30 Years: 1992 - 2022

## NAMMCO ANNUAL MEETING 29

*13-15 September 2022*
*Grand Hotel, Oslo & Hybrid*

# MEETING OF THE COUNCIL

| NAMMCO/29/NPR/ JA-2021 | NATIONAL PROGRESS REPORTS JAPAN – 2021 |
|---|---|
| **Submitted by** | Japan |
| **Action requested** | For information |
| **Background/content** | National Progress Report 2021 from Japan contains:<br>a. Large Cetaceans<br>b. Small Cetaceans<br>c. Satellite Tagging Experiments<br>d. Management Procedures for North Pacific Common Minke Whales |

# Japan. Progress report on large cetacean research during April 2020 to March 2021

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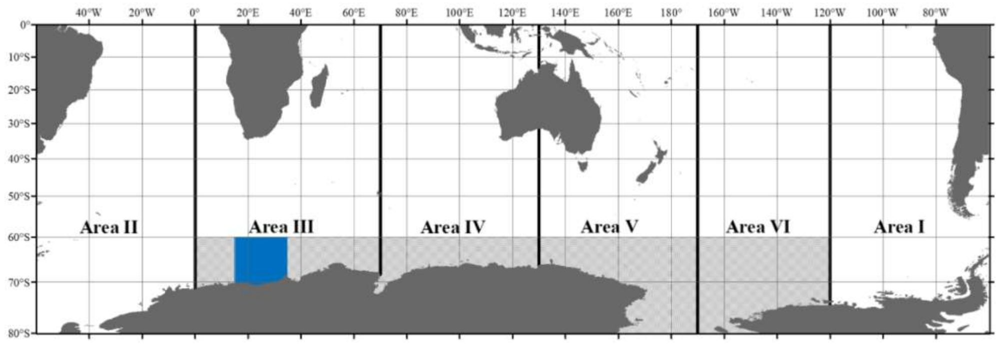
This document summarizes the data and samples of large cetacean, which were collected by the Institute of Cetacean Research (ICR), Fisheries Resources Institute (FRI) and Fisheries Agency of Japan (FAJ) from April 2020 to March 2021 and austral summer season 2020/21. Sighting data for abundance estimates of large cetaceans were collected in the western North Pacific, the Central North Pacific and the Antarctic during systematic sighting surveys. During the surveys, photo-id, biopsy and satellite tracking experiments on large cetaceans were also conducted. A large numbers of biological data and samples were collected from commercial whaling in Japan's Exclusive Economic Zone (EEZ). Species and figures of bycatch and stranding of large cetaceans were based on the reports of prefecture governments to the FAJ, which compile reports from individual fishermen, fishery cooperative associations and the general public. Data and samples collected are being analyzed for contributing to the stock assessment and management of large cetaceans in the North Pacific.

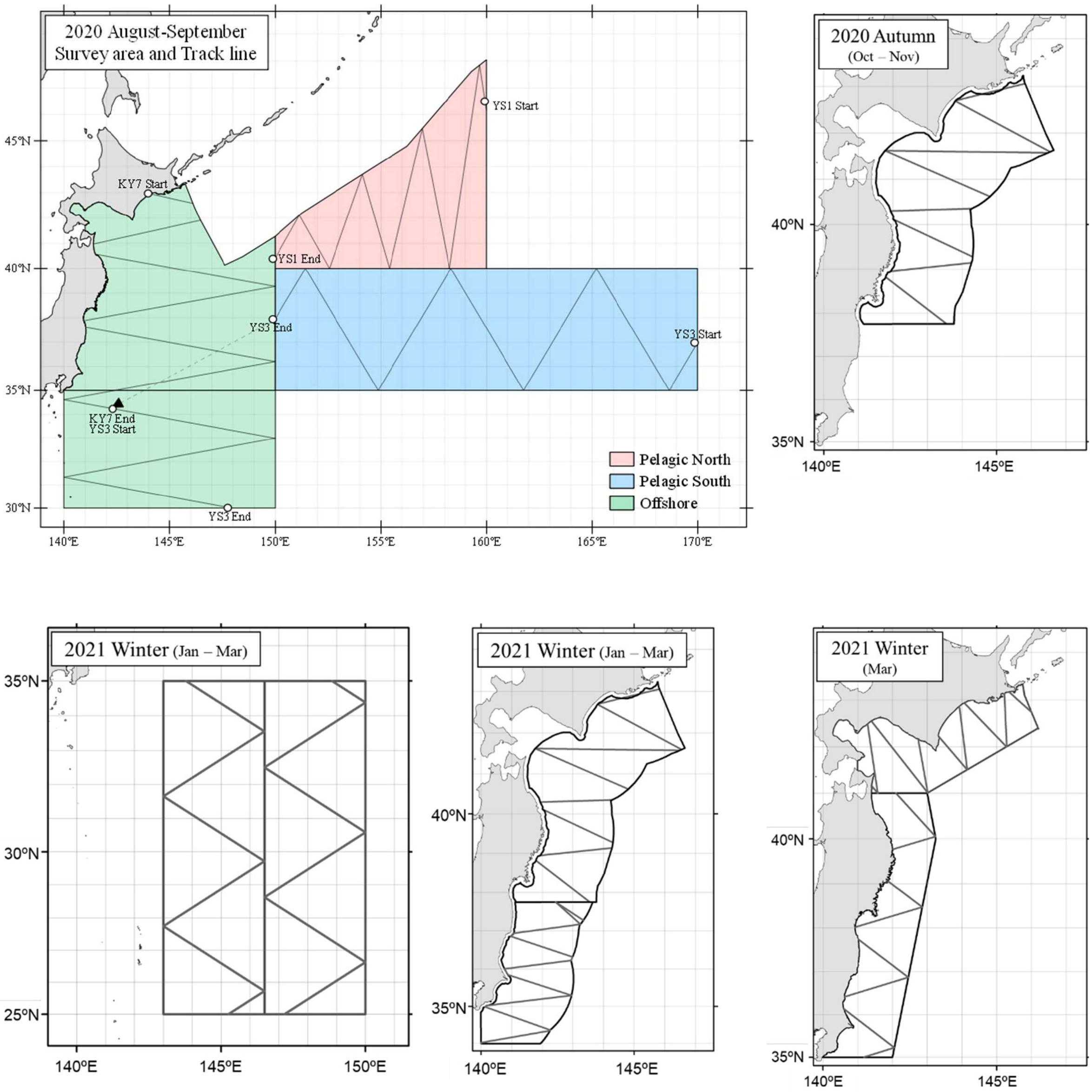
## 1. SIGHTING DATA

Dedicated sighting survey under the program Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A) in the Southern Ocean in the austral summer season 2020/21 (vessel: *Yushin-Maru No.2*).




| Species | Date (research period) | Local area | No. of schools/No. of individuals | Contact person |
|---|---|---|---|---|
| Blue whale | 20 Dec/20 – 4 Mar/21 | Area IIIW | 24/29 | T. Isoda (ICR) isoda@cetacean.jp |
| Fin whale | | Area IIIW + Transit | 153/257 | |
| Like fin | | Area IIIW | 2/2 | |
| Bryde's whale | | Transit | 1/1 | |
| Antarctic minke whale | | Area IIIW + Transit | 53/122 | |
| Like minke | | Area IIIW | 1/1 | |
| Humpback whale | | Area IIIW + Transit | 384/739 | |
| Like humpback | | Area IIIW | 1/1 | |
| Sperm whale | | Area IIIW + Transit | 9/9 | |
| Southern bottlenose whale | | Area IIIW + Transit | 7/20 | |

Dedicated sighting surveys under national program in the western North Pacific in 2020 summer and autumn, and 2021 winter (vessels: *Yushin-Maru*, *Yushin-Maru No.3* and *Kaiyo-Maru No.7*).

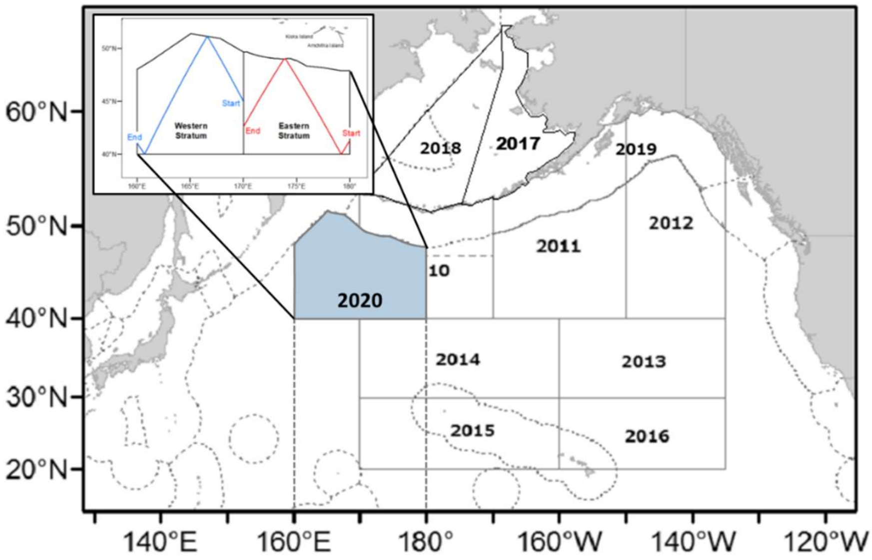



| Species | Date (research period) | Local area | No. of schools/ No. of individuals* | Contact person |
|---|---|---|---|---|
| Blue whale | 4 Aug - 19 Sep/20 | Western North Pacific | 4/4 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Fin whale | 4 Aug - 19 Sep/20 | Western North Pacific | 50/67 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 1/1 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 5/5 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 4/4 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 9/14 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 5/10 | |
| Like fin | 4 Aug - 19 Sep/20 | Western North Pacific | 1/1 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 1/1 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 1/1 | |

| | | | | |
|---|---|---|---|---|
| Sei whale | 4 Aug - 19 Sep/20 | Western North Pacific | 49/60 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 2/2 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 25/28 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 1/1 | |
| Like sei | 4 Aug - 19 Sep/20 | Western North Pacific | 4/5 | |
| Bryde's whale | 4 Aug - 19 Sep/20 | Western North Pacific | 69/101 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 80/104 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 144/180 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 19/22 | |
| | 31 Jan - 4 Mar/21 | Western North Pacific | 7/8 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 2/2 | |
| Like Bryde's | 4 Aug - 19 Sep/20 | Western North Pacific | 6/6 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 1/1 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 3/3 | |
| Common minke whale | 7 Aug - 18 Sep/20 | Western North Pacific | 2/2 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 1/1 | |
| North Pacific right whale | 31 Jan - 5 Mar/21 | Western North Pacific | 1/1 | |
| Humpback whale | 4 Aug - 19 Sep/20 | Western North Pacific | 1/1 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 1/1 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 25/36 | |
| | 31 Jan - 4 Mar/21 | Western North Pacific | 3/6 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 11/15 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 9/12 | |
| Sperm whale | 4 Aug - 19 Sep/20 | Western North Pacific | 61/139 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 42/77 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 115/330 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 25/75 | |
| | 31 Jan - 4 Mar/21 | Western North Pacific | 7/14 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 52/152 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 14/56 | |
| Unidentified large whale | 4 Aug - 19 Sep/20 | Western North Pacific | 10/10 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 4/4 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 10/10 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 6/6 | |
| | 31 Jan - 4 Mar/21 | Western North Pacific | 1/1 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 1/1 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 1/1 | |
| Unidentified cetacean | 4 Aug - 19 Sep/20 | Western North Pacific | 4/4 | |
| | 6 Aug - 4 Sep/20 | Western North Pacific | 1/2 | |
| | 7 Aug - 18 Sep/20 | Western North Pacific | 5/8 | |
| | 14 Oct - 15 Nov/20 | Western North Pacific | 2/2 | |
| | 31 Jan - 4 Mar/21 | Western North Pacific | 2/2 | |
| | 31 Jan - 5 Mar/21 | Western North Pacific | 1/2 | |
| | 4 Mar - 25 Mar/21 | Western North Pacific | 1/1 | |

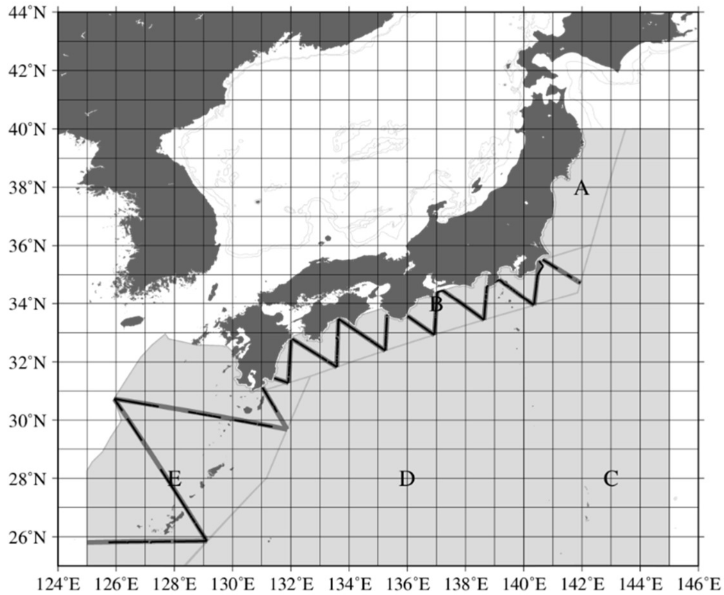
*: Primary sighting

Dedicated sighting survey under the program International Whaling Commission-Pacific Ocean Whale and Ecosystem Research (IWC-POWER) in the North Pacific (vessel: *Yushin-Maru No.2*) in 2020.




| Species | Date (survey period) | Local area | No. of schools/ No. of individuals | Contact person |
|---|---|---|---|---|
| Blue whale | 11 Jul - 24 Sep/20 (1st half: 18 Jul - 12 Aug, 2nd half: 26 Aug - 17 Sep) | Central North Pacific | 22/31 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Fin whale | | Central North Pacific | 29/32 | |
| Like fin | | Central North Pacific | 2/2 | |
| Sei whale | | Central North Pacific + Transit | 131/181 | |
| Like sei | | Central North Pacific | 12/12 | |
| Bryde's whale | | Central North Pacific + Transit | 6/8 | |
| Like Bryde's | | Central North Pacific | 1/1 | |
| Like sei/Bryde's | | Central North Pacific + Transit | 1/1 | |
| Common minke whale | | Central North Pacific | 3/3 | |
| Humpback whale | | Central North Pacific | 7/8 | |
| Sperm whale | | Central North Pacific + Transit | 56/90 | |
| Unidentified large whale | | Central North Pacific + Transit | 18/22 | |
| Unidentified cetacean | | Central North Pacific + Transit | 1/1 | |

Dedicated sighting survey on small cetacean in the western North Pacific in 2020 (vessel: *Kaiyo-Maru No.7*).




| Species | Date (research period) | Local area | No. of schools/No. of individuals* | Contact person |
|---|---|---|---|---|
| Sperm whale | 19 May – 6 Jul/20 | Western North Pacific | 3/3 | H. Yoshida (FRI) hideka@affrc.go.jp |
| Unidentified large whale | | | 3/3 | |

*: Primary sighting

## 2. MARKING DATA

### 2.1. Natural marking data

*JASS-A survey-Antarctic in 2020/21*

| Species | Feature | Local area | No. of individuals photo identified | Contact person |
|---|---|---|---|---|
| Blue whale | Head, dorsal, lateral marking | Area IIIW | 20 | T. Isoda (ICR) isoda@cetacean.jp |
| Humpback whale | Fluke, dorsal marking | | 41 | |

*National dedicated sighting-western North Pacific from April 2020 to March 2021*

| Species | Feature | Local area | No. of individuals photo identified | Contact person |
|---|---|---|---|---|
| Blue whale | Head, dorsal, lateral marking | Western North Pacific | 4 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Humpback whale | Fluke, dorsal fin | Western North Pacific | 5 | |
| North Pacific right whale | Head | Western North Pacific | 1 | |

*IWC-POWER dedicated sighting-North Pacific in 2020*

| Species | Feature | Local area | No. of individuals photo identified | Contact person |
|---|---|---|---|---|
| Blue whale | Head, dorsal, lateral marking | Western North Pacific | 26 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Fin whale | Lateral marking | | 1 | |
| Humpback whale | Fluke, dorsal fin | | 3 | |

### 2.2. Telemetry data

*JASS-A survey-Antarctic in 2020/21*

| Species | Tag type | Local area | No. of individuals tagged | Contact person |
|---|---|---|---|---|
| Fin whale | Satellite | Area IIIW | 7 | K. Konishi (ICR) konishi@cetacean.jp |
| Antarctic minke whale | Satellite | | 10 | |
| Humpback whale | Data logger | | 2 | |

