Sightings and trials for satellite tracking of common minke whales in the Sea of Japan in autumn 2012

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ABSTRACT

A satellite tagging survey targeting common minke whales was conducted from 12 October to 20 November 2012. Initial planned survey area was in the Russian waters of Sea of Japan. However, it was unfortunate that the Government of the Russian Federation did not issue survey permit in their waters. As the results, a survey area was changed in the Japanese waters of the Sea of Japan. Because information about distribution of minke whales in this area in this season was scarce, a systematic sighting survey was conducted to find them. Tracklines were constructed by using a software, DISTANCE. Additional non-systematic tracklines were also constructed within the very coastal survey area where sighting of minke whales were highly expected. During the survey, a total of 8 schools/9 animals of common minke whales were sighted. Satellite tagging was attempted to 8 animals. Two satellite tags were attached to 2 animals. However, only a tag transmitted the geographical locations. The satellite tag was attached to an animal at 45°16.2'N, 141°23.1'E on 6 November 2012. The sighting was mother-calf pair and the tag was attached to mother. The tag transmitted the geographical locations until 19 November 2012 (14 days). A total of 89 geographical positions were obtained out of 141 transmissions. Biopsy sampling from the tagged animal was attempted but failed. Tagged animal was mostly stayed around the tagged positions during that period. The area is known as typical fishing ground of sand lance. Common minke whales might feed on the fish in this area even in late autumn. The results provided new insight of ecology of common minke whales in autumn. However, because the duration of transmission was short, a little information on their migration behaviour was obtained. Technical development of attachment methods to prolong duration of transmission should be considered further. Identification of stock of minke whales and their overwintering ground is vital information for management of this species. Such exercise should be continued and conducted including the Russian waters in the future.

INTORODUCTION

Common minke whale, *Balaenoptera acutorostrata,* has been a main target species for the Japanese coastal small-type whaling, and is now for the second phase of the Japanese whale research program under special permit in the western North Pacific (JARPN II). In the process of the implementation assessment of the North Pacific common minke whales, the stock structure hypotheses is one of the most important and complicated issue, and the IWC scientific committee recognizes that a recurring theme that has limited progress in interpreting analyses to differentiate among stock structure hypotheses is that no data are available from breeding grounds in winter where 'pure' breeding stocks are assumed to exist (IWC, 2012). The lack of the geographical and seasonal information about wintering or breeding grounds of common minke whales restricted to progress those discussions in the SC.

The satellite telemetry is an efficient way to investigate the migratory routes and wintering grounds of marine mammals, and recent development of the tagging techniques have given the opportunity to investigate them (Mate *et.al*., 2007; Heide-Jorgensen *et al*., 2001). In September 2010, a satellite tag (Argos transmitter) was attached to one common minke whale, and tracked for 27 days in the coastal waters off Kushiro, southeastern coast of Hokkaido, northern Japan The results revealed that the tagged whale stayed in the coastal waters off Kushiro for at least four weeks, but the tag was fallen out, and information of the movement after that could not be obtained (Kishiro, *et. al*., 2011).

To increasing the tagging efforts, and gathering the information from other waters, we conducted a satellite tagging survey for common minke whales in the Sea of Japan (sub-area 6 and 10) from 12 October to 20 November 2012. Initial planned survey area was set in the Sea of Japan including the Russian waters (Fig. 1). However, it was unfortunate that the Government of the Russian Federation did not issue survey permit in their waters. As the results, the survey area was re-constructed in the Japanese domestic waters of Sea of Japan. Because information of distribution of the whales in this area in this season was scarce, a systematic sighting survey was conducted to find them. This paper provides the results of the sighting survey, tagging attempt, and tracking results of common minke whales in 2012.

