SCUBA Diving near Syowa Station, Antarctica for Surveying Benthos

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南極大陸沿岸における潜水調査報告

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要　　旨

第9次南極観測（1967—1968）の夏隊生物部門隊員であった著者は，同医学担当の大久保嘉明隊員と共に，1968年2月2日，Lützow-Holm湾に面する Lang Hovde 沿岸においてスキューバ法により最高10m，計37分間の潜水調査を行ない，底生生物を対象とした16mm映画および35mm写真の撮影を行なった．また，スキンダイビング（呼吸器を装着しない潜水方法）を12分間行ない，海草，ウニ，ヒトデなどの底生生物の採集を行なった．

潜水法による海底調査は日本隊としては初めての試みであり，潜水着および呼吸調節器に，2，3の改良すべき問題が残された．

潜水時は無風快晴，気温は＋0.2°C，表面水温＋0.1°C，深度7mでは水温－0.7°Cであった．

採集された底生生物は一種を除き鑑定を依頼中であるため，この報告は主として潜水方法および水中撮影に関するものである．

1. Introduction

Studies on the littoral fauna and flora in the Antarctic littoral have been done by some research members of the Japanese Antarctic Research Expeditions. These studies are significant not only in the ecological study of individual organisms but also from the more macroscopic point of view. That is, the study of the total ecosystem of the Antarctic sea and land includes the study of productivity or the nutritional chain in itself.

Dredging has been employed most commonly to collect the benthos from deep or shallow sea-bottom. In the shallow sea, however, a more direct way of collection and observation is practicable.

In this connection, we thought of the advantage of diving. By this method,

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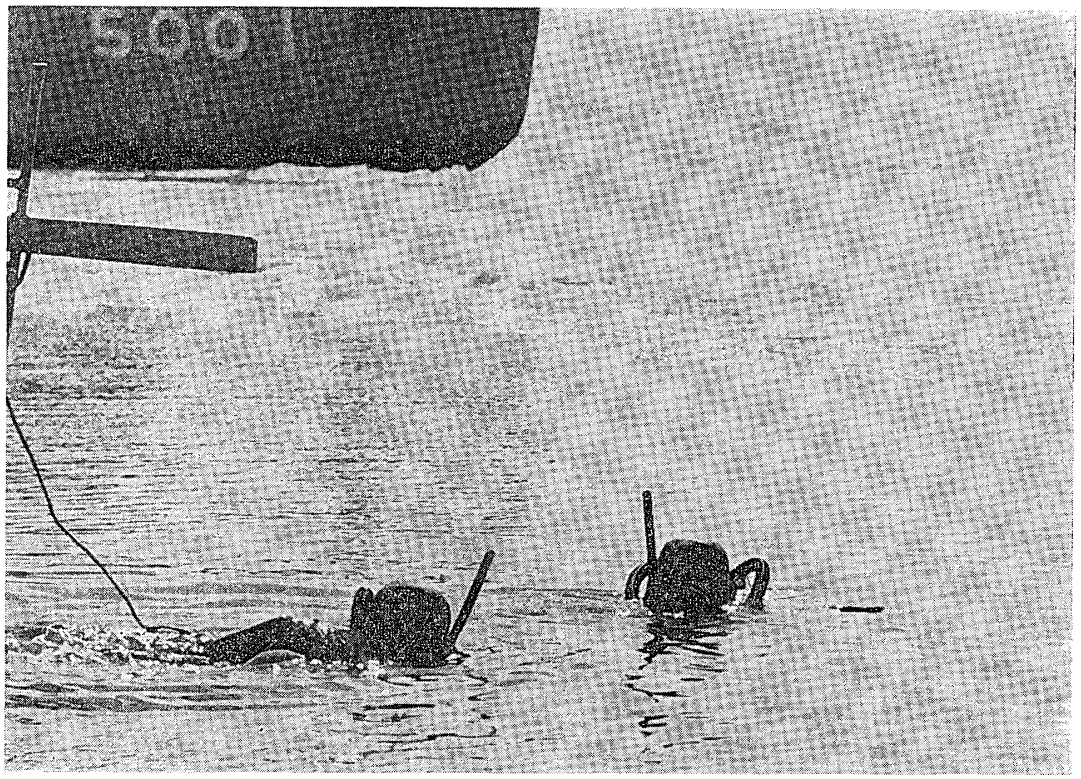

Fig. 1. Two divers surveyed the Antarctic littoral sea-bottom on Feb. 2, 1968. There appears wide open-sea around Lang Hovde every year. FUJI can be seen at the rear and the supporting bar of the steam launch is on the left.

