

The applications and future of biologging technology

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Q. What is the one thing you want to know the most right now?

I am interested in understanding the relationship between the Kuroshio Current, which flows near Japan, and the migration patterns of large fishes (e.g., sharks). The Kuroshio Current is one of the strongest ocean currents in the world, and its speed is so fast that it exceeds the average swimming speed of most fishes. In other words, fishes are swept dozens of kilometers every day just by staying still, and it is almost impossible for them to swim against the current. Such a torrent brings benefits to Japan, mainly in the form of skipjack tunas and other marine resources. However, little is known about how much fishes actually ride the Kuroshio, cross it, or attempt to go against it. Therefore, I am using a technique called "biologging", in which electronic devices are attached to the bodies of animals, to study the movement of large fishes such as sharks in the Kuroshio Current region.



Q. What do you consider to be a challenge at the moment?

It's about collecting more data. For our research, we need to catch pelagic shark species such as blue sharks and shortfin mako sharks in the sea. I moved to SOKENDAI Hayama campus in April 2023, and since then I have tried many things to study sharks in nearby Sagami Bay. I asked fishermen to take me out on their set-net fishing boats and chartered a pleasure fishing boat to try shark fishing. But in the end, I could not catch a single pelagic shark. After more than a year of trying, we finally found a way to catch sharks by using a long-line fishing boat operating not in Sagami Bay, but in Suruga Bay, a neighboring bay. Longline fishing is a fishing method in which a single long rope with hundreds of hooks is set into the sea, and because of the large number of hooks, the chances of catching a fish are higher than with single hook fishing. So far, six blue sharks have been caught, fitted with equipment, and released using this method. Data on the migration routes of sharks in the Kuroshio Current region of the Pacific Ocean have finally begun to be collected. Interestingly, the majority of the blue sharks caught by longline fishing in Suruga Bay are very large, some 3 meters in length. I had no idea that such monstrous creatures were so common in the waters immediately surrounding Japan. However, there are still some issues to be addressed regarding how

to attach equipment to sharks. For example, in addition to blue sharks, we also catch shortfin mako sharks and common thresher sharks, but these sharks are too active or large to be fitted with equipment. We are still working on ways to handle pelagic sharks and increase the data collected from them.



Q. Could you share your thoughts on the future prospects of this field?

I have been studying marine animal ecology using biologging techniques since the early 2000s. Compared to those days, biologging technology today is far more sophisticated and widely used, and has already become almost an infrastructure for researchers. In this context, I believe it will become even more important to integrate biologging with other research methods, rather than relying solely on it. For example, the combination of biologging and genetic analysis is still rare, and I believe it has great potential. For this reason, I am working with Associate Professor Yohey Terai in a neighboring laboratory to combine the swimming depths of large fishes measured by biologging with genetic analysis of their eyes to investigate their adaptation to the dark and deep sea. The previously mentioned shark tracking data in the Kuroshio region must be interpreted in combination with the large amount of ocean environmental data (water temperature, ocean currents, etc.) obtained by remote sensing. This combination of biologging and environmental big data will become increasingly important in the future. But on the other hand, there are still many things that can be done with biologging alone. For example, the deep sea is the last frontier on Earth, and we still know very little about the ecology and movements of fishes that live in the deep sea. I see the fact that Sagami Bay and

Suruga Bay, which are close to the SOKENDAI Hayama Campus, are very deep bays as a great advantage. I am in the process of installing biologging equipment on deep-sea bony fishes such as oilfish, and deep-sea sharks such as kitefin sharks.

Q. What was the most enjoyable moment and the most challenging moment during your research?

The enjoyable part is the moment we get the data. People connections are essential to shark research. I usually contact fishermen and recreational boat operators to gather information. I also make it a point to keep my footwork light and visit the field. I was thrilled when these activities finally bore fruit and for the first time we caught a monstrous blue shark in Suruga Bay, attached equipment to it, released it, and actually obtained data on its migration path. Come to think of it, there was a memorable event during a recent survey. After capturing a blue shark and attaching the equipment, we were about to release the shark when we noticed that part of its intestines had protruded from its cloaca. However, the condition was not fatal, so we released the shark as it was, trusting that it would settle naturally in its body. However, several days passed and no data came in from the shark. I was extremely disappointed. I imagined that the intestines had been bitten by other



sharks or something and the shark had died. One day, however, when I checked the latest information on my smartphone, data suddenly popped up. The shark was alive and began to deliver its location information as it swam across the Pacific Ocean. I was so happy that I almost jumped out of my chair.



Q. Do you have a message for undergraduate and graduate students who are interested in joining your lab?

My laboratory is fieldwork oriented. We value the process of going out to the sea, capturing animals, installing equipment, analyzing the data obtained, and writing a paper. I see that we live in the era of big data, and data worth analyzing is already available in databases or can be provided by collaborating researchers. And that can sometimes produce a much more impressive dataset than fieldwork does. However, I can firmly say from my experience that unless you actually go on board, feel the atmosphere of the field, and touch the animals with your own hands, you will tend to analyze data in a strange way, somewhat detached from the real organisms. Even if the data is incomplete or fragmentary, I believe that analyzing data collected with one's own hands is the royal road to the truth of biology. Besides, it is a lot of fun to get in a car from SOKENDAI Hayama campus, go to the ocean and board a boat while chatting with lab members, and attempt to catch large fishes. Of course, we sometimes end up with no luck or have a tough time because of the rough sea, but that is part of the fieldwork. If you are interested in joining our SOKENDAI Marine Predator Lab, please feel free to contact me, no matter what you studied during your undergraduate years at the university.