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TAGGING EXPERIMENT OF NOTOTHENIID FISH, *TREMATOMUS BERNACCHII* BOULENGER UNDER THE COASTAL FAST ICE IN LÜTZOW-HOLM BAY, ANTARCTICA*

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Abstract: Based on the tagging experiment and size frequency analysis, growth pattern of nototheniid fish, *Trematomus bernacchii* BOULENGER, was studied under the coastal fast ice in the Kitano-ura Cove, Lützow-Holm Bay, Antarctica. This species loses body weight during the overwintering and recovers the loss from spring through summer. Growth in body length takes place from summer to the middle fall probably after recovering the body weight loss in the dark season. The loss in the body weight seems to be also caused by spawning activities in early spring.

1. Introduction

Trematomus bernacchii BOULENGER is the most dominant fish species in the coastal waters off the Ongul Islands, usually accounting for more than 70 percent of total fish catch with a trap, a hook and line and gill net in both number and weight. This species is widely distributed in the coastal waters around the Antarctic continent (HUREAU, 1970; DEWITT, 1971) and has been recognized as ecologically important species (*Anon.*, 1979). The systematic, biogeographical and ecological aspects of this species were studied in detail in the coastal waters off Adélie Land by HUREAU (1970). During the BIOMASS study of SIBEX (1984/85), tagging experiment of *T. bernacchii* was carried out at the Japanese Antarctic base, Syowa Station, since the knowledge on the biology of this species under the fast ice during the winter season has been extremely restricted.

2. Methods and Materials

A total of 52 individuals of *T. bernacchii* collected with a trap or a hook and line were tagged and released under the fast ice at Stn. 2 in the Kitano-ura Cove off East Ongul Island from March to May, 1984 (Fig. 1). Size range of the specimens released

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was from 88 to 232 mm in standard length (SL), including both youngs and adults. Tagging and releasing data are summarized in Table 1.

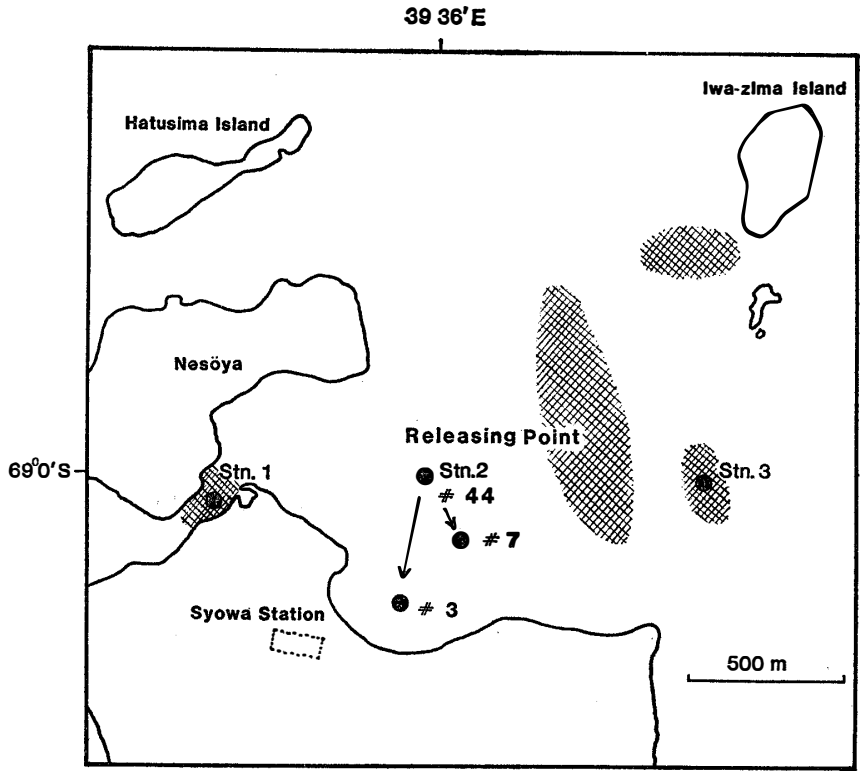

Fig. 1. Localities of the releasing (Stn. 2) and recovery points of tagged fishes in the Kitano-ura Cove, # 3, 7 and 44 indicate the tag numbers recovered. Fishing efforts were also made at Stns. 1, 2 and in the hatched areas, catching a total of 950 fishes.