*National dedicated sighting-western North Pacific from April 2020 to March 2021*

| Species | Tag type | Local area | No. of individuals tagged | Contact person |
|---|---|---|---|---|
| Fin whale | Satellite | Western North Pacific | 7 | K. Konishi (ICR) konishi@cetacean.jp |
| Sei whale | Satellite | | 11 | |

*Abashiri coastal tagging and biopsy survey in 2020*

| Species | Tag type | Local area | No. of individuals tagged | Contact person |
|---|---|---|---|---|
| Fin whale | Satellite | Off Abashiri | 2 | K. Konishi (ICR) konishi@cetacean.jp |

## 3. BIOPSY SAMPLES

*JASS-A survey-Antarctic in 2020/21*

| Species | Local area | No. of individuals sampled | Contact person |
|---|---|---|---|
| Blue whale | Area IIIW | 8 | T. Isoda (ICR) isoda@cetacean.jp |
| Fin whale | | 15 | |
| Bryde's whale | | 1 | |
| Antarctic minke whale | | 14 | |
| Humpback whale | | 16 | |

*National dedicated sighting-western North Pacific from April 2020 to March 2021*

| Species | Local area | No. of individuals sampled | Contact person |
|---|---|---|---|
| Blue whale | Western North Pacific | 2 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Fin whale | | 16 | |
| Sei whale | | 15 | |
| Humpback whale | | 2 | |
| North Pacific right whale | | 1 | |

*IWC-POWER dedicated sighting-western North Pacific in 2020*

| Species | Local area | No. of individuals sampled | Contact person |
|---|---|---|---|
| Blue whale | Western North Pacific | 13 | K. Matsuoka (ICR) matsuoka@cetacean.jp |
| Fin whale | | 9 | |
| Sei whale | | 38 | |
| Bryde's whale | | 1 | |
| Humpback whale | | 2 | |

*Abashiri coastal tagging and biopsy survey in 2020*

| Species | Local area | No. of individuals sampled | Contact person |
|---|---|---|---|
| Fin whale | Off Abashiri | 5 | K. Konishi (ICR) konishi@cetacean.jp |
| Common minke whale | | 1 | |

## 4. DIRECT CATCHES OF CETACEANS

### 4.1. Biological samples from commercial whaling, *offshore component (2020)*

| Species | Area | Samples and data | No. of individuals | Contact person/institute |
|---|---|---|---|---|
| Sei whale | Western North Pacific | Body length and sex | 25 | FAJ<br><br>T. Tamura (ICR)<br>tamura@cetacean.jp |
| | | Photographic record and external character | 25 | |
| | | Record of external parasites | 25 | |
| | | Measurements of blubber thickness (two points) | 25 | |
| | | Body weight | 25 | |
| | | Skin tissues for DNA analysis | 25 | |
| | | Muscle, liver and blubber for various analysis | 25 | |
| | | Collection of blood plasma | 25 | |
| | | Mammary grand; lactation status, measurement and histological sample | 16 | |
| | | Collection of ovary | 16 | |
| | | Foetal sex (identified by visual observation) | 3 | |
| | | Photographic record of foetus | 3 | |
| | | Foetal length and weight | 3 | |
| | | Foetal skin tissues for DNA analysis | 3 | |
| | | Eye lens of foetus for age determination | 2 | |
| | | Testis; weight and histological sample | 9 | |
| | | Stomach contents and convenient record | 25 | |
| | | Observation of marine debris in stomach | 25 | |
| | | Earplug for age determination | 25 | |
| | | Eye lens for age determination | 25 | |
| Bryde's whale | | Body length and sex | 187 | |
| | | Photographic record and external character | 187 | |
| | | Record of external parasites | 187 | |
| | | Measurements of blubber thickness (two points) | 187 | |
| | | Body weight | 187 | |
| | | Skin tissues for DNA analysis | 187 | |
| | | Muscle, liver and blubber for various analysis | 187 | |
| | | Collection of blood plasma | 133 | |
| | | Mammary grand; lactation status, measurement and histological sample | 102 | |
| | | Collection of ovary | 102 | |
| | | Foetal sex (identified by visual observation) | 25 | |
| | | Photographic record of foetus | 25 | |
| | | Foetal length and weight | 25 | |
| | | Foetal skin tissues for DNA analysis | 25 | |
| | | Eye lens of foetus for age determination | 1 | |
| | | Testis; weight and histological sample | 85 | |
| | | Stomach contents and convenient record | 187 | |
| | | Observation of marine debris in stomach | 187 | |
| | | Earplug for age determination | 187 | |
| | | Eye lens for age determination | 187 | |

### 4.2. Biological samples from commercial whaling, *coastal component (2020)*

| Species | Area | Samples and data | No. of individuals | Contact person/institute |
|---|---|---|---|---|
| Common minke whale | Western North Pacific | Body length and sex | 95 | FAJ<br><br>H. Yoshida (FRI)<br>hideka@affrc.go.jp<br><br>T. Tamura (ICR)<br>tamura@cetacean.jp |
| | | External body proportion | 95 | |
| | | Photographic record and external character | 95 | |
| | | Body scar record | 95 | |
| | | Measurements of blubber thickness (two points) | 95 | |
| | | Skin tissues for DNA analysis | 95 | |
| | | Muscle, liver and blubber for various analysis | 95 | |
| | | Mammary grand; lactation status and measurement | 32 | |
| | | Uterine horn; measurements and endometrium sample | 29 | |
| | | Collection of ovary | 28 | |
| | | Foetal sex (identified by visual observation) | 13 | |
| | | Photographic record of foetus | 13 | |
| | | Foetal length and weight | 13,11 | |
| | | Foetal skin tissues for DNA analysis | 13 | |
| | | Eye lens of foetus for age determination | 12 | |
| | | Testis; weight and histological sample | 63 | |
| | | Stomach contents and convenient record | 95 | |
| | | Earplug for age determination | 95 | |
| | | Eye lens for age determination | 95 | |
| | | Baleen plate for age determination (body length ≤ 6 m) | 15 | |

## 5. FISHERIES BYCATCHES OF CETACEANS

| Species | No. of animals | Location[1)] | Fate [2)] | Gear [3)] | Target fish species [4)] | Source or contact |
|---|---|---|---|---|---|---|
| Common minke whale | 8 | Hokkaido | K | FPN | NA | FAJ |
| | 1 | | D | | | |
| | 2 | Aomori | K | FPN | | |
| | 6 | Iwate | K | FPN | | |
| | 8 | Miyagi | K | FPN | | |
| | 1 | Akita | K | FPN | | |
| | 1 | Ibaraki | D | FPN | | |
| | 1 | Chiba | K | FPN | | |
| | 1 | Kanagawa | K | FPN | | |
| | 3 | Niigata | K | FPN | | |
| | 2 | Toyama | K | FPN | | |
| | 13 | Ishikawa | K | FPN | | |
| | 2 | Fukui | K | FPN | | |
| | 1 | Mie | K | FPN | | |
| | 3 | Kyoto | K | FPN | | |
| | 3 | Wakayama | K | FPN | | |
| | 2 | Shimane | K | FPN | | |
| | 1 | Yamaguchi | K | FPN | | |
| | 1 | Tokushima | K | FPN | | |
| | 2 | Kochi | K | FPN | | |
| | 1 | Fukuoka | K | FPN | | |
| | 1 | Saga | K | FPN | | |
| | 6 | Nagasaki | K | FPN | | |
| | 1 | Miyazaki | K | FPN | | |
| | 1 | Kagoshima | K | FPN | | |
| Fin whale | 1 | Kyoto | K | FPN | | |
| Humpback whale | 3 | Shizuoka | R | FPN | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | Wakayama | R | FPN | | |

1) Recorded at the place of fishing gears.
2) Fate of whale: D = discarded dead or seriously injured, K = kept for sale or specimen, R = released alive.
3) Described using "FAO FISHING DESCRIPTION AND CODES", that is, stationary uncovered pound nets (FPN), set gillnets (GNS) and miscellaneous gear (MIS).
4) Target fish species: NA = not available

## 6. STRANDING OF CETACEANS

| Species | No. strandings | Prefecture | Source or contact |
|---|---|---|---|
| Common minke whale | 4 | Hokkaido | FAJ |
| | 1 | Aomori | |
| Sei whale | 1 | Ibaraki | |
| Bryde's whale | 2 | Miyagi | |
| Fin whale | 1 | Hokkaido | |
| | 1 | Kanagawa | |
| | 1 | Fukui | |
| | 1 | Fukuoka | |
| Humpback whale | 3 | Chiba | |
| | 1 | Kanagawa | |
| Gray whale | 1 | Hokkaido | |
| Sperm whale | 1 | Hokkaido | |
| | 1 | Ibaraki | |
| | 1 | Tokyo | |
| | 1 | Shizuoka | |
| | 1 | Yamaguchi | |
| | 1 | Kumamoto | |
| | 1 | Miyazaki | |
| | 1 | Kagoshima | |
| | 1 | Okinawa | |

## 7. PUBLICATIONS (2021)

Cunen, C., Walløe, L., Konishi, K. and Hjort, N.L. 2021. Decline in body condition in the Antarctic minke whale (*Balaenoptera bonaerensis*) in the Southern Ocean during the 1990s. *Polar Biol* 44 (2): 259–273.

Fujise, Y. and Pastene, L.A. 2021. Whales as indicators of historical and current changes in the marine ecosystem of the Indo-Pacific sector of the Antarctic. pp. 85–104. In: M. Kanao, D. Godone and N. Dematteis (Eds). *Glaciers and Polar Environment*. IntechOpen. 200 pp.

Gomes, T.L., Quiazon, K.M., Kotake, M., Fujise, Y., Ohizumi, H., Itoh, N. and Yoshinaga, T. 2021. *Anisakis* spp. in toothed and baleen whales from Japanese waters with notes on their potential role as biological tags. *Parasitology International* 80: 102228.

Matsuoka, K., Crance, J.L., Taylor, J.K.D., Yoshimura, I., James, A. and An, Y-R. 2021. North Pacific right whale (*Eubalaena japonica*) sightings in the Gulf of Alaska and the Bering Sea during IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER) surveys. *Marine Mammal Science*. Doi: 10.1111/mms.12889.

Milmann, L., Taguchi, M., Siciliano, S., Baumgarten, J.E., Oliveira, L.R., Valiati, V.H., Goto, M., Ott, P.H. and Pastene, L.A. 2021. New genetic evidences for distinct populations of the common minke whale (*Balaenoptera acutorostrata*) in the Southern Hemisphere. *Polar Biology* 44 (8): 1575-1589.

Nishimura, F., Kim, Y., Bando, T., Fujise, Y., Nakamura, G., Murase, H. and Kato, H. 2021. Morphological differences in skull and feeding apparatuses between Antarctic (*Balaenoptera bonaerensis*) and common (*Balaenoptera acutorostrata*) minke whales, and the implication for their feeding ecology.

*Canadian Journal of Zoology*. Doi:10.1139/cjz-2020-0237.

Suyama, S., Yanagimoto, T., Nakai, K., Tamura, T., Shiozaki, K., Ohshimo, S. and Chow, S. 2021. A taxonomic revision of *Pennella* Oken, 1815 based on morphology and genetics (Copepoda: Siphonostomatoida: Pennellidae). *Journal of Crustacean Biology* 41 (3): ruab040.

Uchida, M., Suzuki, I., Ito, K., Ishizuka, M., Ikenaka, Y., Nakayama, S.M.M., Tamura, T., Konishi, K., Bando, T. and Mitani, Y. 2021. Estimation of the feeding record of pregnant Antarctic minke whales (*Balaenoptera bonaerensis)* using carbon and nitrogen stable isotope analysis of baleen plates. *Polar Biol* 44 (3): 621–629.

Yamazaki, K., Aoki, S., Katsumata, K., Hirano, D. and Nakayama, Y. 2021. Multidecadal poleward shift of the southern boundary of the Antarctic Circumpolar Current off East Antarctica. *Sci. Adv*. 7 (24): eabf8755.

# Japan's Scientific Progress report on Small Cetaceans in the fiscal year 2019 (April 2019 to March 2020), with statistical data for the *calendar year* 2019

COMPILED BY SHINGO MINAMIKAWA

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This report summarizes statistical data on small cetacean fisheries in 2019（calendar year) as well as research conducted during the fiscal year 2019 (April 2019 to March 2020) by the National Research Institute of Far Seas Fisheries (hereafter NRIFSF) of the Japan Fisheries Research and Education Agency (hereafter FRA) and the Fisheries Agency of the Ministry of Agriculture, Forestry and Fisheries, the Government of Japan (hereafter FAJ) with the cooperation of other organizations concerned. This report covers information on small cetaceans which is not included in the "Scientific Progress Report on Large Cetaceans", http://www.jfa.maff.go.jp/j/whale/attach/pdf/research-25.pdf (notified to the IWC/SC/68b meeting). The Government of Japan considers management of small cetaceans is outside the competence of the International Convention for the Regulation of Whaling.

## 1. SPECIES AND STOCKS STUDIED

| Common name | Scientific name | Area/stock(s) | Items referred to |
|---|---|---|---|
| Dall's porpoise | *Phocoenoides dalli* | Off Pacific coast, Japan Sea, and Okhotsk Sea | 2.1.1, 3.1.3, 3.2, 5.1, 5.2.2, 5.3 |
| Finless porpoise | *Neophocaena asiaeorientalis* | Coastal waters of Japan | 5.2.2, 8.1 |
| Pacific white-sided dolphin | *Lagenorhynchus obliquidens* | Off Pacific coast, and Japan Sea | 2.1.1, 2.1.2, 4.2, 5.1, 5.2.2, 5.3 |
| Striped dolphin | *Stenella coeruleoalba* | Off Pacific coast | 2.1.2, 4.2, 4.4, 5.1, 5.3 |
| Pantropical spotted dolphin | *Stenella attenuate* | Off Pacific coast | 2.1.1, 2.1.2, 4.2, 5.1 |
| Bottlenose dolphin | *Tursiops truncates* | Off Pacific coast, and East China Sea | 2.1.1, 2.1.2, 3.1.1, 3.1.2, 3.1.3, 3.2, 4.2, 4.4, 5.1, 5.3, 8.2 |
| Rough-toothed dolphin | *Steno bredanensis* | Off Pacific coast | 2.1.1, 5.1, 5.3 |
| Melon-headed whale | *Peponocephala electra* | Off Pacific coast | 2.1.1, 4.2, 4.4, 5.1, 5.3 |
| Risso's dolphin | *Grampus griseus* | Off pacific coast, Japan Sea | 2.1.1, 2.1.2, 2.2, 4.2, 4.4, 5.1, 5.3, 8.2 |
| Short-finned pilot whale | *Globicephala macrorhynchus* | Western North Pacific, and East China Sea | 2.1.1, 2.1.2, 4.2, 4.4, 5.1, 5.3, 8.2 |
| False killer whale | *Pseudorca crassidens* | Off Pacific coast | 4.2, 5.1, 5.3 |
| Killer whale | *Orcinus orca* | Off Pacific coast | 2.1.1, 8.1 |
| Baird's beaked whale | *Berardius bairdii* | Off Pacific coast, Japan Sea and Okhotsk Sea | 2.1.1, 2.1.2, 4.2, 5.1, 5.3, 8.1 |
| Additional species | - | Around Japan, others | 5.2.2, 5.3 |

## 2. SIGHTINGS DATA

[*] National Research Institute of Far Seas Fisheries (NRIFSF) was reorganized into Fisheries Resources Institute (FRI) in July 2020.

### 2.1 Field work

*2.1.1 Systematic*

The NRIFSF and FAJ conducted a dedicated shipboard sighting survey in the North Pacific, using a research vessel with a top barrel. During the survey, the following small cetaceans were sighted. Sightings of large cetaceans were provided in the Scientific Progress Report on Large Cetaceans notified to the IWC/SC/68b meeting.

Table 1. Small cetaceans sighted in the dedicated shipboard survey conducted during the fiscal year 2019 (April 2019 to March 2020).

| Species | Date | Area | No. of sightings | Contact institute |
|---|---|---|---|---|
| Baird's beaked whale | 21/05/19-08/07/19 | North Pacific coast | 37 | NRIFSF |
| Rough-toothed whale | 21/05/19-08/07/19 | North Pacific | 2 | |
| Bottlenose dolphin | 21/05/19-08/07/19 | North Pacific | 1 | |
| Spotted dolphin | 21/05/19-08/07/19 | North Pacific | 9 | |
| Pacific white-sided dolphin | 21/05/19-08/07/19 | North Pacific coast | 38 | |
| Risso's dolphin | 21/05/19-08/07/19 | North Pacific | 10 | |
| Short-finned pilot whale | 21/05/19-08/07/19 | North Pacific | 17 | |
| Melon-headed whale | 21/05/19-08/07/19 | North Pacific | 1 | |
| Killer whale | 21/05/19-08/07/19 | North Pacific coast | 1 | |
| Dall's porpoise | 21/05/19-08/07/19 | North Pacific coast | 9 | |

"No. of sightings" indicates the numbers of schools sighted. These sightings were made during the sighting survey for small cetacean conducted in the North Pacific, from 21 May to 8 July 2019, using the research vessel Kaiyo-maru No.7.

