Science for Environment Policy
DG Environment News Alert Service
European Commission

14 April 2011

Can reserve networks protect coral reefs from climate change?

A new study has conducted a preliminary investigation into the design of reserves that would help protect coral reefs from climate change. The results indicate that, 15 per cent of coral reefs in the Bahamas, the study area, would be able to withstand rising temperature, and would therefore be appropriately placed in reserves.

Rises in sea temperature have already caused several mass coral bleaching events, where corals whiten from the death of algae that live in a mutually beneficial relationship with the coral. This can threaten the coral's survival. Oceans are expected to warm under climate change, which could potentially cause more bleaching and greater loss of coral. Although reserves provide no refuge from climate change, they can provide potential for coral to adapt to the stress caused by climate change.

The success of coral reefs under rising temperatures can depend on the connectivity between reefs and the ability of coral larvae to move between locations. The study, partly conducted under the EU FORCE project[1], categorised the response of corals to stress and modelled the larval connectivity to investigate the potential of reserve networks to aid adaptation. It used data from the 1998 bleaching event in the Bahamas to investigate the best location of reserve networks.

Reefs were classified according to their level of acute stress (as measured by the number of weeks when the temperature was 1º C above the normal temperature) and their level of chronic stress (as measured by the maximum monthly mean temperature of all the years when stress was not acute). Acute stress was highest in central Bahamas and chronic stress was highest to the west near the Gulf Stream. As would be expected, acute stress had a greater negative impact than chronic stress. The study then modelled possible larval dispersion, the results of which indicated that scales of dispersion are large enough to connect reefs into plausible reserve networks. Some connections were more feasible than others and the study estimated that optimizing reserve design to network those more feasible areas could produce a six-fold increase in the level of larval dispersal.

In order to further examine the optimal design of reserve networks, the study considered three scenarios: 1.) corals continue to respond to stress as they are now, 2.) coral genetically adapts and 3.) coral locally acclimatises to rising sea temperatures with minor physical changes (phenotypic). With further modelling the study indicated that, if genetic adaptation occurred, reserve design would have to maximise connectivity and larval dispersion so the "new" type of coral could spread. If phenotypic adaptation occurred, connectivity was not so important and the optimal reserve design would be one that protected areas that had been least affected by stress as these would be the healthiest reefs. Nevertheless a small proportion of sites (15 per cent) were selected as suitable to be reserves under all scenarios, which are likely to be those that both increase connectivity between reefs and protect those reefs that are least affected by stress. This indicated that this 15 per cent should be prioritised as reserves,

The researchers pointed out the study did not provide a complete understanding of the response of corals, but its intention was to provide an initial framework for this area to be developed as new results emerge. The analysis also needs to be widened to consider the ecosystem as a whole and possible socio-economic constraints of creating reserves.

1. FORCE (Future of Reefs in a Changing Environment) was supported by the European Commission under the Seventh Framework Programme. See: www.force-project.eu

Source: Mumby, P.J., Elliott, I.A., Eakin, C.M. *et al.* (2011) Reserve design for uncertain responses of coral reefs to climate change. *Ecology Letters*. 14:132-140.

Contact: p.j.mumby@uq.edu.au

Theme(s): Marine ecosystems