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Reprint of: Japanese marine biological stations: Preface to the special issue

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ABSTRACT

This special issue of the Regional Studies in Marine Science includes eight articles of research subjects, most of which have been presented in the 2nd International Symposium of JAMBIO (Japanese Association for Marine Biology), held in December, 2014 in Tokyo, with a scientific topic entitled "Aquatic Ecosystems: Past, Present and Future". Japan is an island country located in the Pacific Ocean of East Asia. The ocean surrounding this country is affected by several unique currents and by seafloor topography with several trenches and troughs. These situations bring richness and diversity in fauna and flora. From 1886, many marine biological stations were founded in Japan for education and research in marine biology. Since summarized information about Japanese marine biological stations is poorly available, here I overview their history, present status, and the future for these key infrastructures which are vital for the Japanese economy, research and education.

Multiple marine stations were founded in late 19th century (Dolan, 2007). The Challenger Expedition (1872–1876) led the establishment for the basis of marine biology not only by its initial finding of organisms in the deep sea but also by clarification of the diversity of marine organisms and their habitats, represented by the descriptions of radiolarians by Ernst Haeckel, a champion of Darwinism, and those of echinoderms by Alexander Agassiz (Deacon et al., 2001). Anton Dohrn was a student of Ernst Haeckel and with the observation that marine organisms are fundamental to the evolution of life, he established Statione Zoologica Anton Dohrn Napoli (SZN) (Italy) in 1872, primarily for creating a "station" for zoologists from all nations to visit and study marine organisms (Fantini, 2000). In the United States, the Marine Biological Laboratory (MBL) (Woods Hole, USA) was established in 1888 by Alpheus Hyatt, a student of the Penikese Summer Schools operated by Louis Agassiz, father of Alexander Agassiz. Charles Otis Whitman, also a student from the Penikese School, became the first director of MBL (Maienschein, 1985). Many other marine stations were established in this period include Roscoff marine Station (France, founded in 1859 for the cultivation of marine species), The Sven Loven Center (Kristineberg, Sweden, 1877), Observatoire Oceanologique de Villefransche-sur-mer (France, 1882) and The Plymouth Laboratory of the Marine Biological Association of the United Kingdom (England, 1888; founded under the direction of T. H. Huxley) (Dolan, 2007; Southward and Roberts, 1987). The purposes for the foundation of marine stations were varied but many of them were influenced by the discovery of a wide variety of marine organisms following several expeditions (Dolan, 2007).

Japan is an island nation with several climate regimes. It is surrounded by the North Pacific Ocean, Japan Sea, Sea of Okhotsk and East China Sea. The Pacific side of Japan is largely affected by two currents: One is a warm current, the Kuroshio (Japan Current), flowing to the north. The other is a plankton-rich cold current, Oyashio, flowing from north to south. The Tsushima Current passes through the Japan Sea from north to south and another two warm currents are present in the northern regions, the Tsugaru Current and the Soya Current, flowing to the east. Japan is intersected with four tectonic plates: the Eurasian plate, the North American plate, the Pacific plate and the Philippine plate. This unique situation is responsible for a number of significant variations in the seabed, including submarine volcanoes, multiple trenches and troughs as well as a wide range in the depth of the sea. All of these conditions bring Japan an enormously rich fauna and flora (Fujikura et al., 2010).

The establishment of Japanese marine biological stations also goes back to the 19th Century. The richness of marine organisms in Japan was recognized by researchers who visited Japan from across the globe. Edward S. Morse was one of these researchers and a former research assistant of Louis Agassiz at Harvard University. Morse became the first professor of the Department of Zoology,

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Fig. 1. Locations of Japanese Marine and Inland Water Stations. As of April 2015, there are 18 marine stations and 3 inland stations, facilities of over 19 national universities. Some marine stations are now one of the branches of an integrated research or educational center.[1] From the north, Akkeshi Marine Station (Hokkaido University); Muroran Marine Station (Hokkaido University); Research Center for Marine Biology, Asamushi (Tohoku University); Sado Marine Biological Station (Niigata University); Noto Marine Laboratory (Kanazawa University); Center for Water Environmental Studies, Itako (Ibaraki University); Department of Atmospheric Environment and Aquatic Ecosystem, Institute of Mountain Science, Suwa (Shinshu University); Tateyama Marine Laboratory (Ochanomizu University); Misaki Marine Biological Station (University of Tokyo); Shimoda Marine Research Center (University of Tsukuba); Sugashima Marine Biological Laboratory (Nagoya University); Center for Ecological Research, Otsu (an inland water station was once located near Lake Biwa at Otsu; Kyoto University); Research Center for Inland Seas, Iwaya (Kobe University); Seto Marine Biological Laboratory (Kyoto University); Marine Biological Science section Oki (Shimane University); Ushimado Marine Institute (Okayama University); Marine Biological Laboratory, Mukaishima (Hiroshima University); Usa Marine Biological Institute (Kochi University); Amakusa Marine Biological Laboratory (Kyushu University); Aitsu Marine Station (Kumamoto University); Sesoko Station, Tropical Biosphere Research Center (University of the Ryukyus).

Tokyo Imperial University. He was impressed to the richness of mollusks and brachiopods and converted a small cottage in Enoshima, Kanagawa prefecture, to provide space for his research in 1877 (Hoshi, 2009). A German zoologist, Ludwig Döderlein, was Professor of Natural History at the Medical Department, University of Tokyo (Isono, 1988) who recognized the richness in fauna of the Sagami-Bay. He recommended Kakichi Mitsukuri, Professor of Zoology, University of Tokyo to found a marine biological station. Thus the first marine biological station was established by the University of Tokyo, at Misaki, Kanagawa Prefecture in 1886. Part of the design of Misaki Marine Biological Station was based on the advice to Mitsukuri from Anton Dohrn, who had already established Statione Zoologica Napoli in 1872 (Isono, 1988).

The significance of marine biological stations in education and research in zoology and basic biology was a key driving force to establish them in the Faculty of Science in other national universities in Japan; including at Seto (Kyoto University, 1922), Asamushi (Tohoku University, 1924), Amakusa (Kyushu University, 1928), Akkeshi (Hokkaido University, 1931), Muroran (Hokkaido University, 1933), Shimoda (University of Tsukuba, 1933), Mukaishima (Hiroshima University, 1933), Sugashima (Nagoya University, 1939) (Yoshida, 1985). The early marine biological stations mostly focused on diverse animals and their zoology. Over time, many of them became developed to take advantage of marine invertebrates as important model organisms for cell and developmental biology. Later marine biological stations embraced several additional research fields, according to the mission of education and research in

[1] Marine or Inland Water Stations which changed the organization in University are those at Akkeshi and Muroran (Field Science Center for Northern Biosphere, Hokkaido University); Noto (Institute of Nature and Environmental Technology, Kanazawa University); Suwa (Institute of Mountain Science, Shinshu University); Otsu (Center for Ecological Research, Kyoto University); Seto (Field Science Education and Research Center, Kyoto University); Oki (Education and Research Center for Biological Resources, Shimane University); Usa (Integrated as Usa Marine Biological Institute, Kochi University); Sesoko (Tropical Biosphere Research Center, University of the Ryukyus).