*2.1.2 Opportunistic, platforms of opportunity*

Opportunistic sighting data have been collected during small-type whaling and dolphin fishery operations. They mainly consist of sightings of target species at the fishing grounds (e.g. the Baird's beaked whale, the short-finned pilot whale, and the Risso's, bottlenose, striped, spotted and Pacific white-sided dolphin).

During the NEWREP-NP coastal component off Abashiri, northeast Japan, conducted in June 2019, sightings of 15 schools (58 animals) of the Baird's beaked whale were obtained by sampling vessels.

### 2.2 Analyses/development of techniques

Kanaji and Maeda compiled fishermen's logbook data for the preparation of stock assessment and population dynamics modelling.

Kanaji analysed shipboard sighting survey data collected in 2006, 2007 and 2014 based on the species distribution model (SDM) to estimate distributional patterns of Risso's dolphins off the Pacific coast of Japan and those seasonal and long-term variations. SDM also provided information on long-term trend in abundance of Risso's dolphins off Japan. Kanaji and Sasaki analysed aerial sighting survey data from 2014-2016 to estimate abundances of Dall's porpoises migrating into the coastal waters off north-eastern Hokkaido using conventional distance sampling approach. Sasaki and Kanaji have continued to analyse shipboard sighting survey data in 2008, 2009, 2015, and 2017 to estimate abundance of Baird's beaked whales.

## 3. MARKING DATA

### 3.1 Field work

*3.1.1 Natural marking data*

Natural marking data were not collected.

*3.1.2 Artificial marking data*

With the cooperation of the Taiji Whale Museum and the Mie University, NRIFSF attached plastic tags to 27 bottlenose dolphins caught by the Taiji dolphin drive fishery from September 2019 to February 2020, and dolphins were released to the sea soon after the tagging. A new project to attach dart tags on free-ranging dolphins from small fishing boat was launched in this fiscal year.

*3.1.3 Telemetry data*

With the cooperation of the Taiji fishermen cooperative and the Mie University, NRIFSF attached smart position and temperature transmitting tags (SPOT tags, Wildlife Computers) to the dorsal fin of three bottlenose dolphins caught by the dolphin drive fishery in Taiji and released them soon after the tagging. These surveys were conducted from September 2019 to January 2020.The lengths of tagging period were from 27 to 32 days. They also released eight Dall's porpoise deploying pop-up archival transmitting (PAT) tag (miniPAT, Wildlife Computers) on their body or SPLASH tag (SPLASH-10, Wildlife Computers) on the dorsal fin in Jun - July 2019, under the collaborative research with Tokyo University of Agriculture. These animals were incidentally caught by stationary uncovered pound nets. Data were available from four of the five miniPAT and two of the three SPLASH. Lengths of tagging period of them were 1 and 112 days, respectively.

Table 2.1. PAT data of small cetaceans collected during the period from April 2018 to March 2019.

| Species | Tag type | No. deployed | No. data abailable | No. popped up | No. retrieved | Contact institute |
|---|---|---|---|---|---|---|
| Bottlenose dolphin | SPOT | 3 | 3 | 0 | 0 | NRIFSF |
| Dall's porpoise | miniPAT | 5 | 4 | 5 | 2 | NRIFSF |
| Dall's porpoise | SPLASH | 3 | 2 | 0 | 0 | NRIFSF |

**3.2 Analyses/development of techniques**

Kanaji and Sasaki has been continuing the analysis of the SPOT, SPLASH and miniPAT tags data, from three bottlenose dolphins and six Dall's porpoises.

## 4. TISSUE/BIOLOGICAL SAMPLES COLLECTED

**4.1 Biopsy samples**

The NRIFSF collected no biopsy samples from small cetaceans during the fiscal year 2019 (April 2019 to March 2020).

**4.2 Samples from directed catches or bycatches**

Samples collected from small cetaceans caught by the small-type whaling and the drive fishery at Taiji during the period of April 2019 to March 2020 are shown in Table 4.

The national quota of Baird's beaked whales for the mentioned period was 67 animals for small-type whaling (includes an animal carryover from the last year's quota). Whaling operation was conducted from 13 July to 27 August, from 1 to 6 October, and from 16 to 21 November at the land station in Wadaura on the Pacific coast, from 13 July to 27 August and 30 September to 22 November at the land station in Ayukawa on the Pacific coast, and from 1 to 23 August and from 27 September to 18 November at the land station in Abashiri on the Okhotsk coast. The operation at the land station in Hakodate at the Sea of Japan coast was not conducted. A total of 47 Baird's beaked whales (one off Abashiri, 46 off the Pacific coast) were taken by five catcher boats (*Seiwa-maru*, *Kohei-maru #8*, *Taisho-maru #3*, *Katsu-maru #7*, and *Sumitomo-maru #51*). All the animals were examined and biological samples were taken by seven researchers.

The national quota of northern form short-finned pilot whales for small-type whaling was 36 animals. The six animals were taken in November at the Pacific coast off north eastern Japan. Two researchers conducted biological examination and sampling for the animals at the Ayukawa station. The national quota of 33 southern form short-finned pilot whales was set for the small-type whaling at the Taiji and Wadaura land stations. But, there was no operation at the Taiji station and no catch in the Wadaura operation. The national quota of 20 false killer whales wase set for small-type whaling at the Taiji station, but no animal was caught.

The surveys for animals caught by the drive fishery at Taiji were conducted to collect data and samples for life history and genetic studies, by 6 researchers during the periods from 1 September to 29 September 2019, from 10 November to 25 December 2019, and from 5 January to 29 February 2020. They examined 47 southern form short-finned pilot whales, 120 melon-headed whales, and 386 striped, 18 pantropical spotted, 103 Risso's, one bottlenose, and one Pacific white-sided dolphins.

Ohizumi (Tokai University) collected stomach contents of 149 animals including Risso's dolphins, melon-headed whales, striped dolphins, and spotted dolphins from November 2019 to February 2020, caught by drive fishery at Taiji for the feeding habit study.

Okinawa Prefectural Government requested fishermen to collect teeth and skin samples as a part of supervision of the fishery, from small cetaceans caught by hand harpoon fishery (crossbow fishery) in Okinawa. Samples collected at 2018-2019 fishery seasons were sent to NRIFSF for age determination and genetic examinations.

Sample collection of small cetaceans from bycatches by the NRIFSF was not conducted during the period from April 2019 to March 2020.

Table 4. Samples collected from small cetaceans caught by the small-type whaling and driven fishery during the fiscal year 2019 (April 2019 to March 2020).

| Species | Area | Tissue type(s) | No. Collected | Archived (Y/N) | Contact Institute |
|---|---|---|---|---|---|
| Baird's beaked whale | Western North Pacific | To, Ma, O, U, Te, E, V, and Sk | 46 | Y | NRIFSF |
| | Okhotsk Sea | To, Te, E, V, and Sk | 1 | Y | |
| Northern form short-finned pilot whale | Western North Pacific | To, Te, E, V, and Sk | 6 | Y | |
| Southern form short-finned pilot whale | Western North Pacific | To, Ma, O, U, Te, and sk | 47 | Y | |
| Bottlenose dolphin | Western North Pacific | To, Te,, and sk | 1 | Y | |
| Risso's dolphin | Western North Pacific | To, Ma, O, U, Te, C, and sk | 103 | Y | |
| Striped dolphin | Western North Pacific | To, Ma, O, U, Te, C, and sk | 386 | Y | |
| Pantropical spotted dolphin | Western North Pacific | To, Ma, O, U, Te, C, and sk | 18 | Y | |
| Melon-headed whale | Western North Pacific | To, Ma, O, U, Te, C, and sk | 120 | Y | |
| Pacific white-sided dolphin | Western North Pacific | To, Te, and sk | 1 | Y | |

E: epidydymis, Ma: mammary gland, O: ovaries, Sk: skin, Te: testis, To: tooth, U: uterine horn, V: vertebral epiphysis, C: crystalline lens.

### 4.3 Samples from stranded animals

Sample collection from stranded small cetaceans by the NRIFSF was not conducted during the fiscal year 2019 (April 2019 to March 2020).

### 4.4 Analyses/development of techniques

Maeda determined ages of a total of 152 animals (southern form short-finned pilot and melon-headed whales, and bottlenose, Risso's and striped dolphins) taken by the drive fishery at Taiji. Maeda also examined ovaries of 92 animals (southern form short-finned pilot and melon-headed whales and bottlenose, Risso's and striped dolphins) caught by the drive fishery and investigated histological samples of testis, mammary gland, and uterine horn of a total of 130 animals (Melon-headed whales and bottlenose and Risso's dolphins) taken by drive fishery at Taiji, for studies on sexual maturity.

Maeda measured the racemization rate of aspartic acid in the ocular lens of 71 Risso's dolphin to examine a method for age estimation using aspartic acid racemization.

Yoshida accumulated SNPs data from 199 animals, to advance the stock structure study of small cetaceans around Japan.

## 5. STATISTICS FOR SMALL CETACEANS

### 5.1 For the calendar year 2019

Target species, fishing season, quota, catcher boats and actual catches for the small type whaling are provided in section 4.2.

Regarding the dolphin fisheries, management season has been set from 1 August to 31 July of the following year for Dall's porpoise fisheries, and from 1 October to 30 September of the following year for other species, since 1996. The management season for fisheries in Wakayama Prefecture has been set from 1 September to 31 August of the following year. The statistics on dolphin fisheries covers catches of the calendar year (1 January to 31 December ), while FAJ manages dolphin fisheries by their own fishing season aforementioned. Thus, in some cases, catches aggregated by calendar year may exceed the seasonal (fishing yearly) catch in appearance, but the actual seasonal catch is below the allocated catch quota. Direct small cetacean catches are given in Table 5 in this section by prefecture and by type of fisheries. The data have been collected by the International Affairs Division of the FAJ based on reports from the prefectural governments.

Catch quota for dolphin fisheries for the 2019/2020 season was 4,137 animals for *dalli*-type Dall's porpoises, 4,398 for *truei*-type Dall's porpoises, 398 for Risso's dolphins, 374 for bottlenose dolphins, 329 for pantropical spotted dolphins, 521 for striped dolphins, 160 for southern form short-finned pilot whales (including 33 transferred from quota of the small-type whaling), 91 for false killer whales, 260 for Pacific white-sided dolphins, 30 for rough-toothed dolphins, and 363 for melon-headed whales.

Corresponding operational months by prefecture in 2019 were as follows: hand harpoon fishery was permitted for nine months (1 January to 31 August and 1-31 December) in Okinawa prefecture, for eight months (1 January to 31 August) in Wakayama, for six months (1 January to 30 April and 1 November to 31 December) in Aomori, Miyagi, Iwate, and Chiba, and for 4.5 months (1 May to 15 June and 1 August to 31 October) in Hokkaido. Drive fishery was permitted for nine months in Wakayama (1 January to 31 May and 1 September to 31 December) and for seven months in Shizuoka (1 January to 31 March and 1 September to 31 December).

Table 5. Direct catch of small cetacean in 2019.

| Species | Type of fishery | Prefecture[1)] | Total landed[2)] |
|---|---|---|---|
| Baird's beaked whale | Small-type whaling | Hokkaido | 1 |
| | | Miyagi | 24 |
| | | Chiba | 22 |
| *truei*-type Dall's porpoise | Hand harpoon | Iwate | 818 |
| | | Miyagi | 8 |
| Pacific white-sided dolphin | Drive | Wakayama | 8 |
| Striped dolphin | Drive | Wakayama | 343 |
| Bottlenose dolphin | Hand harpoon | Wakayama | 24 |

| | | | |
|---|---|---|---|
| | Drive | | 133 |
| Pantropical spotted dolphin | Drive | Wakayama | 18 |
| Rough-toothed dolphin | Drive | Wakayama | 15 |
| Melon-headed whale | Drive | Wakayama | 203 |
| Risso's dolphin | Drive | Wakayama | 191 |
| Northern form short-finned pilot whale | Small-type whaling | Miyagi | 6 |
| Southern form short-finned pilot whale | Drive | Wakayama | 63 |
| | Hand harpoon | Okinawa | 9 |
| False killer whale | Hand harpoon | Okinawa | 1 |

1) Catches by the small-type whaling and the drive fishery were recorded at the place of landing of products. Catches by the hand harpoon fishery were recorded at the place of registration of vessels.

2) Statistics of small-type whaling are based on reports of researchers and gunners. Those of other fisheries are based on reports of prefectural governments to the Fisheries Agency. They are a compilation of landing slips (hand harpoon fisheries in Iwate and Hokkaido) or reports from individual fishermen or fishermen cooperatives (other prefectures).

### 5.2 Non-natural mortality for the calendar year 2019

*5.2.1 Observed or reported ship strikes*

We do not have data collecting system for ship strike incidence of small cetaceans.

*5.2.2 Fishery bycatch*

Provisional figures for incidental mortality of small cetaceans (bycatch) by Japanese fisheries, by Prefecture in January-December 2019, are shown in Table 6. Species and figures are based on the reports of prefecture governments to the FAJ, which are reports from individual fishermen or fishermen cooperatives.

Table 6. Fishery bycatch of small cetaceans in 2019.

| Species | No. of animals | Location[1)] | Fate[2)] | Gear[3)] | Target fish species[4)] | Source or contact |
|---|---|---|---|---|---|---|
| *dalli*-type Dall's porpoise | 11 | Hokkaido | K | FPN | NA | FAJ |
| Harbor porpoise | 9 | Hokkaido | K | FPN | | |
| | 1 | | R | | | |
| | 1 | | K | GNS | | |
| Pacific white-sided dolphin | 1 | Hokkaidoo | K | FPN | | |
| | 1 | Hyogo | R | FPN | | |
| Finless porpoise | 2 | Mie | K | GNS | | |
| | 6 | Osaka | K | GNS | | |
| | 1 | Okayama | K | UN | | |
| | 1 | Hiroshima | D | GNS | | |
| | 1 | Yamaguchi | R | GNS | | |
| | 1 | Ehime | K | GNS | | |
| | 1 | Fukuoka | K | FPN | | |
| | 1 | | K | GNS | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | Oita | K | GNS | | |
| | 1 | Saga | D | UN | | |
| | 1 | Nagasaki | K | FPN | | |
| | 1 | | K | GNS | | |
| | 2 | Kumamoto | K | GNS | | |

1) Recorded at the place of fishing gears.

2) Fate of whale: D = discarded dead or seriously injured, K = kept for sale or specimen, R = released alive

3) Described using "FAO FISHING DESCRIPTION AND CODES", that is, stationary uncovered pound nets (FPN), set gillnets (GNS) and miscellaneous gear (MIS).

4) Target fish species: NA = not available

### 5.3 Strandings of small cetaceans

Provisional figures for strandings of small cetaceans in Japan, for the period January-December 2019, are shown in Table 7. Species and figures are based on reports of prefecture governments to the FAJ, which compile information from individual fishermen, fishemen cooperatives or the general public. Number of postmortems in Table 7 indicate the numbers of dead animals when they stranded.

Table 7. Strandings of small cetaceans in 2019.

| Species | No. strandings | No. post mortems | Contact person(s)/ Institute(s) |
|---|---|---|---|
| *dalli*-type Dall's porpoise | 19 | 19 | FAJ |
| Harbor porpoise | 15 | 15 | |
| Finless porpoise | 190 | 190 | |
| Pacific white-sided dolphin | 19 | 19 | |
| Striped dolphin | 68 | 68 | |
| Long-beaked common dolphin | 1 | 1 | |
| Bottlenose dolphin | 7 | 7 | |
| Rough-toothed dolphin | 2 | 2 | |
| Indo-Pacific bottlenose dolphin | 2 | 2 | |
| Risso's dolphin | 7 | 7 | |
| Short-finned pilot whale | 3 | 3 | |
| False killer whale | 1 | 1 | |
| Melon-headed whale | 1 | 1 | |
| Fraser's dolphin | 2 | 2 | |
| Cuvier's beaked whale | 4 | 4 | |
| Baird's beaked whale | 1 | 1 | |
| Stejneger's beaked whale | 2 | 2 | |
| Blainville's beaked whale | 2 | 1 | |
| Dwarf sperm whale | 2 | 2 | |
| Pygmy sperm whale | 3 | 3 | |
| Unidentified small cetaceans | 38 | 33 | |

In addition, the Institute of Cetacean Research (4-5 Toyomi, Chuo-ku, Tokyo 104-0055, Japan), and the National Science Museum (4-1-1, Amakubo, tsukuba, Ibaragi 305-0005, Japan) voluntarily collected relevant information on strandings.

