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## The Locomotion Behavior of the Disc Abalone, *Haliotis discus hannai* Ino, and the Siebold's Abalone, *Haliotis sieboldi* Reeve, in the Fishing Grounds

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### Summary

1. Staying of the disc abalone, *Haliotis discus hannai* Ino, and Siebold's abalone, *Haliotis sieboldi* Reeve, at the stuck places on a surface of a rock under the sea water and their moving out of that place has been observed in three fishing grounds of Onagawa, Kesenuma and Uchiura Bays, Japan.

2. Abalones were found for several days at the same stuck places in some cases. In other cases, however, they had moved out of their stuck places to other places.

3. Nearly all of the abalones came moved after sunset. Some of them left the stuck places in the nighttime and did not return there — "moving type". These abalones moved to other stuck positions during the nighttime.

4. Other abalones left their stuck places which are called "homing spots" and then returned again before daytime after locomoting around the places — "homing type". The locomotion of the abalone could be traced about 2.5 meters from its stuck place in nighttime.

5. On the other hand, a few abalones stayed at a stuck place through a day, daytime and nighttime, though some rotations of bodies were seen in the nighttime — "staying type". These abalones did not leave the stuck position even in the nighttime.

6. The abalones of the "moving type" and "homing type" may feed on sea weed which was looked for during their locomotion in the nighttime. While other abalones of the "staying type" may feed on floating broken pieces of sea weed which reached their stuck position.

It has been generally known that abalones tend to stay in one place on the surface of a rock under the sea water in the daytime. The stuck places of abalones are called "nashiro" or "toriato" in Japanese. These surfaces are clean, without minute organisms. On the other hand, it is said that abalones consume sea weed more actively in the nighttime. There may be discussions whether abalones are locomoting around the place for feeding in the nighttime and then return home before daytime or if they consume floating broken pieces of sea weed at the one place without locomotion through the day. Therefore, the

locomoting and moving of some abalones around their stuck places have been traced under the sea water of their fishing ground through a day (24 hours).

### Materials and Methods

The positions of stuck places of the disc and Siebold's abalones and their locomotion were observed in the day and night at three fishing grounds in Onagawa and Kesenuma Bays, Miyagi Prefecture and Uchiura Bay, Chiba Prefecture as shown in Fig. 1. The observations under the sea water were performed by using an aqualung and the position of each abalone was recorded on a map at certain times in order to trace their movements.

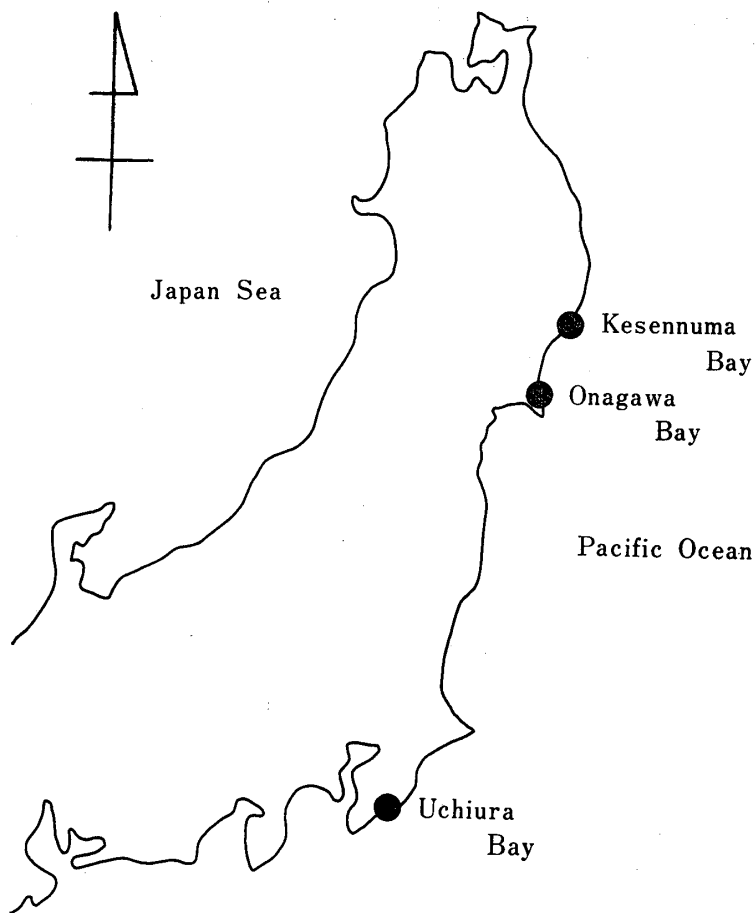


Fig. 1. Fishing grounds where the observations of the behavior of abalone were performed.

