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Historical Records

Initial Remarks

The paper below was a meeting document submitted to the International Cachalot Assessment Research Planning Workshop (CARP) sponsored by the IWC steering group, held at Woods Hole in 2005 (Smith, Reeves and Bannister, 2005)[1]*. However, unfortunately, all the documents that were submitted to the workshop were not to be objects of individual publication and thus became unavailable while they contained valuable and original information. Nevertheless, the Workshop report summarized the paper as follows:*

> "*Kato introduced CARP/LH/2, which examined the age- and body-length structure of a sperm whale school composed of 14 males that stranded on the Ohura coast, Kagoshima, Japan, on 22 January 2022. The authors succeeded in obtaining body lengths for all animals and ages for 12 of the 14. Although one exceptionally large male (15.5 m, 41 yr) was involved, the lengths (mean 12.81, range 12.1–13.7 m) and ages of the remaining animals were consistent with those for medium-sized bachelors as defined by Best (1979)*[2]*. Thus, these data were interpreted as supporting the existence and definition of a male social unit. The authors gave two alternate interpretations for the presence of the large male: either this animal was socially still immature, or large males do not always segregate permanently from other social units.*"

For this opportunity, we, the Publication Committee for the Cetacean Population Studies (CPOPS), retrieve the paper as in the original form (with minor edits to improve clarity) from the point view of its biological importance for understanding the social structure of sperm whales.

[1]*Smith, T. D., Reeves, R. R. and Bannister, J. L. (eds.) 2005. Report of the International Cachalot Assessment Research Planning Workshop, Woods Hole, Massachusetts, 1–3 March 2005. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 45 pp.*

[2]*Best, P. B. 1979. Social organization in sperm whales, Physeter macrocephalus. Pp. 227–289 in H. E. Winn and B. L. Olla (eds.). Behavior of marine mammals: current perspectives in research. Vol 3: Cetaceans. Plenum Press, New York. xix +438 pp. doi: 10.1007/978-1-4684-2985-5_7.*

CARP/LH/2 (Rev.)

AGE AND BODY LENGTH STRUCTURE OF A MALE SPERM WHALE SCHOOL STRANDED ON THE OHURA COAST, KAGOSHIMA, JAPAN IN JANUARY 2002

Hidehiro KATO[1], Toshiya KISHIRO[1], Takeharu BANDO[2], Kazuyo OHATA[3], and Kanji TAMAI[4]

[1]*National Research Institute of Far Seas Fisheries, 5–7-1 Orido, Shimizu-ku, Shizuoka 424–8633, Japan (contact e-mail: katohide@affrc.go.jp)**

[2]*Institute of Cetacean Research, 4–5 Toyomi, Chuo-ku, Tokyo 104–0055, Japan*

[3]*Kasasa Ebisu Maritime Museum, 14847–1, Kataura, Kasasa-cho, Kawabe-gun, Kagoshima 897–1301, Japan;*

*Present contact: katohide@kaiyodai.ac.jp

Graduate School of Kuroshio Marine Science, Kochi University,
200 Monobe-otsu, Nankoku, Kochi 783–8502, Japan
[4]Division of Veterinary Medicine, Faculty of Agriculture, Kagoshima University, Kagoshima 890–0065, Japan

Abstract

A school of 14 male sperm whales, *Physeter macrocephalus*, stranded approximately at 31.22N–130.13E on Kominato-Kantaku beach, Ohura Town, Kagoshima, Japan, in the morning of 22 January 2002. The stranded school was mainly composed of typical medium-sized bachelors whose mean age was 21.36 yrs (SD: 2.993) and mean body length of 12.81 m (SD: 0.467); however, this school involved also one exceptionally larger male (41 yrs and 15.5 m). Interpretations of the presence of such a large male are made.

Key words: sperm whale, mass stranding, social units, medium and large bachelors, age and body length structure.

Introduction

On the morning of January 22, 2002, a mass stranding of sperm whales, *Physeter macrocephalus*, composed of 14 males took place on the west coast of Kagoshima Prefecture, southern Japan. The school stranded on Ohura Town's Kominato-Kantaku beach approximately at 31.22N–130.13E, Kagoshima, Japan (Fig. 1).

Through extensive efforts spent for management of the mass stranding, we were able to rescue one animal. While we further spent much effort, the other 13 animals were finally dead. Subsequently, 12 carcasses were sunk to the bottom of the sea except for one which was buried for future skeletal study and educational display. The chain of events was like an ordeal. We think this event is worth of being reported and expect it will be available somewhere.

