plastic products. An individual swallowed two pieces.

**DISCUSSION**

At the coastal component off Abashiri in 2017, sampling vessels could conduct searching for 13 days of the 26 days survey period (50.0%). The remaining days were not suitable for survey, from bad weather conditions, e.g., low atmospheric pressure and thick fog. The ratio was almost same as that recorded at the coastal component off Kushiro conducted in 2016 (Yoshida *et al*. 2017). However, density index of common minke whales recorded in the present survey (DI=4.00) was extremely high, when it is compared with results of the past surveys off Kushiro (e.g., 0.59 in 2016 and 1.46 in 2015) (Kishiro *et al*. 2016, Yoshida *et al*. 2017).

Sighting positions of common minke whales changed by month. In June, many common minke whales were encountered at coastal waters shallower than 100m (Figure 6). In July, however, animals occurred in deeper and more offshore waters and no sightings were made at the shallow waters. There was not obvious difference in sampling positions between J and O stock animals (Figure 1, Appendix). Figure 7 shows sampling positions of common minke whales by sex and maturity stage. Most of animals collected at offshore waters were mature males. Sampling positions of pregnant females concentrated along 200m isobath north of Abashiri. Difference in seasonal migration of common minke whales by sex and reproductive status was suggested.

In the southern Okhotsk Sea, the Japanese whale research program under special permit (JARPN) was conducted in summer of each of 1996 and 1999 (Fujise et al., 1997, 2000). Body length frequency of 80 common minke whales collected at the surveys is shown in Figure 3. At the surveys, many large males with body length larger than 7.0 m were collected. The 41 of 47 males attained to the sexual maturity (87.2%). The 21 of 33 females were also sexually mature (63.6%). The 17 mature females were pregnant. For both sexes, proportion of sexual maturity was also high, as observed in the present survey. Stock assignment indicates that there is no obvious difference in proportion of mature males between J and O stock animals in each of surveys (Figure 7, Appendix). However, proportion of mature females seems to be different by stock and survey. While the proportion was low in J stock animals in the 2017 NEW-REPNP survey conducted in early summer, it was low in O stock animals in the 1996 and 1999 JARPN surveys conducted in late summer. Biological information also suggest that the seasonal migration of common minke whales differ depending on sex and maturity stage. The biological difference observed between surveys, however, would be caused from difference in the survey design, where the 2017 survey was conducted in more coastal waters than in the previous JARPN surveys. Future surveys will be conducteded at both coastal and more offshore waters in the Okhotsk Sea.

In the Okhotsk Sea, proportion of mature animals was high. But, the proportion was lower at the Pacific coast off Kushiro, where the second phase of the Japanese Whale Research Program under Special Permit (JARPN II) was conducted from 2002 to 2016 (for example, Kishiro et al. 2003). At the surveys, while many large males were collected, small animals were also caught at higher frequency in comparison with surveys in the Okhotsk Sea (Figure. 3). At the Pacific coast, 232 of 472 males were sexually mature (49.2%). The proportion of females was extremely low. Of 240 females caught, only 40 animals attained sexual maturity (16.7%). The 19 females were pregnant. It appears that the results support a hypothesis on feeding migration of common minke whales in the western North Pacific, that is, mature animals migrate to higher latitudinal waters (Hatanaka and Miyashita, 1997).

Foetus conception date was divided in two seasons (Figure 4). The results suggest that animals migrating to the Okhotsk Sea possess separate two breeding seasons, i.e., autumn breeding season and winter breeding season prolonged to spring, as noted Kato (1992). Conception of five foetus was estimated in autumn. Stock assignment shows four of five females pregnant with the foetus were assigned to J stock. The remaining one female could not be assigned. All females assigned to O stock conceived in a period from winter to spring. Fujise et al. (2000) also reported that animals possessing two breeding seasons migrated to the Okhotsk Sea.

Prey species composition of common minke whales caught at the surveys was also different between regions. At the 2017 coastal component off Abashiri, dominant prey species was krill, followed by copepods (Figure 5). Only one whale feed on fish species (walleye pollock). Same results were obtained at the 1996 and 1999 JARPN surveys conducted in the Southern Okhotsk Sea, where krill was dominant prey and fishes were detected from forestomach of only one whale. The fish species was Japanese anchovy. However, animals collected at the Pacific coast off Kushiro under the JARPNII feed on fishes at higher frequency and krill was rare (Figure 5). Results of stock assignment indicated that two animals feeding on copepods were assigned

to O stock. An individual taking walleye pollock was assigned to J stock and an animal feeding on Japanese anchovy was identified as O stock. The results suggest that there is no obvious difference in prey species between J and O stock animals. Possibly, prey availability to whales is different between the oceanic regions.

**ACKNOWLEDGMENTS**

We acknowledge Seiji Ohsumi and Yoshihiro Fujise (ICR), and Messrs. Shigeki Takaya, Takato Maki, and Ryuta Fujio (Fisheries Agency of Japan), for their guidance in the survey design and support. Crew of research vessels, staff of the research station in Abashiri, and the Association for Community-Based Whaling assisted in important aspects of the survey. We also thank the Abashiri Fisheries Cooperative Association, the municipal office of Abashiri, Hokkaido Government Okhotsk general subprefectural bureau, and Hokkaido government office, for their kind assistance.

**REFERENCES**

Fujise Y., Shimada H., Zenitani R., Goto M., Tamura T., Lindstrøm U., Uchjida A., Yoshida H., Shimamoto K., Yuzu S., Kasai H., Kinoshita T., Iwata T. and Tohyama D. 1997. Cruise report of the Japanese Whale Research Program under a special permit in the North Pacific ( JARPN) in 1996 with some preliminary analyses of data collected during the 1994–1996 JARPN surveys. Paper SC/49/NP8 submitted to the 49th IWC Scientific Committee, 38 pp..

Fujise Y., Zenitani R., Tamura T., Bando T., Ohtani S., Takeda S., Kitajima A., Kimura T., Masaki T., and Tohyama D. 2000. Cruise report of the Japanese Whale Research Program under a special permit in the North Pacific (JARPN) in 1999. Paper SC/F2K/J9 submitted to the Workshop on Review the Japanese Whale Research Programme under Special Permit for North Pacific Minke Whales (JARPN), February 2000, 32pp.

Fujise, Y., Tamura, T., Bando, T., Watanabe, H., Kiwada, H., Otani, S., Kanda, N., Yasunaga, G., Mogoe, T., Konishi, K., Inamori, M., Shigemune, H. and Tohyama, D. 2002. Cruise report of the feasibility study of the Japanese Whale Research Program under Special Permit in the western North Pacific-Phase II (JARPN II) in 2001. Paper SC/54/O16 submitted to the 54th IWC Scientific Committee, 51pp.

Goto, M. and Pastene, L. A. 1997. Population structure of the western North Pacific minke whale based on an RFLP analysis of the mtDNA control region. Report of the International Whaling Commission. 47:531-537.

Goto, M. and Pastene, L. A. 1998. Population structure in the North Pacific minke whale as revealed by RFLP and sequencing analyses of the mtDNA control region. SC/50/RMP7. 15pp. presented to the 50th IWC Scientific Committee.

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/index.html

Hatanaka, H. 1997. A short review of hypotheses on minke whale stock structure in the Northwestern part of the North Pacific. Report of the International Whaling Commission 47: 553-555.

Hatanaka, H. and Miyashita, T. 1997. On the feeding migration of Okhotsk Sea. West Pacific stock of minke whales, estimates based on length composition data. Report of the International Whaling Commission 47: 557-564.

Kato, H. and Miyashita, T. 1991. Migration strategy of southern minke whales in relation to reproductive cycles estimated from foetal length. Report of the International Whaling Commission 41:363-71.

Kato, H. 1992. Body length, reproduction and stock separation of minke whales off northern Japan. Report of the International Whaling Commission 42:443-453.

Kato, H., Kishiro, T., Fujise, Y., and Wada, S. 1992. Morphology of minke whales in Okhotsk Sea, Sea of Japan and off the East Coast of Japan, with respect to stock identification. Report of the International Whaling Commission 42: 437-442.

Kishiro, T., Kato, H., Ohizumi, H., Yoshida, H., Saito, T., Isoda, T., Tabata, S., Sakakibara, M., Saino, S., Hara., T., Hayashi, T., Miyashita, T., Fukudome, K., Kiwada, H., and Kawahara, S. 2003. Report of the 2002 JARPN II survey in the western North Pacific. Part II: Coastal component - Coastal Survey off Kushiro, northeast Japan. Paper SC/55/O8 submitted to the 55th IWC Scientific Committee, 26pp.

