

OBSERVATION OF TOOTH SCARS ON THE HEAD OF MALE SPERM WHALE, AS AN INDICATION OF INTRASEXUAL FIGHTINGS

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ABSTRACT

In order to examine the relation between intra-sexual fightings and sexual maturity, observations of tooth scars on the head of sperm whales (*Physeter catodon*) were made collected in South Pacific Oceans during 10 to 18 March 1979 on the *Niishin maru No. 3*. Tooth scars on the head were observed on 48 males based on the following four relative stages; none, indistinct, distinct and heavy. Distinct tooth scars including "pallarel scar" which suggest intra-sexual fightings occurred among whales over 43 ft, and scars of most heavey stage were observed among whales over 46 ft in body length. Whales having relatively heavier scars were taken in solitary or a pair in either high latitudes ($>40^{\circ}\text{S}$) or northern parts of females's range. Although no whales was directly taken from *mixed school*, three solitary large males taken around the *mixed school* had scars of most heavy stage. From the informations of body length, school size and catch position, most of these whales having relatively heavy scars were classified to *large bachelor*, these suggest intra-sexual fightings took place among *large bachelors*.

The relation between tooth scar stage and testes weight were also examined. Mean weights of single testis (heavier) for males were 4.88 kg (combined both sides, 9.26 kg) and 2.68 kg (4.70 kg) at scar stages of heavy and distinct, respectively. Comparing testis weights among the whales of same body length, whales with heavier scar tend to have heavier testis.

In conclusion, it can be said that sexual maturity rate tend to increase with increasing of body length and with development of scar stages. This suggests that tooth scars indicate one of the evidences of sexual maturity.

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Polygyny is the most characteristic behaviour among the social structure of sperm whale, *Physeter catodon*. Ohsumi (1971) estimated that a school master may serve up to 14 mature females in a breeding season, and Best (1970) gave an estimation of 10–20 females.

Although there is sexual unbalance in the adult population of the sperm whale due to the male's slower attainment of sexual maturity, it is only such a low magnitude as 2.6: 1 (Best, 1979). However, as suggested by Ohsumi (1966) and Best (1979) only 10–25% of mature males can become school master and join breeding school in a year. There has to be expected large surplus males and serious intra-

sexual competition in the male population.

Although no direct observation on the intra-sexual competition was made, Ohsumi (1971), Best (1979) and Gaskin (1982) suggested the presence of tooth scars on the head and/or the body might be one of the evidences of the fighting among mature males. No analysis on the tooth scars have not been done previously.

I had an opportunity to observe tooth scars on carcasses of sperm whale on board of a whaling factory ship in the 1978/79 Antarctic whaling season, and to analyze in relation to the growth stage.

MATERIALS AND METHOD

In the 1978/79 Antarctic whaling season, *Nisshin maru No. 3* fleet, on which I was on board, mainly caught sperm whales in pre (25 Nov.-3 Dec. 1978, southern areas of Indian Ocean) and post minke whaling season (10-18 March 1979, South Pacific