### 5.4 Earlier years' statistics

There are no changes in earlier years' statistics.

## 6. OTHER STUDIES AND ANALYSES

No other study nor analysis on small cetaceans was conducted during the fiscal year 2019 (April 2019 to March 2020).

## 7. LITERATURE CITED

## 8. PUBLICATION ON SMALL CETACEANS

### 8.1 Published or In Press' papers only


Kanaji, Y. 2020. Killer whale. The Current status of International fishery stocks. Fisheries Agency and Japan Fisheries Research and Education Agency. http://kokushi.fra.go.jp/R01/R01_58_KIW.pdf. 3pp. (in Japanese)

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Kanaji, Y., Yoshida, H., Sasaki, H., Okazaki, M. and Kobayashi, M. 2019. Distribution and abundance of dalli-type Dall's porpoises *Phocoenoides dalli* migrating into waters off southeastern Hokkaido, Japan, during summer: results of 2014-2016 aerial surveys. Fisheries Science 86: 287 – 298.

Maeda, H. and Kishiro, T. 2019. Baird's beaked whale, *Berardius bairdii*, Sea of Japan, Sea of Okhotsk and Pacific Ocean. In Ohashi, Y. (ed) The Current status of international fishery stocks. Fisheries Agency and Fisheries Research Agency. http://kokushi.fra.go.jp/R01/R01_51_BEW.pdf 6pp. (in Japanese)

Yoshida, H. 2019. Fisheries and research on small cetaceans (review). The Current status of international fishery stocks. Fisheries Agency and Japan Fisheries Research and Education Agency. http://kokushi.fra.go.jp/R01/R01_49_whalesS-R.pdf . 4pp. (in Japanese)

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### 8.2 Unpublished literature


Kuno, T., Ohizumi, H. and Kishiro, T. 2019. Feeding habits and niche of short-finned pilot whales and bottlenose dolphins around Kii Peninsula. The fourth Asian Marine Biology Symposium. Taipei, Taiwan.

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Maeda, H. and Kishiro, T. 2019. Analysis of ovarian tissue for reliable ovarian corpora counts in cetacean. Abstract for 2019 Spring Meeting of the Mammal Society of Japan. p.169 . (in Japanese)

Maeda, H., Yasunaga, G., Fujise Y. and Kishiro, T. 2020. Age estimation using aspartic acid racemic ratio of eye lens in Risso's dolphin. Abstract for 2020 Spring Meeting of the Japanese Society of Fisheries Science. p. 140. (in Japanese)

# Satellite tagging experiments at the Institute of Cetacean Research (2021)

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**Introduction**
Satellite-monitored tagging tool is being used in Japan's whale survey programs to study distribution, diving behavior, movement and stock structure of baleen whales. This paper presents an update of the tag experiments at the Institute of Cetacean Research (ICR) during 2021, including field results in the western North Pacific, Okhotsk Sea and the Antarctic.

**Technical aspects**

*Tag types*

SPLASH-type tags were used since 2021 in addition to SPOT-type tags (Wildlife Computers, Redmond, Washington, USA). Transdermal SPLASH10-302B was used for fin whales *Balaenoptera physalus* using the tether-line carrier LKTTBC with LK-ARTS for both tracking and diving behavior of baleen whales (launcher details is described in Konishi *et al*. 2021). Transdermal SPOT-303 tags were used for North Pacific fin whales and SPOT177 tags were used for Antarctic fin, Antarctic minke, *B.bonaerensis*, North Pacific fin and sei, *B. borealis*, whales. When possible, skin biopsies were simultaneously sampled using Larsen gun or bow gun after the deployment of the satellite tags, and stored for later molecular analyses. Since 2021, preliminary experiments for deploying limpet tags (SPLASH, SPLASH10) on baleen whales were started to estimate surfacing timing.

**Progress in Antarctic Research**
*Scientific needs*
Stock structure is important information to interpret abundance estimates and for defining management areas. For instance, genetic and non-genetic analyses support the hypothesis of two stocks of Antarctic minke whales in the Indo-Pacific sector of the Antarctic, which mix spatially in a transition area (Pastene 2006; Pastene and Goto, 2016). However, their migration pattern, e.g. timing of arrival and departure from feeding area, migration routes and movement in the feeding area are unknown. Also, there is a need to investigate change in distribution and movement of whales in response to environmental changes. It is also important the elucidation of the time whales remain in the feeding areas, which is important parameters for estimation of prey consumption, which in turn is important to understand species interactions and monitoring ecosystem changes.

The tracking of whales based on satellite tags is a very useful approach to respond those scientific needs. Japan started the satellite tag studies under the New Scientific Whale Research program in the Antarctic Ocean (NEWREP-A) program (2015/16-2018/19 austral summer seasons), and the technique is being used to cover some of the research objectives of the current Japanese Abundance and Stock structure Surveys in the Antarctic (JASS-A program). Priority target species for the tagging study in JASS-A are the Antarctic minke, fin and blue whales *B. musculus*.

*Experiments*
Satellite-monitored tags were deployed on the Antarctic minke and fin whales during the austral summer seasons in January-February 2021 in the longitudinal sector 15-25°E (Atlantic and Indian sectors of the Antarctic). Ten Antarctic minke and seven fin whales were successfully tagged and the locations were tracked (Table 1; Figures 1 and 2). Tagging experiments for Antarctic minke whales were conducted in the later period of the survey, during 2-4 February in the vicinity of the ice edge.

*Tracking results*
A tag deployed on an Antarctic minke whale (PTT ID 181835) on 3 February 2021 was tracked for 89 days, and the transmission stopped on 5 May 2021. This Antarctic minke whale showed a long westward and then eastward movements along the continent and started a northward movement in April (Figure 1). This pattern of longitudinal movement (westward first and then eastward) was also observed in another tagged Antarctic minke whale (PTT ID 181857). The long-term tracking of the Antarctic minke whale in 2021 supports the hypothesis that minke whales have breeding areas in the Indian Ocean and Pacific Ocean, respectively, with a longitudinal area of spatial mixing of stocks in the feeding grounds.

The long-tracking records for the Antarctic minke whales, so far obtained, were summarized in Figure 3. In the Pacific sector, Antarctic minke whales at the Ross Sea departed toward the Pacific Ocean (results from the 2017/18 season). On the other hand, whales feeding in areas of the Weddell Sea moved north reaching low latitude waters of the Indian Ocean (results from the 2019/20 season). The tracked Antarctic minke whale in 2021 (Figures 1 and 3) also moved north toward waters of the Indian Ocean at longitude 75°E (north of Prydz Bay).

Fin whales did not show remarkable movement and they remained at the same area (Figure 2). Fin whales in Antarctic waters are likely to stay in narrow areas and did not show substantial longitudinal movements.

**Table 1.** Summary of the satellite-monitored tags for the Antarctic minke and fin whales in 2020/21 JASS-A cruise.

| No | Date | Species | School size | Estimated body length (m)* | PTT ID | Biopsy samples |
|---|---|---|---|---|---|---|
| 1 | 22 January 2021 | Fin | 2 | 17.6 | 196148 | Y |
| 2 | 22 January 2021 | Fin | 1 | 23.8 | 196142 | N |
| 3 | 24 January 2021 | Fin | 3 | 21.3 | 196155 | Y |
| 4 | 28 January 2021 | Fin | 3 | 21.6 | 181859 | Y |
| 5 | 30 January 2021 | Fin | 3 | 21.7 | 196159 | Y |
| 6 | 02 February 2021 | Ant. minke | 6 | 7.1 | 181836 | Y |
| 7 | 02 February 2021 | Ant. minke | 3 | 8.2 | 181857 | Y |
| 8 | 02 February 2021 | Ant. minke | 29 | 7.8 | 66621 | Y |
| 9 | 02 February 2021 | Ant. minke | 29 | 7.2 | 181834 | Y |
| 10 | 03 February 2021 | Ant. minke | 29 | 7.0 | 181842 | N |
| 11 | 03 February 2021 | Ant. minke | 5 | 6.8 | 181826 | Y |
| 12 | 03 February 2021 | Ant. minke | 8 | 8.1 | 181835 | Y |
| 13 | 03 February 2021 | Ant. minke | 8 | 8.3 | 196161 | Y |
| 14 | 03 February 2021 | Ant. minke | 8 | 7.7 | 196166 | Y |
| 15 | 04 February 2021 | Ant. minke | 7 | 8.6 | 196153 | Y |
| 16 | 09 February 2021 | Fin | 2 | 21.3 | 196150 | Y |
| 17 | 09 February 2021 | Fin | 1 | 21.8 | 196151 | Y |

* Body lengths of whales were estimated by the researcher on board.

The tagging experiments in Nos.8-10 and 12-14 were conducted for the same schools, respectively.

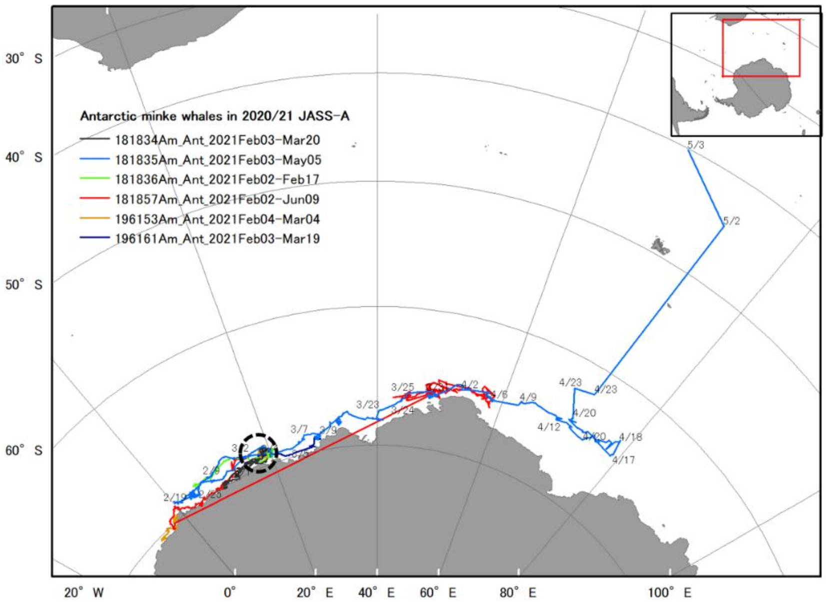


**Figure 1.** Tracks of five tagged Antarctic minke whales in the 2020/21 austral summer season. (2-4 February 2021). The lines are drawn by all ARGOS Location Classes. Colored square symbols show deployed locations. The dates at locations are shown for ID181835. Deployment locations are within the dotted circle.

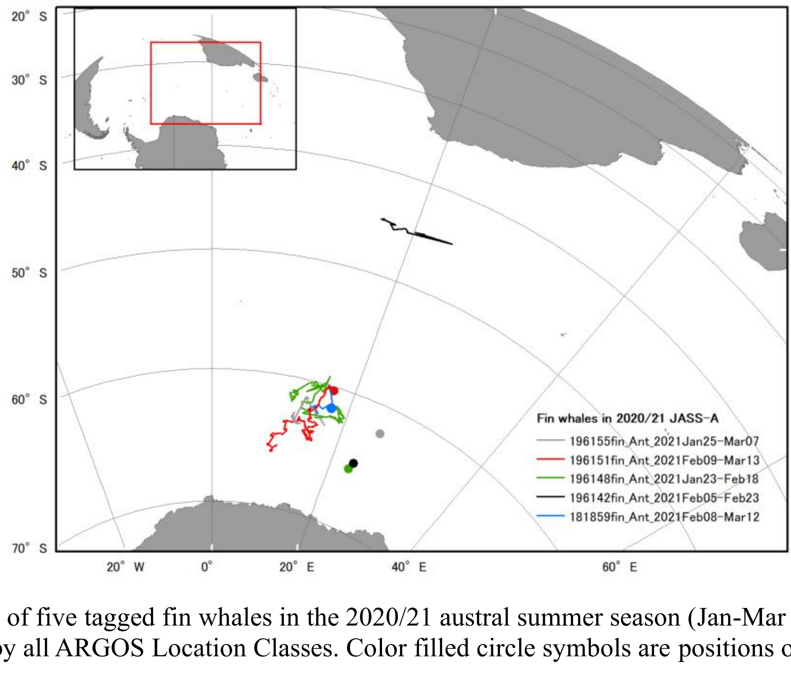


**Figure 2.** Tracks of five tagged fin whales in the 2020/21 austral summer season (Jan-Mar 2021). The lines are drawn by all ARGOS Location Classes. Color filled circle symbols are positions of deployments.

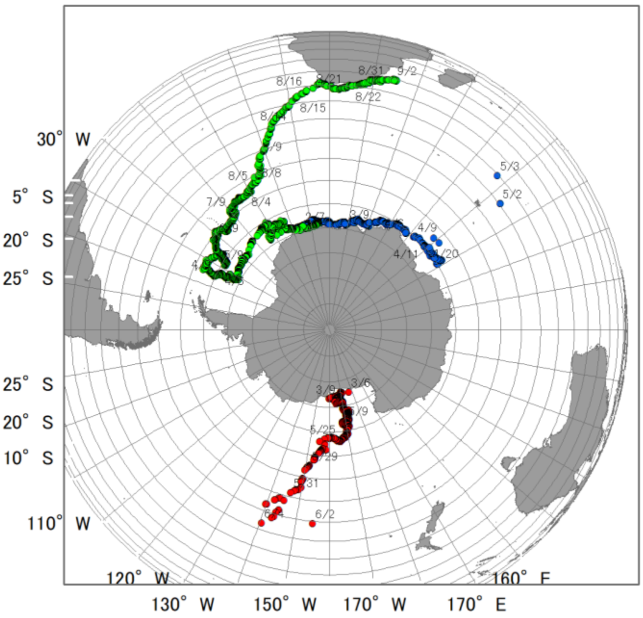


**Figure 3.** Long telemetry tracks of three Antarctic minke whales tagged in the vicinity of Antarctic in the austral summers of 2017/18 (red), 2019/20 (green) and 2020/21 JASS-A (blue) surveys.

**North Pacific Research**

*Scientific needs*

Japan is surrounded by the Pacific Ocean, Sea of Japan, Sea of Okhotsk and Eastern China Sea. Cold- and warm-currents meet at the Pacific coast of northern Japan where pelagic fish is abundant. This area is important foraging area for pelagic fisheries and for whales. Stock structure and movement information is important to define management areas for sustainable whaling, and satellite tracking in combination with genetic analyses can provide that information.

Environmental change, such as global warming and prey abundance, may cause prey species changes in distribution, abundance and possibly cause interaction between whales and fisheries. In fact, sea water temperature raised and change of fish distribution have been reported around Japan. However, little is known about whale migration and movement patterns of whales in relation to environmental changes in the western North Pacific. Satellite-monitored tags are useful to monitor seasonal movements with physical environmental data from satellite images for migration. Whale tagging also elucidate important feeding spots by estimating duration of occurrence in particular areas.

Target species for ICR's tagging are baleen whales, especially common minke *B. acutorostrata*, sei, Bryde's *B. edeni brydei*, fin and blue whales.

*Experiments*

Tagging results in 2021 are listed in Table 2. The tagging experiments were conducted in the three areas, which are northern Japan (February, June), eastern-central North Pacific at the latitude between 45-50°N (August-September), and south coastal area of Okhotsk Sea (May) (Table 2, Figures 4-7). Large sighting survey vessels and a small whale watching boat were used for these experiments in the Pacific and Okhotsk Sea, respectively.

*Tracking results*

<u>Sei whales</u>

Sei whales were tracked in early summer in northern Japan (Figures 4), and in late summer in the eastern-central North Pacific (Figure 5). In northern Japan, tags were deployed in a small area around 41°N 148°E. The tracked sei whales showed dispersed movements in the feeding area. Some whales moved to the western area along with the Kuril Islands, while some whales moved to western offshore or stayed around the deployment area. In the eastern-central North Pacific, tracked sei whale moved slowly probably seeking for preys.

Fin whales

A fin whale in February and five fin whales in May were tracked in the coast of northern Japan and Okhotsk Sea, respectively (Figure 6). Some tracked fin whales moved within the southern part of Okhotsk Sea, while some whales crossed the Kuril Islands and moved between the Sea of Okhotsk and the Pacific Ocean.