MATERIALS AND METHODS

Sighting survey protocol

The research was conducted within Exclusive Economic Zones (EEZ) of Japan of the Sea of Japan. Necessary permits to conduct the survey were obtained from Governments of Japan. The research vessel, *Shonan-maru*

No.2 (712GT, 4,045KW) was used as a sighting and tagging vessel. The barrel and front bridge heights are 20m and 14m above the water surface, respectively. Cruise was scheduled for 40 days, from 12 October to 20 November 2012. One of us (HM) acted as the cruise leader. Embarkation and disembarkation of the researcher occurred at Shimonoseki, Japan. Tracklines were constructed by using software, DISTANCE version 6.0 (Thomas *et al*., 2010). Additional non-systematic tracklines were also constructed within the survey area where sightings of minke whales were highly expected. The survey was conducted daily from 30 minutes after sunrise to 30 minutes before sunset in local time. The vessel covered a predetermined trackline at a speed of 11.5konts. On effort observations were only conducted when visibility was greater than 2 n.miles (3.7km) and Beaufort scale was lower than 4. During the on-effort periods, two observers were in the top barrel and five observers, including the captain and the researchers, were at the front bridge. No observers were allocated to the platforms during off-effort period in principle. For each sighting, the distance from the vessel to the whales was estimated using 7×50 binoculars with reticule and the sighting angle with reference to the course of the vessel was estimated using an angle board installed in each observation booth. The survey was conducted in closing mode (all cetacean schools found were approached close enough to confirm species identity, number of individuals in the school and approximate body length of individuals). These data along with sighting positions were recorded. The cruise leader confirmed the species identity while experienced observers in the top barrel made visual estimates of number and body length of individuals. Cetacean groups recorded during on effort and off effort are considered primary and secondary sightings, respectively. No distance and angle estimation experiment was conducted because abundance estimation was not primary objective of the survey.

Satellite tagging

Basically, all common minke whales encountered were targeted for tagging. The time for chasing was usually limited to a maximum of 120 minutes against one animal. The Wildlife Computers Spot-5 implantable tags were used as the Argos transmitter. The tagging dart system and methods of attachment were followed to the methods developed for the coastal Bryde's whales by the NRIFSF (Kishiro and Minamikawa, 2006) and same methods for common minke whales in the 2010 survey (Kishiro, *et. al*., 2011). A handy air gun with a 40mm-caliber (Miroku Machinery Co. Ltd) was used for attachment. The filling pressure was set to 110kgf/cm^2, and firings were made from the bow when the vessel could adequately approach the whale during the chasing. The tagging dart consists of a dart with 3-bladed tip, an Argos transmitter, and retrievable float. The float was connected with dart by aqueous rope. When the whale is hit, the dart becomes embedded in the blubber and muscle, the float is come off, and antenna of the transmitter is exposed on the body surface. When the whale is missing, the dart with float can be retrieved. The dart was coated with povidone iodine to mitigate physical damage and potential infection caused by tagging. The location data of tags were obtained through the Argos satellite-based data collection and location system.

Biopsy sampling

Biopsy sampling was attempted for common minke whales. Sampling was conducted from the bow of the vessel with a Larsen gun.

Bottom topography and SST data

Following data were used in the illustrative maps in Fig.2: "A Global Self-consistent, Hierarchical, High-resolution Geography Database" for coastline (Wessel and Smith, 1996), "ETOPO1 Global Relief Model" for bottom topography (Amante and Eakins, 2009) and "Level 3 Rolling 32-day composite SST data (from 15 October to 15 November 2012, 11 μ daytime, 9km) derived from the Moderate Resolution Imaging Spectro-radiometer (MODIS) aboard the satellite Aqua". The Aqua MODIS data were downloaded from Ocean Color Web (http://oceancolor.gsfc.nasa.gov/).

RESULTS

Sightings

Fig. 2 shows the actual tracklines covered by the vessel and sighting positions of large whales. The vessel covered 1,537.7 n.miles. Average survey distance per day was 39.7 n.miles. Numbers of sightings are given in Table 1. A total of 8 schools/9 animals of minke whales were sighted in the survey. Among them, 6/7 were primary sightings. A total of 10/17 of fin whales were sighted during the survey. All of them were primary sightings. Fin and minke whales were only large whales observed during the survey. Fin whales were distributed in the south of the survey area where STT and bottom depth were relatively high and deep, respectively. Minke whales were distributed in the north of the survey area where SST and bottom depth were relatively low and shallow, respectively.