### Results

#### *The Daily Observation in the Fishing Ground*

The daily observation of the location of the stuck places of the disc abalone at Konori-hama fishing ground in Onagawa Bay has been performed once a day during July 27 to August 6 in 1967 at about 20°C of water temperature. The observation has been occasionally continued to September 3 of this year.

The positions of the abalones on July 30 is shown in Fig. 2. On the day, four abalones, 0-44, 0-70, 0-82 and 0-89, stuck in a hollow and on the surface of rocks inside of the area having 25 m<sup>2</sup> and depth of 3 to 4 m. These abalones, however, locomote in and out this area. The daily change of stuck place of each abaloon during July 27 to September 3 is shown in Fig. 3. The 0-44 which stuck at pt. 1 in this area on July 28 and 29 moved to pt. 2 on July 30 and it disappeared from this area on July 31. The 0-81 which stuck at pt. 6 on July 27 also disappeared on the next day and then it appeared at Pt. 7 on July 31. However, it was out of observation on the next day. The 0-89 which stuck at Pt. 8 on July 30 and 31 disappeared and then it was found again at Pt. 9 which was outside of the area and about 20 meters from Pt. 8 on August 5, after being out of observation for several days. The change of the location of the stuck place of another abalone, 0-70, was more complicated with staying at and moving from the places. 0-70 stuck at