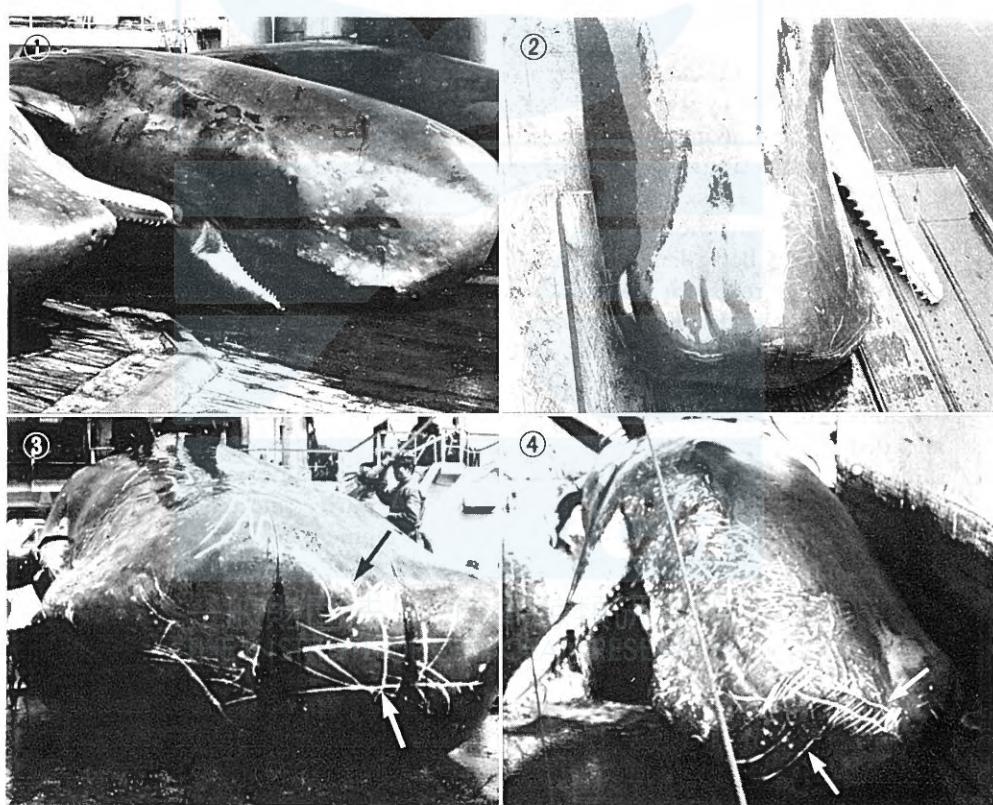


Fig. 1. Typical appearances of tooth scars on the head of sperm whale in each scars stage, arrows show examples of "parallel scar".

- 1: Stage 0, photograph from North Pacific. (in the possession of WRI)
- 2: Stage I, from Antarctic. (WRI)
- 3: Stage II, from North Pacific. (WRI)
- 4: Stage III, from the Antarctic. (WRI)

TABLE 1. CRITERIA OF TOOTH SCAR STAGES ON THE HEAD OF SPERM WHALES

Tooth scar stage		Criterion
0	None	No tooth scar present on the head.
I	Indistinct	Small number of indistinct and sparse scars present.
II	Distinct	Scars distinct, at least a pair of "parallel scars" present.
III	Heavy	Tooth scars including "parallel scar" are more frequent than previous stages.

Ocean). The catches were 43 (all males) and 157 whales (70 males and 89 females), respectively.

I observed tooth scars on 48 males out of 70 males caught in the latter periods, the approximate position of catch of those samples were on a line connecting two points; 41°S, 154°E and 26°S, 173°E. Tooth scars on the head region were observed on the flensing deck. Scars presumably caused by sucker and hooks on cephalopod tentacles or by some other accidental scratchers were excluded. The density of tooth scars was classified into following four relative categories; none "0", indistinct "I", distinct "II" and heavy "III" (Fig. 1 and Table 1).

Both testes were weighed to nearest 50 g on the deck, school size and position caught for each whale were taken from the operation report of respective catcher boats.

RESULTS AND DISCUSSION

Gaskin (1970) and Ohsumi (1971) recognized six types of school as the principally social units of sperm whale school; nursey school, harem school, juvenile school, bachelor school, bulls school and lone bull. While Best (1979) proposed somewhat different interpretation of the social structure. He considered the *mixed school*, which was composed of adult females, their calves and juveniles of both sex as a basic social unit. This school changes into breeding school in breeding season. Furthermore, he classified mature males into three developmental stages; *small bachelor* (31–39 ft in body length), *medium-sized bachelor* (40–45 ft) and *large bachelor* (over 46 ft). Best (1979) considered that, in a breeding season *large bachelors* will join *mixed school* to serve as a school master only for short periods. For the convenience of the analyses, above three male body length criteria were adopted below without further consideration. Furthermore, although the term of "social maturity" has recently been used for male's sexual maturity mainly by International Whaling Commission (1979) due to unique social breeding behaviour of this species, the term of "sexual maturity" was adopted in the present study.