As reported by Rice *et al.* (1986), also currently by Evans (2002) and Wright (2005), the mass stranding of sperm whales gives a rare opportunity to investigate school structure or social structure which is hard to clarify. By official request from the governor of the Kagoshima Prefecture, Kato engaged in the management process of the operation as technical and scientific advisor and had an opportunity to collect and investigate biological data from the stranded animals in cooperation with Kishiro, Bando and other volunteers from Kagoshima University. Here, we briefly report some biological aspects of the stranded sperm whale school.

Materials and Methods

Body length

Body length data used for the present study were measured in two opportunities. The primary measurement was made on the deck of the salvage boats, which had enough space to conduct body length measurements, during their operation to carry whale carcasses for sinking in the sea bottom. We measured the body length of the respective animals as being from the posterior tip of the upper jaw (head) to the notch of the tail flukes to the nearest 10 cm. With this method we finally got good body length measurements for 11 animals (OU1–OU6, OU8–OU12). Additionally, we also made body length measurements of the animals when they were moored at the pier; however, under such conditions the position of the carcasses did not necessarily provide a suitable orientation for body length measure-

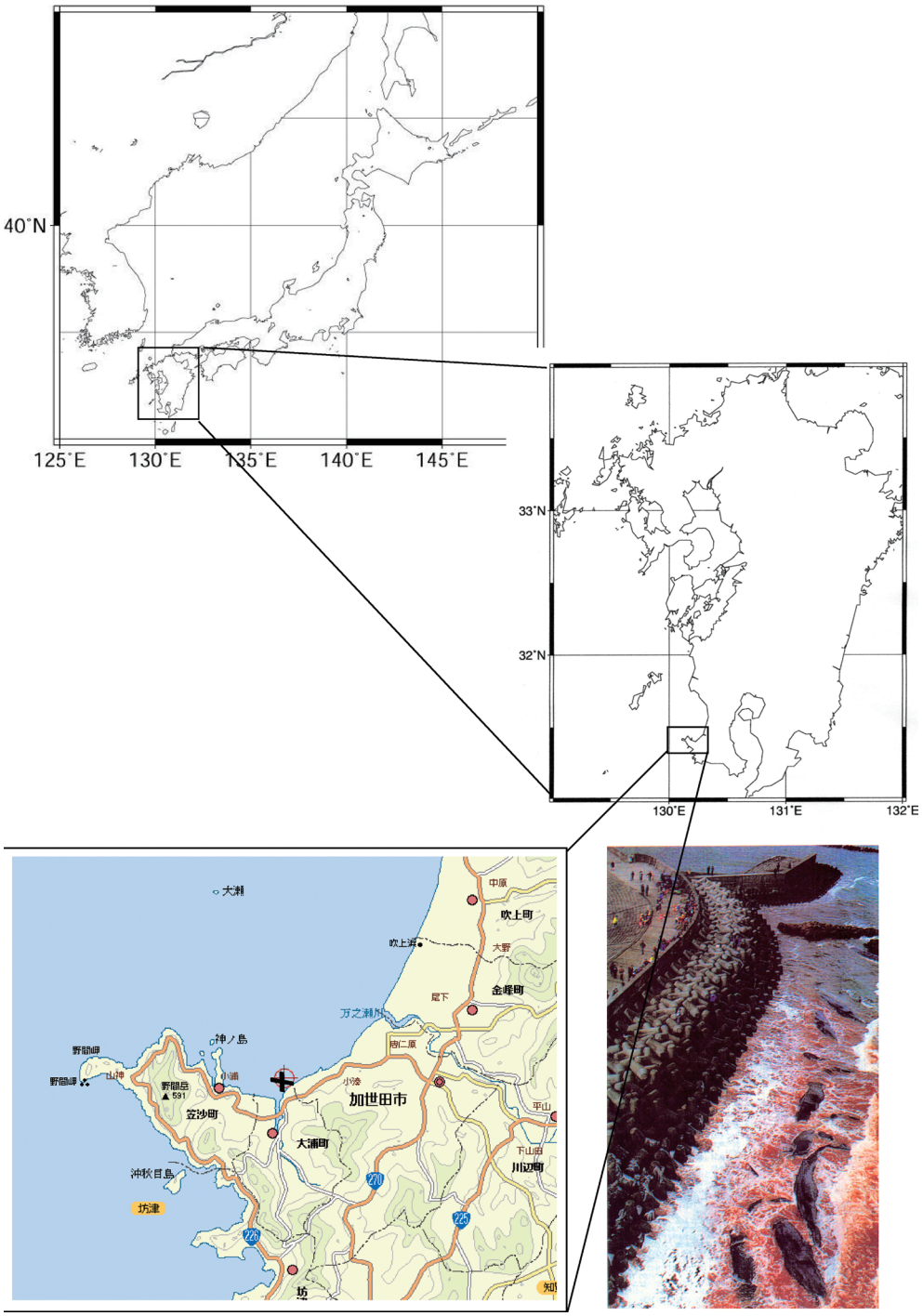

Fig. 1. Geographical location of the present sperm whale stranding that took place in January 22, 2002. A bold cross symbol in the bottom map represents the detailed location of the stranding, Kominato-Kantaku beach. Photograph by Mr. Yamano, Minami Nihon New Press.

ments. We used such measurement data for one animal (OU7) for which we had been unable to obtain an enough qualified measurement by the primary method, due to the crooked posture of its body axis.

Some other measurements for the stranded animals were also tried by other people working at the stranding location during the earlier stage of the event, although the sea and topographic conditions of the site were obviously not suitable, and the situation of the animals did not necessarily allow a suitable posture for the measurements. We have also referred to some of such measurements by Messrs. Naoto Higashi (Okinawa Churaumi Aquarium), Masayuki Nakamura (Marine World Uminonakamichi

Aquarium), Nobutaka Kubo (Iwo World Kagoshima Aquarium) and their colleagues, for the animal that was buried. Because there is a gap between their data set and our data set such that their measurements are significantly larger than our measurements for the 11 animals (overlapped discrepancy as being 2.5% or 33 cm in average), we corrected their direct measurements and used the estimated value of 13.0 m body length for the buried individual (OU13).