Kishiro, T., Yoshida, H., Yasunaga, G., Bando, T., Mogoe, T., and Kato, H. 2016. Methodology and survey procedure under the JARPN II-coastal component of Sanriku and Kushiro-, during 2008 to 2014, with special emphasis on whale sampling procedures. Paper SC/F16/JR3 submitted to the Final Review Workshop on the Western North Pacific Japanese Special Permit Programme (JARPN II), February 2016, 19pp.

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 submitted to the 66bth IWC Scientific Committee, 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 Scientific Publications 10: 17pp.

Nakamura, G., Kadowaki, I., Nagatsuoka, S., Hayashi, R., Kanda, N., Goto, M., Pastene, L. A., and Kato, H. 2016. White Patch on the Fore-Flipper of Common Minke Whale, as a Potential Morphological Index to Identify Stocks. Open Journal of Animal Sciences, 2016, 6, 116-122.

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

Pastene, L. A., Goto, M., and Kishino, H. 1998. An estimate of mixing proportion of "J" and "O" stocks minke whales in sub-area 11 based on mitochondrial DNA haplotype data. Report of the International Whaling Commission 48: 471-474.

Pastene, L. A., Goto, M., Taguchi, M., and Kitakado, T. 2016. Temporal and spatial distribution of the 'J' and 'O' stocks of common minke whale in waters around Japan based on microsatellite DNA. Paper SC/F16/JR38 submitted to the JARPNII special permit expert panel review workshop, Tokyo, February 2016, 14pp.

Perrin, W. F., and Brownell Jr., R. L. (2002): Minke whales (*Balaenoptera acutorostrata* and *B. bonaerensis*). *In* Perrin, W. F., B. Wursig, and J. G. M. Thewissen (eds.), Encyclopedia of marine mammals. Academic Press. 750-754pp.

Yoshida, H., Shimetani, K, Maeda, H., Nakamura, G., Nakai, K., Inoue, S., Hirose, A., Hayashi, R., Akagi, M., Nakajyo, K., Nishimura, F., Asano, H., 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. Paper SC/67a/SCSP7 submitted to the 66ath IWC Scientific Committee, 14pp.

Table 1. Searching days, distances, hours, and number of cetacean sightings made during the 2017 NEWREP-NP coastal component off Abashiri.

| Period | Search days | Distances (n. miles) | Hours | Number of sightings* | | | |
|---|---|---|---|---|---|---|---|
| | | | | Species | Primary (Ind/Sch) | Secondary (Ind/Sch) | Total (Ind/Sch) |
| 6/11-6/30 | 11 | 1,722.1 | 170.7 | Common minke whale | 65/62 | 23/22 | 88/84 |
| | | | | Like minke whale | 9/9 | 1/1 | 10/10 |
| | | | | Blue whale | 2/2 | 0/0 | 2/2 |
| | | | | Fin whale | 39/28 | 0/0 | 39/28 |
| | | | | Humpback whale | 2/1 | 0/0 | 2/1 |
| | | | | Sperm whale | 1/1 | 0/0 | 1/1 |
| 7/1-7/6 | 6 | 727.8 | 72.7 | Common minke whale | 36/36 | 8/8 | 44/44 |
| | | | | Like minke whale | 10/10 | 1/1 | 11/11 |
| | | | | Fin whale | 16/11 | 0/0 | 16/11 |
| | | | | Humpback whale | 8/3 | 0/0 | 8/3 |
| Total | 17 | 2449.9 | 243.4 | Common minke whale | 101/98 | 31/30 | 132/128 |
| | | | | Like minke whale | 19/19 | 2/2 | 21/21 |
| | | | | Blue whale | 2/2 | 0/0 | 2/2 |
| | | | | Fin whale | 55/39 | 0/0 | 55/39 |
| | | | | Humpback whale | 10/4 | 0/0 | 10/4 |
| | | | | Sperm whale | 1/1 | 0/0 | 1/1 |

*: The number probably includes some duplicated sightings made by plural vessels.

Table 2. Summary of biological data and samples collected during the 2017 NEWREP-NP coastal component off Abashiri.

| Samples and data | Number of animals | | |
|---|---|---|---|
| | Male | Female | Total |
| Body length and sex | 9 | 38 | 47 |
| External body proportion | 9 | 38 | 47 |
| Photographic record and external body character | 9 | 38 | 47 |
| Diatom film record | 9 | 38 | 47 |
| Body scar record | 9 | 38 | 47 |
| Measurements of blubber thickness (five points) | 9 | 38 | 47 |
| Body weight | 9 | 38 | 47 |
| Skin tissues for DNA analysis | 9 | 38 | 47 |
| Muscle, liver, kidney, spleen, blubber, and heart for various analysis | 9 | 38 | 47 |
| Urine for various analysis | 2 | 7 | 9 |
| Muscle, liver, kidney, and blubber for heavy metal analysis | 9 | 38 | 47 |
| Muscle, liver, kidney, and blubber for organochlorine analysis | 9 | 38 | 47 |
| Collection of blood plasma | 7 | 24 | 31 |
| Mammary grand; lactation status, measurement and histological sample | - | 38 | 38 |
| Uterine horn; measurements and endometrium sample | - | 38 | 38 |
| Collection of ovary | - | 38 | 38 |
| Photographic record of foetus | 11 | 12 | 25* |
| Foetal length and weight | 11 | 12 | 23 |
| External body measurements of foetus | 11 | 12 | 23 |
| Skin tissues for DNA study of foetus | 11 | 12 | 23 |
| Muscle, liver, kidney, heart, blubber and skin tissues of foetus | 6 | 7 | 13 |
| Eye lens of foetus for age determination | 6 | 5 | 11 |
| Collection of foetus | 5 | 5 | 12* |
| Testis and epididymis; weight and histological sample | 9 | - | 9 |
| Stomach contents, convenient record | 9 | 38 | 47 |
| Volume and weight of stomach content in each compartment | 9 | 38 | 47 |
| Observation of marine debris in stomach | 9 | 38 | 47 |
| Collection of stomach contents for feeding study | 9 | 36 | 45 |
| Record of external parasites | 9 | 38 | 47 |
| Earplug for age determination | 9 | 38 | 47 |
| Eye lens for age determination | 9 | 38 | 47 |
| Baleen plate with V-shape notch on its outer edge for age determination | 0 | 0 | 0 |
| Baleen plate measurements (length and breadth) | 8 | 38 | 46 |
| Photographic record of baleen plate series | 9 | 38 | 47 |
| Length of baleen series | 9 | 37 | 46 |
| Vertebral epiphyses sample | 8 | 34 | 42 |
| Number of ribs | 9 | 38 | 47 |
| Skull measurement (length and breadth) | 9 | 38 | 47 |
| Measurement of flipper white patch | 4 | 11 | 15 |

*: Two unknown sex foetus are included.

Table 3. Body length (m) of common minke whales collected in the 2017 NEWREP-NP coastal component off Abashiri.

| Period | Male | | | | | Female | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min. | Max. | *n* | Mean | S.D. | Min. | Max. | *n* |
| 6/11-6/30 | 6.91 | 0.69 | 5.62 | 7.55 | 6 | 7.33 | 0.88 | 4.96 | 8.18 | 24 |
| 7/1-7/6 | 6.95 | 0.14 | 6.82 | 7.10 | 3 | 7.38 | 0.82 | 5.45 | 8.10 | 14 |
| Total | 6.92 | 0.55 | 5.62 | 7.55 | 9 | 7.35 | 0.85 | 4.96 | 8.18 | 38 |

Table 4. Composition of sexual maturity of common minke whales collected in the 2017 NEWREP-NP coastal component off Abashiri.

| Period | Male | | | | Female | | | | | | | Sex ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Im | M | Total | Maturity* | Im | R | O | P | Total | Pregnancy* | Maturity* | (%males) |
| 6/11-6/30 | 1 | 5 | 6 | 83.3 | 5 | 3 | 2 | 14 | 24 | 73.4 | 79.2 | 20.0 |
| 7/1-7/6 | 0 | 3 | 3 | 100.0 | 3 | 0 | 0 | 11 | 14 | 100.0 | 78.6 | 17.6 |
| Total | 1 | 8 | 9 | 88.9 | 8 | 3 | 2 | 25 | 38 | 83.3 | 78.9 | 19.1 |

Im: Immature; M: Mature; R: Resting; P: Pregnant; *: %.