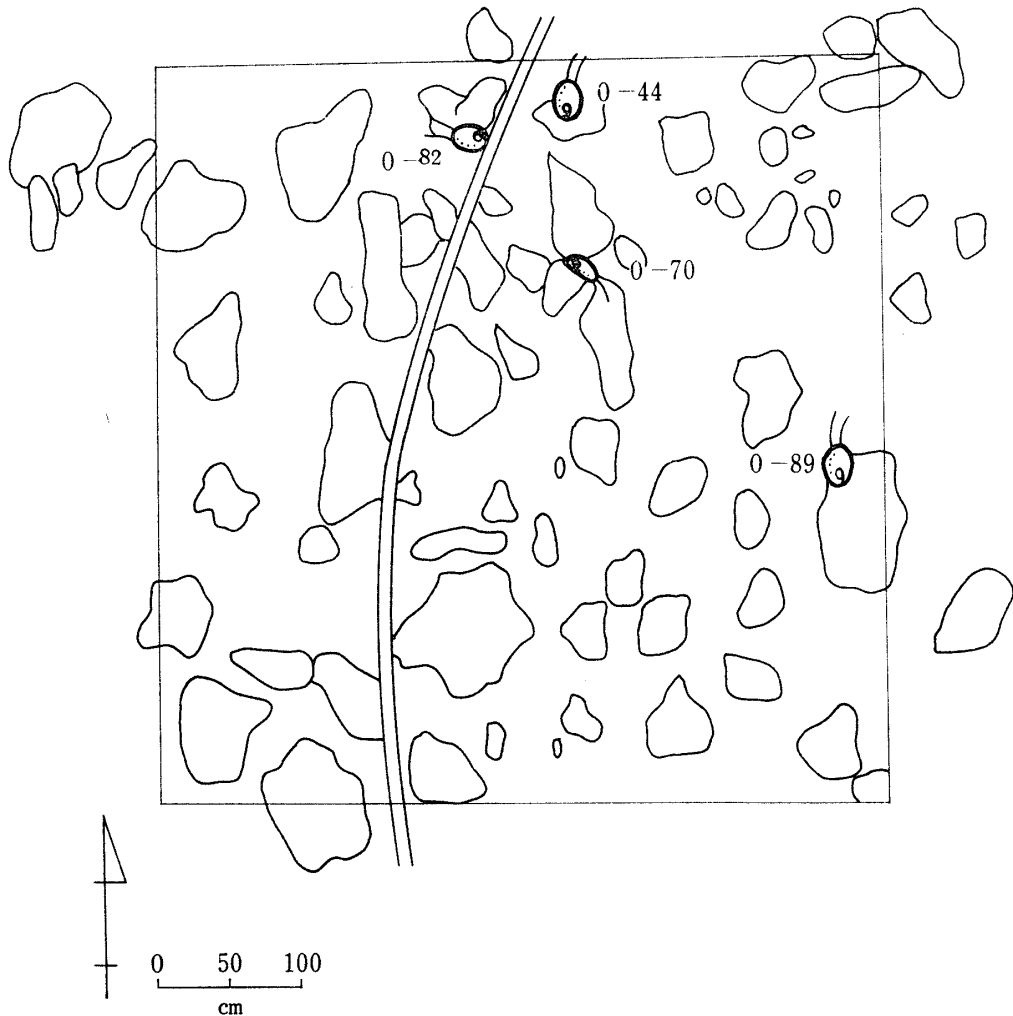


Fig. 2. The locations of the stuck places of the four disc abalones 0-44, 0-70, 0-82 and 0-89, at the Konori-hama fishing ground in Onagawa Bay, in the daytime on July 30, 1967. The line indicates the rope demarcating the area of observation.

position, Pt. 3, on July 27 disappeared from this area on July 28 and reappeared at Pt. 4 on July 30. The position of the stuck place of 0-70 at Pt. 4 was not changed for 8 days, from this day to August 6. 0-70, however, was found at Pt. 5 which is less than one meter from Pt. 4 on August 12.

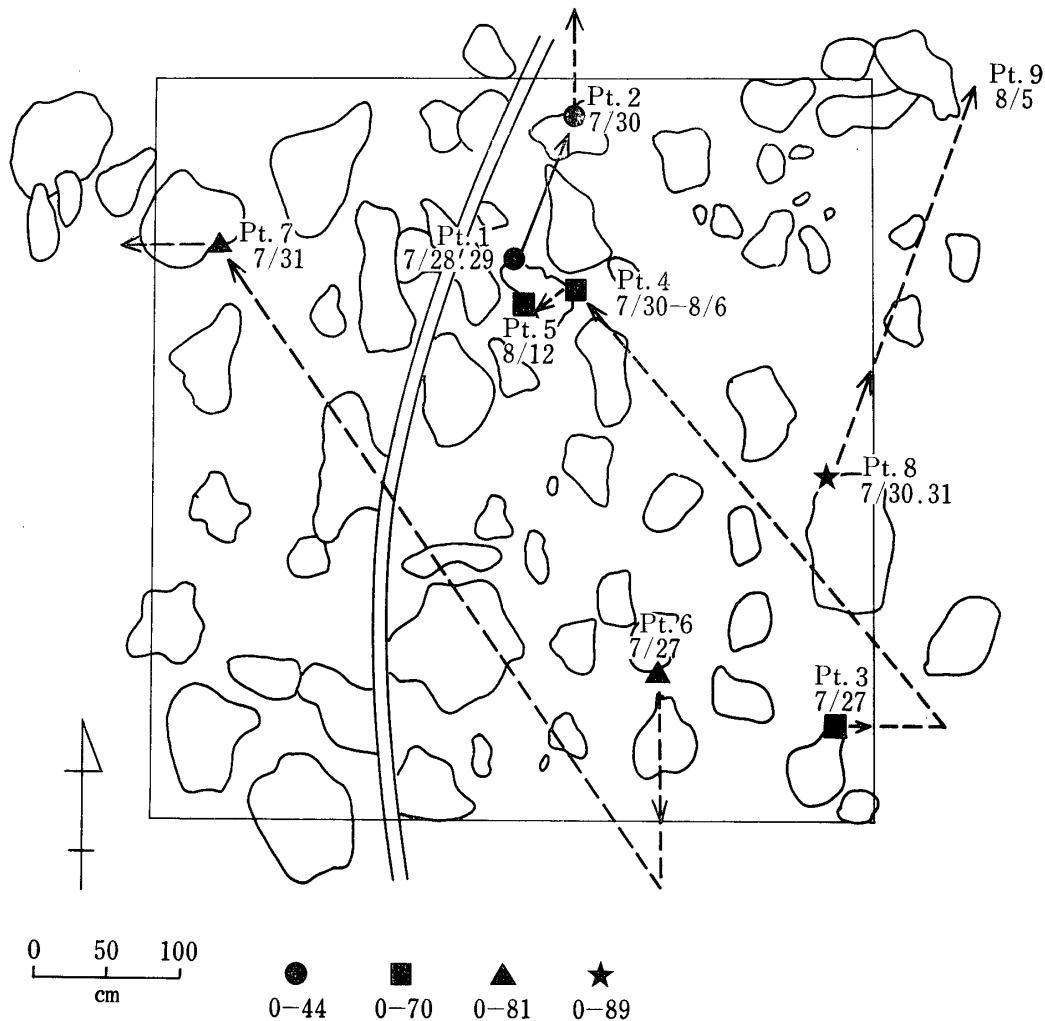


Fig. 3. The daily transition of the four disc abalones, 0-44, 0-70, 0-81 and 0-89 at the Konori-hama fishing ground in Onagawa Bay on July 27 to September 3, 1967.

