Citizen participation in augmenting a museum database enhances fish monitoring and public awareness

CITIZEN PARTICIPATION IN AUGMENTING A MUSEUM DATABASE ENHANCES FISH MONITORING AND PUBLIC AWARENESS

Yusuke Miyazaki[1,*], Atsunobu Murase[2] and Hiroshi Senou[1]

[1]Kanagawa Prefectural Museum of Natural History, 499 Iryuda, Odawara-shi, Kanagawa 250-0031, Japan
[2]Laboratory of Ichthyology, Faculty of Marine Science, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo 108-0075, Japan
*Corresponding author: miyazaki@nh.kanagawa-museum.jp; yukke-bibimba@10.alumni.u-tokyo.ac.jp

ABSTRACT

A number of politicians and official workers have drawn up plans for a large tide embankment to be constructed in the coastal area affected by the tsunami that followed the Great East Japan Earthquake of 11 March, 2011. However, these plans do not consider the potential effects of construction on marine biodiversity and the coastal landscape because biological monitoring has not been continuously conducted in this area. Thus, we cannot predict or evaluate how the levees will affect the area's biodiversity. Since 1994, the Kanagawa Prefectural Museum of Natural History in Japan (KPM) has collected photographs of fish in the Image Database of Fish (KPM-NR), as re-verifiable secondary source, as well as specimens (primary sources). Both researchers and citizen scientists, via participation in volunteer programs, have contributed to this collection. The citizen volunteers have mainly consisted of SCUBA divers because the KPM curator (last author) has fostered relationships with the diving community. In addition, sport fishing fans have increased the number of volunteers in recent years via simple collaboration with *WEB sakana-zukan* (online pictorial encyclopedia of fish), a Japanese non-governmental organization. To date, more than 150,000 photographs and 35,000 lots of specimens have been deposited in KPM collections. Parts of these collections have been utilized in fish taxonomic and biogeographic studies, in which a number of volunteers participated, resulting in published scientific papers. Thus, citizen participation in museum activities has contributed considerably to fostering biodiversity awareness. Connections with divers and sport fishers allow for significant biological monitoring in large area of water, enabling us to evaluate the effects of human development such as the above levee constructions on aquatic organisms.

INTRODUCTION

Natural disaster occur unexpectedly worldwide, and rich biodiversity helps to mitigate natural disasters that might otherwise threaten human well-being (e.g., Kareiva et al., 2011; Millennium Ecosystem Assessment, 2005; Takahashi, 2013). The giant tsunami resulting from the Great East Japan Earthquake on 11 March 2011, severely affected coastal residents, deleteriously impacting coastal ecosystems and benthic species biodiversity as well (Kanaya et al., 2012). After the earthquake, ecologists highlighted the importance of monitoring coastal ecosystem recovery at both the governmental and grassroots levels (Suzuki, 2013; Urabe and Suzuki, 2012). Nevertheless, many politicians and officials have drawn up plans that would see a huge embankment (~14.7 m height) constructed along the affected coastline, without considering the effects on ecotone biodiversity between marine and inland or the broader coastal landscape (e.g., Nagahata, 2012; Washitani, 2012; Suzuki and Hirabuki, 2014) until the revision approval of the Seacoast Act in a cabinet meeting on 7 March 2014. Additionally, monitoring of fish communities, which is challenging compared to working with less motile benthic organisms, remains insufficient for evaluating the impacts both of the tsunami and of any proposed coastal construction projects because of its re-verifiability and/or no extensive data of locality and date (e.g., Funabashi, 1998; Maruyama, 1971; Sakai, 1986; Sato and Hasebe, 1982; Shinohara, Endo, and Matsuura, 1996; Shiogaki et al., 2004; Zama, 2001).

The Kanagawa Prefectural Museum of Natural History, Japan (KPM) has been collecting photographs of fishes in the Image Database of Fishes (KPM-NR) as a re-verifiable source of secondary data, as well as specimens (primary data), since 1994 (Matsuura and Senou, 2002; Miyazaki et al., 2014). These activities have been conducted by researchers but also by nonscientists, including voluntary citizen participation and crowd-sourcing programs. The volunteers consist mainly of SCUBA divers because the curator of the KPM (the last author) has fostered relationships within the diving community (Matsuura and Senou, 2002; Miyazaki et al., 2014). In addition, sport fishers have recently increased the volunteer ranks through collaboration with the *WEB sakana-zukan* (online pictorial encyclopedia of fishes), a Japanese non-governmental organization (Miyazaki et al., 2014).

Here, we briefly review the past activities of KPM with the goal of proposing methods for monitoring coastal biodiversity.