Satellite tagging and biopsy sampling

Satellite tagging was attempted to 8 animals from 8 schools but there were only two occasions to shoot. Satellite tags were attached to two animals in these occasions (Table2). In other occasions, the vessel could not approach to animals within enough shooting range (about 20m from the vessel). The first shooting was taken place at 45°16.2'N, 141°23.1'E on 6 November 2012. One animal of 1 school was targeted in this case. Estimated body length of the animal was 6.7m. A satellite tag was successfully attached to lower part of abdomen in the left side of the animal after 22 minutes of chasing, but no geographical position was obtained. This could be largely because of position of attachment on the body of animal.

Second shooting was taken place at almost same location (45°17.2'N, 141°24.0'E) on 6 November 2012. The sighted school was mother and calf pair. Their estimated body lengths were 6.7 and 3.8m respectively. The target was mother. A satellite tag was successfully attached on the dorsal body region near the blowhole after 1 hour and 42 minutes of chasing. In this occasion, the tag transmitted the geographical locations until 19 November 2012 (14 days). Biopsy sampling with a Larsen gun was attempted simultaneously when tagging the whales, but it was failed, and samples could not be obtained.

Tracking results

Fig. 3 shows results of the electric wave reception by the Argos satellite. In first animal (Argos ID 112513), although the tag transmitted signals 20 times during the period from 7 to 25 November, no geographical position was obtained, as mentioned above. Number of transmissions was ranged from one to four per day, and sporadic transmission caused by the position of the tag attachment (almost stayed in under waters) prevented the estimation for geographical location. After 26 November, no signal has been received by the satellite, and the tag was thought to be fallen out.

In second animal (Argos ID 112512), a total of 141 transmissions were obtained during the period from 6 to 19 November. Among them, a total of 89 locations were obtained with the accuracy location class of 1(one time), 0(one time), A (ten times) and B (77 times). The accuracy of each location class is 350-1,000m for class 1, 1,000m and more for class 0, 46km or below for class A, and 73km or below for class B, respectively. (Baba, *et. al.,* 1997). The movement of the whale is shown in Fig. 4. The whale was tagged in the near shore area of the east coast of the Rishiri Island, north of Hokkaido and almost stayed around there until 17 September (12 days from the attachment). After that, the whale moved to the Okhotsk Sea through the south of Sakhalin to the coast off Abashiri, during the period from 19:36pm on 17 September to 9:07am on 19 September. During that period, the distance travelled was 302.8km, and the average speed of the movement was 8.07km/hour. After 20 November, no signal has been received by the satellite, and the tag was thought to be fallen out.

DISCUSSION

This is the second time of successful tracking of movement of common minke whales in the western North Pacific. In this cruise, we attached two tags to two animals out of 8 sightings. We are confident that our tagging methodology is feasible in the field. However, tracking periods was still short, and more improvements were need for increasing the tagging success rate and the extension of the tracking period. Improvement for blades of the dart is thought to be necessary, and use of the other shooting gears such as the Norwegian LK-Arts system (e.g. Heide- Jorgensen et al. 2001; Olsen et al., 2009) will be also useful to examine the technical improvements.

