Coral fish biodiversity loss: Humankind could be responsible

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An international study, conducted by researchers from IRD's Indo-Pacific Coral Ecosystem Biocomplexity Laboratory and the CNRS/Ifremer/IRD/Montpellier Universities 1 and 2 Coastal Marine System Ecology Laboratory in partnership with the Australian Centre of Excellence for Coral Reef Studies and the Secretariat of the Pacific Community in Noumea, New Caledonia has for the first time revealed the effects of human activity on all facets of South Pacific coral reef fish community diversity. Scientists have shown that human population density has a more marked impact on the phylogenetic and functional diversity of species than it does on species richness. As well as causing species loss, man has thus considerably reduced the diversity of functions performed by fish communities and diminished the wealth of their evolutionary history. The results, emphasising man's impact on the tree of life, have been published in the 20 February 2014 edition of **Current Biology**.

Endangered ecosystems

Literal biodiversity reservoirs, coral reefs and associated ecosystems are in grave danger from natural and man-made disturbances. The latest World Resources Institute assessment is alarming with 75% of coral reefs reported as endangered worldwide, a figure that may reach 100% by 2050. The numbers are concerning, particularly as coral reefs provide sustenance and economic benefits for many developing countries and fish biodiversity on coral reefs partly determines the biomass available for human consumption.

A multi-facetted biodiversity

While phylogenetic diversity in communities is acknowledged for its vital heritage value, illustrating, as it does, a "part" of the tree of life, ecosystem functional diversity has long been overlooked in impact studies. An ecosystem's richness is also measured both in taxonomic biodiversity terms (number of different species) as well as by the number of lineages or functions performed by many ecosystem goods and services.[2]

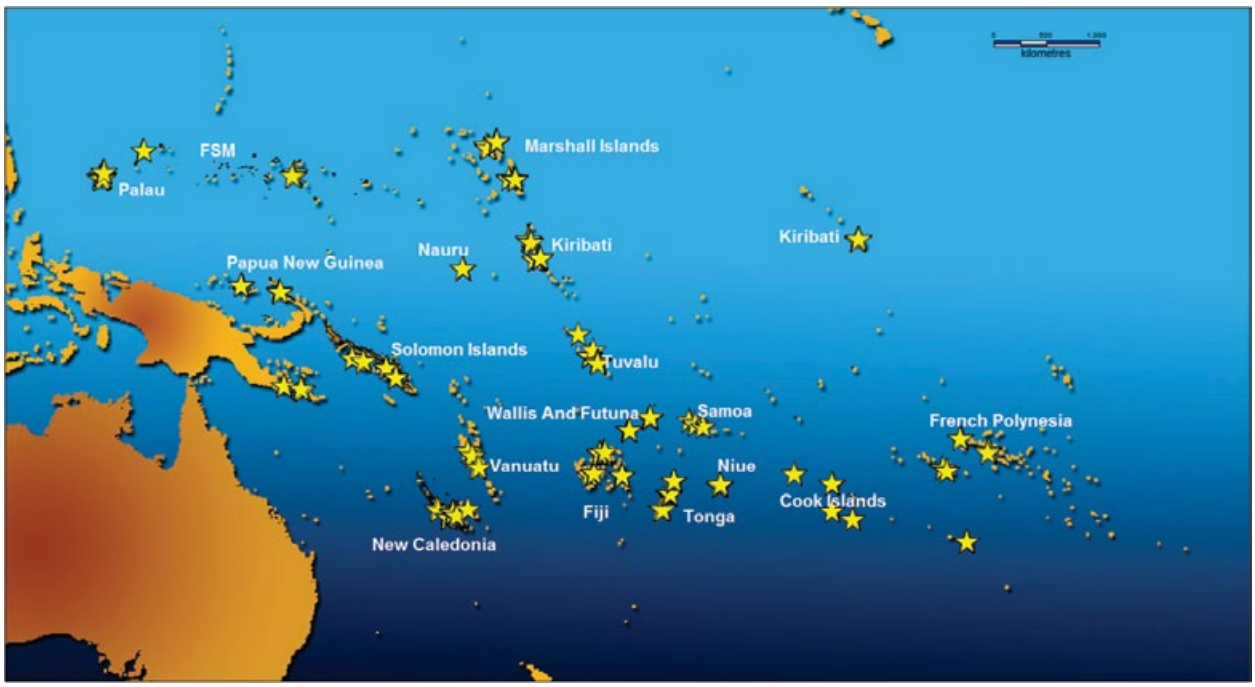

Figure 1. Locations of available data in the PROCFish and CoFish projects. © IRD/ L. Vigliola.

[1] D'agata S., Mouillot D., Kulbicki M., Andrefouët S., Bellwood D.R., Cinner J.E., Cowman P., Kronen M., Pinca S., Vigliola L. 2014. Human-mediated loss of phylogenetic and functional diversity in coral reef fishes. Current Biology, 2014. http://dx.doi.org/10.1016/j.cub.2014.01.049.

[2] Some reef fish species play key roles in ecosystem functions: regulating competition between algae and coral colonies; and creating areas that are conducive to recruiting coral larvae by bio-erosion, etc.

There have not as yet been any studies into the impact of human activity on coral fish community taxonomic, functional and phylogenetic taxonomic diversity loss.