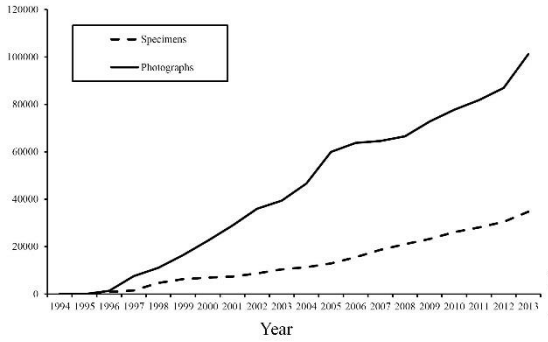

Fig. 1 Changes in the total numbers of all fish specimens (dotted line) and photographs (solid line) registered with the KPM.

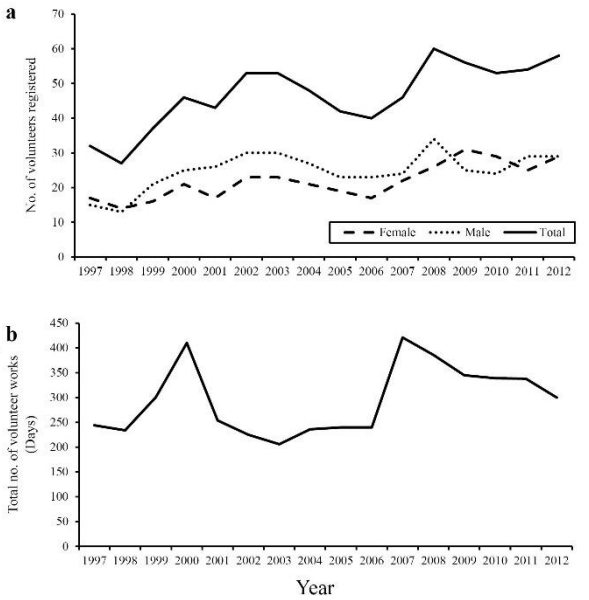

Fig. 2 Changes in (**a**) the number of registered volunteers in the KPM's fish division and (**b**) the mean annual number of volunteer days worked.

MUSEUM COLLECTIONS AND VOLUNTEER CONTRIBUTIONS

The KPM collections of fishes comprises more than 150,000 photographs and 35,000 lots of specimens (Fig. 1). Of these, more than half the photographs and thousands of specimens were provided by general citizens consisted mostly of museum volunteers (also see Miyazaki et al. 2014). The annual average number of volunteers in the fish division of KPM for 1994–2012 was 46.8 ± 9.7 (±SD) persons (Fig. 2a), with a roughly even sex ratio (*G*-test: $p = 0.97$; Fig. 2a). Similarly, the average cumulative number of volunteer work days in the KPM's fish division for 1994–2012 was 295 ± 70 days each year (Fig. 2b). As noted earlier, volunteers consisted mainly of SCUBA divers.

Portions of the KPM collection have been used in faunistic, taxonomic, and/or biogeographic studies as voucher specimens. For example, underwater photographs taken by SCUBA diving KPM volunteers and registered in the KPM-NR, along with other museum specimens, have been used as vouchers for creating checklists with zoogeographical comments in Japanese diving spots such as Hachijō-jima Island (Senou et al., 2002), Ōsezaki (Senou et al., 1998), Ie-jima Island (Senou et al., 2006a), Sagami Sea (Senou, Matsuura, and Shinohara, 2006b), and Miyako Group (Senou et al., 2007). Analyzing these ichthyofaunal data qualitatively, Senou et al. (2006) suggested that the Kuroshio Current functions as a barrier preventing temperate fishes in the main islands of Japan from moving toward the Ryukyu Islands, while transporting tropical species northward. Additionally, fish specimens collected by sports fishers and/or aquarists and registered with the KPM have been used as vouchers in confirming species range expansions (e.g., Senou, Fujiwara, and Sato, 2003; Senou, Hibino, and Yamada, 2014) and in identifying previously undescribed species (see Miyazaki et al., 2014). Notably, these scientific reports include participation by volunteers, who have served both as coauthors and corresponding authors (i.e., Uchino,

Senou, and Yoshino, 2012). Thus, citizen participation in museum activity, including the publication of scientific papers, has helped both to develop ichthyological understanding and to foster awareness of issues in biodiversity conservation.