Results of the tacking suggested that the whale dose not moved for long distances, and possibly stayed in the northern coastal waters, for at least 14 days in autumn season. The east coast of the Rishiri Island where tagged animal stayed is known as a fishing ground of two species of sandlance, Pacific Sand Lance (*Ammodytes hexapterus*) and Japanese sand lance (*A. presonatus*) in spring to autumn (Kaga, *et. al*., 2012). Since the sand lance is one of the major prey species for common minke whales in this area (Kasamatsu and Tanaka, 1992) as well as other part of Japan (Yoshida, *et. al*., 2011), those prey may attract the whales, and possibly contribute short residence of the whales in this waters. Movements of the tagged animal suggested that southbound migration to wintering breeding ground did not start in late November, and the animal continued to feed in the northern coastal regions. The concentrated distribution of the sightings of common minke whales in the northern regions observed (Fig. 2) also suggested that the southbound migration did not start in at least the periods of this cruise. Similar result was obtained in the Pacific side of the Hokkaido (off Kushiro) where tagged animal stayed until 9 October in 2010 (Kishiro, *et. al*., 2011). Furthermore, the tagged animal was mother with a calf. Since the body length at birth of the northern Hemisphere common minke whales was estimated to be 2.6m (Kato, 1990), the estimated body length of the observed calf (3.8m) suggested that the birth was occurred in much earlier in elsewhere. In the case of Gary whales, it is known that the timing to start migration is different among sex, maturity, and reproductive state, and females with calves begin to travel last (Wolman, 1985). These implied possible longer stay of mother and calf of common minke whales in northern feeding grounds.

Unfortunately, biopsy samples from the tracking animal could not be obtained, though the sampling attempt was made. Around the coastal waters off Japan including the research area in this study, two stocks (J stock: mainly distributed in the Sea of Japan; O stock: mainly distributed in the western North Pacific) of common minke whales are known to be existed, and genetically identified. Because the J stock distributed in both the Sea of Japan and the Okhotsk Sea, and the O stock distributed in both the northern coastal part of the Sea of Japan and the Okhotsk Sea (Kanda, *et. al*., 2009), we could not determine the stock identity of the tracking animal based on the short tracking results of this study, though the estimated body length of the calf implied that the conception of the calf might be occurred in autumn in last year. The autumn conception is one of the biological features of the J stock (Kato, 1992). However, there is no definite evidence. Continuing the simultaneous tagging and biopsy sampling is important in future surveys.

Anyway, sample size is too small to obtain the firm conclusions. In addition to the tagging methodological improvements, it is important to continue the exercise, and gather much more tracking data from many other individuals. For understanding the migration of animals in both the Sea of Japan (sub-area 6 and 10), and the Okhotsk Sea (sub-area 11 and 12), surveys in the Russian waters are critically important. Those surveys and data could bring further information on the migratory route, breeding ground, and stock identification, and could contribute to the future works on implementation assessment, and management of the North Pacific common minke whales.

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Table 1. Number of sightings made by the *Shonan-maru No.2* survey in 2012.

	Primary		Secondly		Total	
Species	sch.	ind.	sch.	ind.	sch.	ind.
Common minke whale	6	7	2	2	8	9
fin whale	10	17	0	0	10	17

Table 2. Results of shooting the satellite tags for common minke whales in 2012.

Argos ID no.	Date	School size	Estimated BL (m)	Time for chasing (h:m)	Firing distance (m)	Verdicts	Transmitter attached
112513	6 Nov.	1	6.7	0:22	15	Hit	Fix
112512	6 Nov.	2*	6.7	1:42	15	Hit	Fix

*Cow (6.7m) and calf (3.8m) pair. Mother was targetted and attached.

