# Acoustic remote sensing of marine organisms

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The goal of our project is to provide maps of aquatic animals similar to the satellite image of clouds. Three major means for the visualization were the passive acoustics, the active acoustics, and the submarine cables. Approximately 100,000 hours recording was conducted during 5 years period in this project. In addition, 20 years recordings, which was archived by the cable systems were included for the analysis. Species specific detectors were developed referring the sound feature database of crustaceans, fish and marine mammals. By far, passive acoustic monitoring have been applicable only for the presence of phonating animals. Hydrophone array systems and mathematical models enabled monitoring of spatial distribution, behavior and number of animals in Japanese waters. Off Chiba and Ibaraki prefectures, we showed movies of acoustic distribution of fish, crustacean and cetaceans using 20 passive acoustic monitoring stations. In Tateyama Bay, Chiba prefecture, combined methods of passive and active means visualized benthic and pelagic species simultaneously. Kushiro-Tokachi cable system, off Hokkaido showed seasonal presence of fin whales that has never been identified due to rough weather in winter time. Achieved sound data during 20 years revealed frequent presence of sperm whales in Sagami bay, off Kanagawa prefecture. Using support vector machine, deep learning and neural networks, classification of broadband echoes from fish was improved to monitor individual moment and identify species. Even in a limited area, species maps of marine animals have been presented. Acoustic remote sensing technology will be used for the census of aquatic animals.

Keywords: passive acoustic monitoring, submarine cable, fish echosounder