Tooth scars were abundant on the side and front portions of the head, but sometimes few were seen even on the back of body. None of them were new. This suggests that the intra-sexual fighting did not take place considerably before the season of the present observation (March).

Body length

Table 2 shows relationship between body length and tooth scar stage in 48 male

TABLE 2. LENGTH DISTRIBUTIONS OF OBSERVED WHALES
BY EACH STAGE OF TOOTH SCAR

Length (ft)	Stage of tooth scar				Total
	0	I	II	III	
31	2	—	—	—	2
32	—	—	—	—	—
33	2	—	—	—	2
34	2	2	—	—	4
35	1	3	—	—	4
36	1	8	—	—	9
37	—	6	—	—	6
38	—	3	—	—	3
39	—	3	—	—	—
40	—	2	—	—	2
41	—	—	—	—	—
42	—	—	—	—	—
43	—	1	1	—	2
44	—	—	1	—	1
45	—	—	—	—	—
46	—	—	2	1	3
47	—	—	1	2	3
48	—	—	1	1	2
49	—	—	—	1	1
50	—	—	—	1	1
Total	8	28	6	6	48
Mean length (ft)	33.71	36.72	45.67	47.83	

sperm whales. Mean body lengths for scar stages "0", "I", "II" and "III" were 33.71, 36.72, 45.67 and 47.83 ft, respectively. The difference between stages of "I" and "II" was significant (*t*-test, $0.005 < P < 0.01$). It is clear that magnitude of scars on the head increase with increasing body length.

Best (1979) reported that the presence of "parallel scar" (Fig. 1), which he considered as attributable to attack of another sperm whale, is one of the evidence of intra-sexual fightings. This type of scars were peculiar to whales classified to the scar density stages of "II" and "III" (Fig. 1), and observed among whales at 43 ft in body length or more (Table 2). This result coincides with the result obtained off the west coast of South Africa (Best, 1979). The heaviest scars ("III") were observed only whales over 46 ft in body length.

School size and position of catch

Best (1979) and Gaskin (1982) showed that males segregate latitudinally by growth stages (or by groups mentioned above) in Southern Hemisphere, the southern limits of migration for *small* and *medium-sized bachelors* are about 35°S and 45°S, respectively, and *large bachelors* migrate to the Antarctic region.

The mean size of bachelor schools relates to the above mentioned growth stage, *i.e.* 15 whales, 4–6 whales and solitary (or sometimes a pair) for *small*, *medium-sized* and *large bachelor*, respectively (Best, 1979). Table 3 shows the relationship

TABLE 3. SCHOOL SIZES OF OBSERVED WHALES RECORDED BY RESPECTIVE CATCHER BOATS IN EACH TOOTH SCARS STAGES

School size	Tooth scars stage			
	0	I	II	III
1.0	—	7	1	4
1.1-1.5	1	6	4	2
1.6-2.0	1	5	—	—
2.1-2.5	—	—	—	—
2.6-3.0	3	3	—	—
3.1-3.5	—	—	—	—
3.6-4.0	2	1	—	—
≥4.1	1	6	—	—
Unknown	—	—	1	—
Total	8	28	6	6

between tooth scar stage of whales and school size of those whales. Mean school sizes decreased with increasing scar stage, 3.27 (stage "0"), 2.58 ("I"), 1.30 ("II") and 1.13 ("III"). However, since the school size tended to be recorded after disruption of the original school by chasing, these school sizes might be underestimated, and the actual value of group size would be less important rather than the trend. It is notable that whales having the relatively heavier scars ("II" and "III") were mainly taken from solitary whales or those in a pair.

