Snow Crab Behaviors in the Deep-sea Floor Revealed by VPS

Kanawa K[1], Yamoto H[1], Mitamura H[1, 4], Arai N[2, 4], Ohtani T[3], Ozaki T[3]

[1] Graduate School of Informatics, Kyoto University, Kyoto, Japan

[2] Field Science Education Research Center, Kyoto University, Kyoto, Japan

[3]Tajima Fisheries Technology Institute, Hyogo Prefecture, Hyogo, Japan

[4]JST CREST

Abstract

The catch of snow crab in the Sea of Japan has decreased. Therefore, there are many regulations including the size limitation and protected season, protected areas and production of fingerlings to enhance the resources. However, these measures may be insufficient to maintain and restore resources because the effect of the regulation was not evaluated very well. It is very difficult to observe the snow crab behaviors because they inhabited the deep-sea floor in the Sea of Japan. Therefor we began to investigate the challenging biotelemetry study in order to reveal their behaviors. In this paper, we introduced preliminary results of the deep-sea trials of Vemco positioning system (VPS). This was our first experience using the deep-sea VPS study.

Keywords: Snow crab, the Sea of Japan, VPS, acceleration transmitters.

Introduction

It is difficult to measure the behavior of the marine organism such as snow crabs, *Chionoecetes opilio* that inhabit the deep-sea floor by conventional biotelemetry. However, the biotelemetry in recent years can measure fine scale positions and behaviors using Vemco positioning system (VPS) with acoustic coded transmitters installed with acceleration sensors. We deployed the VPS in the deep-sea floor (240~250m depth) to clarify the snow carb behaviors such as movement direction, diurnal behavior after the release. Recently, there are many biotelemetry studies using VPS [1-7], but the deep-sea application is not conducted. In this paper, we introduced the first result of the deep-sea VPS study.

Materials and Methods

Indoor tank experiment

We conducted the preliminary study to confirm the relationship between the snow crab behaviors and the output of the acceleration transmitters conducted in indoor tank (Fig. 1).

Fig. 1 Five snow crabs were placed in a 300-L tank with chilled seawater, which was fitted with an acoustic receiver (VR2W) and covered with mud in the bottom. The infrared projectors of both sides were used at night.

Open water tracking

Next, we conducted the open water tracking study. The study site was the Hamasaka snow crab protected area off the coast of Hyogo Prefecture (Fig. 2). This protected area is 4 km by 4 km square and have a distance of 18 km from the coast of Hamasaka. The sea floor is relatively flat and water depth is approximately 240 m.

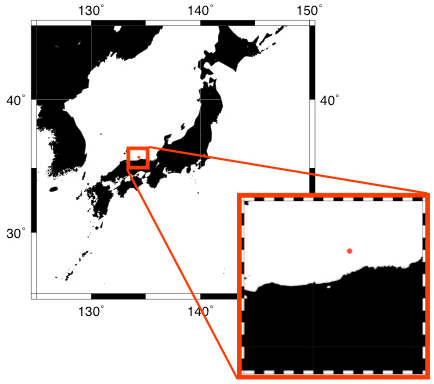

Fig. 2 Map of study site; a red point is Hamasaka snow crab protected area off the coast of Hyogo Prefecture (35°47.4'N, 134°21.8'E)

VPS set-up

Seven ultrasonic receivers (VR2W, Vemco) were set up to construct the VPS area (Fig. 3). We released 28 snow crabs (20 females and 5 males) in the VPS area attached with V9AP (Vemco) on Oct. 25, 2012 and monitored until Dec. 13, 2012.

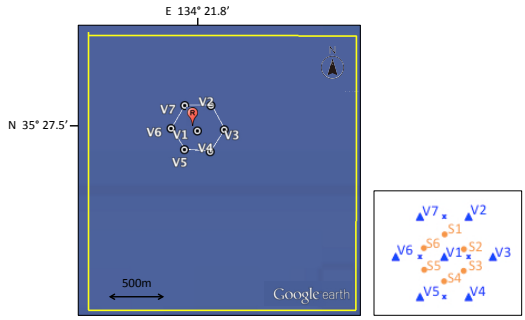

Fig. 3 The VPS array consisting of 7 VR2W receivers (V1 ~ V7) and reference tags (S1 ~ S6). A yellow line shows the periphery of the protected area and R pin shows the release point.