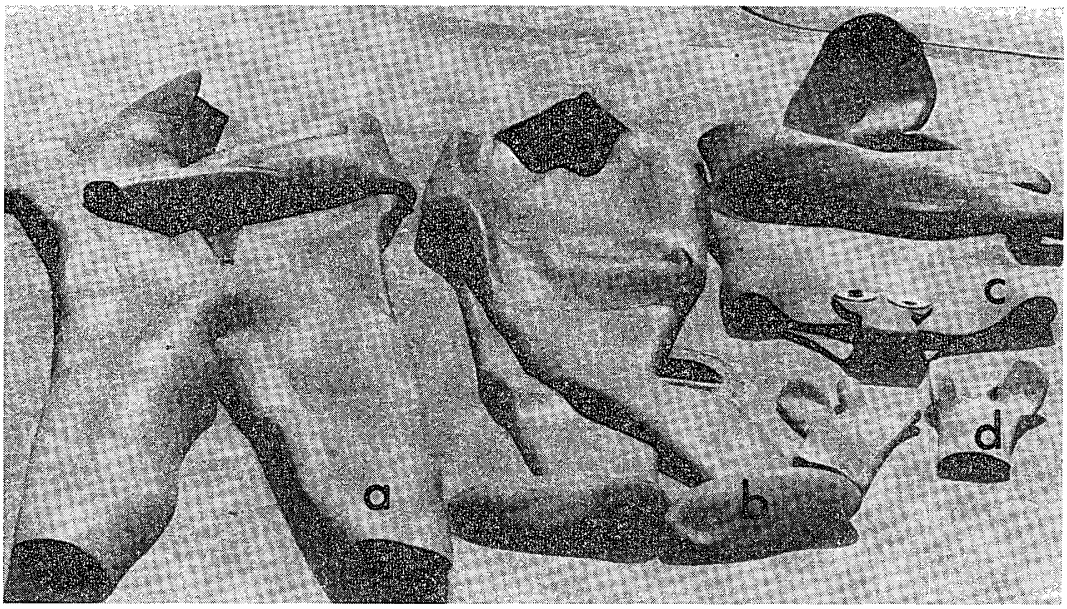

Fig. 2. Double wet-suits made of Neoprene. The thickness of Neoprene was 11.5mm altogether. The mittens were also made of Neoprene 3.0mm thick.

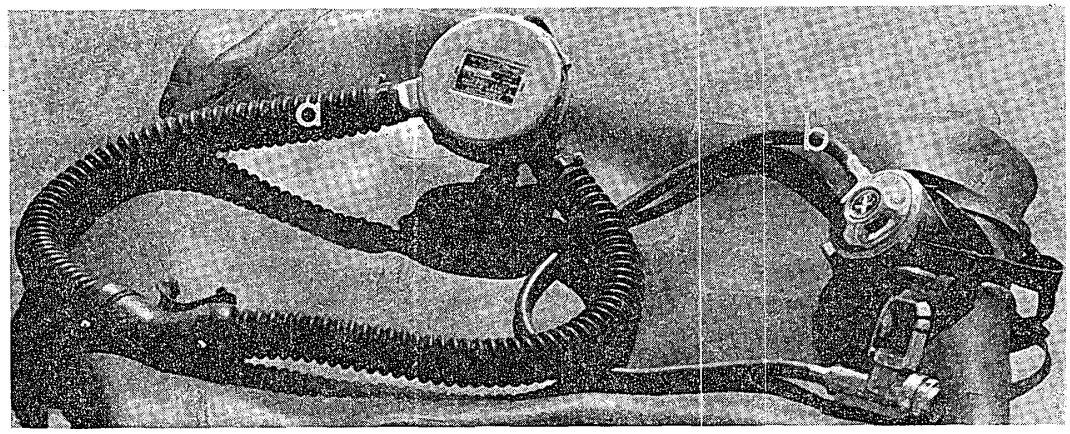

Fig. 3. The commercial double-hose (a) and single-hose (b) regulators used. One of double-hose regulators went wrong at the second trial.

