Integrative taxonomy of tectractinellid sponges

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Project
» Testing the most striking tropical marine biodiversity gradient on the planet: does it hold for sponges? (Cryptobentic Sponge Gradients)

Program
» Indo-Pac Research Coordination Network (Indo-Pac RCN)

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Testing the most striking tropical marine biodiversity gradient on the planet: does it hold for sponges? (Cryptobentic Sponge Gradients)

Coverage: Indo-Pacific

NSF Award Abstract:
Coral reefs are among the most species-rich ecosystems on the planet, occupying only about 1% of the seafloor, but housing more than a quarter of known marine biodiversity. Sometimes called the rainforests of the sea, coral reefs have great intrinsic biological, cultural and economic value. Nearly a billion people across the planet rely on coral reef ecosystems as a significant source of their diet, and the annual economic benefits of coral reefs are estimated to be around $9.9 Trillion USD. Thus, the global decline of coral reefs by an estimated 30-50% since the 1980s is of considerable concern as scientists struggle to understand whether species are being lost before they are even discovered. While coral reefs are spectacularly diverse, the majority of this biodiversity actually lives hidden deep within the three-dimensional framework of the reef itself. This hidden (or cryptic) community of organisms are both dramatically understudied and fundamentally important for the persistence of coral reefs. Sponges are a dominant group among these cryptic organisms within the reef which provide food from the bottom of the food chain and help sustain coral reef biodiversity. Despite the vital ecological role of sponges on coral reefs, little is known about their diversity, abundance or species ranges across the Indo-Pacific. For example, the most striking marine biodiversity gradient on the planet is described from several of the visibly dominant groups on coral reefs, including corals and reef fishes. From the global hotspot of species richness in the Indo-Pacific Coral Triangle there is a sharp eastward decline in species numbers to more remote oceanic islands in the Central Pacific, such as the Hawaiian Archipelago. However, no survey to date has evaluated whether the diversity of poorly known cryptic coral reef species, such as sponges, show the same pattern as the visible species that dominate the surface of the reef. Summer training modules introduce at-risk Pacific Islander youth to coral reef biodiversity to recruit and train a new generation of sponge taxonomists. Identification guides are being produced to help resource managers in establishing a

baseline of sponge diversity, which allows resource managers to identify and protect native species, improves detection of alien species introductions and serves as a tool for monitoring changes in the ecosystem in response to human impacts. The work is being disseminated widely through scientific literature, public and professional presentations, popular press articles, and an educational display about sponges and coral reef biology in collaboration with the Waikīkī Aquarium.

This important knowledge gap is addressed by analyzing an existing backlog of standardized sampling devices (ARMS) collected from throughout the Pacific Ocean to determine whether sponges that live largely unseen within the reef framework follow the same diversity gradient as has been previously reported for fish and corals. By integrating taxonomy with multi-locus DNA barcoding and metabarcoding, this project is documenting species richness and biodiversity patterns among the cryptic sponge community across five ecoregions spanning over 10,000 km of the tropical Pacific. These collections include many new species and are providing vouchered DNA barcodes to existing reference databases that currently include fewer than 1% of sponge species across the planet. Sponges are a rich source for pharmaceutical development, so discovery of new species also provides opportunity for exploration of natural products from both the sponges and culturable microbes associated with them. By examining sponge species occurrence and diversity along both environmental and anthropogenic gradients in each ecoregion, the data also address whether coral reef sponges can serve as indicators of human impacts. Collectively, these results are transforming our knowledge of tropical Pacific sponge biodiversity, species ranges, and providing much-needed reference barcodes to global sequence databases. By determining whether sponges show the same Indo-Pacific richness gradient as reported in fishes and corals, this project is testing how well generalizations made from the visible subset of species that live on the surface of coral reefs apply to rest of coral reef biodiversity. This study is greatly advancing our knowledge of Pacific coral reef sponges and will ultimately inform the scale over which vital ecological roles performed by this understudied taxon, such as the production of nutrients at the bottom of the food chain, are acting across the Pacific.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Program Information

Indo-Pac Research Coordination Network (Indo-Pac RCN)

Website: https://indopacificnetwork.wikispaces.com/

Description from NSF award abstract:
The objective of this Research Coordination Network project is to develop an international network of researchers who use genetic methodologies to study the ecology and evolution of marine organisms in the Indo-Pacific to share data, ideas and methods. The tropical Indian and Pacific Oceans encompass the largest biogeographic region on the planet, the Indo-Pacific. It spans over half of the Earth's circumference and includes the exclusive economic zones of over 50 nations and territories. The Indo-Pacific is also home to our world's most diverse marine environments. The enormity and diversity of the Indo-Pacific poses tremendous logistical, political and financial obstacles to individual researchers and laboratories attempting to study the marine biology of the region. Genetic methods can provide invaluable information for our understanding of processes ranging from individual dispersal to the composition and assembly of entire marine communities.

The project will:
(1) assemble a unique, open access database of population genetic data and associated metadata that is compatible with the developing genomic and biological diversity standards for data archiving,
(2) facilitate open communication and collaboration among researchers from across the region through international workshops, virtual communication and a collaborative website,
(3) promote training in the use of genetic methodologies in ecology and evolution for researchers from developing countries through these same venues, and
(4) use the assembled database to address fundamental questions about the evolution of species and the reservoirs of genetic diversity in the Indo-Pacific.

The network will provide a model for international collaborative networks and genetic databasing in biodiversity

research that extends beyond the results of this Research Coordination Network effort.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2048457

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