Table 5. Number of common minke whales by major prey species found in forestomach, collected in the 2017 NEWREP-NP coastal component off Abashiri.

| Period | Number of whales (%) | | | | Total |
|---|---|---|---|---|---|
| | Walleye pollock | Krill | Copepods | Empty | |
| 6/11-6/30 | 1 (3.3) | 26 (86.7) | 2 (6.7) | 1 (3.3) | 30 (100.0) |
| 7/1-7/6 | 0 (0.0) | 16 (94.1) | 0 (0.0) | 1 (5.9) | 17 (100.0) |
| Total | 1 (2.1) | 42 (89.4) | 2 (4.3) | 2 (4.3) | 47 (100.0) |

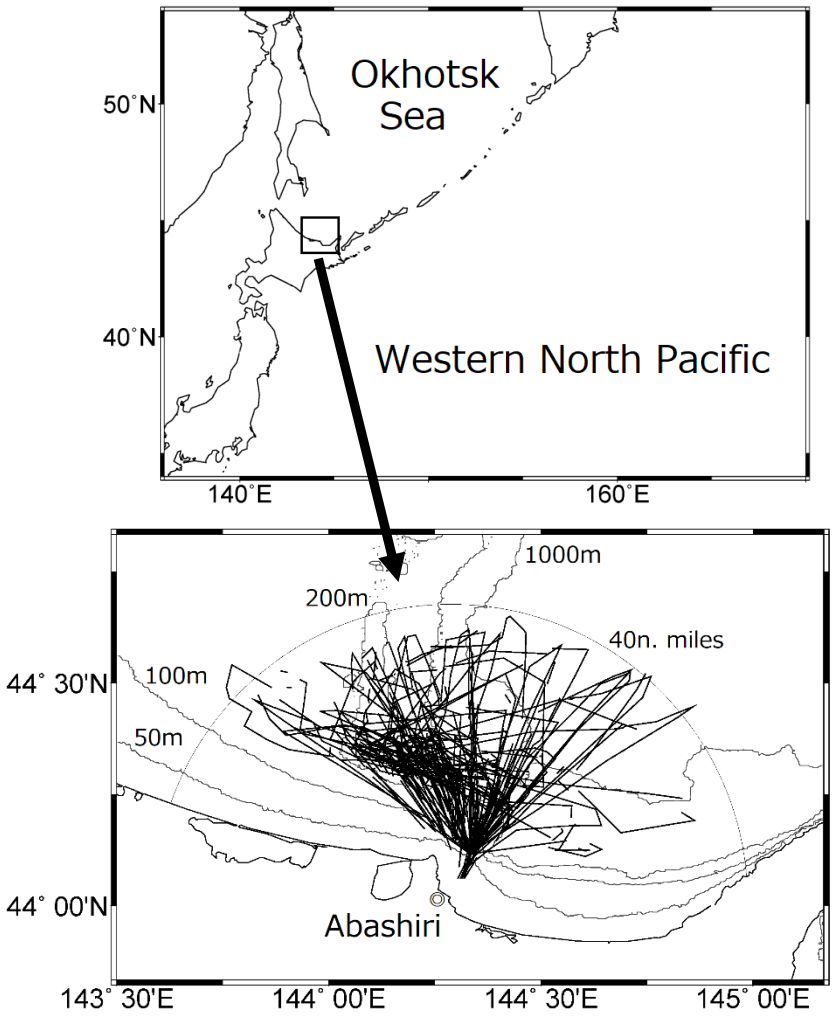


Figure 1. Research area set for the 2017 NEWREP-NP coastal component off Abashiri (upper) and cruise tracks made by sampling vessels at the component (lower). The survey was conducted mainly in 40 nautical miles from Abashiri. Isobaths are 50m, 100m, 200m, and 1000m.

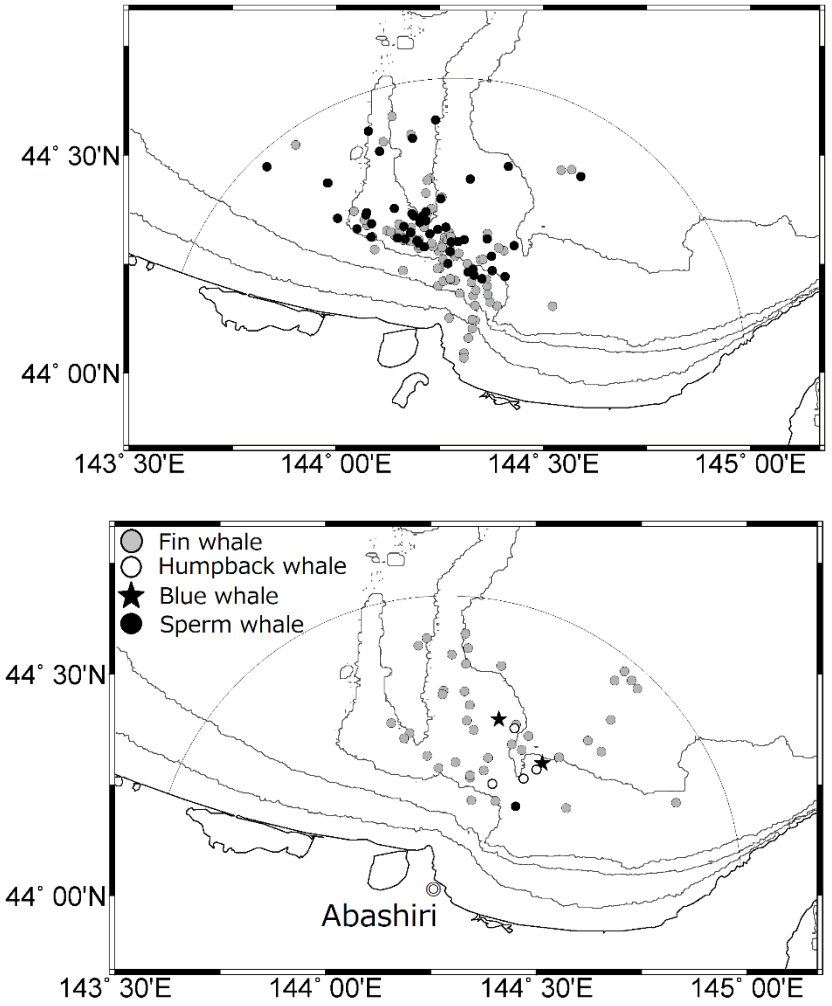


Figure 2. Sighting positions of common minke whales (upper) and large whales (lower) made by sampling vessels at the 2017 NEWREP-NP coastal component off Abashiri. Black circles in upper map shows sighting positions of common minke whales collected. Isobaths are 50m, 100m, 200m, and 1000m.