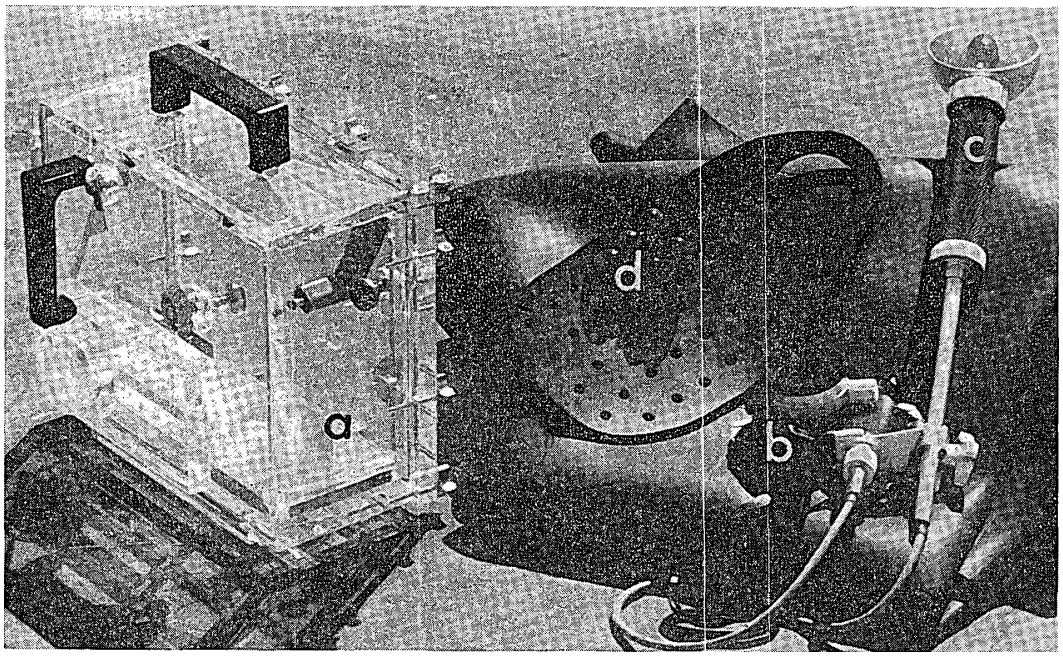

Fig. 4. The special house for 16mm motion picture camera which was made of acrylic acid resin 20mm thick (a). 35mm camera was an ordinary underwater camera on the market (b).

it seemed possible to observe with the naked eye the littoral ecosystem of fauna and flora from land to sea-bottom, and, at the same time, to collect samples by hand. We can also take photographs or motion pictures which are greatly helpful in the analysis of the local ecosystem.

The present paper is a report of our survey in the littoral of Lang Hovde, one of the ice-free areas near Syowa Station, Antarctica, on February 2, 1968. This survey was operated as one of the 9th Japanese Antarctic Research Expedition programs. It was the first attempt in the history of Japanese expeditions to survey the Antarctic sea-bottom by diving (Fig. 1).

2. Methods

2.1. Diving apparatus

We adopted SCUBA (Self-Contained-Underwater-Breathing-Apparatus) method for diving. It was said that this method enables one to swim freely in water, so that we thought this was very suitable for taking photographs or motion pictures. Another merit of this method was that the operation was comparatively simple. In the Antarctic littoral, it is not too much to say that the safety of an operation cannot be discussed apart from its mobility.

For the purpose of keeping sufficient warmth, we used the double wet-suits. The inner wet-suit is separated into two parts which are made of Neoprene 6.5mm thick; the upper part (Fig. 2c) has a hood and the lower part (Fig. 2b) has socks. The outer wet-suit (Fig. 2a) is made of Neoprene 5.0mm thick, and the mittens (Fig. 2d), 3.0 mm thick.

Other SCUBA apparatus were ordinary ones on the market (Nihon Aqualung Co., Ltd.). The tanks were single ones with the capacity of 12 l (M.P. 180 kg/cm^2) and the regulators were with a double-hose (Fig. 3a) and a single-hose (Fig. 3b). To keep the balance, each diver prepared a 12kg weight for a depth of more than 10m.

2.2. 16mm motion picture

The Meguro Factory of Canon Co., Ltd. made for us a special waterproof house (Fig. 4a) in which Canon 16mm motion picture camera "Scoopic" was set. This house was made of acrylic acid resin 20mm in thickness, and weighed 14.4kg in the air and 0.6kg in fresh water; it was tested to resist the hydrostatic pressure of no less than 3 kg/cm^2, which is the pressure imposed upon at 30m in fresh water. We can operate shutter, select zoomlenses and adjust focus from the outside of the house with remote-control knobs. To take close pictures, we selected 13mm lens and adjusted focus to 2m.