Table 1. The tagging and releasing data of Trematomus bernacchii *in the Kitano-ura Cove in Lützow-Holm Bay.*

Date released	Date tagged	Date captured	No. inds. released	Size (SL, mm)	Tag number	Tag recorvered
Mar. 26	Mar. 20	Mar. 11	8	113–157	0–7	3, 7
Mar. 26	Mar. 24	Mar. 11	11	126–163	14–28*	
Mar. 26	Mar. 24	Mar. 20	5	88–158	8–10, 12, 13	
Apr. 30	Mar. 24	Mar. 20	1	177	11	
Apr. 30	Apr. 30	Mar. 19	2	130–150	33, 35	
Apr. 30	Apr. 30	Mar. 20	1	159	41	
Apr. 30	Apr. 30	Mar. 26	1	151	36	
Apr. 30	Apr. 30	Apr. 8	1	189	44	44
Apr. 30	Apr. 30	Apr. 12	1	167	34	
Apr. 30	Apr. 30	Apr. 29	6	149–161	32, 38–41, 43	
May 11	May 10	Apr. 30	3	179–203	70, 71, 73	
May 11	May 10	May 10	12	135–232	74, 78–88	

* Tag numbers 16, 19, 24 and 26 were not released.

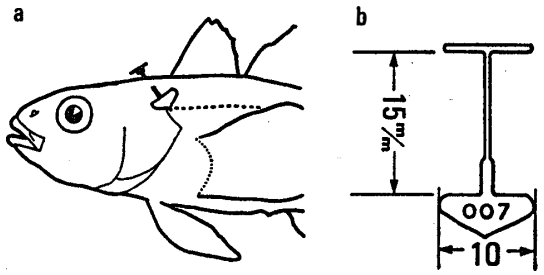

Fig. 2. a. Tagging position; b. dimension and shape of the plastic tag, indicating position of inscribed consecutive number 007.

The plastic tag adopted is 15 mm long, 10 mm wide, 0.8 mm thick and about 0.04 g in weight (*ca.* 0.02 g in water), and its shape is as shown in Fig. 2b. Consecutive number was inscribed on each tag. The standard length and body weight were measured and then tag was quickly attached to the fish by a tagging gun just in front of the first dorsal fin base (Fig. 2a). Before the first release on March 26, 8 individuals of tagged fishes were reared for a week in 400 liter tank together with 10 fishes not tagged to observe the effect of tagging. No significant effect was observed on the behavior, probably because of the small size of tag, the weight of which was less than 0.1 percent of the body weight of fish, and also a sluggish nature of this benthic species.

From February, 1984 through January 1985, a total of 562 fishes were also collected with a trap, a hook and line and gill net in the Kitano-ura Cove and its neighboring waters to analyze the size frequency distribution. Data for 83 individuals collected on September 24, 1983 during the JARE-24 are added for the comparison in Fig. 3.

3. Results

Three of the 52 individuals released were recaptured, 2 with a hook and line, 1 with a trap, at the recovery rate of 5.9 percent. The data on the recovered fishes are summarized in Table 2.

Migration: The 3 specimens were recovered after 216, 251 and 254 days respectively. The specimen of tag # 44 was collected at the releasing point. In spite of considerable catching effort in the cove all the specimens were recovered within a 500 m radius from the releasing point as shown in Fig. 1, suggesting the very restricted migration of this species during the first winter season of the experiment.

Growth: The 3 specimens recovered showed no significant growth in standard

Table 2. Recovery data and growth of the 3 fishes recovered 7–8 months after the release in the Kitano-ura Cove.

