

Technical Report-Note (not peer reviewed)

Japan’s system for monitoring of whale products sold in its domestic market through DNA registration

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As in the case of Norway and Iceland, Japan has been using a DNA-based system for monitoring (tracking origins of) large whale products sold in the retail market (Figure 1). Such a task is entrusted to the Institute of Cetacean Research (ICR) by the Government of Japan (Fisheries Agency of Japan) as an outsourced program every year.

The system is composed of two main components, i) a DNA register including genetic profiles of all large whales legally taken (including bycatches) and imported into Japan, and ii) systematic surveys of large whale products sold in the retail market. The objective of this system is to prevent illegal take of large whales and illegal import of large whale products by comparing DNA profiles of large whale products obtained in the market with those filed in the DNA register.

The Japanese DNA register (JDR) is established based on technical specifications similar to those of the Norwegian DNA register (Glover *et al.*, 2012). It contains DNA profiles of large whales sampled from different sources:

- i) Scientific whaling conducted under special permit in the Antarctic (JARPA/JARPAII and NEWREP-A). This category includes Antarctic minke whales collected between 1987/88 and 2018/19, and fin whales between 2005/06 and 2011/12.
- ii) Scientific whaling conducted under special permit in the western North Pacific (JARNP/JARNPII

and NEWREP-NP). This category includes common minke whales collected between 1994 and 2019; Bryde’s whales between 2000 and 2019; sei whales between 2002 and 2019; and sperm whales between 2000 and 2013.

- iii) Commercial whaling within Japan’s Exclusive Economic Zone (EEZ). This category includes common minke, Bryde’s and sei whales collected since 2019.
- iv) Bycatches in set nets. This category includes mainly common minke whales sold/used domestically (register system established since 1 July 2001).
- v) Imports. This category includes North Atlantic common minke whales from Norway and North Atlantic fin whales from Iceland since 2008.

By the end of 2019, DNA profiles of a total of 19,000 individual whales were registered in the JDR.

In the cases of scientific whaling and current commercial whaling, samples for genetic analysis have been collected by researchers from each whale. Samples include skin samples (two or three pieces of 5×5×5 mm kept frozen or in 99% ethanol). In addition, a large amount of information is collected using established protocols from every whale sampled including species, catch date and location (longitude, latitude), body length, sex and maturity status.

The Japanese regulation on bycatches of large whales (established from 1 July 2001) requires that all animals should be registered with a DNA profile before any products derived from a bycaught animal are sold in the market. Details of the regulation and procedure can be found in the following web page: <http://www.icrwhale.org/pdf/higekujira.pdf>. Skin or muscle samples (5×5×5 cm) are taken by the fisherman who intends to sell the bycaught whale and sent to the laboratory at ICR (as frozen samples). Together with the genetic samples, the fishermen should provide the following information in accordance with an established protocol: species, date and location of the bycatch, type of set net, body length

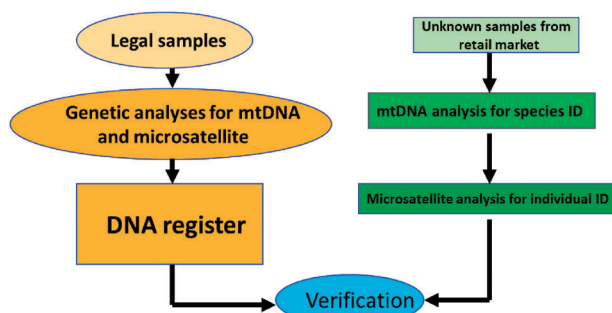


Figure 1. Flow chart of the DNA monitoring system of large whale products sold in the Japanese retail market.

Table 1

The number of whale products by sampling sites in the 2017 survey.

City/Town	Meat	Blubber	Ventral grooves	Total
Sapporo	23	2	7	32
Sendai	27	2	6	35
Niigata	3	10	3	16
Kanazawa	3	3	1	7
Noto	5	5	1	11
Anamizu	1	1	0	2
Toyama	4	0	0	4
Himi	3	5	1	9
Nagoya	13	1	5	19
Kochi	14	11	9	34
Kobe	10	8	3	21
Osaka	12	5	7	24
Taiji	5	6	2	13
Nachikatsuura	2	5	2	9
Hiroshima	11	0	4	15
Shimonoseki	18	6	10	34
Fukuoka	16	5	14	35
Nagasaki	14	6	10	30
Total	184	81	85	350



Figure 2. Sampling sites in the 2017 DNA market survey.

and sex of the bycaught whale to be used (sold).

The following genetic markers are used in the JDR:

- i) An approximately 500bp fragment of the 5'-end of the mitochondrial DNA (mtDNA) control region, which is used for the purpose of identification of the origin of the whale products (species identification), through phylogenetic analyses constructed by 'test' and 'type' sequences;
- ii) Microsatellite DNA (genotyping with 13–17 loci in each species), which is used for the purpose of individual identification; and
- iii) Y chromosome DNA, which is used for the purpose of sex determination.