Fig. 2 shows the latitude of catch positions of present materials (males) together those of females which were not analysed in the present study. Whales having relatively heavier scars ("II" and "III") were mainly caught either in higher latitudes ($>40^{\circ}$ S) outside of females range or in northern parts of the range

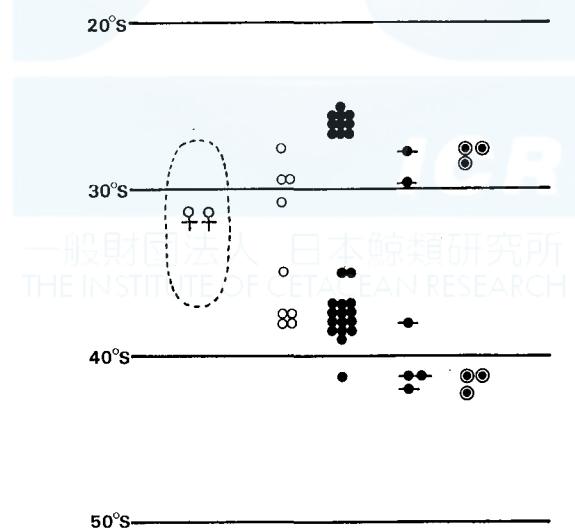


Fig. 2. Latitudinal catch positions of male sperm whales in each tooth scar stage and females (unobserved).

○: Stage 0 ●: Stage I •: Stage II ○: Stage III

TABLE 4. NUMBER OF MALES IN THE PRESENT MATERIALS CLASSIFIED BY TYPE OF GROUP, SCARS STAGE AND KINDS OF SCHOOLS TAKEN FROM

Scars stage	Type of group	From bachelor school n (%)	From mixed school n (%)
0	Small bachelor	5 (62.5)	3 (37.5)
I	Small bachelor	23 (78.5)	1 (7.2)
	Medium-size bachelor	3 (10.7)	1 (3.6)
II	Medium-size bachelor	1 (16.7)	—
	Large bachelor	5 (83.3)	—
III	Large bachelor	6 (100.0)	—

(Fig. 3). Although three solitary males having scars of stage " III " were not caught from the *mixed school*, they were found relatively near a mixed school ($26^{\circ}44'S$, $165^{\circ}04'E$) from which five resting females and one pregnant female were taken. Their positions were $27^{\circ}21'S$, $163^{\circ}57'E$; $27^{\circ}14'S$, $164^{\circ}27'E$; $27^{\circ}13'S$, $164^{\circ}24'E$. Distances from the mixed schools ranged from 44.7 to 70.5 nautical miles. There is no observation on the social relationship between these males and the *mixed school* above.

Male group type

Table 4 was constructed using male growth stage criteria mentioned above (Best, 1979) and information of schools recorded by the catcher boats. All the six whales at scar stage " III " and five of six whales at scar stage " II " belonged to body length stage of *large bachelor*. Although the presence of " parallel scars " are not recorded for all individuals, as mentioned previously, only stages of " II " and " III " had " parallel scars " which indicate possible intrasexual fighting (Best, 1979), therefore, it can be said that most of intrasexual fightings take place between large bachelor whales.

Testes weight

Best (1969) reported that rapid increase of testes weight relative to body length start at around 43–46 ft, which almost coincides with the length where 50% of individuals are sexual mature by his histological criteria. Furthermore, Gambell (1972) found on sperm whales off Durban that the increase in growth rate of testes weight start at a body length of 45.4 ft or at a combined weight of both testes of 4.85 kg. They concluded that mean body length at sexual maturity is about 45–45 ft, and Gambell (1972) suggested whales having combined weight of testes of 4.85 kg are sexual mature.

Fig. 3 shows the relation between weight of testis, body length and tooth scar stages. It is apparent that testis weight increases with increasing body length. And if compared among the whales of same body length, the whales having heavier testes tend to have heavier scars on the head. This trend is more evident among the whales over 43 ft in body length. Mean weight of single testis (heavier in both side) for males at scar stage " III " were 4.88 kg (range, 2.75–7.50 kg), which was much larger than 2.68 kg (range, 1.45–3.80 kg) for males at the stage " II ". The