Tag #	Date released recovered	Releasing period (days)	SL (mm)	BW (g)	ΔBW (% of BW)
3	Mar. 26, 1984 Oct. 28, 1984	216	130 132	46.43 39.26	−7.17 (−15.4)
7	Mar. 25, 1984 Dec. 2, 1984	251	147 147	61.64 58.20	−3.44 (−5.6)
44	Apr. 30, 1984 Jan. 6, 1985	254	189 186	115.19 145.27	+30.08 (+26.1)

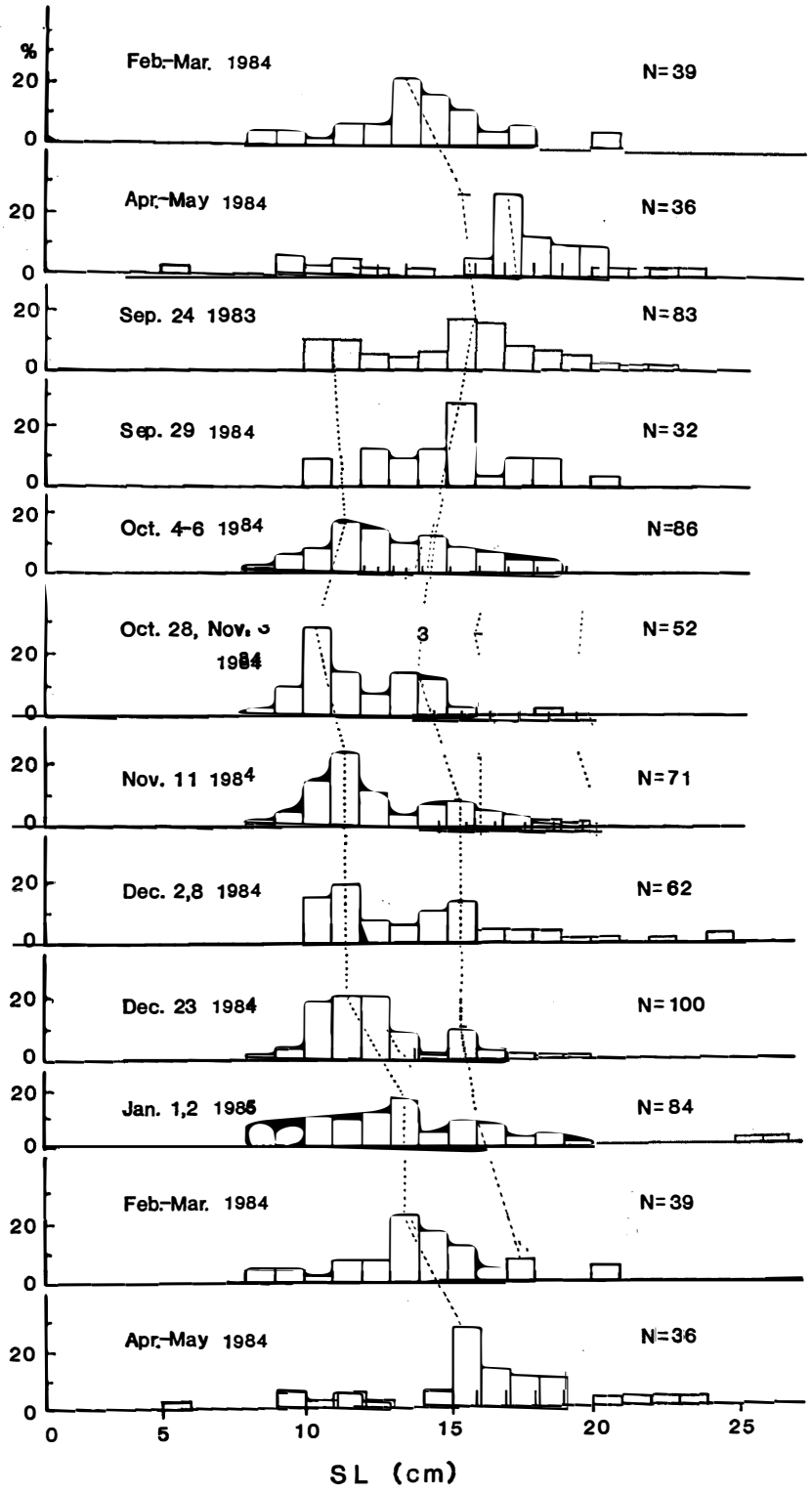

Fig. 3. Size frequency histograms of Trematomus bernacchii *taken under the fast ice in the Kitano-ura Cove in different months. Histograms for Feb.–Mar. 1984 and Apr.–May 1984 are placed after Jan. 1985 for the comparison.*