It should be said from these observations that abalones are found at the same stuck place for several days as seen in the cases of abalones, 0-44, 0-70 and 0-89. However, it was also observed that they moved to another place by day.

#### *Observation through a Day in the Fishing Ground*

As already mentioned, it may be said that abalones tend to locomote more in the nighttime. Therefore, the locomotion behavior of abalones which stayed at the same stuck places for several days or were moving by day were observed in the

nighttime. The locomotion of the disc abalone observed at Iwaizaki fishing ground in Kesenuma Bay where are shown in Fig. 4.

The place was 2 to 3 m depth and 23°C water temperature on August 21 to 22, 1967, and the results of the observations are shown in Fig. 5. The abalone, I-1, which stuck at position, Pt. 11, in the daytime of August 21 began to locomote at night and it was not found at the same position on the next day. The abalone, I-2, which was found at the stuck position, Pt. 12, on August 21 was out of observation at mid-night of the same day after locomoting 2.5 meters from the stuck position. This abalone, however, returned on August 22, to the same position of the previous day.



Fig. 4. Iwaizaki fishing ground in Kesenuma Bay. Arrow indicates the rock where the observation of the locomotion of two disc abalones was performed.

The locomotion of the Siebold's abalones, U-1, U-2 and U-3, which were observed at a fishing ground in Uchiura Bay at 5 to 6 m depth and 20 to 22°C water temperature through a day, from nine o'clock of September 12 to nine o'clock of the next day in 1965 is shown in Fig. 6. The observation showed that these individuals did not locomote at all in this nighttime, though they were actively changing the body-axis and extending the tentacles.

The locomotion of abalones through a day indicate three types, "the moving type" which changes its stuck position during the nighttime as in case I-1, "the homing type" which returns to the same stuck position "home" on the next day after locomoting in the nighttime as in case I-2, and "the staying type" which did not locomote at all as in cases U-1, U-2 and U-3.