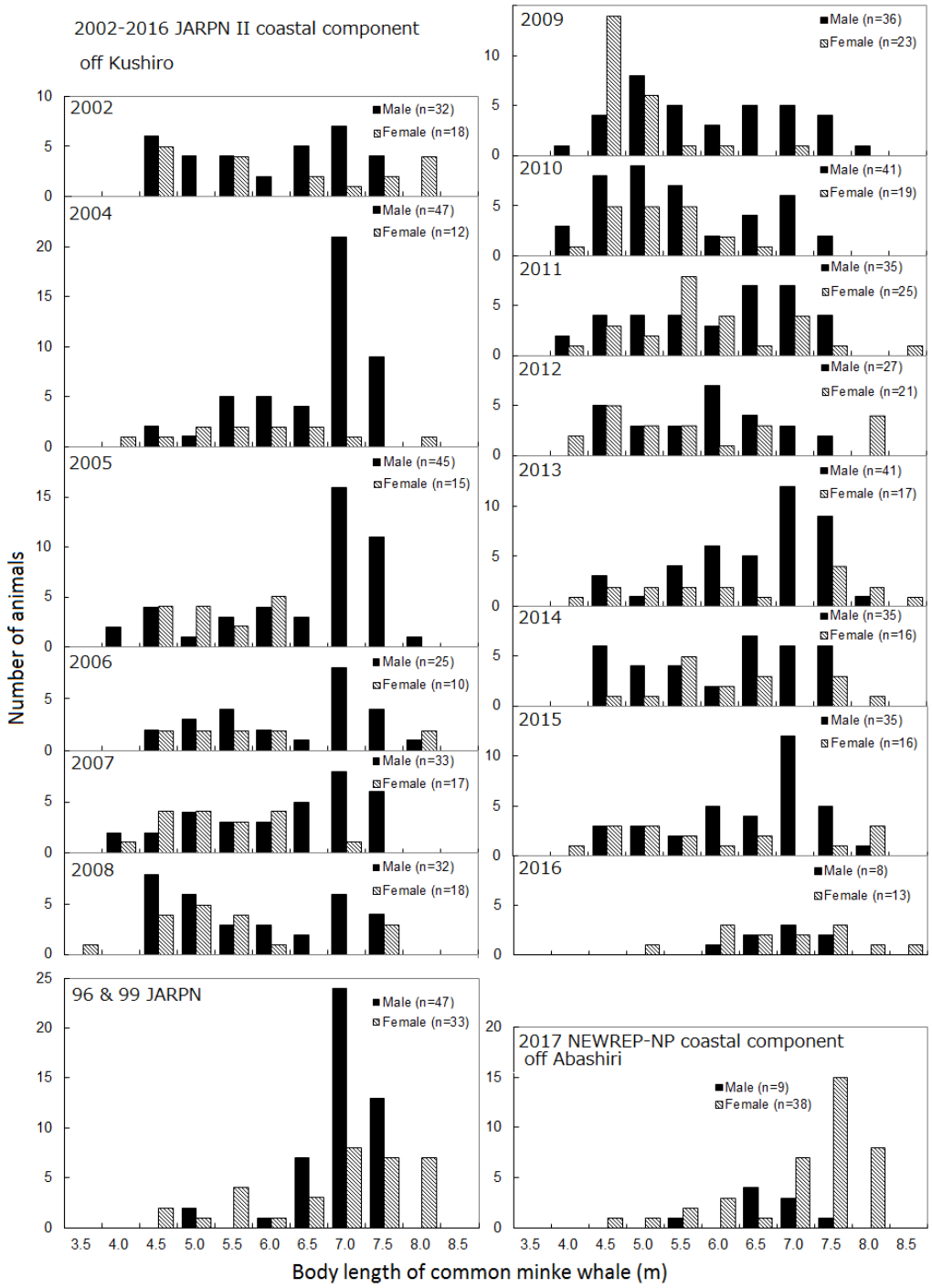


Figure 3. Body length frequency of common minke whales collected at the 2017 NEWREP-NP coastal component off Abashiri, with results of the 2002-2016 JARPN II coastal component off Kushiro and of the JARPN surveys conducted in 1996 and 1999 in the southern Okhotsk Sea.

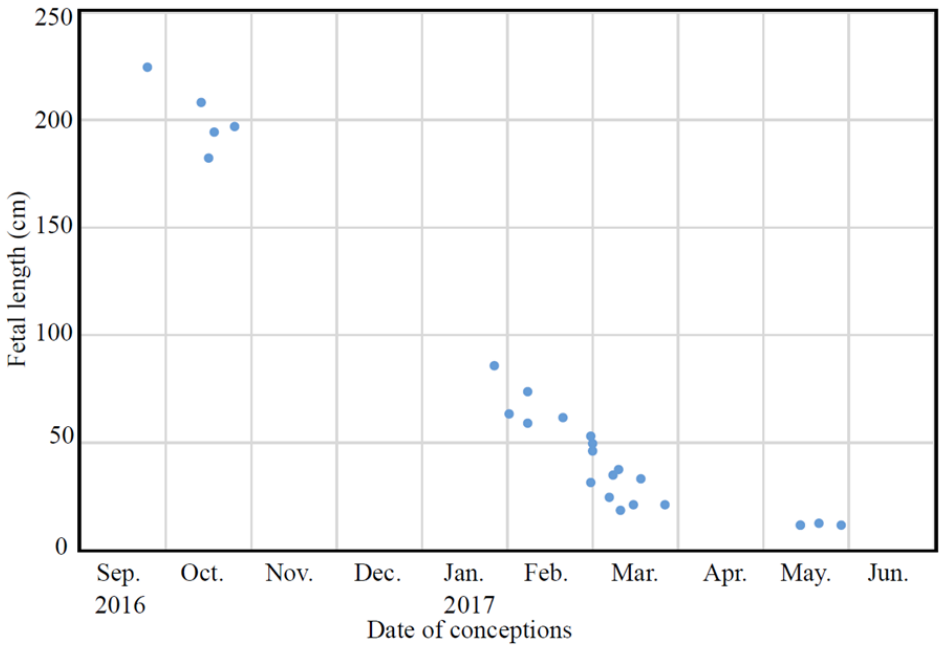


Figure 4. Estimated conception date of common minke whale foetus collected at the 2017 NEWREP-NP coastal component off Abashiri.

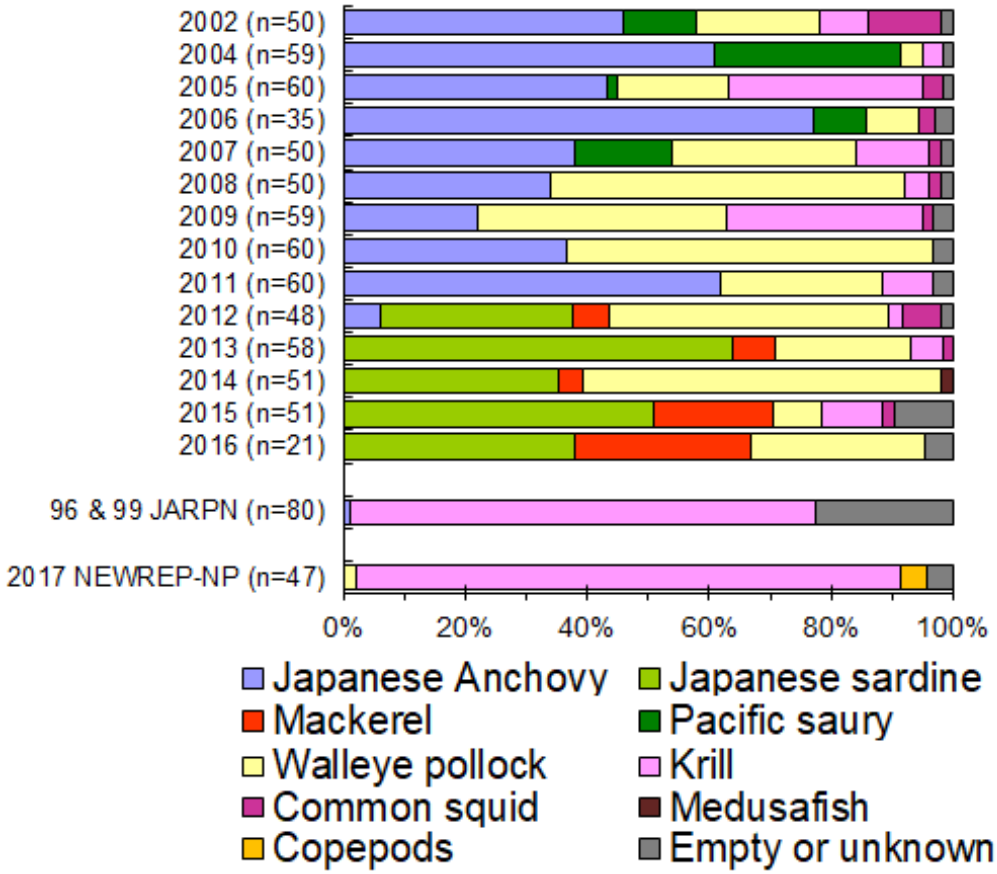


Figure 5. Prey species composition of common minke whales collected at the 2017 NEWREP-NP coastal component off Abashiri, with results of the 2002-2016 JARPN II coastal component off Kushiro and of the JARPN surveys conducted in 1996 and 1999 in the southern Okhotsk Sea.