In the eastern-central North Pacific, two fin whales were tracked at latitude 45°N during mid-late summer season (Table 2, Figure 7). These whales showed latitudinal movements, and one reached the area near Aleutian Islands at latitude 55°N. Another whale one reached south of 40°N in October.

**Table 2.** Summary of satellite-monitored tag experiments in 2021 in the Western North Pacific and Sea of Okhotsk.

| No | Date | Area | Species | School Size | PTT-ID | Biopsy samples |
|---|---|---|---|---|---|---|
| 1 | 7 February 2021 | North Pacific | fin | 1 | 203440 | Y |
| 2 | 19 May 2021 | Okhotsk Sea | fin | 5 | 181860 | Y |
| 3 | 19 May 2021 | Okhotsk Sea | fin | - | 181884 | N |
| 4 | 20 May 2021 | Okhotsk Sea | fin | 2 | 54121 | Y |
| 5 | 26 May 2021 | Okhotsk Sea | fin | 2 | 181861 | Y |
| 6 | 27 May 2021 | Okhotsk Sea | fin | 2 | 196183 | N |
| 7 | 19 June 2021 | North Pacific | sei | 1 | 181838 | Y |
| 8 | 19 June 2021 | North Pacific | sei | 1 | 196141 | Y |
| 9 | 22 June 2021 | North Pacific | sei | 2 | 196143 | Y |
| 10 | 23 June 2021 | North Pacific | sei | 2 | 181827 | Y |
| 11 | 23 June 2021 | North Pacific | sei | 2 | 196144 | Y |
| 12 | 24 June 2021 | North Pacific | sei | 1 | 196162 | Y |
| 13 | 24 June 2021 | North Pacific | sei | 2 | 196163 | Y |
| 14 | 25 June 2021 | North Pacific | sei | 1 | 196170 | Y |
| 15 | 25 June 2021 | North Pacific | sei | 1 | 196169 | Y |
| 16 | 25 June 2021 | North Pacific | sei | 1 | 196156 | Y |
| 17 | 17 August 2021 | North Pacific | fin | 2 | 196152 | Y |
| 18 | 26 August 2021 | North Pacific | sei | 6 | 66626 | Y |
| 19 | 27 August 2021 | North Pacific | sei | 2 | 196165 | Y |
| 20 | 29 August 2021 | North Pacific | sei | 1 | 203481 | Y |
| 21 | 2 September 2021 | North Pacific | fin | 2 | 203469 | N |
| 22 | 10 September 2021 | North Pacific | sei | 1 | 203482 | Y |

| | | | | | | |
|---|---|---|---|---|---|---|
| 23 | 12 September 2021 | North Pacific | sei | 1 | 203456 | Y |
| 24 | 13 September 2021 | North Pacific | sei | 4 | 203458 | Y |
| 25 | 13 September 2021 | North Pacific | sei | 4 | 203467 | N |
| 26 | 14 September 2021 | North Pacific | sei | 1 | 203485 | Y |

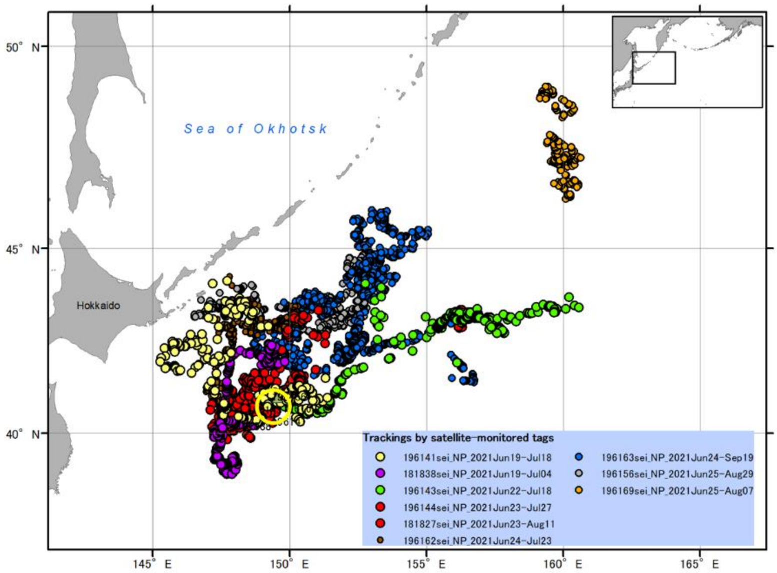


**Figure 4.** Tracks of eight tagged sei whales in 2021 in northern Japan. Yellow open circle shows the area of deployments.

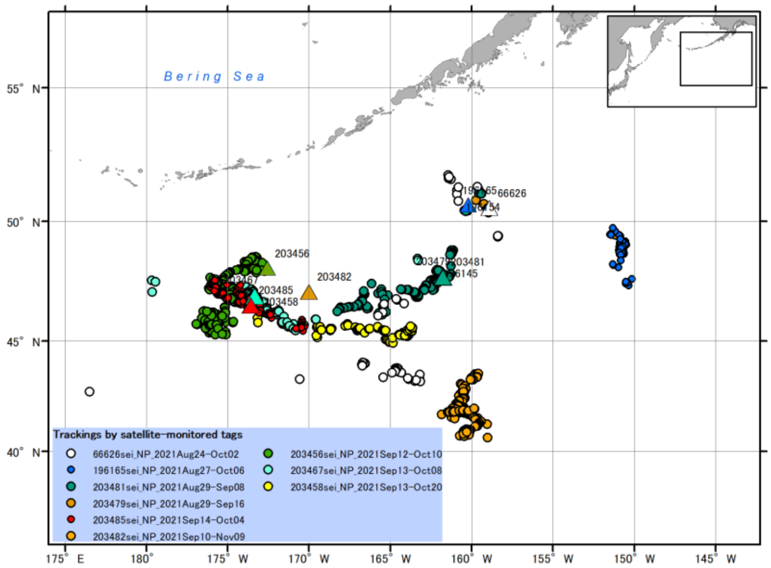


**Figure 5.** Track locations of eight North Pacific sei whales in 2021 in the offshore area of eastern-central North Pacific in summer. Triangles show deployed locations.

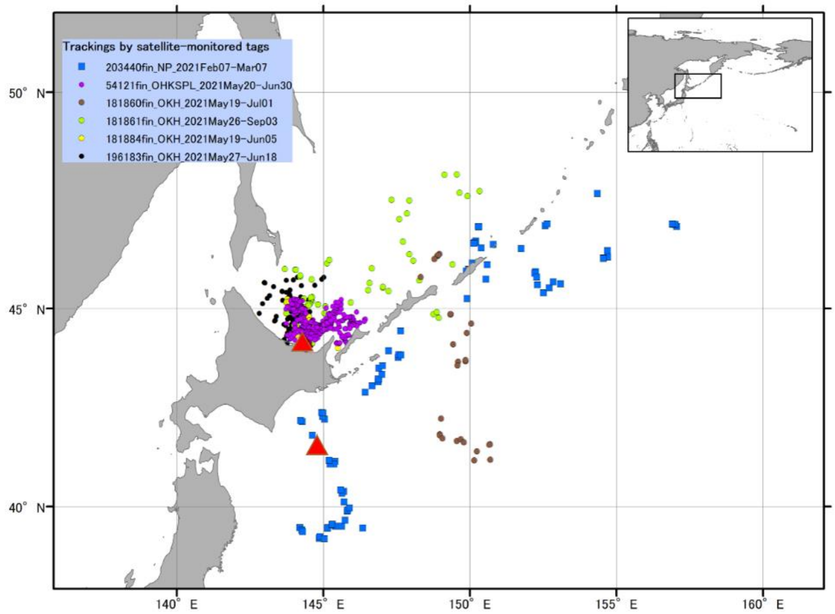


**Figure 6.** Tracks of tagged fin whales in 2021. Deployments occurred in February in the Pacific coast of northern Japan and in May in the Okhotsk Sea. Red triangles show the locations of deployments.

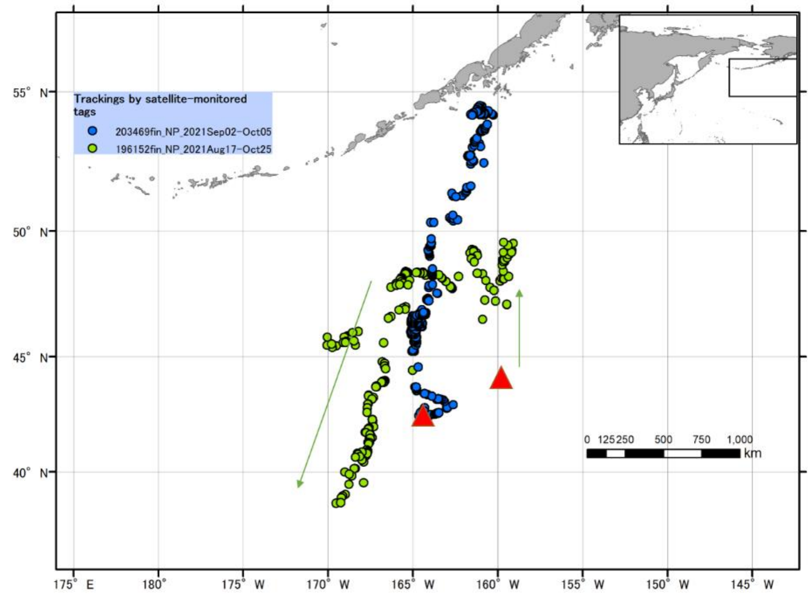


**Figure 7.** Track locations of two fin whales in 2021. Red triangles show deployment locations. Arrows indicate the direction of movements.

**Tracking vertical movements**

SPLASH data-archiving Argos satellite transmitting tags (Wildlife Computers, Redmond, Washington, USA) can monitor both movement and diving profiles. The SPLASH10-302B (PTTID 54121) was deployed on a fin whale from a whale watching boat in the Southern Okhotsk Sea in May 2021 (Figure 8). This fin whale was tracked for a month and occasionally dived around 100-200m depth (Figure 9).

Limpet type SPLASH tags were deployed as preliminary experiments, and a fin whale was tracked for four days, and a humpback whale *Megaptera novaeangliae* in Southern Ocean was tracked for a week (Figure 10). The tags were deployed with the two separated anchors (default products by Wildlife Computers Inc.). Since ICR use large vessels and tag shooting ranges likely to be longer, the single attachment anchor for LIMPET tags needs to be developed for longer tracking on baleen whales.

**Figure 8.** SPLASH10-302B (PTT ID 54121) deployed on the fin whale off the coast of Abashiri in the southern Okhotsk Sea on May 2021. The position of tag at the bottom of the dorsal fin is also shown.


**Figure 9** Time series of diving record in fin whale (PTT ID 54121) using a transdermal SPLASH tag.

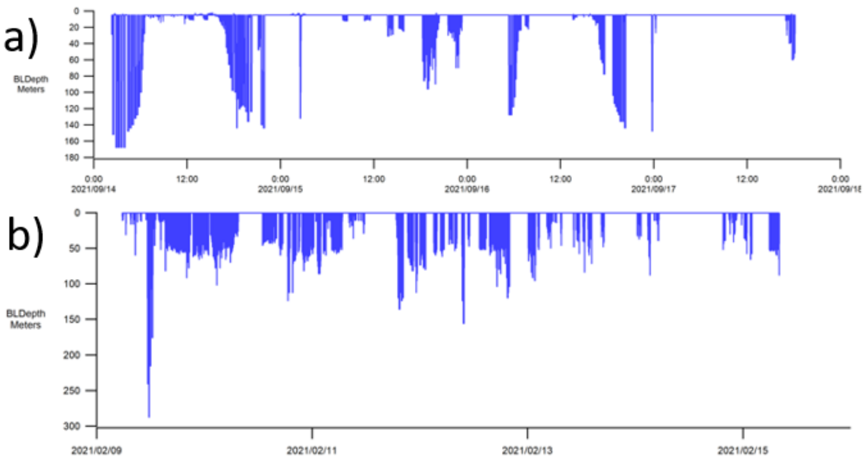


**Figure 10.** Preliminary results of deployments of LIMPET-type SPLASH-tag on baleen whales. a) diving record of a fin whale in the North Pacific (4 days) and b) of a humpback whale in the Southern Ocean (one week).

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# An outline of the data and procedures for calculation of catch limits for sustainable commercial whaling of western North Pacific common minke whales

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## ABSTRACT

In 2019 Japan calculated catch limits for sustainable commercial whaling of western North Pacific sei, Bryde's and common minke whales in line with the IWC's Revised Management Procedure (RMP). A mode of example, this document presents a brief outline of the data and procedures used by Japan to calculate catch limits for western North Pacific common minke whales. These calculations by a Japan RMP Team (JRT) have taken into account data and assumptions used in the assessment of this species by the IWC Scientific Committee. The calculation of catch limits by the JRT were reviewed by a team of international experts, and the Fisheries Agency of Japan (FAJ) sets the total catch quota including FAJ's reserves within the catch limits for domestic use based on the suggestions and advice of this international team. This document deals only with data and procedure issues. Details of the calculations and result for common minke whales and other species can be found in separate documents.

## BACKGROUND

On 26 December 2018, Japan announced its withdrawal from the International Convention for the Regulation of Whaling (ICRW), which entered into force on 30 June 2019. Japan eventually resumed commercial whaling from July 2019.

On the resumption of commercial whaling, Japan stressed that its whaling will be conducted within catch limits calculated in line with the method adopted by the International Whaling Commission (IWC), to avoid any negative impact on the health of cetacean resources i.e., along the lines of the Revised Management Procedure (RMP) (see explanation of the RMP in the next section).

Based on the scientific information available, Japan specified that the baleen whale species to be targeted by commercial whaling are the North Pacific sei (*Balaenoptera borealis*), Bryde's (*B. brydei*) and common minke (*B. acutorostrata)* whales. A group of domestic specialists drawn from several research institutions in Japan worked on the application of an approach along the lines of the RMP for calculating catch limits for the stocks of these species. This is the Japanese RMP Team (JRT)

The objective of this document is to provide an outline of the data and analytical procedures used by Japan for catch limit calculations in line with the RMP. The case of the calculation for the common minke whale in 2019 is given as illustrative example.

## MANAGEMENT PROCEDURE

The management procedure used was in line with the IWC's RMP.

### Brief history of the development of the RMP in the IWC

In 1982, the International Whaling Commission (IWC) adopted catch limits of zero for commercial whaling (commonly referred to as the moratorium). The primary rationale offered was the argued absence of a sound scientific basis for setting safe catch limits. Specifically, paragraph 10 (e) of the Schedule of the ICRW stated the following: 'Notwithstanding the other provisions of paragraph 10, catch limits for the killing for commercial purposes of whales from all stocks for the 1986 coastal and the 1985/86 pelagic seasons and thereafter shall be zero. This provision will be kept under review, based upon the best scientific advice, and by 1990 at the latest the

Commission will undertake a comprehensive assessment of the effects of this decision on whale stocks and consider modifications of this provision and the establishment of other catch limits.'

As part of the comprehensive assessment mentioned in paragraph 10 (e), the IWC Scientific Committee (IWC SC) began the process of developing a procedure for setting safe catch limits for commercial whaling for baleen whales (Donovan, 1989). The procedure developed by the IWC SC in 1992 was called the Revised Management Procedure (RMP). Its agreed management objectives were:

i) Stability of catch limits which would be desirable for the orderly development of the whaling industry;

ii) Acceptable risk that a stock not to be depleted (at a certain level of probability) below some chosen level (e.g., fraction of carrying capacity), so that the risk of extinction is not seriously increased by exploitation;

iii) Making possible the highest possible continuing yield from the stock (IWC, 1992).

The IWC (i.e., the Commission) adopted the RMP in 1994.

**Main characteristics of the RMP**

The core component of the RMP is the Catch Limit Algorithm (CLA), which is a feedback control algorithm that sets baleen whale harvest levels to meet the objectives above, on the basis of catch histories and a time series of estimates of absolute abundance with their precisions, derived from sighting surveys. It was developed over a six-year period by the IWC SC, who took particular care to ensure its robustness to a very wide range of conceivable scientific uncertainties (e.g., the effect of environmental change) using simulation testing. The RMP has a built-in safety threshold, i.e., zero catch if the population size is estimated to be below 54% of carrying capacity.

The term 'continuing yield' in objective number iii) above refers to the mean (maximum) yearly harvest in the long term, i.e., when the exploited stock has reached a stationary state (Aldrin *et al*., 2008). The CLA has previously been tuned to a specified final depletion after 100 years of management, based on simulations from a population model with maximum sustainable yield (MSY) at 1% of the mature component of the stock. With regard to the tuning procedure, median depletion after 100 years is set to 60%, 66% or 72% of carrying capacity, one of which could be eventually chosen by relevant managers.