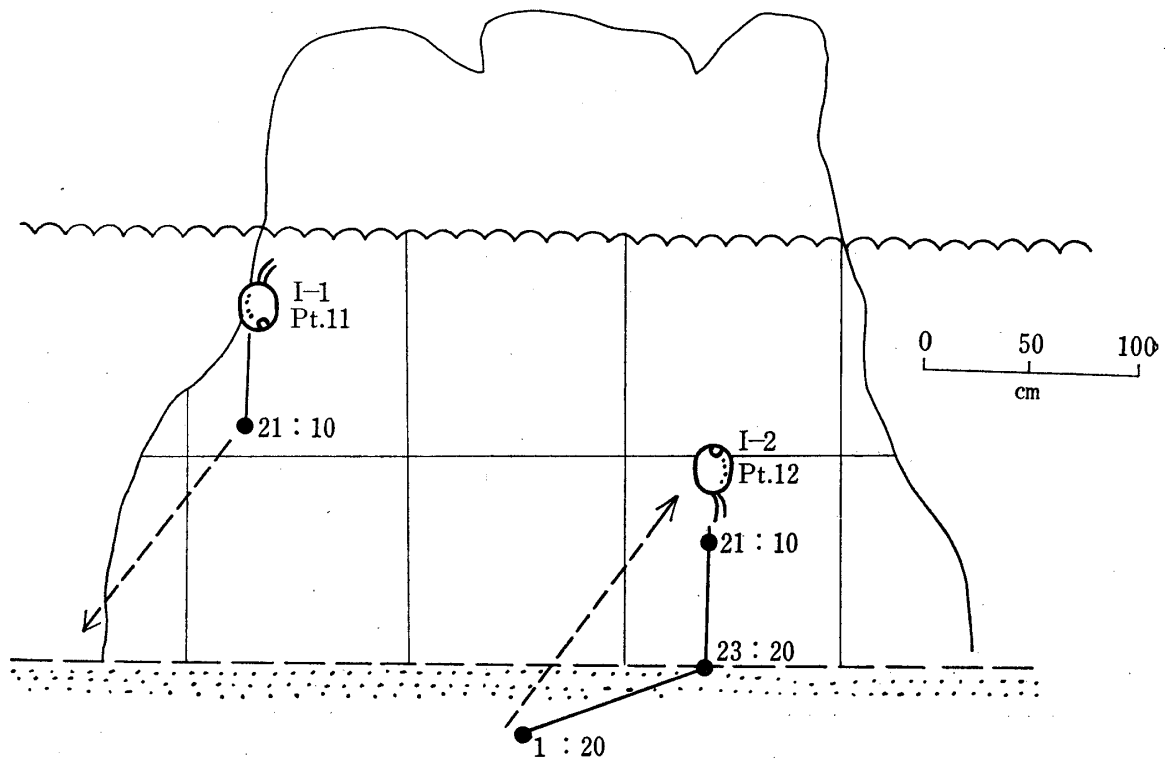


Fig. 5. The paths of the locomotion of two disc abalones on the rock-face through a day, 9 a.m. of August 21 to 9 a.m. of August 22, 1967, at Iwaizaki fishing ground in Kesennuma Bay.

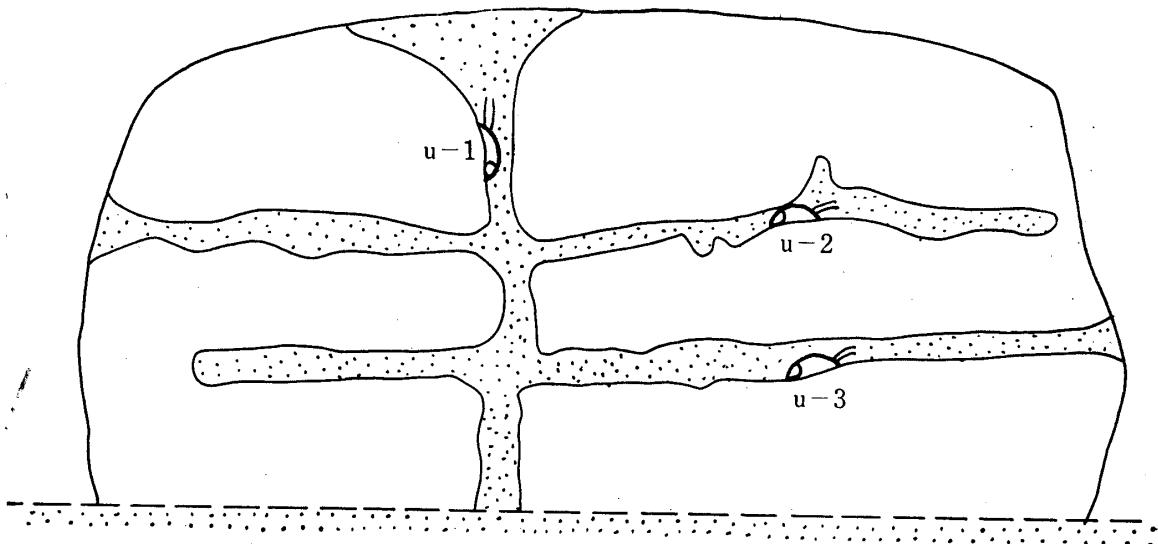


Fig. 6. The stuck positions of the three Siebold's abalones which did not locomote during the day, 9 a.m. of September 12 to 9 a.m. of September 13, 1956 on a rock-face under the water at a fishing ground in Uchiura Bay.

### Discussion

Abalones have been said to be nocturnal in behavior by Tago (1) and Forster (2). This is also known from catching them by trap net and deep water dredge which are set in the night at Aomori and Hokkaido coasts as reported by Ino (3). It can be said from these studies that the abalone tends to begin to locomote immediately after sunset and the locomotion continued during the nighttime in the fishing ground. This habit of the abalone seems to be to get food in the nighttime. The greatest distance of locomotion of the abalone was more than 2.5 m during a night in the fishing ground in the present study. It was longer than the distance of locomotion observed of other little molluscs such as chitons, limpets and some other species reported by Abe (4) and Newell (5). On the other hand, the homing habits of Gastropods such as limpets and a Japanese top-shell have been known by Abe (6) and Nishimura (7). The homing behavior of limpets has been also introduced by Wells (8). It was also found from the present study that the abalone tended to return, before day light, to the same stuck place which the abalone was found at the previous day. The stuck position of the abalone where it was found in this study is similar to the "homing spot" in the case of chitons by MacGinitie and MacGinitie (9). In addition to this behavior, it has been shown from the observation of this study that there are not only a "homing type", which was seen in some species of Gastropods including abalones but also two other types of locomotion of abalone i.e. the "moving type" and the "staying type". The "staying type" which did not locomote even in the nighttime may consume floating broken pieces of sea weeds as a food at their stuck places under the sea water.

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