As to the body length of the rescued animal (OU14), no measurement had been made at the stranding site including any provisional one. However, we were able to obtain verbal evidence from the head of the workers engaging in the rescue process that the animal was rather small than the majority (Mr. C. Mori, personal communication) and also obtained both photographs and video images of this individual while stranded and swimming afterwards. Under such circumstances, we incorporate the body length estimate by one of the authors (Kato), who has extensive field experience for sperm whale sightings including works under the commercial whaling era. This estimation is 12.5 m based on photograph/video sequences and verbal evidence.

Age

At least one maxillary tooth was collected from the palate of each respective animal. After removing the adhering flesh by corrosion, the tooth was bisected longitudinally on the ISOMET saw, and one cut face was polished on a wet stone. The polished half was etched for 30 hours in a 10% formic acid solution (Clark *et al.*, 1968; Bow and Purdy, 1966). The growth layers in the dentine were counted using a stereoscopic microscope under reflecting light, and the respective age was determined by such counting growth layers in dentine under the assumption that each postnatal dentine layer represents one year. Kato and Kishiro independently aged on all the animals.

Others

We also collected morphological data, tissues for genetic analysis, and other biological samples; however, these were not used for the present study.

Results and Discussion

The sex of all of the stranded school components including one rescued individual was determined by observation of their external sexual organ. It was confirmed that all of them were males; thus, the stranded school was composed of 14 males. Although their total body size range was rather spread out between 12.1 and 15.5 m, their size range is close between each other, ranging from 12.1 m to 13.7 m, with a mean of 12.81 m (SD 0.467) if we exclude one large animal (Fig. 2). It was significantly bigger than the other animals; it had a body length that was up to 15.5 m. However, as confirmed by many people, the large individual stranded at the same time as the other animals. Thus, undoubtedly this large male was one of the components of the stranded school.

Figure 3 plots the relationship between body length and age for the 12 males for which their ages were determined and also indicates the ideal growth curve of body length and age for males assumed by Kato (1995). The plot almost agrees with the line of the ideal growth curve, and then we understand our age information is mostly acceptable. Looking at the age distribution (Fig. 4), the youngest male was 17 yrs and the oldest one 41 yrs, but again if we exclude the oldest animal of 41 yrs, the animal ages are rather close each other between 17 and 28 yrs with a mean of 21.36 yrs (SD, 2.993).

From the above, the present materials can be summarized as: the stranded male school was composed of 14 males, and the biological features of the majority (13 out of 14 individuals) shared similar characteristics in terms of animal age and body length, however, the school also involved one very larger and elder male than the others.