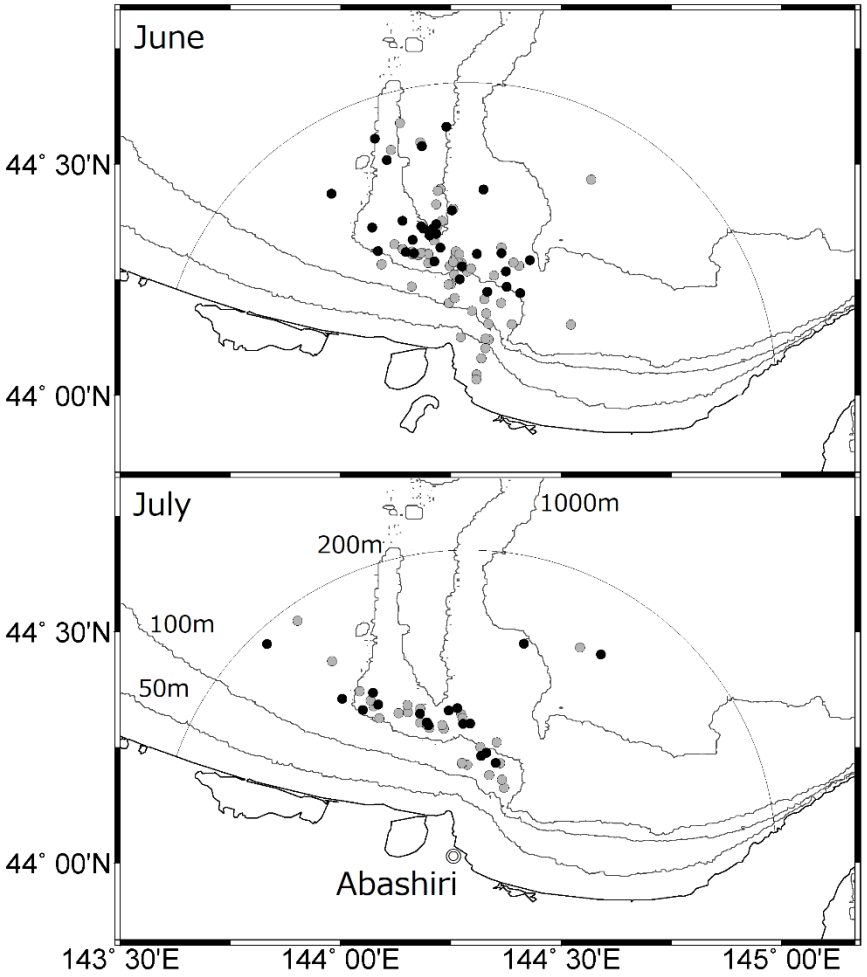


Figure 6. Sighting positions of common minke whales made by sampling vessels at the 2017 NEWREP-NP coastal component off Abashiri, by month. Black circles are sighting positions of common minke whales collected. Isobaths are 50m, 100m, 200m, and 1000m.

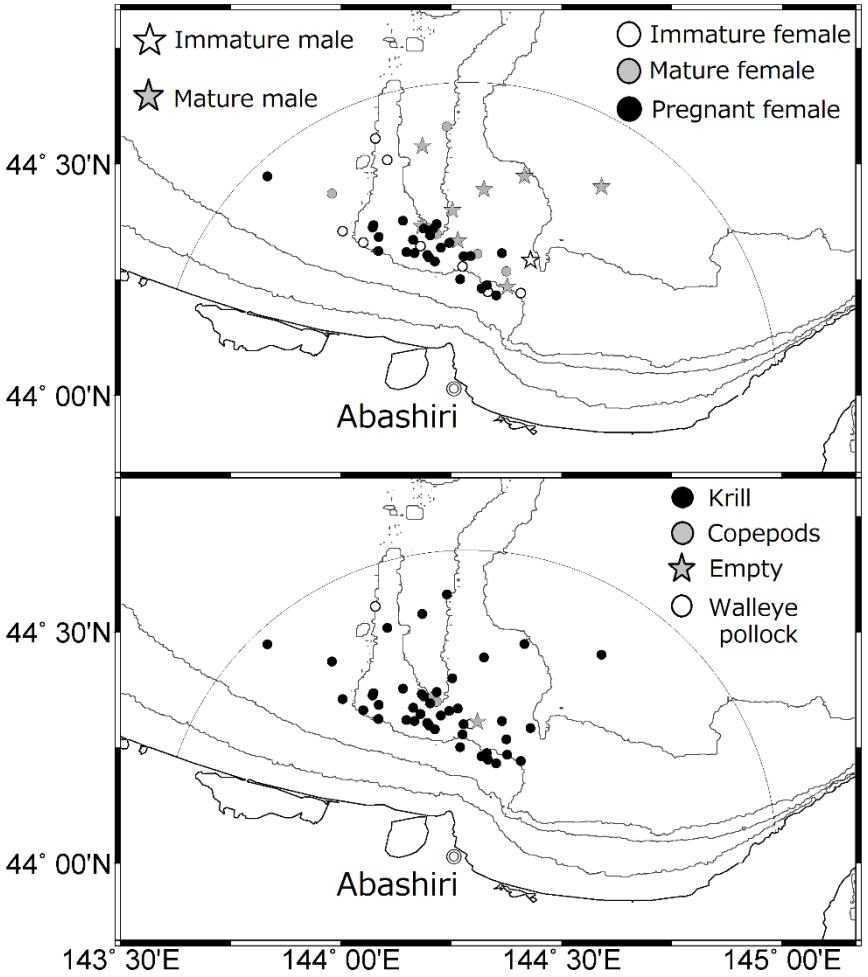


Figure 7. Sighting positions of common minke whales at the 2017 NEWREP-NP coastal component off Abashiri, shown by sex and reproductive status (upper) and by prey species (lower). Isobaths are 50m, 100m, 200m, and 1000m.

## Appendix

## Preliminary genetic stock assignment of J and O stocks common minke whales based on samples and data collected during the 2017 Abashiri survey of NEWREP-NP

Mioko Taguchi, Mutsuo Goto and Luis A. Pastene
*Institute of Cetacean Research, 4-5, Toyomi-cho, Chuo-ku, Tokyo, 104-0055, JAPAN*

This paper shows: (1) the genetic stock assignment, *i.e.*, mixing proportion of J and O stocks, including their body length and reproductive status, for a total of 47 common minke whales from the 2017 coastal component off Abashiri under the NEWREP-NP, and (2) the results of preliminary comparison of biological properties between the 2017 NEWREP-NP, and the 1996 and 1999 JARPN surveys, conducted in sub-area 11.

*Genetic stock assignment*
Total DNA for a total of 47 common minke whales from the 2017 coastal component off Abashiri under the NEWREP-NP was extracted, and all individuals were genotyped for sixteen nuclear microsatellite loci. The details of laboratory procedures are available in Pastene *et al*. (2016).

The Bayesian clustering analysis was performed to estimate an assignment probability for each sample using the program STRUCTURE version 2.3.4 (Pritchard *et al*., 2000) and all available microsatellite data of common minke whales from JARPN, JARPNII and bycatch in addition to the present data. The details of analytical procedures for the stock assignment are available in Pastene *et al*. (2016).

*Biological outline based on genetic stock assignment*
Of 47 common minke whales, 28 and 17 individuals were assigned to J and O stocks, respectively (Table 1), and the remaining two individuals could not be assigned to stock. There was no difference in sampling position between the stocks (Figure 1). Overall apparent pregnancy rate was high in either stocks, which was 92.3% in J stock and 80.0% in O stock (Table 1). The mixing proportion of the two stocks varied during the research period (Figure 2), and the proportion of J stock was increased in July (Figure 2). The body length in J stock females ranged from 4.96 to 8.10 m, which was broader than J stock males ranged from 5.62 to 7.40 m, as well as O stock females ranged from 6.70 to 8.18 m (Figure 3). Figure 4 shows the composition of reproductive status by stock and sex, which suggests that the proportion of pregnant female is increased in second half of the research period for both stocks, and ovulating females are observed only for O stock in June. Figure 4 also shows that immature females are observed in J stock through the research period but not in O stock, and most male caught in this research is matured.

*Comparison of biological properties between the NEWREP-NP and JARPN*
Considering that this was the first survey in Abashiri of a series of the NEWREP-NP planned over the next six years, the biological properties of common minke whales sampled in the present survey aforementioned were preliminarily assessed by comparing with those from a total of 80 common minke whales, consisting of J ($n$ = 23), O ($n$ = 49) and unassigned ($n$ = 8) individuals sampled in sub-area 11 under the JARPN in 1996 and 1999 (Table 1 and Figure 1). The mixing proportion of the two stocks was different between surveys (Figure 5), which suggested the larger proportion of J stock in the present survey than the JARPN for both sexes. The range of body length for J stock females in the present survey was broader than that in the JARPN (Figure 6), and vice versa for the O stock females. Additionally, the body length for J stock males in the present survey seemed to be slightly smaller than that in the JARPN surveys (Figure 6). There is not notable difference in the composition of reproductive status for J stock females between surveys (Figure 7), whereas the proportion of pregnant individuals for O stock females was higher in the present survey, and the ovulating individuals that were not observed in the JARPN were observed in the present survey.

The preliminary analyses based on a genetic stock assignment showed that the biological properties for each stock in the present survey was different from those in the JARPN, especially in females. Hatanaka and Miyashita (1997) proposed the possible feeding migration process and distribution pattern for O stock which was different by sex, age, and reproductive status. In addition, Fujise *et al*. (2000) suggested the possibility that the species in sub-area 11 segregated by sex and reproductive status depending on the water depth. Considering these previous studies, together with the fact that the present research period and area (Figure 1 in the main text) were different from those of the JARPN surveys (Figure 8), the biological difference between surveys observed in this preliminary comparison would be caused by the difference in the survey design, especially the seasonal and geographical coverages, with the survey in 2017 conducted in more coastal areas than the previous JARPN surveys. Effort will be made to cover both coastal and offshore areas in future surveys in Abashiri.