The RMP, or CLA to be precise, is a generic method for calculating safe catch limits that could be applied to any baleen whale population on its feeding grounds given perfect knowledge of stock structure (Punt and Donovan, 2007). While the robustness of catch limit calculated by the CLA is thoroughly examined as mentioned above, if the whale population concerned shows more complex behavior, the robustness of the CLA has to be re-checked taking into account such specific situations. In an IWC context, before recommending that the RMP be applied to a species in a region (generally part of an ocean basin), simulation trials are developed and run to capture the uncertainties deemed to be the most important for that stock complex/region. This process, referred to as '*Implementation*', focuses primarily on uncertainties about stock structure, in particular temporal and spatial variation in the mixing of stocks in areas where whaling is to take place (Punt and Donovan, 2007).

**Japanese concept for the implementation of the RMP**

The Japanese catch limit calculation in line with the RMP is based on the best and latest available scientific information of the species involved (mainly related to stock structure and abundance). Therefore, even though the discussion at the IWC SC has been duly considered, there are cases where the Japanese implementation of the RMP is based only on the most plausible hypothesis/scenario considered by the IWC SC which are reasonably supported by actual scientific data.

Japan's implementation of RMP will continue in the future to be based on best available science; hence the catch limits will be revised from time to time to reflect the latest scientific information.

Japan's catch limits were calculated based on the Norwegian code for the CLA (Aldrin and Huseby, 2007; Aldrin *et al*., 2008), though for a tuning level of 0.6 as is also used by Norway for its calculations of catch limits for common minke whales in the North East Atlantic. Input files as well the CLA R program were checked by an independent specialist.

## CALCULATION OF CATCH LIMITS: THE CATCH LIMIT ALGORITHM

As indicated above, the CLA sets catch limits based on catch histories and a time series of estimates of absolute abundance with their precisions derived from sighting surveys. These data are compiled for specific management areas. This section explains the procedure how the management area was defined in the case of western North Pacific common minke whales; and the abundance and catch history information associated to this management area.

**Stock structure hypotheses**

Studies on stock structure of western North Pacific common minke whale in the context of management have been conducted since 1993, based on genetic and non-genetic data. Different stock structure hypotheses have been proposed during previous the IWC SC RMP *Implementations* but the IWC SC had been generally unable to agree on the relative plausibility of stock structure hypotheses proposed. Ideally stock structure hypothesis with high plausibility should be the basis for defining management areas.

Results of the most comprehensive studies on stock structure were presented initially during the JARPNII final review workshop (IWC, 2017), and subsequently to annual meetings of the IWC SC. The genetic and non-genetic analyses presented followed generally previous recommendations by the IWC SC related to the relevant analyses.

Recently the IWC SC completed a new RMP *Implementation* of western North Pacific common minke whales, and new genetic analyses were conducted and discussed (IWC, 2020). These analyses and the emerging hypotheses on stock structure agreed by the IWC SC are summarized below. To facilitate the understanding of the hypotheses, a map with sub-areas is shown in Figure 1.

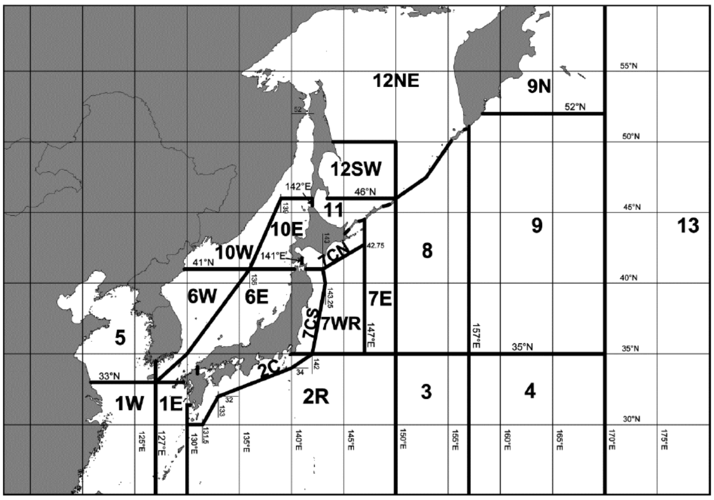



**Figure 1**. The 22 sub-areas used during the IWC SC *Implementation* of western North Pacific common minke whale (IWC, 2014).

During the *Implementation* the IWC SC agreed on three stock structure hypotheses: A, B (which were similar to hypotheses in previous *Implementations*), and a new hypothesis called E which was based on a single genetic study.

> Hypothesis A: there is a single J stock distributed in sub-areas 1W, 1E, 2C, 5, 6W, 6E, 7CS, 7CN, 10W, 10E, 11 and 12SW, and a single O stock in sub-areas 2C, 2R, 3, 4, 7CS, 7CN, 7WR, 7E, 8, 9, 9N, 10E, 11, 12SW, 12NE and 13;
>
> Hypothesis B: as for hypothesis A, but there is a third stock (Y) that resides in sub-area 1W, 5 and 6W and overlaps with J stock in the southern part of sub-area 6W; and
>
> Hypothesis E: there are four stocks, referred to Y, J, P, and O, two of which (Y and J) occur to the west of Japan, and three of which (J, P, and O) are found to the east of Japan and in the Okhotsk Sea. Stock

P (earlier termed "purple") is a coastal stock.

The IWC SC assigned high plausibility to Hypotheses A and B above. It was unable to assign plausibility to Hypothesis E, needing first to await additional genetic and demographic analyses (IWC, 2020). It should be noted that the occurrence of Y stock (Hypotheses B and E) has no management implication for the Pacific side of Japan.

Based on the information reviewed above, the JRT concluded that the most appropriate stock hypothesis for the domestic implementation of the RMP was Hypothesis A, which was given high plausibility by the IWC SC (IWC, 2020).

Under Hypothesis A there are geographical and temporal mixing of the J and O stocks in sub-areas 7CN, 7CS (Pacific side of Japan) and 11 (southern Okhotsk Sea) (Figure 1). Only J stock occur in the Sea of Japan (sub-areas 7E and 10E) and there is no mixing of the J and O stocks in offshore areas on the Pacific side of Japan (from sub-area 7WR to the east).

**Specification of management areas**

As a first step in the specification of RMP *Small Areas* (IWC terminology, which means management unit), four aggregations of sub-areas (see Figure 1 for definition of sub-areas) were considered based on stock structure Hypothesis A (Figure 2):

A: sub-areas 7CS and 7CN combined (mixing of J and O stocks occurs)

B: sub-areas 7WR, 7E, 8 and 9 combined (only O stock is present)

C: sub-area 11 in the southern part of the Okhotsk Sea (mixing of J and O stocks occurs)

D: sub-area 12 in the central and northern part of the Okhotsk Sea (mixing of J and O stocks occurs)

It was decided then to specify A+B+C+D as a *Small Area*, and consequently the abundance estimate and catch history (required for the CLA) were computed for this *Small Area*.

It was assumed that the abundance in this *Small Area* reflects O stock whales only. However, other more conservative options assuming different proportions of this stock in the aggregations of sub-areas were also considered (based on genetic information of the O and J mixing proportion).

All historical catches in this *Small Area* were attributed to the O stock, which constitutes a conservative decision from the perspective of the O stock.

There is scientific evidence based on length compositions of common minke whale that that O stock migrates to the Okhotsk Sea (D) through sub-areas 7, 8 and 9 (A and B) in summer (Hatanaka and Miyashita, 1997).

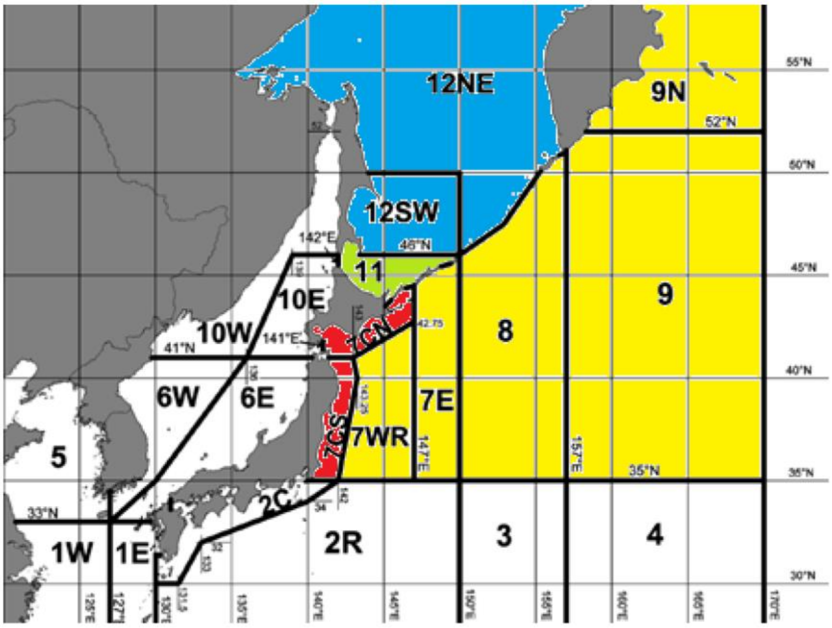



**Figure 2**. Four aggregations of sub-areas: A (red): 7CS+7CN; B (yellow): 7WR+7E+8+9; C (green): 11; and D (blue): 12SW+12NE.

Table 1 shows the proportions of whales from the O stock in various sub-area aggregations which were considered for the more conservative options mentioned above. These proportions are based on genetic data for the J and O stocks available for the sub-area aggregations A, B and C. Yoshida *et al.* (2010; 2011) reported the only recent genetic information available for aggregation sub-area D. They analysed eight biopsy samples taken from sub-areas 12NE (7) and 12SW (1). All animals in sub-area 12NE were identified as O stock while only a single minke whale from 12SW was identified as J stock. Although this sample size is small, the study suggests that most of the common minke whales in 12NE are O stock whales. The more conservative options S3 and S4 in Table 1 considered smaller proportions of the O stock in 12NE.

Abundance estimates of the O stock are computed for the aggregation of sub-areas based on the proportions of this stock shown in Table 1.

**Table 1**. Four alternative options (S1-S4) for the proportions of whales present in various aggregations of sub-areas that belong to the O stock.

| Aggregated sub-areas | S0 | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| A (7CS,7CN) | 100 | 80 | 80 | 80 | 80 |
| B (7WR, 7E, 8.9) | 100 | 100 | 100 | 100 | 100 |
| C (11) | 100 | 80 | 80 | 70 | 60 |
| D (12SW) | 100 | 80 | 90 | 70 | 60 |
| D (12NE) | 100 | 100 | 100 | 90 | 75 |

**Abundance estimates**

Abundance estimates should be computed for the *Small Area*, considering the information of O stock proportions in Table 1.

Abundance estimates were based on sighting data collected during systematic sighting surveys, which were analysed using the Line Transect Method. Surveys have been conducted in a systematic manner through the years, and in general followed the survey design and analytical procedure guidelines of the IWC SC (IWC, 2012). Sighting data used for the abundance estimates of common minke whales come from two sources: Japanese dedicated sighting surveys and JARPNII surveys.

*Data*

Abundance estimates in the Pacific side of Japan are based on sighting data collected during the JARPNII surveys in 2002-2004 (Fujise *et al.*, 2003; Tamura *et al.*, 2004; Tamura *et al.*, 2005), and Japanese sighting surveys conducted in 1990, 1991 and 1992 (Miyashita and Shimada, 1994). Abundance estimates in the Sea of Okhotsk are based on sighting surveys conducted in sub-areas 11 and 12 in 1990, 1992, 2000 and 2003 (Buckland *et al*., 1992; Miyashita *et al*., 2000; Miyashita and Okamura, 2011). IO (Independent Observer) mode data were collected from a series of sighting surveys conducted for stock assessment of common minke whales (Miyashita, 2007; 2008; Miyashita *et al*., 2009). These data were used for the estimation of g(0).

The abundance estimates for the purpose of the application of the CLA were based on surveys which were conducted mainly during the summer season.

Figure 3 shows the track-lines and the geographical distribution of common minke whale primary sightings on JARPNII surveys over 2002 to 2004. Figure 4 shows this same information for Japanese sighting surveys in 1991 and 1992, while Figure 5 does this for four surveys in the Sea of Okhotsk that took place over the period from 1990 to 2003.

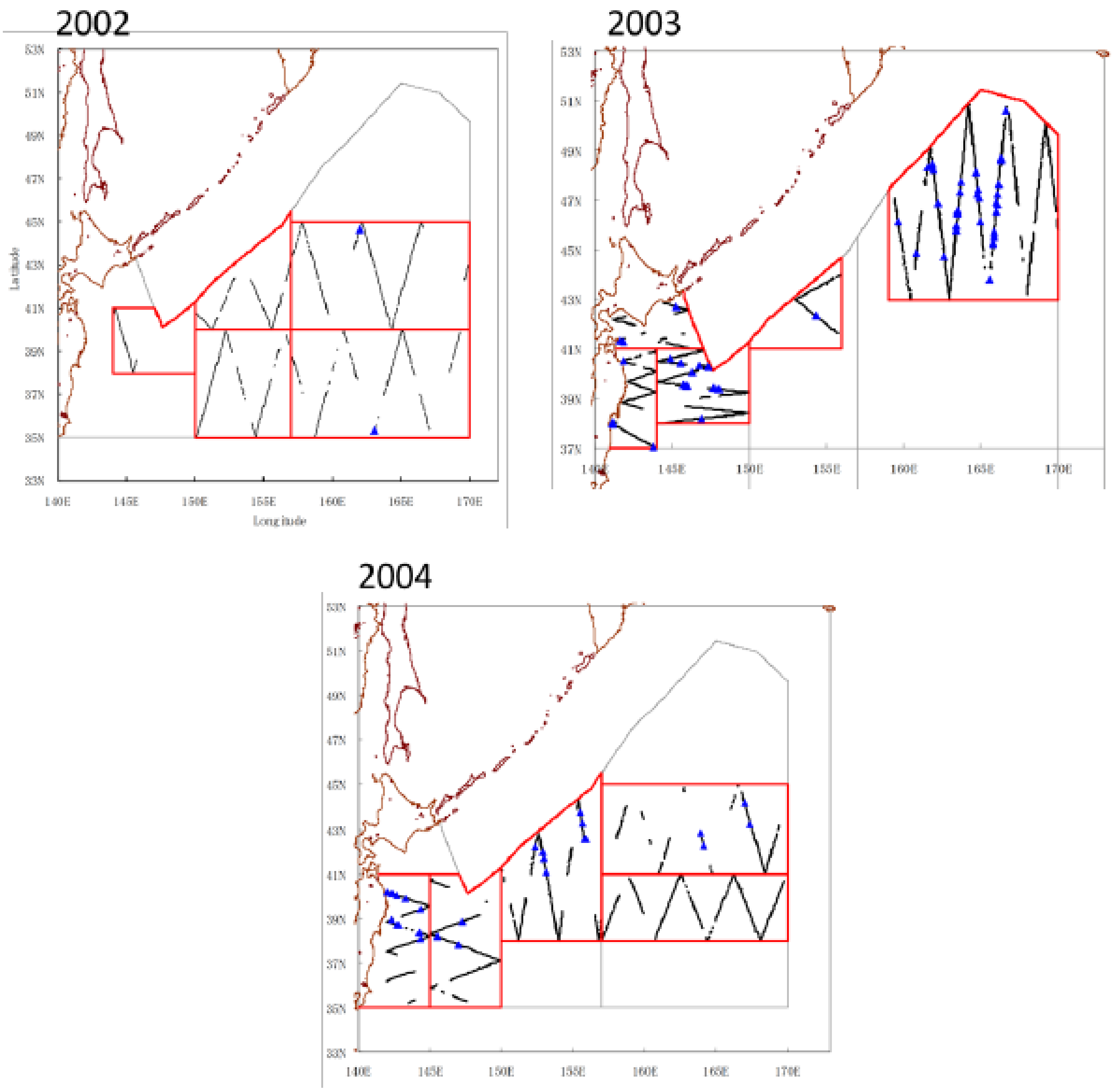
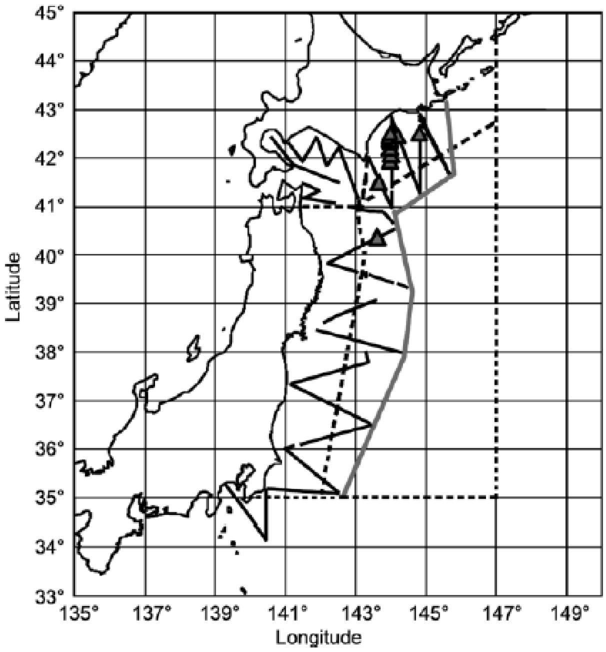



**Figure 3.** Track-lines and primary sighting positions of common minke whales for the JARPNII surveys in 2002 (June-August), 2003 (May-September) and 2004 (May-July) (Hakamada and Kitakado, 2010).