Several scientists pioneered investigations on the social structure of male sperm whales, such as

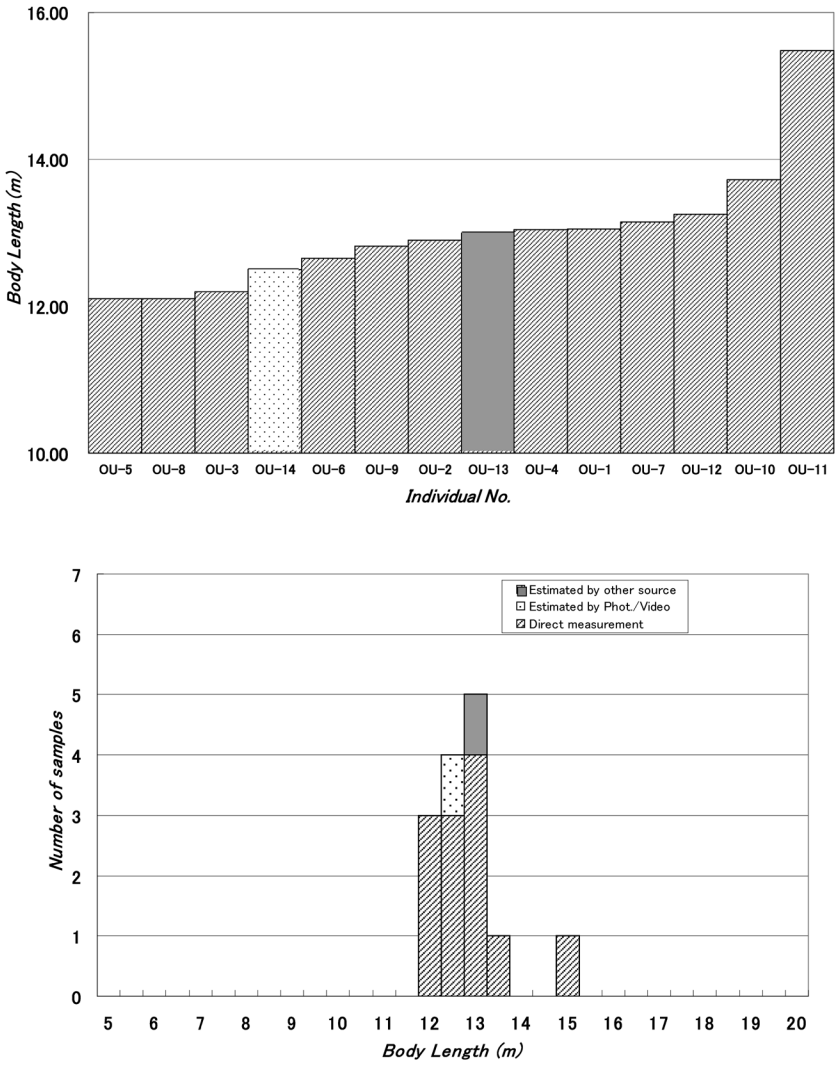

Fig. 2. Body length composition of the stranded sperm whale school by the order of their size from smaller to larger (Upper), and frequency distribution of the body length by every 50 cm (Bottom). Hutched bar represents direct measurement, dark colored and light-colored bars represent estimate by other source and photograph/video estimate (see text).

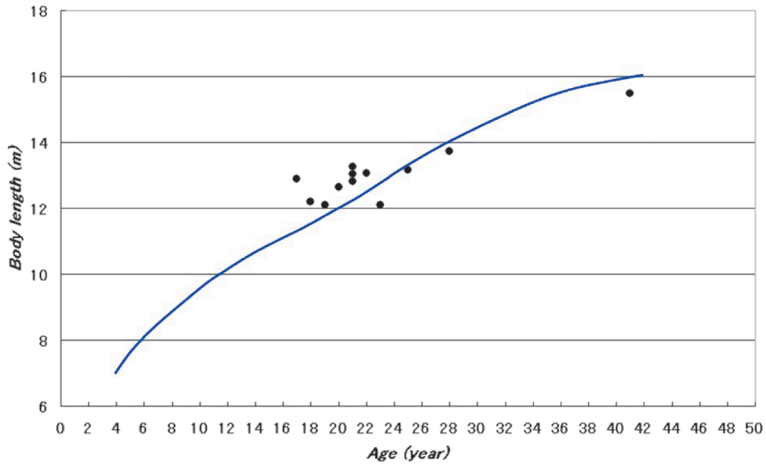

Fig. 3. Plot of the relationship between body length and age of the stranded sperm whale school, in conjunction with the ideal growth curve assumed by Kato (1995).