**REFERENCES**

Fujise, Y., Shimada, H., Zenitani, R., Goto, M., Tamura, T., Lindstrøm, U., Uchida, A., Yoshida, H., Shimamoto, K., Yuzu, S., Kasai, H., Kinoshita, T., Iwata, T., and Tohyama, D. 1997. Cruise Report of the Japanese Whale Research Program under a Special Permit in the North Pacific (JARPN) in 1996 with some preliminary analyses of data collected during the 1994-1996 JARPN surveys. Paper SC/49/NP8 presented to the IWC Scientific Committee, May 1997 (unpublished). 38pp.

Fujise, Y., Zenitani, R., Tamura, T., Bando, T., Ohtani, S., Takeda, S., Kitajima, A., Kimura, T., Masaki, T., and Tohyama, D. 2000. Cruise Report of the Japanese Whale Research Program under Special Permit in the North Pacific (JARPN) in 1999. Paper SC/F2K/J9 presented to the IWC Scientific Committee, May 2000 (unpublished). 32pp.

Hatanaka, H. and Miyashita, T. 1997. On the feeding migration of the Okhotsk Sea-West Pacific stock of minke whales, estimates based on length composition data. *Rep. int. Whal. Commn* 47: 557-564.

Pastene, L. A., Goto, M., Taguchi, M. and Kitakado, T. 2016. Temporal and spatial distribution of the 'J' and 'O' stocks of common minke whale in waters around Japan based on microsatellite DNA. Paper SC/F16/JR38 presented to the JARPNII special permit expert panel final review workshop, February 2016 (unpublished). 14pp.

Pritchard, J. K., Stephens, M. and Donnelly, P. 2000. Inference of population structure using multilocus genotype data. *Genetics* 155: 945-959.

**Table 1** Sample size of common minke whale in the 2017 NEWREP-NP, and the 1996 and 1999 JARPN surveys conducted in sub-area 11, by sex, maturity and stock

| Data source | Stock | Year. Month | Female | | | | | | | Male | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Imm. | Resting | Ovulating | Preg. | Apparent Preg. % | Unknown mature | Total | Imm. | Mat. | Total | |
| NEWREP-NP | J | 2017. 6 | 4 | 1 | | 5 | 83.3 | | 10 | 1 | 4 | 5 | 15 |
| | | 2017. 7 | 3 | | | 7 | 100.0 | | 10 | | 3 | 3 | 13 |
| | | Total | 7 | 1 | | 12 | 92.3 | | 20 | 1 | 7 | 8 | 28 |
| | O | 2017. 6 | 1 | 1 | 2 | 8 | 72.7 | | 12 | | 1 | 1 | 13 |
| | | 2017. 7 | | | | 4 | 100.0 | | 4 | | | | 4 |
| | | Total | 1 | 1 | 2 | 12 | 80.0 | | 16 | | 1 | 1 | 17 |
| | Unasgn. | 2017. 6 | | 1 | | 1 | 50.0 | | 2 | | | | 2 |
| | | 2017. 7 | | | | | | | | | | | |
| | | Total | | 1 | | 1 | 50.0 | | 2 | | | | 2 |
| | Total | 2017. 6 | 5 | 3 | 2 | 14 | 73.7 | | 24 | 1 | 5 | 6 | 30 |
| | | 2017. 7 | 3 | | | 11 | 100.0 | | 14 | | 3 | 3 | 17 |
| | | Total | 8 | 3 | 2 | 25 | 83.3 | | 38 | 1 | 8 | 9 | 47 |
| JARPN | J | 1996. 8 | | | | 1 | 100.0 | | 1 | 1 | 6 | 7 | 8 |
| | | 1999. 7 | 2 | | | 7 | 100.0 | 1 | 10 | | 5 | 5 | 15 |
| | | Total | 2 | | | 8 | 100.0 | 1 | 11 | 1 | 11 | 12 | 23 |
| | O | 1996. 8 | 3 | 2 | | 4 | 66.7 | | 9 | 1 | 7 | 8 | 17 |
| | | 1999. 7 | 6 | 1 | | 5 | 83.3 | | 12 | 2 | 18 | 20 | 32 |
| | | Total | 9 | 3 | | 9 | 75.0 | | 21 | 3 | 25 | 28 | 49 |
| | Unasgn. | 1996. 8 | 1 | | | | | | 1 | | 4 | 4 | 5 |
| | | 1999. 7 | | | | | | | | | 3 | 3 | 3 |
| | | Total | 1 | | | | | | 1 | | 7 | 7 | 8 |
| | Total | 1996. 8 | 4 | 2 | | 5 | 71.4 | | 11 | 2 | 17 | 19 | 30 |
| | | 1999. 7 | 8 | 1 | | 12 | 92.3 | 1 | 22 | 2 | 26 | 28 | 50 |
| | | Total | 12 | 3 | | 17 | 85.0 | 1 | 33 | 4 | 43 | 47 | 80 |

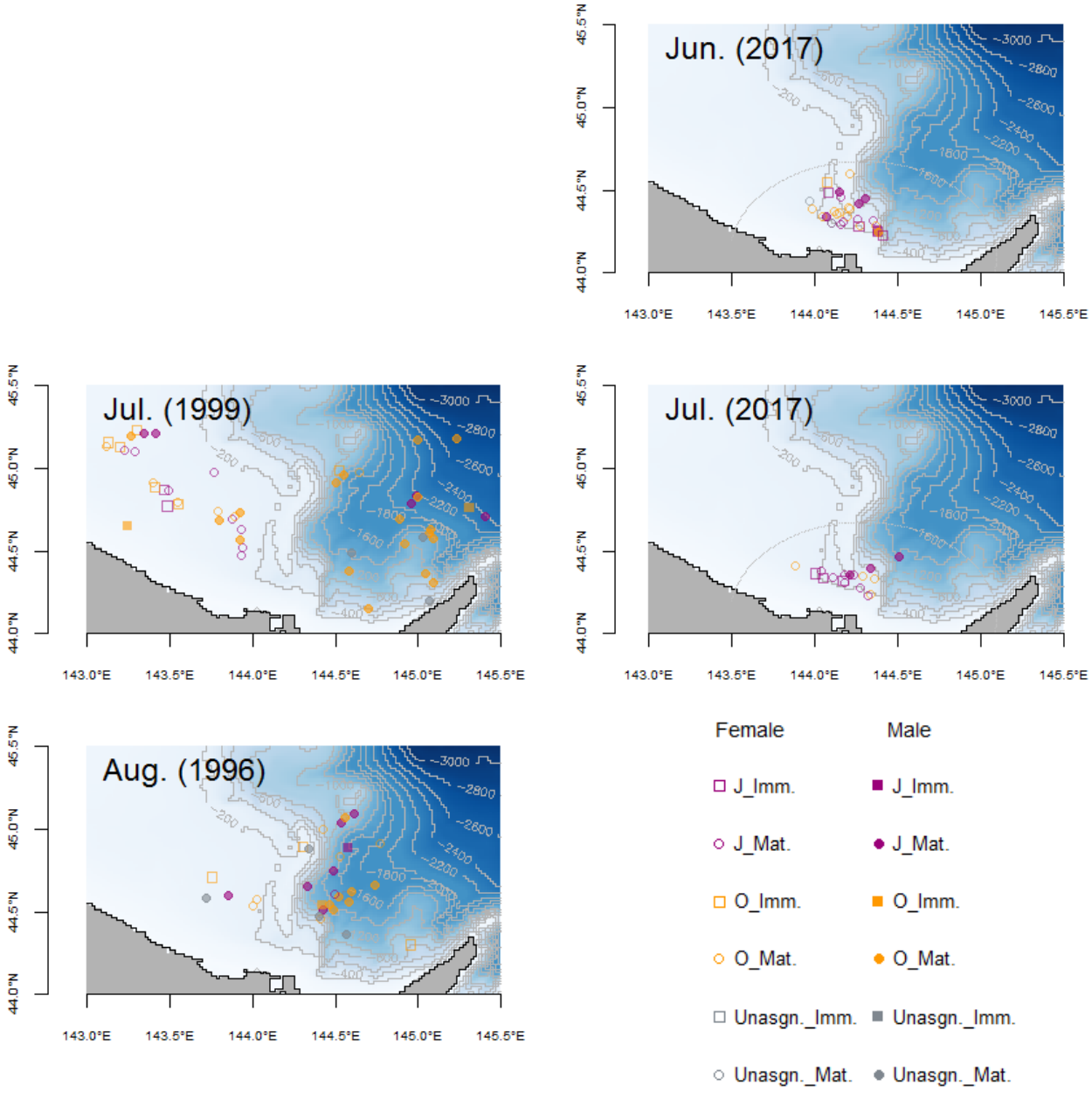


**Figure 1** Sampling position of common minke whales in the 2017 NEWREP-NP and the 1996 and 1999 JARPN in sub-area 11. Dashed gray line indicates the main area surveyed ranging 40 nautical miles from Abashiri

