Ancient reefs preserved tropical marine biodiversity

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Habitat refugia in which coral reefs have remained stable over time played a key role in preserving tropical marine fish biodiversity, a study highlights. Researchers at the Laboratoire Ecologie des Systèmes Marins Côtiers have shown that the current distribution of tropical marine biodiversity is mainly due to the persistence of such refugia during glacial periods in the Quaternary. This imprint left by history thus has a greater impact on tropical fish biodiversity than contemporary environmental factors such as water temperature and reef area. The study, carried out in collaboration with several international teams, demonstrates the need to protect certain irreplaceable habitats that allow

species to persist during periods of climate change. It is published in the journal *Science* dated 30 May 2014.

Scientists have long been intrigued by the marine biodiversity peak located around Indonesia and the Philippines, in the so-called Coral Triangle, which hosts approximately three thousand coral reef fish species, i.e. ten times more than in the eastern Pacific and Atlantic at the same latitude and in similar habitats. This biodiversity gradient is still poorly understood. Although many hypotheses have been put forward, most of them focus on the impact of current variables such as reef area and water temperature.

Coral reef habitats develop under highly specific temperature and light conditions. On the basis of reconstructed Quaternary sea temperatures, the authors of the study were able to map the reefs and observe their evolution over 2.6 million years. By comparing the contemporary global distribution of tropical marine fish with that of the paleo-reefs, the researchers were for the first time able to test the key role of habitats that persisted over many glacial periods and thus served as biodiversity refugia.

The researchers showed that the degree of isolation of contemporary reefs from Quaternary refugia is the most significant factor explaining the distribution of tropical marine fish observed today. The closer a reef is to one of these regions that are stable over time, the greater its biodiversity today. These findings point to the persistence of species in these regions, massive extinction rates outside them, and the ability of habitat refugia to act as sources for the colonization of new coral reefs that appeared in warmer periods.

If fish did leave refugia to occupy new regions, contemporary biodiversity should also depend on the recolonization ability of each species. To test this hypothesis, the researchers investigated three

families of fish that are characteristic of coral reef habitats and have different dispersal capacities. Damselfish are less effective colonizers than butterflyfish and wrasse. As a result, with increasing distance from refugia, species diversity in damselfish falls significantly faster than for the other two families. The very old history of reefs therefore has a crucial effect not only on contemporary biodiversity distribution but also on the species and phylogenetic lineage composition of tropical fish communities.

By studying the ages of the various species in these three families of fish , the researchers also observed that both the oldest species and the most recent ones occur only in coral habitats near refugia. These reefs that have persisted over time have thus played a dual role as museum and cradle: they have preserved old species and led to the emergence of new ones (speciation). Quaternary climate fluctuations have therefore left a lasting imprint on the global distribution of coral reef biodiversity. This message from the past highlights the need to protect habitat refugia, since it is these stable regions, associated with corridors favorable to recolonization, that ensure the large-scale preservation of biodiversity. In today's context of global change leading to extreme climate events impacting habitats, this message is more important than ever.

More information: "Quaternary coral reef refugia preserved fish diversity," L. Pellissier, F. Leprieur, V. Parravicini, P.F. Cowman, M. Kulbicki, G. Litsios, S.M. Olsen, M.S. Wisz, D.R. Bellwood & D. Mouillot, *Science*, 30 May 2014. DOI: 10.1156/science.1249853

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