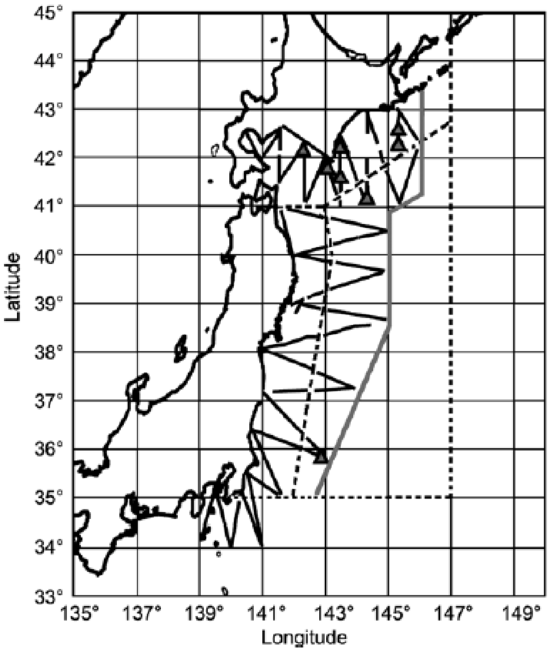




**Figure 4.** Track-lines and primary sighting positions (triangles) of common minke whales for the Japanese sighting surveys in 1991 (left) and 1992 (right) (Butterworth and Miyashita, 2014). Surveys were conducted in August-September.

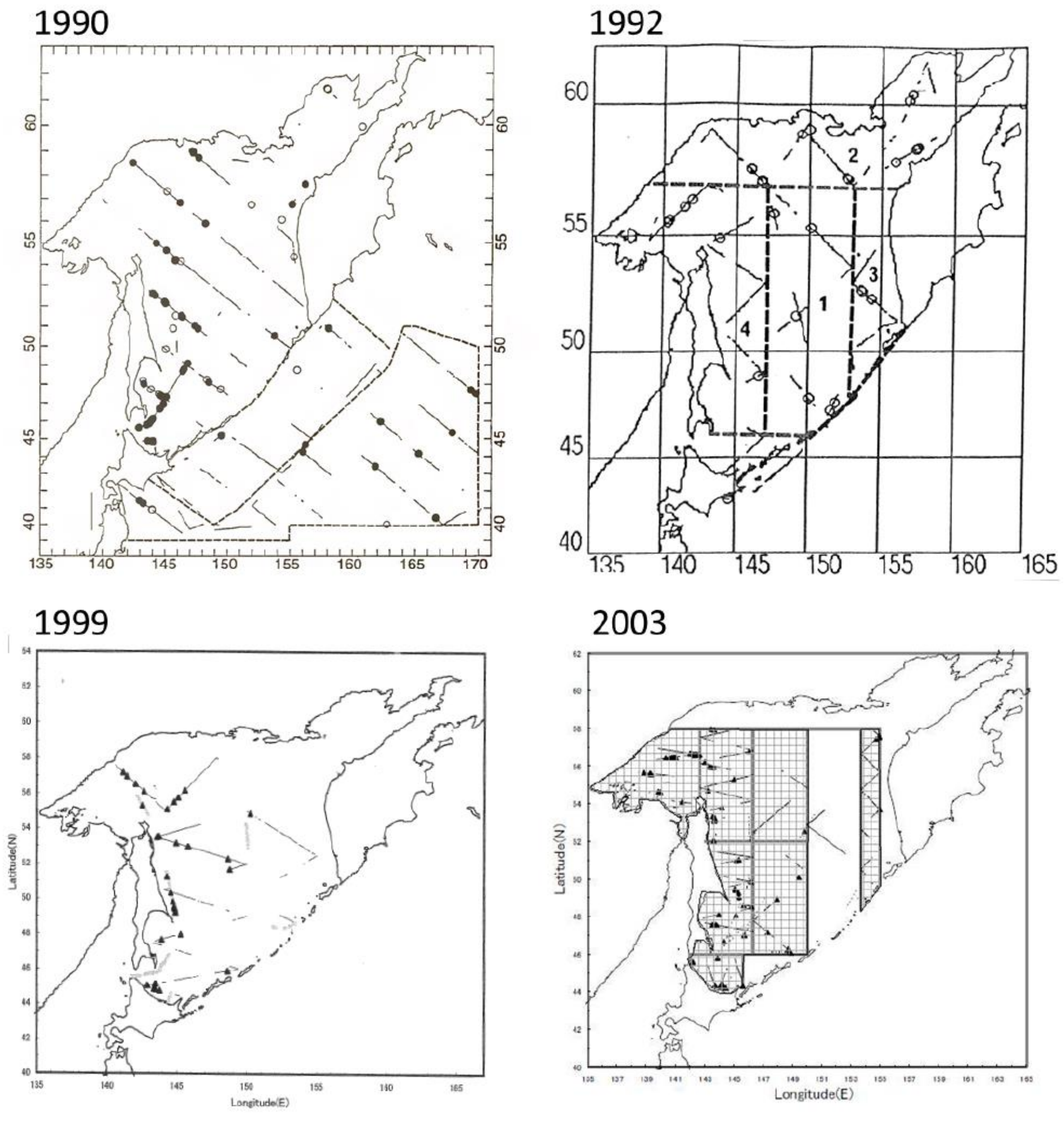



**Figure 5**. Track-lines and primary sighting positions for common minke whales for the surveys in 1990 (top left; Buckland *et al*., 1992; solid circles indicate primary sightings), 1992 (top right; Miyashita and Shimada, 1994; open circles indicate primary sightings), 1999 (bottom left; Miyashita *et al*., 2000) and 2003 (bottom right; Miyashita and Okamura, 2011).

*Analytical procedures including g (0) estimates*

Details of the analytical procedures applied to obtain abundance estimates are given in Buckland *et al*. (1992), Miyashita and Shimada (1994), Miyashita *et al*. (2000), Miyashita and Okamura (2011) and Butterworth and Miyashita (2014) for the Japanese sighting surveys, and in Hakamada and Kitakado (2010) for the JARPNII surveys.

Basically, the distance sampling method was applied to estimate abundance. Abundance and its CV were estimated based on a Horvitz-Thompson like estimator. The detections were truncated at 1.5 n.miles perpendicular distance for this species according to the standard convention, and the probability to detect this species on the track-line, g(0), was set at 0.798 (see below). Hazard Rate and Half-normal models were considered as candidate models for the detection function. In order to consider the effect of covariates such as Beaufort state, school size and year on estimated detection functions, the MCDS (Multiple Covariates Distance Sampling) engine in the

DISTANCE program was used. The best model was selected as the case for which the AIC value was smallest. Furthermore, if the difference in AIC amongst detection functions was not substantially different, the weighted average using Akaike weight was calculated (Buckland *et al*., 1997; Burnham and Anderson, 2002).

The latest estimate of g(0) for Top barrel and Upper bridge combined is 0.798. This was obtained by applying the OK method (Okamura and Kitakado, 2009), and using the IO passing mode sighting survey data from 2003, 2005, 2006 and 2007 in sub-areas 10, 11 and12 (Okamura *et al.*, 2010). A hazard probability model was used for the estimation of esw (the effective strip width). The analysis assumed that there was no need to consider school size effects in the estimation model because common minke whale schools in Russian and Japanese waters nearly all consist of single animals.

*Results of estimates*
Detailed results for abundance estimates of North Pacific common minke whales are available in IWC (2014) and in the documents referenced above.

Table 2 provides a summary of these abundance estimates for the different sub-areas. In cases where more than one abundance estimate is available for the same sub-area, the abundance estimates were averaged using inverse variance weighting. Abundance estimates for the *Small Area* (A+B+C+D) were obtained from the sum over abundance estimates by sub-area taking into account of the estimate of g(0)=0.798 with SE=0.134 (Okamura *et al*., 2010). Table 3 shows the abundance estimates assuming different proportions of the whales present in the *Small Area* that are from the O stock (see Table 1 above).

**Table 2.** Abundance estimates for North Pacific common minke whale assuming g(0)= 1, based on sighting surveys during JARPNII and other national surveys, presented by IWC SC sub-area. These data were used in 2013 *Implementation Simulation Trials* (IWC, 2014).

| Sub-area | Year | Estimate | CV | Areal Cover | Used | Month |
|---|---|---|---|---|---|---|
| 7CS | 1991 | 0 | - | 100 | Y* | |
| 7CS | 2004 | 504 | 0.291 | 36.7 | Y* | May |
| 7CN | 1991 | 853 | 0.230 | | Y* | Aug-Sep |
| 7CN | 2003 | 184 | 0.805 | 75.4 | NA* | May |
| 7WR | 1991 | 311 | 0.230 | | Y* | Aug-Sep |
| 7WR | 2003 | 267 | 0.700 | 26.7 | Y* | May-Jun |
| 7WR | 2004 | 863 | 0.648 | 88.8 | Y | May-Jun |
| 7E | 1990 | 791 | 1.848 | | N | Aug-Sep |
| 7E | 2004 | 440 | 0.779 | 57.1 | Y | May-Jun |
| 8 | 1990 | 1,057 | 0.706 | 62.2 | Y | Aug-Sep |
| 8 | 2002 | 0 | - | 65 | Y | Jun-Jul |
| 8 | 2004 | 1,093 | 0.576 | 40.5 | Y | Jun |
| 9 | 1990 | 8,264 | 0.396 | 35.1 | Y | Aug-Sep |
| 9 | 2003 | 2,546 | 0.276 | 33.2 | Y | Jul-Sep |
| 11 | 1990 | 2,120 | 0.449 | 100 | Y | Aug-Sep |
| 11 | 1999 | 1,456 | 0.565 | 100 | Y | Aug-Sep |
| 11 | 2003 | 882 | 0.820 | 33.9 | Y* | Aug-Sep |
| 12SW | 1990 | 5,244 | 0.806 | 100 | Y* | Aug-Sep |
| 12SW | 2003 | 3,401 | 0.409 | 100 | Y* | Aug-Sep |
| 12NE | 1990 | 10,397 | 0.364 | 100 | Y* | Aug-Sep |
| 12NE | 1992 | 11,544 | 0.380 | 89.4 | Y* | Aug-Sep |
| 12NE | 1999 | 5,088 | 0.377 | 63.8 | Y* | Aug-Sep |
| 12NE | 2003 | 13,067 | 0.287 | 46 | Y* | Aug-Sep |

*: indicates that further analysis needs to be considered for an estimate to become acceptable for use in a real application of the RMP.

**Table 3**. Abundance estimates for the O stock of common minke whale under several assumptions for the proportion of whales present in *Small Area* (A+B+C+D) which are from that stock (see Table 1).

| Year | A+B+C+D | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S0 | | S1 | | S2 | | S3 | | S4 | |
| | Estimate | CV | Estimate | CV | Estimate | CV | Estimate | CV | Estimate | CV |
| 1991 | 37,001 | 0.273 | 34,941 | 0.267 | 35,598 | 0.271 | 32,654 | 0.267 | 29,685 | 0.269 |
| 2003 | 20,513 | 0.227 | 19,205 | 0.226 | 19,631 | 0.227 | 17,792 | 0.225 | 15,956 | 0.223 |

**Catch history**

Catch history should be allocated to the '*Small Area*'. The historical catch series used for the CLA (Table 4) corresponds to the 'best' series used during the *Implementation* of western North Pacific common minke whale by the IWC SC. Details concerning these data can be found in Appendix 2 of IWC (2014). The series shown in Table 4 were updated to 2017 from that shown in IWC (2014).

**Table 4**. Catch history for North Pacific common minke whale for the *Small Area* (A+B+C+D).

| Year | A+B+C+D | Year | A+B+C+D | Year | A+B+C+D |
|---|---|---|---|---|---|
| 1930 | 13 | 1959 | 281 | 1988 | 0 |
| 1931 | 14 | 1960 | 257 | 1989 | 0 |
| 1932 | 22 | 1961 | 333 | 1990 | 0 |
| 1933 | 23 | 1962 | 239 | 1991 | 0 |
| 1934 | 32 | 1963 | 220 | 1992 | 0 |
| 1935 | 33 | 1964 | 289 | 1993 | 0 |
| 1936 | 24 | 1965 | 312 | 1994 | 21 |
| 1937 | 58 | 1966 | 360 | 1995 | 100 |
| 1938 | 68 | 1967 | 270 | 1996 | 77 |
| 1939 | 69 | 1968 | 225 | 1997 | 100 |
| 1940 | 79 | 1969 | 202 | 1998 | 100 |
| 1941 | 58 | 1970 | 310 | 1999 | 100 |
| 1942 | 68 | 1971 | 268 | 2000 | 40 |
| 1943 | 102 | 1972 | 340 | 2001 | 100 |
| 1944 | 79 | 1973 | 518 | 2002 | 150 |
| 1945 | 69 | 1974 | 363 | 2003 | 150 |
| 1946 | 97 | 1975 | 328 | 2004 | 159 |
| 1947 | 125 | 1976 | 339 | 2005 | 220 |
| 1948 | 169 | 1977 | 246 | 2006 | 195 |
| 1949 | 132 | 1978 | 400 | 2007 | 207 |
| 1950 | 201 | 1979 | 392 | 2008 | 169 |
| 1951 | 231 | 1980 | 364 | 2009 | 162 |
| 1952 | 291 | 1981 | 358 | 2010 | 119 |
| 1953 | 234 | 1982 | 309 | 2011 | 126 |
| 1954 | 274 | 1983 | 279 | 2012 | 182 |
| 1955 | 374 | 1984 | 367 | 2013 | 95 |
| 1956 | 455 | 1985 | 319 | 2014 | 81 |
| 1957 | 357 | 1986 | 311 | 2015 | 70 |
| 1958 | 516 | 1987 | 304 | 2016 | 37 |
| | | | | 2017 | 128 |

The series of bycatches (Table 5) is also that used during the IWC SC *Implementation* (IWC, 2014), again updated to 2017.

**Table 5**. Incidental catches (bycatches) of western North Pacific common minke whales for A+B+C+D aggregations.

| Year | A+B+C+D | Year | A+B+C+D |
|---|---|---|---|
| 1946 | 11.67 | 1982 | 37.17 |
| 1947 | 12.83 | 1983 | 37.67 |
| 1948 | 13.50 | 1984 | 37.83 |
| 1949 | 14.50 | 1985 | 38.33 |
| 1950 | 15.83 | 1986 | 37.50 |
| 1951 | 16.83 | 1987 | 37.50 |
| 1952 | 17.33 | 1988 | 36.67 |
| 1953 | 18.17 | 1989 | 37.83 |
| 1954 | 19.67 | 1990 | 37.01 |
| 1955 | 20.33 | 1991 | 36.84 |
| 1956 | 21.34 | 1992 | 37.01 |
| 1957 | 21.83 | 1993 | 37.00 |
| 1958 | 23.00 | 1994 | 35.66 |
| 1959 | 23.66 | 1995 | 33.50 |
| 1960 | 24.33 | 1996 | 34.66 |
| 1961 | 25.00 | 1997 | 34.83 |
| 1962 | 26.00 | 1998 | 35.00 |
| 1963 | 27.17 | 1999 | 35.00 |
| 1964 | 27.83 | 2000 | 35.00 |
| 1965 | 28.83 | 2001 | 35.00 |
| 1966 | 29.33 | 2002 | 35.00 |
| 1967 | 30.16 | 2003 | 36.00 |
| 1968 | 31.33 | 2004 | 35.00 |
| 1969 | 31.66 | 2005 | 34.00 |
| 1970 | 32.33 | 2006 | 35.00 |
| 1971 | 31.84 | 2007 | 32.00 |
| 1972 | 32.67 | 2008 | 32.83 |
| 1973 | 32.33 | 2009 | 32.83 |
| 1974 | 32.00 | 2010 | 32.83 |
| 1975 | 31.83 | 2011 | 32.67 |
| 1976 | 33.00 | 2012 | 32.67 |
| 1977 | 35.49 | 2013 | 23.00 |
| 1978 | 36.66 | 2014 | 38.00 |
| 1979 | 37.83 | 2015 | 38.00 |
| 1980 | 37.17 | 2016 | 38.00 |
| 1981 | 37.83 | 2017 | 38.00 |

Using the CLA catch limit was calculated based on the abundance estimates and catch history summarized for the *Small Area* as explained above. Details of the procedures and results are available in JRT (2019).