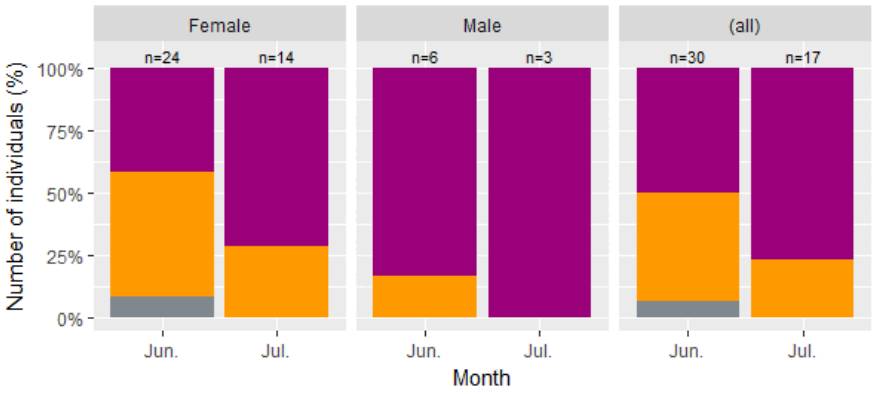


**Figure 2** Monthly mixing proportion of J and O stocks by sex in the 2017 NEWREP-NP

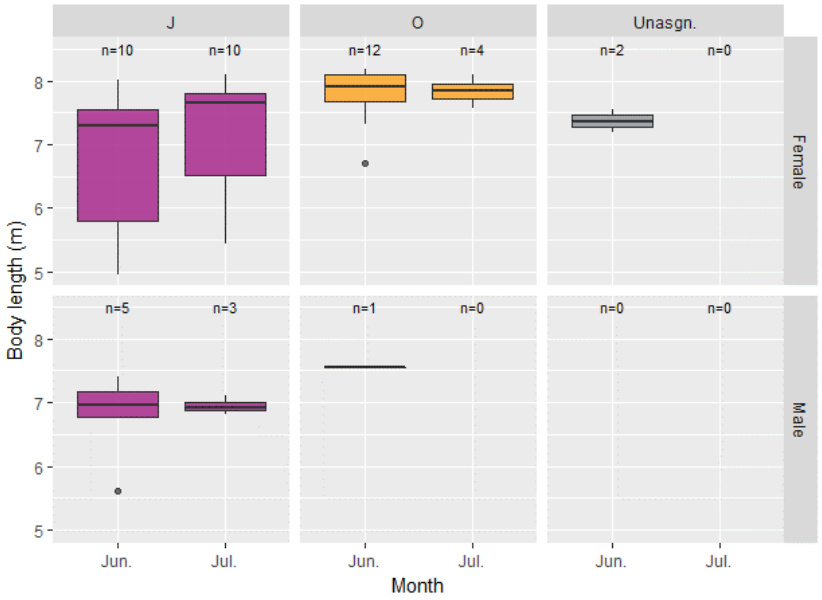


**Figure 3** Monthly body length distribution, by stock and sex, in the 2017 NEWREP-NP

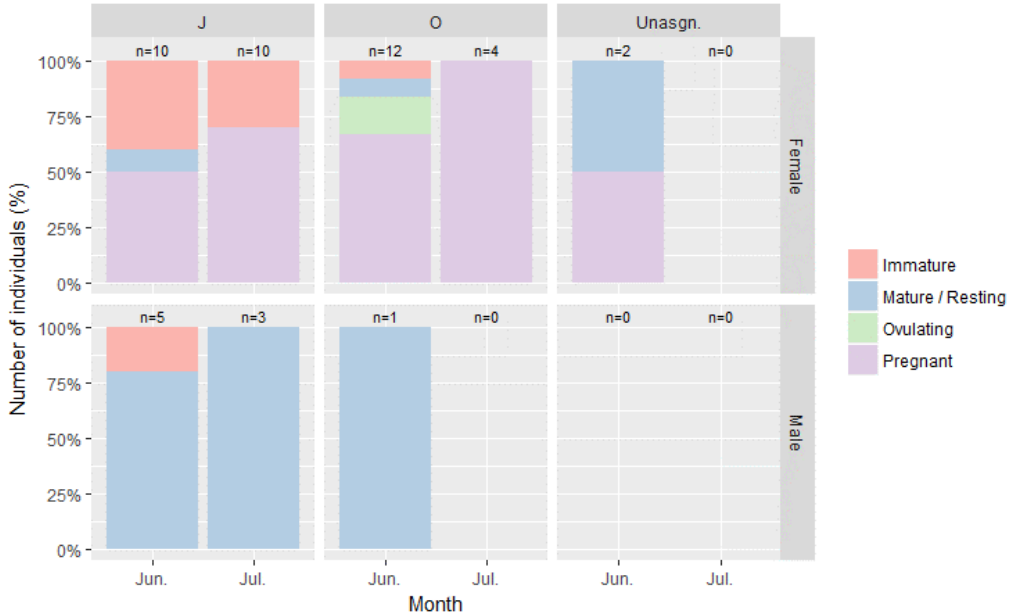


**Figure 4** Monthly composition of reproductive status, by stock and sex in the 2017 NEWREP-NP

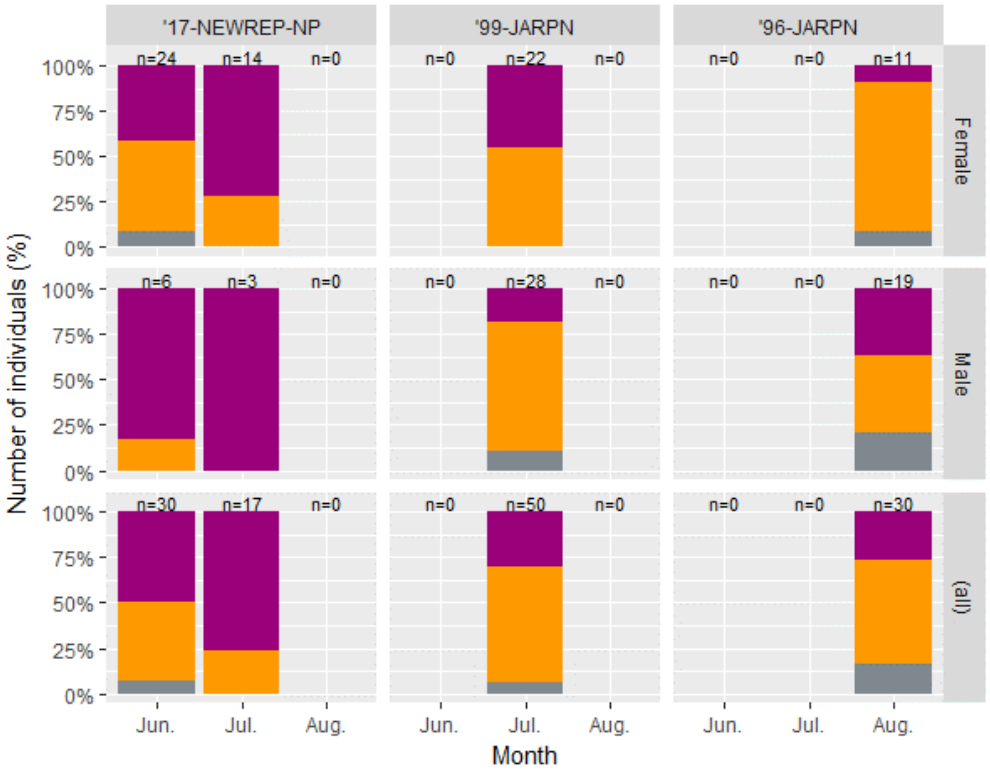