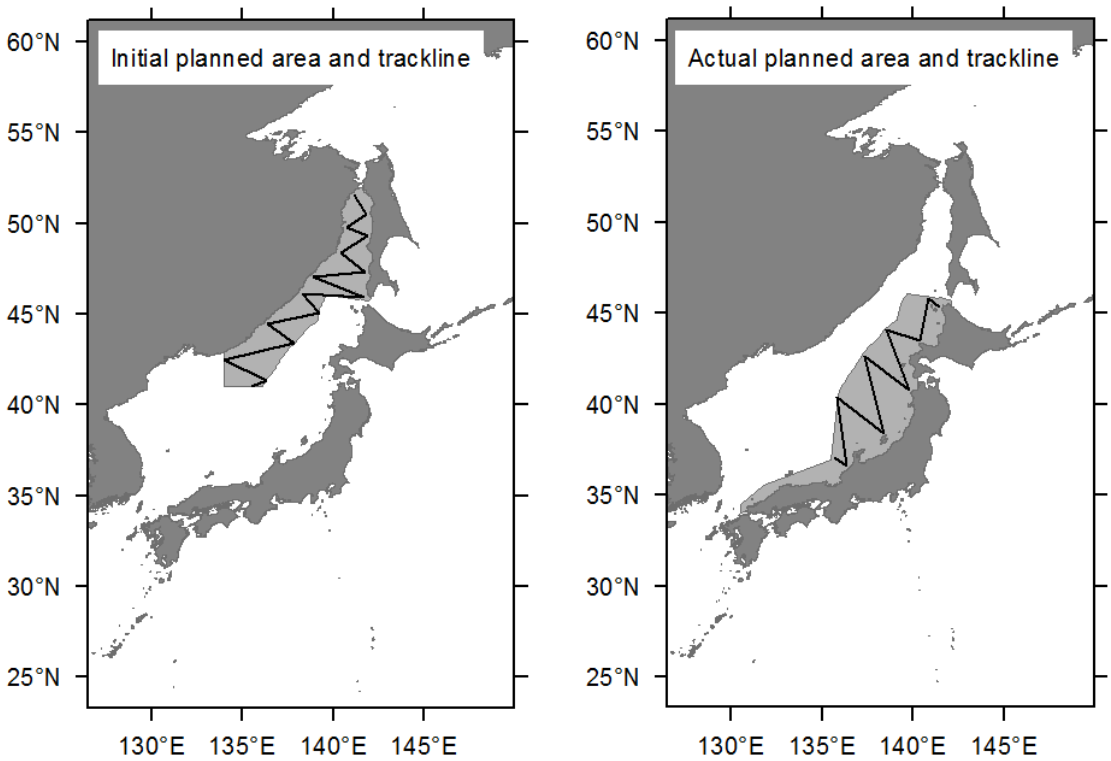

Fig. 1. Planed survey areas and tracklines in autumn 2012. Initially, the survey was planned in the Russian waters of Sea of Japan (left). However, it was unfortunate that Government of the Russian Federation did not issue survey permit in their waters. Given that condition, alternative survey area and tracklines were set in the Japanese waters of Sea of Japan (right).