## EXAMINATION OF UNCERTAINTIES: THE IMPLEMENTATION SIMULATION TRIALS

*Implementation Simulation Trials* (*IST*s) were conducted to evaluate uncertainties in several assumptions, data and parameters. The *ISTs* were evaluated in the context of management variants, which specify the mode of whaling operations and options on how to apply CLA (IWC, 2012b). Through the *IST*, management variants that are 'acceptable' from the conservation point of view are determined. Mode of acceptability is explained in a section below.

Taking several kinds of uncertainty into account, a total of 30 *ISTs* (Table 6) was conducted for each management variant.

**Table 6**. List of the *ISTs* conducted for western North Pacific common minke whale.

| Trial numbers | *MSYR* | Description | Trial weight |
|---|---|---|---|
| A01-1, | 1%(1+) | Baseline two stock scenario, $g(0)$=0.8, Chinese bycatch | L* |
| A01-2 | 2%(1+) | | M |
| A01-4 | 4%(mature) | | M |
| A02-1, | 1%(1+) | High direct catches and alternative Korean and Japanese bycatches | L* |
| A02-2 | 2%(1+) | | M |
| A02-4 | 4%(mature) | | M |
| A03-1, | 1%(1+) | Assume $g(0)$=1 | L* |
| A03-2 | 2%(1+) | | M |
| A03-4 | 4%(mature) | | M |
| A04-1 | 1%(1+) | 10% J stock in sub-area 12SW in August (20% in base case) | L* |
| A04-2 | 2%(1+) | | M |
| A04-4 | 4%(mature) | | M |
| A05-1 | 1%(1+) | 30% J stock in sub-area 12SW in August (20% in base case) | L* |
| A05-2 | 2%(1+) | | M |
| A05-4 | 4%(mature) | | M |
| A06-1 | 1%(1+) | 40% J stock in sub-area 12SW in August (20% in base case) | L* |
| A06-2 | 2%(1+) | | M |
| A06-4 | 4%(mature) | | M |
| A07-1 | 1%(1+) | 10% J stock in sub-area 12 in August | L* |
| A07-2 | 2%(1+) | | M |
| A07-4 | 4%(mature) | | M |
| A08-1 | 1%(1+) | 20% J stock in sub-area 12 in August | L* |
| A08-2 | 2%(1+) | | M |
| A08-4 | 4%(mature) | | M |
| A09-1 | 1%(1+) | 30% J stock in sub-area 12 in August | L* |
| A09-4 | 4%(mature) | | M |
| A09-2 | 2%(1+) | | M |
| A10-1 | 1%(1+) | 40% J stock in sub-area 12 in August | L* |
| A10-4 | 4%(mature) | | M |
| A10-2 | 2%(1+) | | M |

*: The plausibility of MSYR 1% (1+) is considered to be low, but trails were conducted as a sensitivity test.

**Uncertainties associated to stock structure**
There is uncertainty on the mixing proportion of O and J stocks in sub-areas12SW and 12NE because the genetic information there is limited.

There were four scenarios on the mixing proportion of the J stock in sub-area 12SW, which were 10% (A04), 20% (A01, base case), 30% (A05) and 40% (A06). There were four scenarios on mixing proportion in sub-areas 12SW and 12NE in August, which were 10% (A07), 20% (A08), 30% (A09) and 40% (A10). Sighting surveys were conducted in these sub-areas in August when the peak of the migration is assumed. The *IST* examined the effect of the assumed mixing proportions on the conservation performances.

**Uncertainties related to abundance estimates**
In the *IST*, *g*(0)=0.8 was assumed as the base case. In order to examine uncertainty of abundance estimate, scenario assuming g(0)=1 was considered as a conservative scenario (A03).

**Uncertainties related to MSYR**
Scenarios with MSYR(1+)=1% and MSYR(mat)=4% were examined in the 2013 IWC SC *Implementation Review* of this species. Based on Kitakado and Goto (2018), scenario with MSYR(1+)=2% was also examined in the *IST* and scenario with MSYR(1+)=1% was treated as low plausibility.

**Uncertainties related to catch history**
There were some uncertainties in the catch history statistics (Table 4) in old years. The Japanese coastal catches from 1930-31 and 1936-45 (in sub-areas 7CS, 7CN and 11) were summarized by Ohsumi (1982), and the values in the 'high' series are doubled for those periods (IWC, 2014). The catch series off Korea (in sub-areas 5 and 6W) assumes a linear increase from 60 whales in 1946 to 249 in 1957 in the 'best' series whereas the 'high' series assumes an annual catch of 249 minke whales over this period.

For incidental catches, alternative effort series (i.e., series of the number of set net) off Japan and off Korea were considered. The values in the 'high' series between 1946 and 1969 off Japan were doubled regarding the 'best' values or set up to be equal the number of nets in 1969. The values in the 'high' series between 1957 and 1969 off Korea are doubled regarding the 'best' values or set up to be equal the number of nets in 1969. These higher catch series were assumed in scenario A02.

Trial scenarios are denoted using the format 'Ann-r' (nn is the trial number and r is MSYR value). The trials A01 are baseline trials, and their specifications are almost the same as those used in the 2013 IWC SC *Implementation* of this species (but the CLA tuning level of 0.6 was used instead of 0.72 for tests under these trials). Trials A02 (alternative numbers of the historical catches and bycatches), A03 (assuming g(0)=1 for abundance estimates) and A04-10 (alternative proportions of J and O stock whales in the Okhotsk Sea) were conducted for testing robust to major uncertainties. All trials were conducted for both MSYR 4% (mature) and 2% (1+) (Ann-4 or Ann-2), and the results were treated as medium weight when deciding the acceptability of the variants (see section below).

## EXAMINATION OF FUTURE SIGHTING SURVEYS AND WHALING OPERATION

The process for catch limits calculation in line with the RMP requires that the future sighting surveys be specified. In the simulation, abundances in the *Small Area* will be estimated using future sighting surveys (for use in future updates of catch limit). Based on the frequency of the future surveys, an idea will be obtained on how often future abundance estimates will be available.

**Future sighting surveys**
The same future survey plan as in the *Implementation* for the common minke whale (IWC, 2020) was applied. Tables 7a and 7b show the assumed future Japanese sighting survey plan during 2020-2027 in the Sea of Japan, and in the North Pacific and Okhotsk Sea. The same pattern is to be repeated every four years.

**Table 7a**. Future Japanese sighting survey plan assumed for 2020-2027 in sub-areas 5, 6 and 10 (Sea of Japan) (IWC, 2020).

| | 5 | 6W | 6E | 10W | 10E |
|---|---|---|---|---|---|
| 2020 | - | - | - | - | - |
| 2021 | - | - | - | - | - |
| 2022 | - | - | - | - | - |
| 2023 | - | - | Aug-Sep | Aug-Sep | Aug-Sep |
| 2024 | - | - | - | - | - |
| 2025 | - | - | - | - | - |
| 2026 | - | - | - | - | - |
| 2027 | - | - | Aug-Sep | Aug-Sep | Aug-Sep |

**Table 7b**. Future Japanese sighting survey plan assumed for 2020-2027 in sub-areas 7, 8, 9, 11 and 12 (North Pacific and Okhotsk Sea) (IWC, 2020).

| | 7CS | 7CN | 7WR | 7E | 8 | 9 | 11 | 12SW | 12NE |
|---|---|---|---|---|---|---|---|---|---|
| 2020 | - | - | - | - | - | - | Aug-Sep | Aug-Sep | Aug-Sep |
| 2021 | - | - | Aug-Sep | Aug-Sep | Aug-Sep | Aug-Sep | - | - | - |
| 2022 | Aug-Sep | Aug-Sep | - | - | - | - | - | - | - |
| 2023 | - | - | - | - | - | - | - | - | - |
| 2024 | - | - | - | - | - | - | Aug-Sep | Aug-Sep | Aug-Sep |
| 2025 | - | - | Aug-Sep | Aug-Sep | Aug-Sep | Aug-Sep | - | - | - |
| 2026 | Aug-Sep | Aug-Sep | - | - | - | - | - | - | - |
| 2027 | - | - | - | - | - | - | - | - | - |

**Management variants**

Whaling is conducted in sub-areas 7CS, 7CN, 7WR and 11 within Japan's EEZ. Catch limits were to be calculated treating sub-areas 7, 8, 9, 11 and 12 as a *Small Area*, with the catches taken from sub-areas 7CS, 7CN, 7WR and 11. There were four factors considered to define the management variants (for convenience, the variants examined in the trials are represented by four-digit numbers):

*Abundance estimates for using actual CLA*

There are five options to calculate abundance estimates as inputs for the CLA. One is to sum over abundance estimates for sub-areas 7, 8, 9, 11 and 12 (hereafter, this option is termed All O stock or S0). Given that there may be some J stock animals in this aggregation of sub-areas, the assumed proportion in each aggregation sub-area consisting of O stock whales (Table 1) was multiplied by the abundance estimates in order to obtain approximate abundances of the O stock in each sub-area (options S1-S4 in Table 3).

*Whaling: Spatial closure*

Two options for spatial closure are considered: i) no whales are to be taken in waters within 10n.miles from the coast in sub-areas 7CS and 7CN, and ii) no spatial closure. Past studies have shown that the proportion of the whales present that are from the J stock is higher within 10 n.miles of the coast than that from further offshore (i.e. more than 10 n.miles away from the coast) (IWC, 2014).

*Whaling: temporal closure*

Two options for temporal closure are considered: i) whaling is to be restricted to the period April-October in sub-areas 7CS, 7CN and 7WR, and to the period August to October in sub-area 11, and ii) whaling occurs in all months. If the proportion of J stock is higher in months when temporal closure is applied, temporal closure could be effective to reduce the catches from the J stocks.

*Allocation of catch limit to sub-areas*
Alternative allocations of the catch limit to the four coastal sub-areas are investigated. One option is the application of *Catch Cascading* (IWC terminology). The other option is assigning catch proportions to the sub-areas as set out in Table 8.

**Table 8.** Proportions of the catch allocated to sub-areas 7CS, 7CN, 7WR and 11 (%)

| | Opt 1 | Opt 2 | Opt 3 | Opt 4 | Opt 5 |
|---|---|---|---|---|---|
| 7CS | 40 | 100 | 0 | 0 | 0 |
| 7CN | 20 | 0 | 100 | 0 | 0 |
| 7WR | 20 | 0 | 0 | 100 | 0 |
| 11 | 20 | 0 | 0 | 0 | 100 |

*ID representing the variants*
With a combination of four factors, a total of 120 variants (5 sets of abundance estimates × 2 spatial options × 2 temporal options × 6 catch limit allocations) were examined for the 30 *ISTs* listed in Table 6. For convenience, those variants are represented by four-digit numbers (Vxxxx) as shown in Table 9.

**Table 9**. Variant ID for the trials for common minke whales.

| Factor | Place | |
|---|---|---|
| Abundance for CLA | Thousand's place ( Vx*** ) | 0: All O stock, 1: S1, 2: S2, 3: S3, 4: S4 |
| Spatial closure | Hundred's place (V*x** ) | 0: Closure within 10n.m in 7CS and 7CN, 1: No closure |
| Temporal closure | Ten's place (V**x*) | 0: Restriction of whaling season, 1: No restriction |
| Catch Allocation | One's place (V***x) | 0: Catch cascading, 1: Opt1, 2: Opt2, 3: Opt3, 4: Opt4, 5: Opt5 |

For example, V0001 means the variant with All O stock abundance option, spatial closure option, temporal restriction option, and catch allocation Opt1. V1011 means the variant with S1 abundance option, spatial closure option, no temporal restriction option, and catch allocation Opt1.

## CONSERVATION PERFORMANCE AND ACCEPTABILITY

### Conservation performance

The conservation performance for each trial and variant was examined following the IWC SC's guidelines to determine whether each combination of variant and *IST* is classified as 'acceptable', 'borderline' or 'unacceptable'. There are two conservation performance statistics for each of the two stocks (J and O stocks). They are the final depletion and the minimum depletion ratio (the minimum over each of the 100-year projections of a trial of the ratio of the population size to that when there are only incidental catches) (IWC, 2012b).

To construct thresholds of the acceptability, equivalent single stock trials were conducted for *MSYR*(1+)=1%. Details are provided in IWC (2012b). The tuning levels of 0.6 and 0.48 were used because the catch limit calculation is based on the 0.6 tuning level as in the case of the North Atlantic fin whales (NAMMCO, 2017). Tuning parameters to provide tuning levels of 0.6 and 0.48 after 100 years were those obtained by Aldrin *et al.* (2008) (Table 10).

**Table 10**. Median depletion for combinations of tuning parameters (Aldrin *et al*., 2008). α is the probability and γ is slope parameter of the catch control law of the CLA.

| α | γ | Year 100 | Year 300 | Year 500 |
|---|---|---|---|---|
| 0.4015 | 3 | 0.72 | 0.76 | 0.76 |
| 0.4629 | 3 | 0.66 | 0.74 | 0.74 |
| 0.5222 | 3 | 0.60 | 0.73 | 0.73 |
| 0.5 | 4.7157 | 0.54 | 0.71 | 0.72 |
| 0.5 | 9.3443 | 0.48 | 0.67 | 0.70 |

**Acceptability of the variant**

The lower 5%-ile of the two conservation performances, which were calculated through 100 simulations shall form the basis for determining whether the performance of the RMP for the *IST* is 'acceptable', 'borderline' or 'unacceptable' (IWC, 2012b).

Acceptability of the variant in one *IST* are decided by the same method in IWC (2012b) but running the equivalent single stock trials using tuning levels of 0.60 and 0.48, as follows;

(a) if the 5%-ile of the final depletion or the 5%-ile of the depletion ratio for the IST that shows better performance is less than for the equivalent single stock trial with 0.48 tuning of the CLA, the performance of the RMP shall be classified as 'unacceptable';

(b) if the 5%-ile of the final depletion or the 5%-ile of the depletion ratio for the IST that shows better performance is greater than for the equivalent single stock trial with 0.48 tuning of the CLA but less than for the equivalent single stock trial with 0.60 tuning of the CLA, the performance of the RMP shall be classified as 'borderline';

(c) if the 5%-ile of the final depletion or the 5%-ile of the depletion ratio for the IST that shows better performance is greater than for the equivalent single stock trial with 0.60 tuning of the CLA, the performance of the RMP shall be classified as 'acceptable'.

Acceptability of the variants could be different among the *ISTs*. To decide acceptability of the variants, the questions listed below were examined, following the procedure set out in IWC (2012b):

Q1: Is the performance 'acceptable' on all trials? If yes, the variant is acceptable, otherwise go to Q2.

Q2: Are there any 'unacceptable' performance for at least one 'high' weight trial? If yes, the variant is 'unacceptable', otherwise go to Q3.

Q3: Do the only problems relate to 'borderline' performance on medium trials? If yes, go to Q4, otherwise the variant is not acceptable.

Q4: Are results 'acceptable' through detailed evaluation of results. If yes, the variant is acceptable, otherwise the variant is not acceptable.

In this way, 'acceptable' variants can be determined from the results of the *IST*. We can choose one variant among the 'acceptable' ones and catch limit was calculated along with the variant chosen.

Based on the results of the *IST* the acceptable scenario for sustainable whaling of common minke whales was the following:

- S2 option for the abundance estimate for the CLA.
- A 10n. miles spatial closure was to be introduced on the Pacific side of Japan to decrease the catch of J stock whales.
- Twenty percent of the catch limit was to be allocated to sub-area 11, while 80% of the catch was to be allocated to the Pacific side of Japan (a block quota for sub-areas 7CS, 7CN and 7WR).

Details of the *ISTs* procedures and results are available in JRT (2019).

## FINAL REMARKS

Catch limits for sustainable commercial whaling of western North Pacific sei, Bryde's and common minke whales were calculated in 2019 in line with the IWC RMP. The data and procedures used in the calculations were illustrated in this document based on the case of the common minke whales. As indicated previously, Japan's implementation of RMP will continue in the future to be based on the best available science; hence the catch limits will be revised from time to time to reflect the latest scientific information. In fact, the catch limit for common minke whales is being updated considering new information on abundance obtained for the Okhotsk Sea and Pacific side of Japan. Updates of catch limits for the other species are expected for the near future as well.

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