fishes

Editorial

Sharing Scientific Evidence of the Response of Aquatic Animals to Environmental Change

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Aquatic animals, which are ecologically important consumers in aquatic ecosystems and widely distributed in rivers, lakes, and seas, which occupy 70% of the earth's surface, respond in unique ways to environmental changes at various temporal and spatial scales, and have optimized strategies for survival. These organisms play a role in transferring energy to each trophic level through the ecosystem and show different types of responses depending on their ability to adapt to environmental changes [1–3]. They may increase local adaptability through genetic variation, or may change their habitat, regulate population density, and adapt to the changed food web as a survival strategy [2–4]. Consequently, the response of organisms to environmental changes leads to changes in biodiversity. Marine environments vary from tropical to polar seas, coastal to deep seas, and pelagic to benthic zones, and these environments are affected by local environmental changes, as well as global climate change. During the life cycle, sedentary species (that adapt and live in a relatively narrow spatial range) and migratory species respond sensitively to these environmental changes, e.g., changes in the migration patterns of salmon (*Oncorhynchus keta*) between rivers and seas, squid (*Todarodes pacificus*) moving from subtropical to subarctic waters [5–7], or the physiological response of sedentary clams to temperature increases in temperate coastal zones [3]. Moreover, changes in the marine environment lead to species extinction, invasion, and changes in dominant species (Figure 1), which may lead to new biological competitions such as changes in the food web, and both predators and prey should have adaptive strategies to survive. In addition, effective analysis techniques are needed to understand the response of ecosystems to environmental changes [2,8].

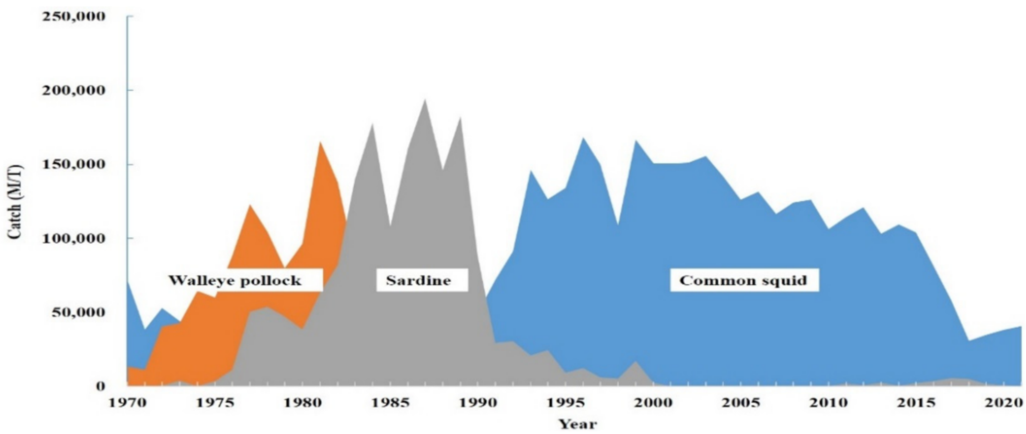

Figure 1. Changes in dominant species of fishery resources caught in the Pacific Northwest marginal seas.

Invertebrates and fishes are ecologically important consumers in aquatic ecosystems, and information on their dietary sources and trophic interactions is essential for predicting the top–down consequences of potential climatic change and anthropogenic stressors. Assessing the nutritional sources of consumer species and trophic pathways in aquatic ecosystems is of utmost importance in understanding ecosystem functioning. Many scientists have demonstrated alterations in aquatic food web structures caused by changes in community structure and the migration, replacement, and depletion of specific aquatic organisms in response to changing environmental conditions [2,9,10]. Especially, climate change via ocean warming can directly or indirectly influence the abundance and composition of aquatic organisms and their feeding strategies, as well as prey–predator interactions. To evaluate changes in dietary sources and the food web structure, stomach content analysis has been traditionally used as a common tool [11]. Recently, the stable isotope technique has been commonly applied to examine the trophic transfer of organic matter and the trophic structure of aquatic organisms based on actual assimilated diets of consumer species over longer periods [12,13]. More recently, both quantitative and qualitative analyses of prey species could possibly be used for metabarcoding [14,15]. Those tools would enable us to obtain a better insight into food web changes due to climate change. In addition to ecological changes, individual physiological responses would be another area of study to understand the impact of climate change on aquatic animals. Changes in variable physicochemical parameters such as temperature, salinity, currents, or carbon dioxide would definitely induce various physiological responses in individual animals, e.g., in relation to the metabolic pathway, growth, or reproduction. The development of various novel technologies could be applied to understand various responses to climate change.

Overall, in the past hundred years, human activities have had a great impact on the earth's environment, and the water environment is no exception. The environments in which aquatic animals live are facing the consequences of human activities, e.g., climate change, industrial pollution, agricultural emissions, and recreational activities. Aquatic animals cope with and adapt to the stresses resulting from these impacts and continue to survive. This Special Issue will provide important information to understand the physiological and ecological response characteristics of aquatic animals to changes in the marine environment at various temporal and spatial scales that appear in the process of climate change, and share scientific evidence for future change prospects.

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