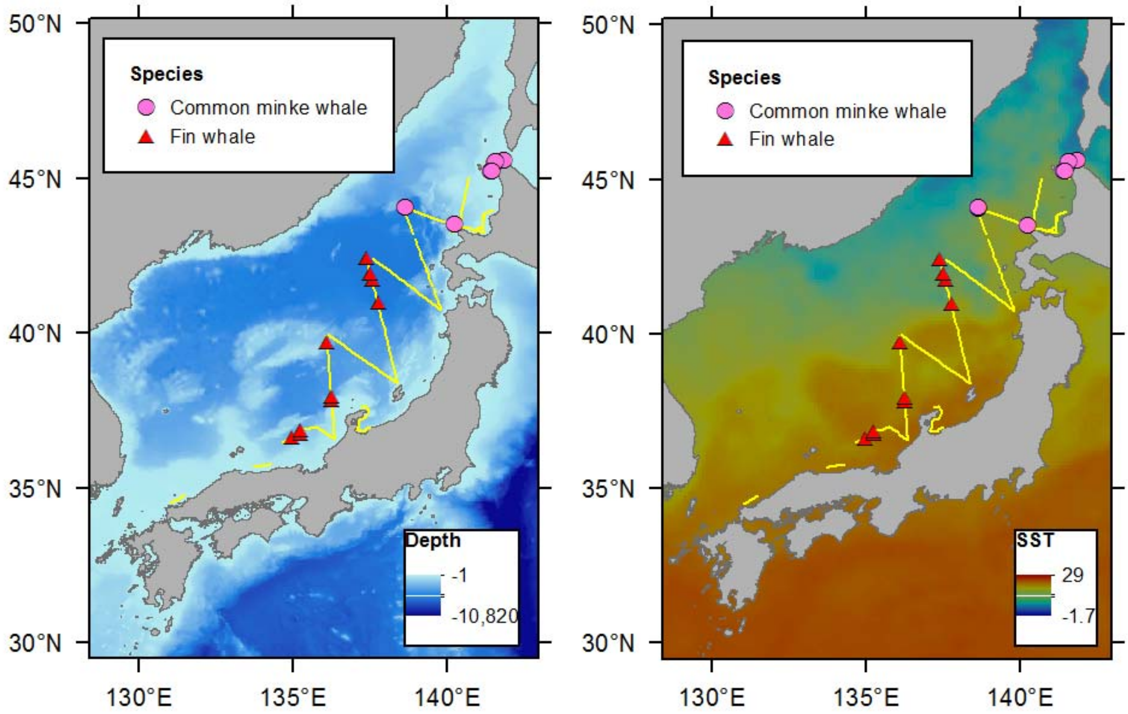

Fig. 2. Sighting positions of large whales in the Japanese waters of Sea of Japan in autumn 2012. Fin and common whales were only large whales in the area. Yellow lines represents surveyed tracklines. Bottom topography (left) and sea surface temperature (SST, right) are overlaid in the figures.

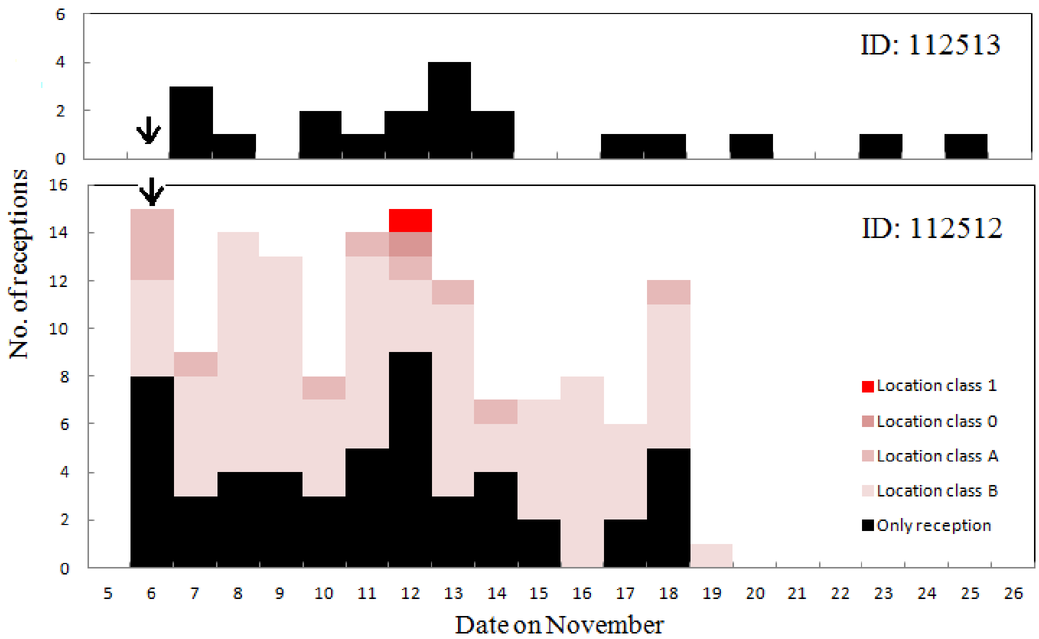

Fig. 3. The electric wave receptions by the Argos satellite. Arrows indicate the date of tag attachment.