For further details, see Pastene and Goto (2006).

Regarding sampling in the market, one or two technicians, who are familiar with whale products and market operations, carry out the sampling of whale products at retail shops each year. On an annual basis, around 350 samples are collected between September and December throughout Japan, including around 18 cities or towns. Table 1 shows the cities/towns surveyed and the whale products sampled in 2017. Figure 2 shows the geographical distribution of the sampling site in the

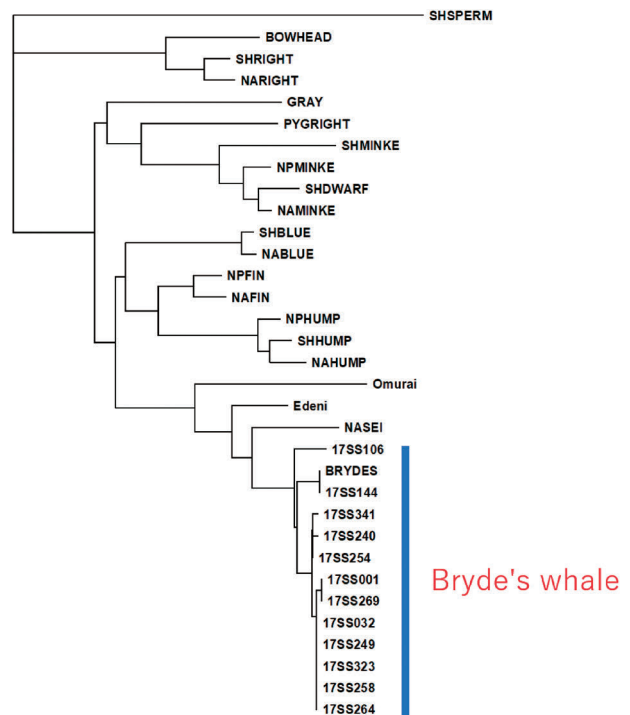


Figure 3. An example of species identification by phylogenetic analysis of 'test' and 'type' sequences of the whale products identified as Bryde's whale in the 2017 market survey. SH: Southern Hemisphere; NA: North Atlantic; and NP: North Pacific. 17SS+3 digits indicates the market samples collected in the 2017 survey.

2017 survey. The sampling attempts to cover the whole Japanese archipelago, but the method of sampling is not a random procedure. The following information is collected for each whale product sampled: kind of whale

Table 2

Results of species and individual identification of the 2017 market survey. The numbers of individual whales are shown in parenthesis. NG: Failed DNA extraction. NP: North Pacific and NA: North Atlantic.

Species identification	N	Individual identification	N
Antarctic minke whale	110	Not conducted*	—
Common minke whale: NP	87	Special permit: Offshore	1 (1)
		Special permit: Coastal	28 (13)
		Bycatch	58 (37)
Common minke whale: NA	9	Import from Norway	9 (7)
Fin whale: NA	40	Import from Iceland	40 (35)
Sei whale	84	Special permit: Offshore	84 (66)
Bryde's whale	12	Special permit: Offshore	12 (11)
Baird's beaked whale	6	Not conducted**	—
Striped dolphin	1	Not conducted**	—
NG	1	—	—
Total	350	Total	232 (170)

*Individual identification of Antarctic minke whales was not conducted because of the low probability of illegal products thereof being introduced into the Japanese market.

**Small cetaceans are not subject to the JDR.

product, sampling locality, date, weight and price. Once sampled, the products are sent to the laboratory at ICR for genetic analysis.

The laboratory work for the whale product samples were conducted with designated genetic markers for the JDR described above.

Standard phylogenetic analyses of 'test' (whale products sampled in the market) and 'type' (whale species in the JDR) mtDNA sequences are conducted to determine the species of the sampled whale products. Figure 3 shows an example of species identification by phylogenetic analysis in the case of Bryde's whales sampled in the 2017 survey.

For individual identification, matching of microsatellite genotypes of 'test' and 'type' samples was conducted using the computer program 'Cervus 3.0 software package' (Kalinowski *et al.*, 2007).

The results of the Japanese market survey in 2017 are shown in Table 2. All 350 market samples, but one, were successfully identified for the species and the origin (area) by the mtDNA analysis. One whale product (fried whale blubber or 'Koro' in Japanese) failed in the DNA extraction. The microsatellite analysis revealed that the 232 collected samples included 170 individual whales originating from the Northern Hemisphere. The genetic profiles of the 'test' and 'type' samples matched in all the cases (Table 2). Individual identification for Antarctic minke whales was not conducted because of the low

probability of illegal products thereof being introduced into the Japanese market.

Results of the comparisons between 'test' and 'type' samples are summarized in the annual report to the Fisheries Agency of the Government of Japan.

Considering results of the work obtained so far, it can be concluded that the DNA-based system is an effective tool for monitoring (tracking origins of) large whale products in the Japanese retail market.

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