length during 7 to 8 months from the middle fall through the middle summer (Table 2). For checking this growth pattern, size frequency histograms of *T. bernacchii* collected in the cove and its adjacent waters in different months are shown in Fig. 3. Usually 2 modes are recognizable on the histograms, although the modes are not always clear probably reflecting a rather wide variation in low growth rate due to the restricted food condition under the fast ice. The first mode in September 24 showed no significant shift until early December and then shifted 4cm from the late December to May. The second mode of April–May overlaps with that of September 24, indicating no significant growth in body length from May to September. Based on the results of tagging experiment and size distribution analysis, it is concluded that *T. bernacchii* increases its body length during the period from the austral summer to the middle fall, *i.e.* from December through April, under the fast ice.

The change in body weight of the 3 recovered fishes is clearly different in relation to the when the fish was recaptured, *i.e.* the first fish (tag ♯ 3) recovered in October lost the body weight (BW) of 7.2 g (15% loss of original BW), the second one (♯ 7) recovered in December lost 3.4 g BW (5.6% loss), and the third one (♯ 44) collected in January of the next year gained 30.1 g (26.1% increase) as shown in Table 2. This suggests that *T. bernacchii* loses its body weight during the overwintering under the fast ice and recovers the loss from spring through summer.

4. Discussion

HUREAU (1970) reported that the growth rate of *T. bernacchii* off the coast of Adélie Land is very low, 30 to 40 mm per year in the young and 15 to 20 mm in the adult over 150 mm SL. This growth rate well agrees with the present result in the Kitano-ura Cove, about 40 mm per year for the young fish. The low growth rate in the adult explains the absence of clear mode in the adult size range in Fig. 3. The reason why the 3 recovered fishes showed no significant growth in body length is not thought due to the tagging effect, but due to the starving condition during winter. Because size frequency analysis of the field-collected fishes also shows no significant growth in body length during winter and spring. They increase their body length from summer through the middle fall probably after recovering their body weight loss during the overwintering.

SAKAKIBARA *et al.* (1989) reported on the relationship between food quantity and growth based on the rearing of 2 individuals of *T. bernacchii*, one mature female and one immature, for 6 years. The 2 specimens proved to have extremely lower feeding activity periodically every year which resulted in the loss of body weight. This period is closely synchronized between the 2 specimens and seems to be related to the spawning season. The adult female spawned in 4 consecutive years and spawning itself also caused the 20–30% loss of her body weight. Their observation indicates that the body weight loss during the dark season is caused by not only starvation, but also by its lowering feeding activity in relation to spawning in early spring.

In the Kitano-ura Cove, the Antarctic krill (*Euphausia superba* DANA) begins to lead a benthopelagic life from March through October during the dark period to feed on bottom detritus, which is closely related to the abrupt decrease in chlorophyl-*a* in

the upper 2.5m layer to the level below the feeding threshold of the krill in April (KAWAGUCHI *et al.*, 1986). Furthermore, this benthopelagic krill is common in the cove and thought to be inactive because it lowers the metabolic rate to the level below a half of the summer level. These facts suggest that the krill is an important prey for this overwintering benthic fish in starved condition. NAITO and IWAMI (1982) reported that the occurrence frequency of the krill is 23.7% in the stomachs (excluding empty stomachs) of *T. bernacchii* collected from May through August, 1980.

It seems possible to raise the recovery rate of tagged fish, 5.9% in this study, by increasing the fishing effort, since the fishing was extremely restricted during the winter. If the recovery rate of at least 6% can be expected, tagging experiment of a much larger scale would be promising in future to assess the population of *T. bernacchii* and its productivity in the Kitano-ura Cove, based on the much more systematic sampling and releasing designs. Re-release of recovered fish after growth measurement would be also interesting to monitor the growth of the same individual in the field for several years. As the Weddell seal sometimes uses a releasing hole on the fast ice as a breathing hole, the timing of release must be considered to avoid predation of tagged fishes. Redish to yellowish or camouflaged colors are preferable for the tag to decrease the selective feeding pressure to the tagged fish.

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