Population genetics of sandfish (*Holothuria scabra*) in Fiji: Implications for resource management and aquaculture development

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Tropical sea cucumbers are mostly exported to Asian markets, where they are considered a delicacy and have the reputation of providing medicinal and nutritional benefits. Intense harvesting of high- and medium-value sea cucumber species has had a great impact on wild stocks. Putting in place and enforcing effective management measures for sea cucumber fisheries has become an urgent necessity.

In Fiji, sandfish (*Holothuria scabra*) is the highest value species among the 28 reported commercial species found. But, overharvesting led authorities to declare an export ban for this species in 1988, a ban that is still in place. However, between leniency in the regulations and seasonal openings, the species continues to be exported with ease at a price of USD 115–1,668 per kilogram for dried and processed product (beche-de-mer).

Research project

In conservation science, maintaining biological diversity at a level of genes, individuals, populations and species through viable breeding populations or metapopulations is a challenge. An important feature of the metapopulation theory is that although connected by gene flow, demes are dominated by local adaptation, extinction and colonisation dynamics. In the sea, populations are assumed to be genetically open systems with high levels of gene flow and limited potential for local adaptation. In marine invertebrates, species with a high larval dispersal potential, the association between gene flow and ocean currents is particularly important for species conservation and management issues.

Habitat discontinuities in Fiji, such as deep water trenches and isolated islands and ecosystems, are ideal for testing theories of biodiversity and conservation.

Sandfish, one of the highest value tropical sea cucumber species (image: Roveena Chand).

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Three different colour morphs of sandfish specimens collected in Fiji waters (image: Roveen Chand).

Distances between islands, the presence or absence of reefs and lagoons, and urban development often restrict the movements of terrestrial and marine organisms, which may result in reduced gene flow among individual populations. Through conservation genetics, our research project attempts to determine if geographically isolated demes of *H. scabra* from various islands in Fiji are genetically different, because of a limited gene flow, and whether populations share a common genetic structure imprinted in the early years of their life cycle supporting a metapopulation dynamics model throughout its geographic range.

Method

The research funded by the Australian Centre for International Agricultural Research is currently being conducted at the University of the South Pacific, Faculty of Science Technology and Environment (FSTE), School of Marine Studies. For the study, 10 individuals of *H. scabra* will be collected at eight different sites in Fiji. The samples will be transported to the FSTE laboratory for DNA extractions. Using standard DNA extraction protocols and polymerase chain reaction (PCR) amplification, samples will be prepared accordingly and sent abroad to a commercial laboratory for DNA sequencing. Sequences received will be analysed using genetic based software programs such as Arlequin and Geneclass.

Expected outcome

The major outcome of the current research will be to evaluate whether ocean currents and distances between islands in Fiji affect *H. scabra*'s gene flow, and its population genetic diversity, structure and effective size. The study will report on whether captive breeding of individual sandfish from two selected sites for the purpose of restocking depleted stocks in the wild is safe genetically at a species level. The results will identify genetic diversity of *H. scabra* in Fiji and assess the probable consequences of overharvesting in terms of *H. scabra* vulnerability to allele effects.

The need for conservation of dwindling populations of *H. scabra* was highlighted in Fiji by the 1998 fishing ban, which is still in place but only partially enforced. The current study may provide the supporting evidence, at a genetic level, that strict and well-enforced conservation measures are urgently needed not only for the *H. scabra* fishery, but also for the survival of the species itself in Fijian waters. It will also be the first time in Fiji that genetics are used to support the management of a marine species.