2.3. 35mm photographs

We used a commercial underwater 35mm camera "Nikonos" (Fig. 4b) of Nikon Co., Ltd. and a flash-gun (Fig. 4c) made exclusively for "Nikonos". Flash-bulbs (Fig. 4d) used were also commercial ones.

3. Results

3.1. Actual operations

The survey was operated on February 2, 1968. The surveyed littoral was located at Lang Hovde, Antarctica; 69°12.0′S, 39°37.4′E*(Fig. 5).

The divers were Yoshiaki OKUBO, a medical scientist and myself. The weather was fine all day, the temperature being +0.2°C in the air at 14:00 o'clock. The water temperature was +0.1°C at the surface and −0.7°C at 7 m below the surface at 14:00 o'clock.

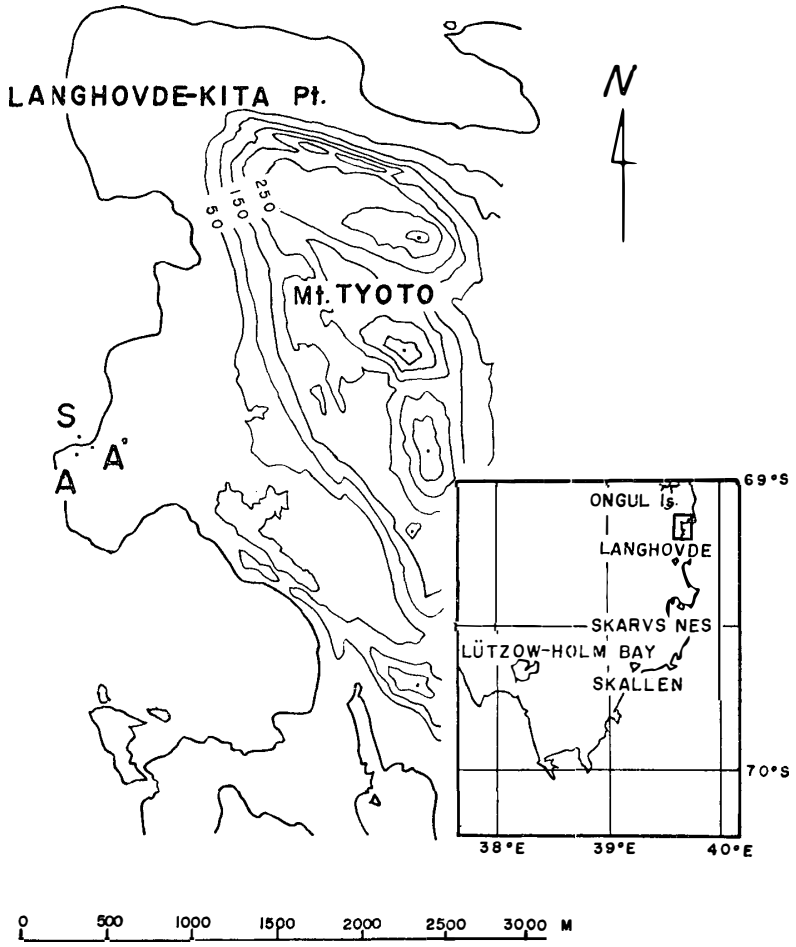

Fig. 5. Map of the northern part of Lang Hovde. **S** *shows the littoral which was surveyed on Feb. 2, 1968.* **A** *and* **A′** *show the rookeries of Adélie penguins.*

* The position observed by the icebreaker FUJI.

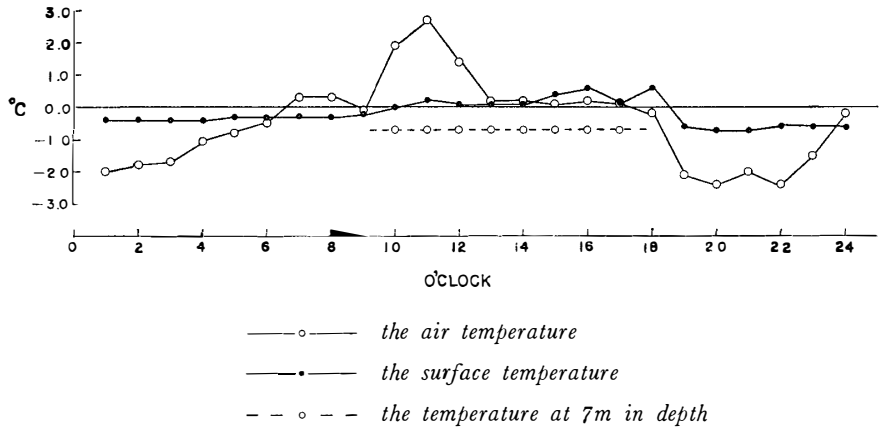

Fig. 6. Changes in temperature on Feb. 2, 1958. The survey was operated from 13:00 to 15:00 o'clock.

