

Anticipated impacts of ocean acidification on local societies in Japan

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Ocean acidification is anticipated to affect marine ecosystem services and human activities such as fisheries, aquaculture, tourism and recreation. However, extent of the impacts is expected to differ spatially. Thus ocean acidification may widen regional gaps of economic conditions and pose a social security threat in future by damaging specific local industries. Things might be further complicated because suitable habitats for the calcifiers, such as corals, scallops, oysters, pearls and shrimps, are projected to become sandwiched between migrating northern and southern limits regulated by ocean warming and acidification, respectively. Considering such backgrounds, this study aims to call for stakeholders' attention to the possible impacts of ocean acidification on local societies in Japan by sharing fundamental scientific knowledge through everyone's common interests: economic values.

Change in economic values of Japanese coral reefs was calculated by the product of changes in the area and health condition of coral reefs. The area was assumed to be regulated by annual maximum and minimum water temperature and minimum saturation state of aragonite (Ω_{arg}) (Yara et al., 2012; 2016). The health condition was assumed to be deteriorated by 15% per Ω_{arg} (Chan and Connolly, 2013; van Hooijdonk et al., 2004). The change in economic values of Japanese fisheries and aquaculture was assumed to decrease by 10 through 40% per one pH unit of the water (Wootton et al., 2008).

Currently, calcifiers account for one-fifth of total fish catch in Japan (Ministry of Agriculture, Forestry and Fisheries, 2015). The annual economic values of tourism and fisheries profited by calcifiers in Japan were estimated to be 14,107 and 779-2,399 million USD, respectively (Cesar et al., 2003; Ministry of Environment, 2010).

The economic values of Japanese coral reefs were projected to increase by mid-century because of expansion of coral reefs in response to ocean warming (Figure 1). However, the economic value will decrease dramatically in the latter half of the century, due to possible extinction of coral reefs caused coral bleaching and ocean acidification. As a result, the total loss of economic values of Japanese coral reefs in this century was estimated to be 22-67 billion USD for tourism and 5-6 billion USD for fisheries by the end of the century.

Likewise, the total economic loss of Japanese fisheries by ocean acidification was estimated to be 15-37 billion USD by the end of the century. However, the impacts of ocean acidification are considered to be spatially different. For example, it is more concerned that the impacts on local industries are relatively prominent in such prefectures as Hiroshima, Okayama, Hokkaido, Fukui and Aichi where calcifiers currently account for the local fish catch by more than 30%.

It is obvious that global mitigation of ocean acidification such as reducing CO₂ emissions is essential to alleviate the impacts of ocean acidification. On the other hand, adaptive strategies would also be needed for aquaculture of calcifiers, which are very important for the local industries. Such strategies will only be achieved after consensus building among various stakeholders including citizens, policy makers and both natural and social scientists.

Keywords: Ocean acidification, Local society, Mitigation, Adaptation