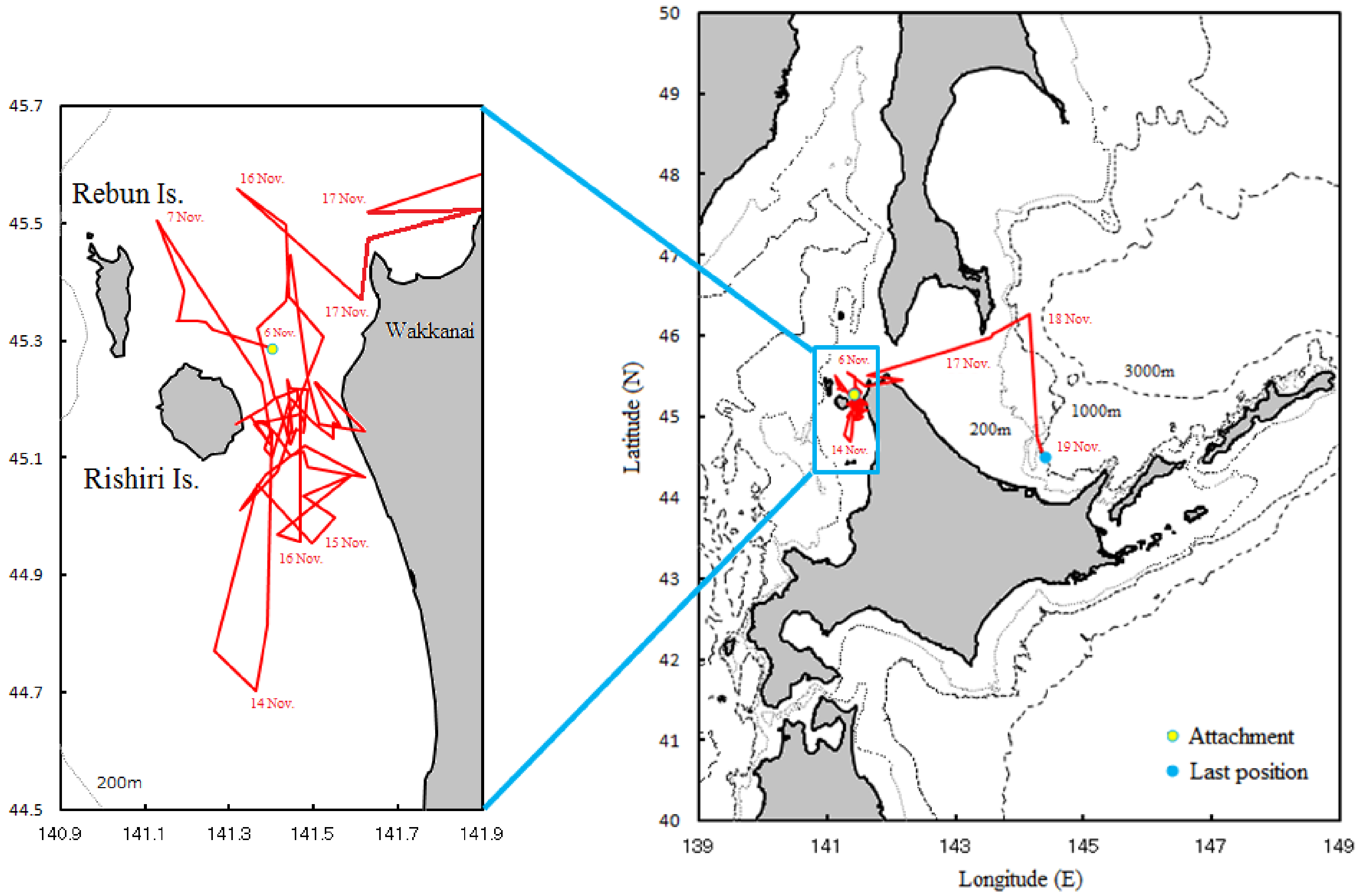

Fig. 4. Movements of a common minke whale tagged on 6 November, and tracked until 19 November (14 days) in 2012.