Functional and phylogenetic diversity loss revealed

After sampling 1,553 fish communities through underwater surveys in 17 Pacific countries (see Fig. 1), researchers assessed the taxonomic, functional and phylogenetic diversity levels of a group of species fished along a human density gradient ranging from 1.3 to 1,705 people per square kilometre of reef.

Definitions:

Phylogenetic diversity:
range of genes and lineages among species.

Functional diversity:
value and range of functions performed by species.

The social and environmental data were collected under the PROCFish and CoFish projects co-ordinated by the Secretariat of the Pacific Community and funded by the European Union.

The results showed a sharp drop in functional and phylogenetic diversity levels, particularly above 20 peopleper square kilometre of reef, while species richness was barely affected along the gradient (Fig. 2).

When human population density reached 1,700 people per square kilometre of reef, the impact on functional and phylogenetic diversity levels (-46% and -36%, respectively) was greater than on species richness (-12%).

A tree of life that needs protecting

The research shows that species numbers are a poor indicator of anthropogenic pressure, while two other biodiversity components are far more heavily affected by human density. These components make up the tree of life (i.e. the diversity of biological traits and phylogenetic lineages that are essential for coral systems to function).

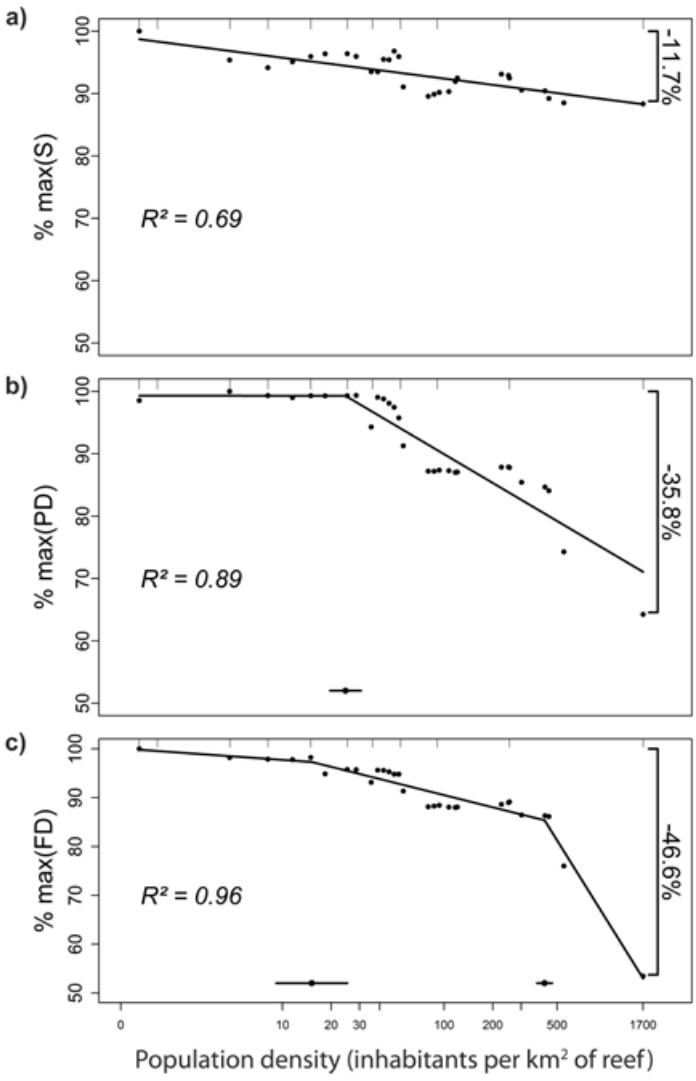

Figure 2. Effect of human density on three coral fish biodiversity components: species numbers (top), phylogenetic diversity (middle), functional diversity (bottom). © D'agata et al.

The researchers emphasised how important it was to conserve all the components of biodiversity. They also recommended using trait and lineage diversity as reliable and sensitive indicators of damage to species communities.

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The number of active tuna fisheries observers in the Pacific islands region has been well over 400 per year since 2010, and keeps increasing (see article on p. 3). This is a direct consequence of the Western and Central Pacific Fisheries Commission's Conservation and Management Measure 2008–01, which prescribes 100% observer coverage of purse-seine vessels operating in the region. For an outside viewer it seems that all that needs to be done to achieve this goal is to hire people with a basic knowledge of what a fish looks like and send them on fishing cruises to record what they see. Piece of cake, right?

Not surprisingly, reality is quite different. A basic knowledge of what a fish looks like is clearly not enough when you need to identify dozens of different species, some of them looking very similar, and a fishing cruise is often anything but a cruise: it can be several weeks long in harsh and uncomfortable conditions among crew members who are not necessarily happy to be observed and may not speak the same language as the observer. Furthermore, accurate data is the cornerstone of good fisheries management, so the quality of the data provided by these observers, who are totally independent from the fishing companies, is essential for verifying the quality and accuracy of the data provided by the companies themselves.

Select the right people, train them to become qualified observers, verify the quality of the data they have collected at sea, organise the work of observers at the national and regional level — for all of these activities there is a need for qualified people. And this scale of qualifications has drawn a new career path (Observer–Debriefer–Trainer–National/Regional Coordinator) for young Pacific Islanders — an opportunity several of them have already firmly seized.

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Observer training session on a purse-seine vessel bridge in the Marshall Islands (image: Peter Sharples).

Secretariat of the Pacific Community

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