Marine Pollution Bulletin 194 (2023) 115246

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Potential impacts of climate change on the distribution of echinoderms in the Yellow Sea and East China Sea

Yong Xu [a,b,c,d], Lin Ma [a,b,c,d], Jixing Sui [a,b,c,d,*], Xinzheng Li [a,b,c,d,*], Hongfa Wang [a], Baolin Zhang [a]

[a] Department of Marine Organism Taxonomy and Phylogeny, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China
[b] University of Chinese Academy of Sciences, Beijing 100049, China
[c] Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao 266071, China
[d] Laboratory for Marine Biology and Biotechnology, Qingdao National Laboratory for Marine Science and Technology, Qingdao 266237, China

ARTICLE INFO

Keywords:
Climate change
Echinoderms
Species distribution models
Yellow Sea
East China Sea

ABSTRACT

To detect potential impacts of climate change on the distribution of common echinoderm species in the Yellow Sea (YS) and East China Sea (ECS), species distribution models (SDMs) were applied. Ensemble SDMs were constructed and were in good model performance for six of the eight selected common echinoderm species. Under future climate scenarios, the brittle stars *Ophiopholis mirabilis*, *Amphioplus depressus* and the sea cucumber *Protankyra bidentata* were projected to expand in the southwestern areas of the YS, the ECS, and the coastal areas of the YS and ECS, respectively; the brittle stars *Stegophiura sladeni*, *Amphiura digitula* and *Amphiura vadicola* will likely contract their ranges in the south distribution areas and expand in the north, showing a northward movement trend. Temperature was the most important environmental variable influencing the distribution of the latter three echinoderms. Our findings will improve our understanding of the impacts of climate change on marine species distributions.

1. Introduction

Climate change has unprecedented impacts on marine ecosystems, causing variations in the marine environment, such as water warming (Burt et al., 2016), sea-level rising (Strauss, 2013), ocean pH decreasing (Matsumoto and McNeil, 2013), hypoxia (Altieri and Gedan, 2015) and ocean circulation changes (Luo and Rothstein, 2011). Many marine species have been proven to be influenced by those variations in the marine environment caused by climate change, such as the species belonging to plankton (Richardson and Schoeman, 2004), benthos (Gaudin et al., 2018), fishes (Roessig et al., 2004) and marine mammals (Learmonth et al., 2006). Many of them show a poleward migration in their distribution areas (Barton et al., 2016; Hastings et al., 2020; Salvedeo et al., 2010). The variations of species may have cascade effect through food chain and food web (Johnson et al., 2011). Echinoderms are important components of marine macrobenthos. Most of wild echinoderms living in the subtidal areas have little economic value except some sea urchins and sea cucumbers. Thus many of them did not attract much attention of the public. However, they play crucial roles in marine ecosystems as many of them (e.g. the brittle stars) are important food resources to the demersal fishes (Templeman, 1982; Zamarro, 1992) and some large sized invertebrates with economic value (Squires and Dawe, 2003). Many of them are important detritivores for consuming particulate organic matter (Pearson and Gage, 1984). Climate-induced variations in the distribution of echinoderms will influence the structure and function of the marine ecosystem. So precisely predicting the distribution of echinoderms under climate change will help us to better understand the variations of marine ecosystem in the future.

Species distribution models (SDMs) have been successfully applied to predict the distribution of marine species under future climate scenarios, such as marine mammals (Sun et al., 2022), fishes (Chen et al., 2021), macrobenthos (Xu et al., 2022) and plankton (Zhang et al., 2020). SDMs are based on the assumption that individuals belonging to the same species are all adapted to live in the same ecological niche and have the same response to climate change across the distributional range, which was also called “niche conservatism” (Wiens et al., 2009). By illustrating the associations between species distribution data and environmental predictors, SDMs can be used to estimate species' potential geographic

* Corresponding authors at: Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China.
E-mail addresses: jxsui@qdio.ac.cn (J. Sui), lixzh@qdio.ac.cn (X. Li).

https://doi.org/10.1016/j.marpolbul.2023.115246
Received 19 December 2022; Received in revised form 27 June 2023; Accepted 30 June 2023
Available online 13 July 2023