**Figure 5** Monthly mixing proportion of J and O stocks, by survey and sex

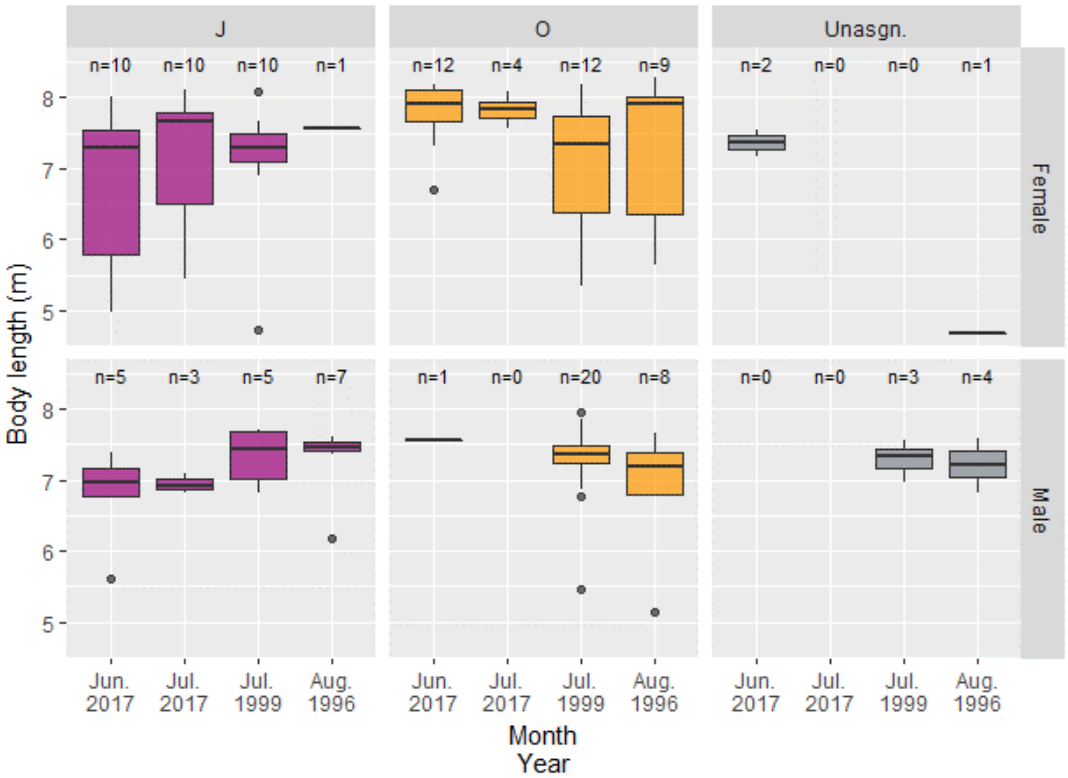


**Figure 6** Comparison of body length distribution among surveys, by stock and sex

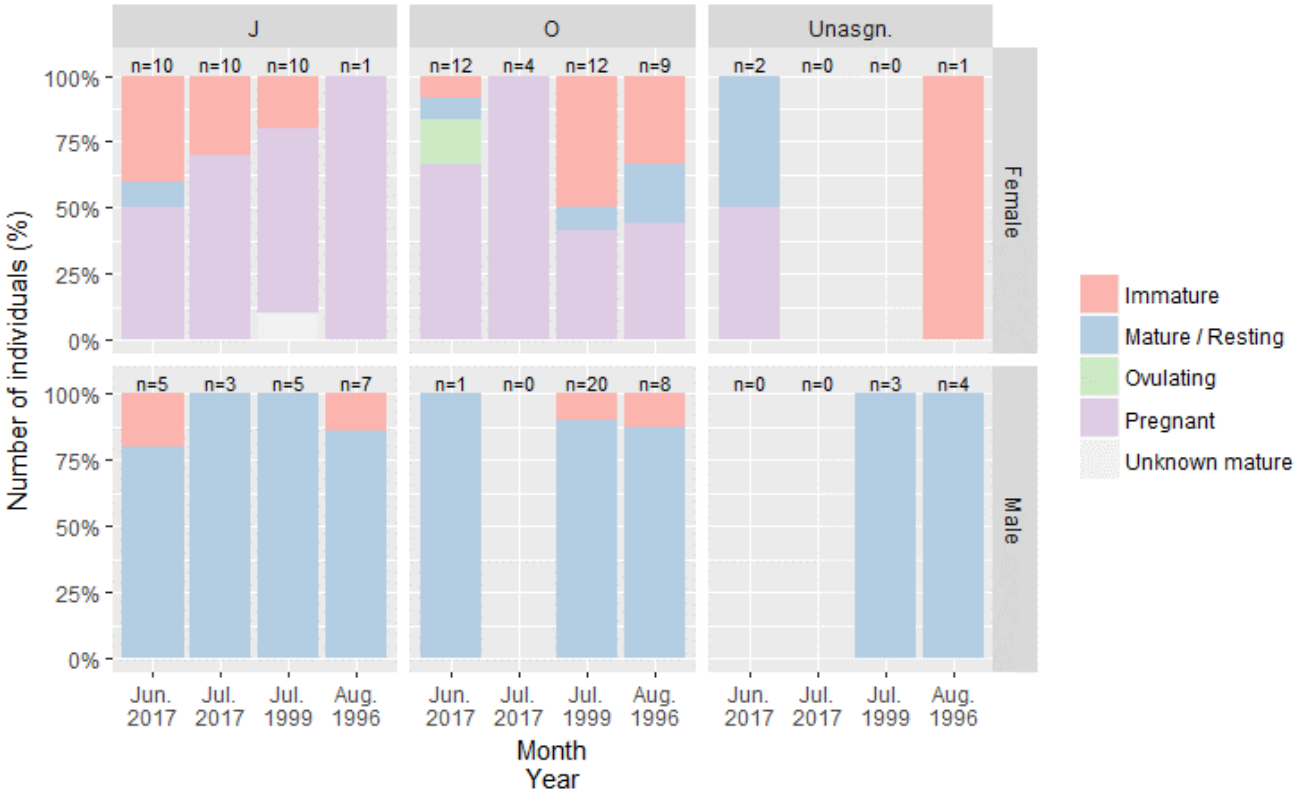


**Figure 7** Comparison of monthly composition of sexual maturity among surveys, by stock and sex

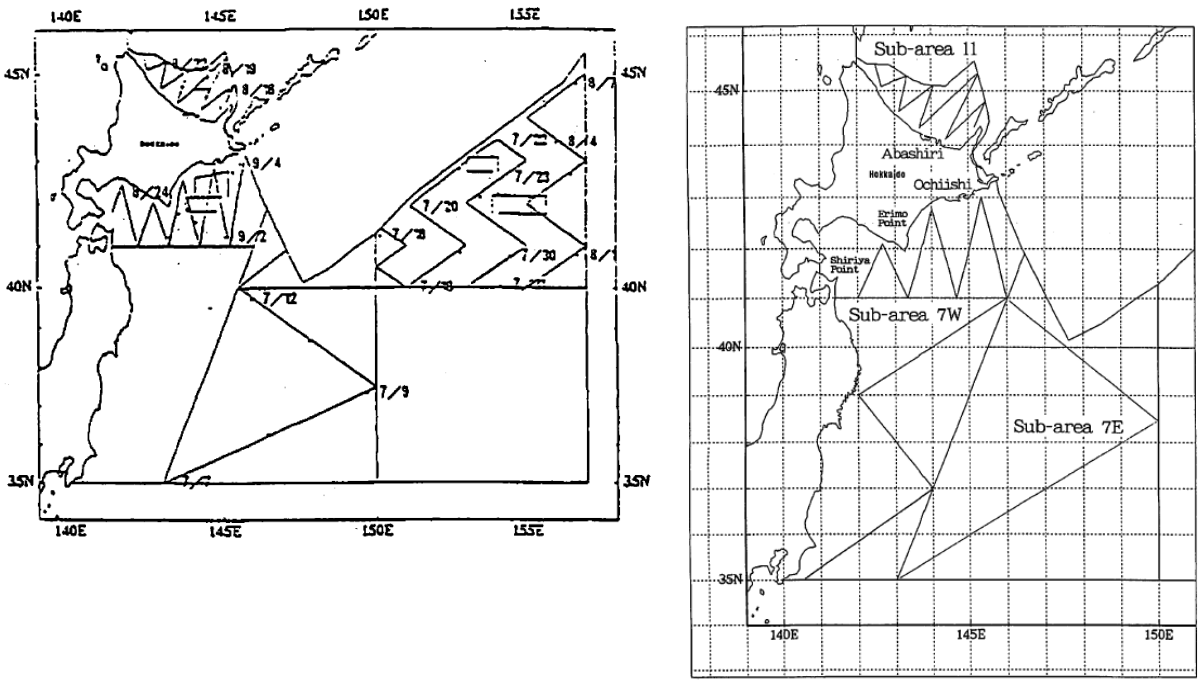


**Figure 8** Cruise tracks for the 1996 (left: reprinted from Fujise *et al*. (1997)) and 1999 (right: reprinted from Fujise *et al*. (2000)) JARPN surveys