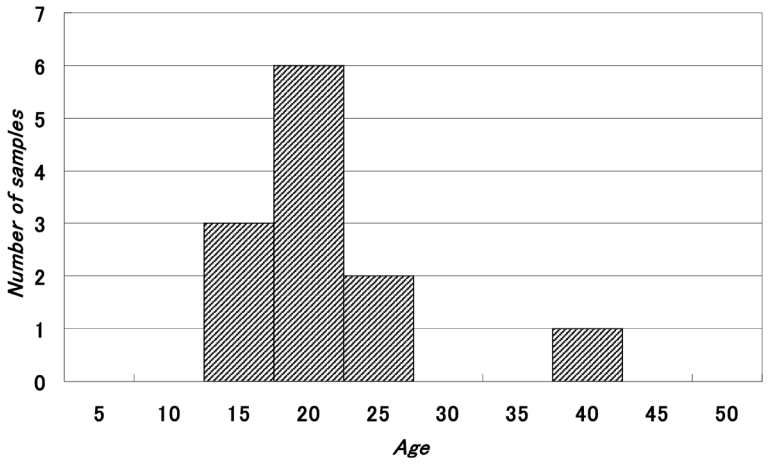

Fig. 4. Age composition of the stranded sperm whale school, based on counting growth layers in maxillary teeth.

Table 1. Comparison of age and body length of the present materials with values by social unit based on Tables II and IV in Best (1979). Body length values are converted to metric units.

	Best (1979), Tables II and IV, values converted to meters	Present study excluding an exceptional large male
Body length		
Small bachelors	10.95 m (SD, 0.415) Range: 9.4–11.9 m (31–39 ft)	12.81 m (SD. 0.467) Range: 12.1–13.7 m
Medium-sized bachelors	12.80 m (SD, 0.516) Range: 12.2–13.7 m (40–45 ft)	
Large bachelors	14.45 m (SD, 0.456) Range: 14 m–46 ft)	
Age		
Small bachelors	16.28 yrs (SD,16.248) Range: 10–25 yrs	21.36 yrs (SD, 2.993) Range: 17–28 yrs
Medium-sized bachelors	21.59 yrs (SD, 3.737) Range: 15–29 yrs	
Large bachelors	26.42 yrs (SD, 6.651) Range: 21–42 yrs	

Best (1969, 1979, 1979), Ohsumi (1966), Gaskin (1970) and others. Among them, Best (1979) clarified the nature of the social units and classified them into Small bachelors, Medium-sized bachelors and Large bachelors. In Table 1 we compared age and length of the present materials with the values given by Best (1979).

Our present samples mostly correspond to the range of the medium size bachelors. However, the reason why the exceptional large male was involved in such medium size bachelor group is still uncertain. One interpretation is that the large male concerned here had not yet been independent, still remaining in the medium bachelor school due to some biological or physiological reasons.

Unfortunately, because testicle samples were not collected due to the highly difficult situation the sexual or social status of the large male is not known. Best (1979) and Kato (1984) reported that parallel scars on the head region represent intra-sexual fighting among the large males to have mating and that the magnitude of the scaring can be used as an indication of attainment of the social maturity. Scaring on head region of the present large male was rather scarce and no parallel scar was recognized, this may indicate the present large male had fewer experiences of the intra-sexual fighting and may suggest the large male is socially immature.

An alternative interpretation is that the present large male had already attained the social maturation but opportunistically joined the medium size bachelor school due to some behavioral or social reason. Otherwise, involvement of a large male with the medium size bachelor group is not a surprising one and may happen especially in the non-feeding season at which usually the large males segregate to higher latitudes.

Acknowledgements

We are largely indebted to the many persons who engaged in extensive and hard work to manage the mass standing, especially Messrs. Teruyuki Maeno (Mayor of Ohura Town), Kazumi Maeda (Director of the Fisheries Division, Kagoshima Prefecture) and Chiaki Mori (President of Mori-gumi Co. Ltd.). Also, Mses. Yuko Nishikido, Kyoko Hamamoto and Chie Tokuzane (Division of Veterinary Medicine, Faculty of Agriculture, Kagoshima University) assisted with data and sample collection from the stranded animals. Messrs. Naoto Higashi (Okinawa Churaumi Aquarium), Masayuki Nakamura (Marine World Uminonakamichi Aquarium) and Nobutaka Kubo (Iwo-world Kagoshima Aquarium) kindly provided us with their measurements of the stranded animals, which were very useful as comparison materials. Finally, we also appreciate the encouragement by many peoples who joined the stranding site in the earlier stage, especially Drs. Tadasu Yamada (National Science Museum) and Akihiko Shinomiya (Faculty of Fisheries, Kagoshima University), and Messrs. Kotaro Ogino and Shigehisa Shima (Iwo-world Kagoshima Aquarium).

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