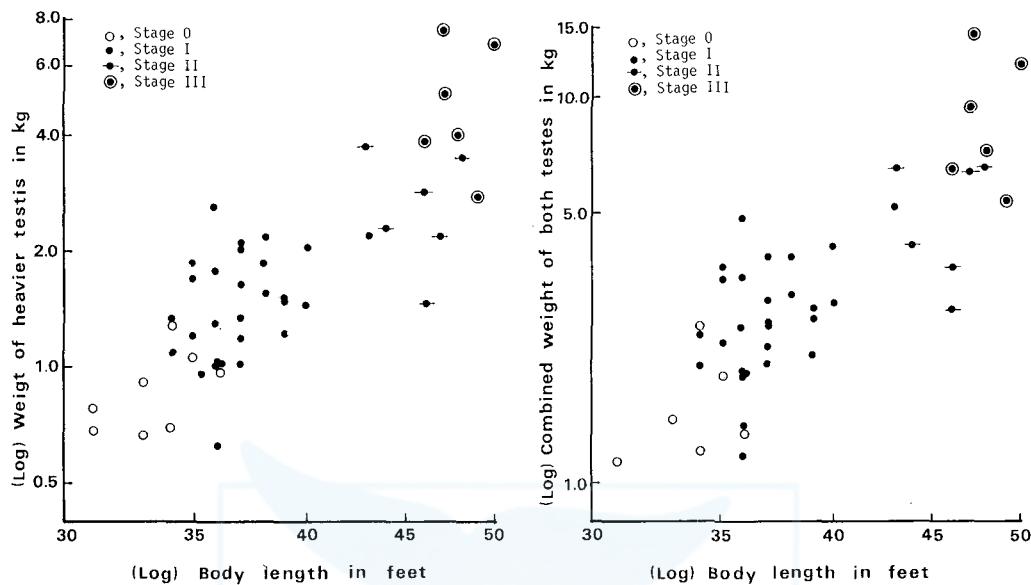


Fig. 3. Relationship between body length (in logalithmic scale), tooth scar stage and weight (in logalithmic scale) of heavier testis (left) or combined weight of both testes (right).

difference of above two weights was statistically significant (*t*-test, $0.01 < P < 0.05$). The combined weights of testes for whales ranged 5.30–14.80 kg ($\bar{x} = 9.26$ kg) for scar stage "III" and 2.85–6.60 kg ($\bar{x} = 4.70$ kg) for stage "II". The difference of two mean values was also statistically significant (*t*-test, $0.01 < P < 0.05$).

Adopting the criterion of sexual maturity of the combined testes weight of 4.85 kg (Gambell, 1972), all males at stage "III", three of six males at stage "II" and one of 27 males at stage "I" can be sexually mature (Table 5). On the other hand, comparing with body length criteria of male's group type and adopting the above mentioned criterion of testes weight as sexual maturity, eight of 12 males in *large bachelor*, two of four males in *medium size bachelor* can be sexually mature (Table 5).

TABLE 5. RELATIONSHIP BETWEEN BODY LENGTH (FT), TOOTH SCAR STAGES AND SEXUAL STATUS OF SPERM WHALES

Type of group (length)	Sexual status	Tooth scar stage				Total
		0	I	II	III	
Small bachelor (31–39 ft)	Immature	8	25	—	—	33
	Mature	—	—	—	—	0
Medium-size bachelor (40–45 ft)	Immature	—	2	—	—	2
	Mature	—	1	1	—	2
Large bachelor (46 ft)	Immature	—	—	3	—	3
	Mature	—	—	2	6	8
Total	Immature	8	27	3	0	38
	Mature	0	1	3	6	10

Judging from testes weight, among the *large bachelors* all males having scars of stage III are sexually mature, while three of five males of stage "II" are sexually immature (Table 5). Among four *medium-size bachelors* two sexually matured males also exist; one from tooth scar stage "I" and the other from stage "II" (Table 5). But it's doubtful whether males having scar of stage "I" actually contribute to reproduction of this species or not.

Summarizing the above, judging from testes weight of the present materials, it can be said that sexual maturity rate tends to increase with increasing of body length and with development of scar stages. Moreover, even in males of the *large bachelors*, although all males attained sexual maturity in the tooth scar stage "III", both of sexually matured and immature males coexist in stage "II". These suggest that magnitude of tooth scar closely relate to sexual maturity.

In conclusion, tooth scars on the head of sperm whales seem to increase with growth and presumably indicate the experience of intra-sexual fighting. For the further examination of this point, individual age information should be taken in account. It will be examined in future study.

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