FUTURE PROSPECTS FOR COASTAL FISH DIVERSITY MONITORING

The relationship between the KPM and the diving community has helped to develop the KPM's fish collection. Diving shops are found throughout coastal Japan (Fig. 3a) and from tropical to temperate regions of the Indo-Pacific (Fig. 3b). SCUBA diving strongly depends on the presence of a diving shop, whereas sport fishing does not depend as much on the presence of fishing shops. Therefore, if sport fishers increase their contributions to the KPM-NR, evaluating coastal biodiversity and effects of environmental change on it more broadly will become easier. In other words, making more connections with the diving and sport fishing communities would be extremely helpful in monitoring both coastal and inland waters.

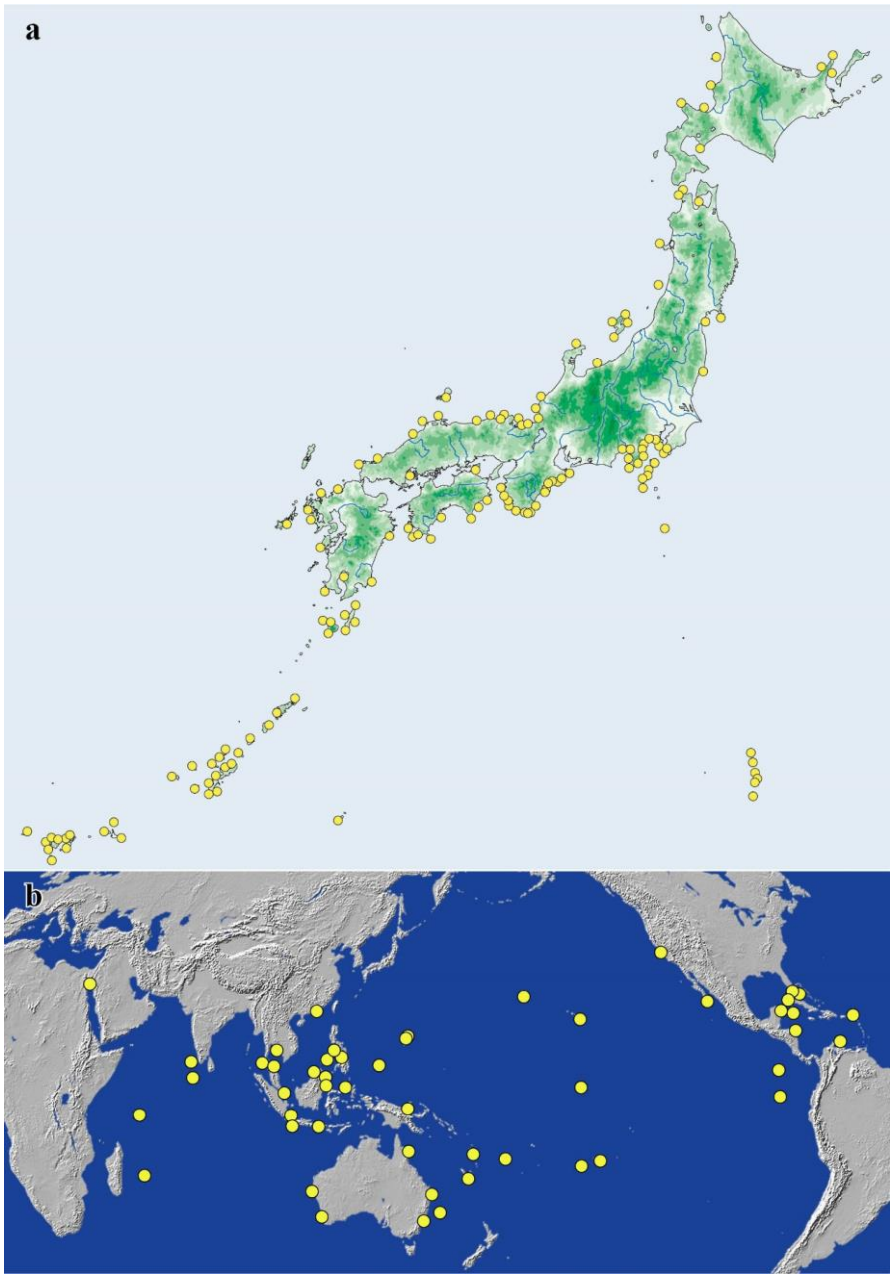

Fig. 3. Map of main dive sites in (**a**) Japan and (**b**) the Indo-Pacific region. Each open circle indicates a specific diving shop.

Moreover, Miyazaki et al. (2014) proposed that the development of informatics and the adoption of fair-use agreements will make gathering biodiversity data much easier. If so, Web-based monitoring will play an important role in biodiversity conservation and evaluation, and in fostering general awareness.

Together, these efforts will allow us to evaluate the effects of human development, such as the levee construction mentioned above. Again, we note that high biodiversity ensures human benefits as one of its ecosystem services.

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