Results & Discussion

As the results from the indoor experiment, it was clear that snow crabs were "still" when less than 0.13m/s, vise versa. We could judge whether snow crabs were active or not using acceleration transmitters.

Resulting from the VPS analyses, all the snow crabs were tracked very well in the deep-sea floor. We found the snow crabs moved against the current (Fig. 4) and they moved mainly in nighttime (Fig. 5).

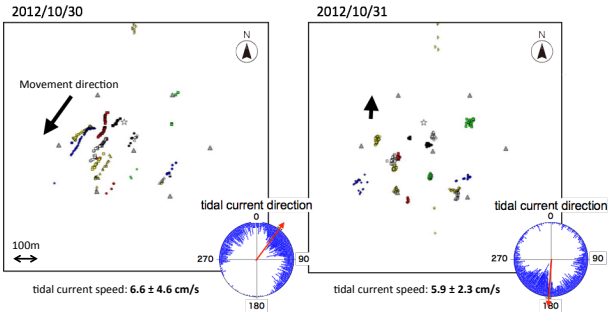

Fig. 4 Movement pathway of snow crabs on Oct. 30 and 31. Each crab is divided by the color. Black arrow is mean movement direction of snow crabs. Red arrow is the mean current direction.

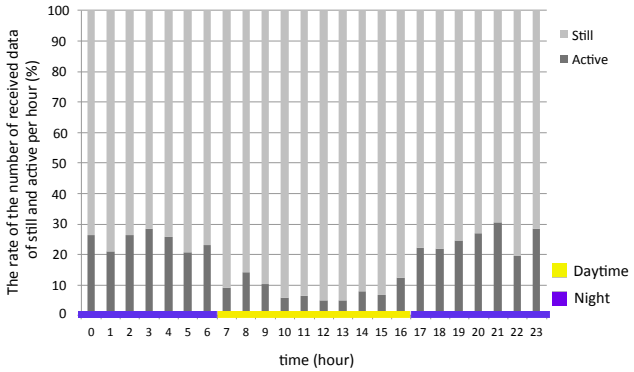

Fig. 5 The rate of the number of received data about "still" and "active" for a male crab (Tag ID: 79) in every hour during the monitoring period.

Conclusions

We conducted the deep-sea biotelemetry study to track snow crabs. The VPS was very useful to track the snow crabs in the sea floor about depth of 240m. We found that the snow crabs moved in the nighttime and they moved against the tidal currents.

References

[1] Andrews K, Tolimieri N, Williams G, et al. Comparison of fine-scale acoustic monitoring systems using home range size of a demersal fish. Mar.Biol., 158, 2377-2387, 2011

[2] Espinoza M, Farrugia D, Webber D, et al. Testing a new acoustic telemetry technique to quantify long-term, fine-scale movement of aquatic animals. Fish. Res., 108, 364-371, 2011

[3] Armstrong M, Dean M, Hoffman W, et al. The application of small scale fishery closures to protest Atlantic cod spawning aggregations in the inshore Gulf of Maine. Fish. Res., 141, 62-69, 2013

[4] Thums M, Whiting S, Reisser J, et al. Tracking sea turtle hatchlings – A pilot study using acoustic telemetry. J. Exp. Mar. Biol. Eco., 440, 156-163, 2013

[5] Coates J, Hovel K, Butler J, et al. Movement and home range of pink abalone Haliotis corrugate: implications for restoration and population recovery. Mar. Ecol. Prog. Ser., 486, 189-201, 2013

[6] Rankin P, Hannah R, Blume M. Effect of hypoxia on rockfish movements: implications for understanding the roles of temperature, toxins and site fidelity. Mar. Ecol. Prog. Ser., 492, 223-234, 2013

[7] Kessel S, Cooke S. Heupel M, et al. A review of detection range testing in aquatic passive acoustic telemetry studies. Rev. Fish. Biol. Fish., 24, 199-218, 2014

Author's Address

Nobuaki Arai

Field Science Education Research Center, Kyoto University
arai.nobuaki.8c@kyoto-u.ac.jp