The more detailed data are shown in Fig. 6. The survey was done mainly at the depth of 5-7m with the maximum of 10m.

In the morning of February 2, we did sounding around the littoral to be

Table 1. The process and the duration of the survey.

Method	Duration	Subject matters and remarks
Skin-diving	12 min. *	Collection of sea-urchins, starfish and sea-algae.
Rest	20	Diagnosis of pulsation.
SCUBA	12 **	35mm photographs.
Rest	10	
SCUBA	6 **	Something wrong with a double-hose regulator of OKUBO.
Rest	10	Exchange of the regulator for a single-hose regulator. Readjustment of the balance of weight.
SCUBA	11 **	16mm motion picture.
Rest	5	
SCUBA	8 **	16mm motion picture.

* The total time that we were in water.

** The time during which we were under water.

surveyed. In the afternoon, from 13:00 to 15:00 o'clock, we did skin-diving for 12 minutes and then SCUBA diving for 37 minutes altogether (Table 1).

3.2. Technical aspects

By wearing the double wet-suits, only a small area around the face-mask was exposed. Although we felt little cold except in the exposed part of the face, we consumed our physical strength considerably. The difficulty was not in the coldness but in the tightness of the suits.

Since the sea water itself was turbid with planktons or incrustation, we could see nothing but dark green water at a depth greater than 10m in spite of sufficient intensity of light. Accordingly, we took 3 photographs and 80 feet of ciné film at the depth of 2 – 7 meters.

3.3. Biological aspects

On the seacoast, two small rookeries of Adélie penguins were found (Fig. 5). Only small pieces of ice remained on the beach; the greater part of the shore reef was exposed above ice.

There were small tide-pools on the shore where we saw some green algae. We also found similar green algae on the rocks under water 1 – 2m in depth.

The bottom was made up of rocks with rather smooth surfaces and sand with which crevices of rocks were covered.

At the depth of 2 to 4m, brown algae were predominant and red algae were also found.

At 5 to 7m, sea urchin was evidently dominant. The brown algae were attached thickly to some of the sea urchins found on the shallower bottom. Some starfish were also found at the depth of 5 to 7m.

At the bottom as deep as 10m, the sea water became so dark and turbid that all we could see was only a small number of sea urchins, starfish and mudfish.

The algae collected by us belong to *Phaeophyta* and *Rhodophyta*. We also collected some of *Asteroidea*, *Echinoidea* and *Amphipoda*.

The Amphipods were found on the collected brown algae and also on a dead starfish. All these benthos await expert opinions, except a species of *Asteroidea* which has been identified as *Odontaster validus* KOEHLER by Dr. HOSHIAI, at Department of Polar Research, National Science Museum.

4. Discussion

We had expected the following difficulties in connection with the survey. The

first one was the physiological difficulty which might be caused by the cold sea water. In consequence of wearing the wet-suits doubly, however, we felt neither coldness nor drowsiness which would be caused by the lowered body temperature in water all the time.

As mentioned before, we got tired because of the tightness and stiffness of the suits. The double wet-suits made of Neoprene 5.0mm and 3.0mm thick would have been more comfortable than the 6.5mm and 5.0mm thick ones. Our wet-suits proved effective enough in preventing invasion of cold water and in keeping our body warm.

The second one was the mechanical difficulty which might occur in the SCUBA apparatus. The sea water usually freezes around −1.8°C. But if the air in tanks is moist, water-drops may be formed in the valves of regulators and may freeze around 0°C. This phenomenon happened actually; in our second trial the air continued to come out of OKUBO's double-hose regulator in water 10m deep. This trouble still remains unsolved but all other apparatus worked well.

The third difficulty was experienced in taking photographs or motion pictures. Although it was thought possible to dive in a good light because of the appearance of a considerably wide ice-free sea every year around Lang Hovde, the great multiplication of planktons made the sea turbid and dark. Accordingly, we could not take photographs or motion pictures at the bottom deeper than 7m.

The last difficulty was how to use a life-rope and a signal-rope. This was solved, eventually, owing to the cooperation of the crew of the icebreaker FUJI who made the steam launch available for this purpose.

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