Sacoleve - Spatial And Temporal Adaptation Of A Traditional Mediterranean Fishery Facing Regional Change: Combining History And Ecology To Study Past, Present And Future Of Sponge Harvesting

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The production of Mediterranean bath sponges collapsed during the past century as it is shown by Tunisian catches which fell from 108 tons in 1920 down to 9 tons in 1988. Another example is given by the well-known sponge fishing island of Kalymnos which lost about 90% of its active fishermen population in a century between 1858 and 1967. For what reasons a Mediterranean traditional fishery once prosperous has dramatically declined? What part of the decline can be attributed to the lessening of the bath sponge stock and what to a decreasing number of fishermen? How can this sponge fishery collapse be related to changes in uses, overfishing, disease outbreaks triggered by climate events? How did sponge fishermen adapt to Regional Changes in the past? What is the future of such a fishery? What kind of guidelines can we provide for this fishery facing the on-going Regional Change? To answer these questions, SACOLEVE looks through ecological and historical windows into past evolution of the sponge fishery, chosen here as a model of traditional fishery which suffered good number of upheavals over the last three centuries. The overreaching aim of this program is to propose a management strategy for traditional fisheries that will allow attaining eco- durable practices in the current environmental, socio-economic and geopolitical contexts.

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Effects of temperature stress on survival, pigmentation and regeneration of three Caribbean sponges

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One threat of climate change to coral reefs is the increase of ocean temperatures, which can produce coral bleaching and mortality. While coral abundances have declined, marine sponges have become abundant and are becoming increasingly important habitat-forming animals on Caribbean coral reefs. This study evaluated if anomalous water temperatures affect the survival, pigmentation and regeneration of three common Caribbean sponges. Fragments of sponges (*Aplysina cauliformis*, *Cliona delitrix* and *Desmapsama anchorata*) were collected from a reef in St. Thomas, U.S. Virgin Islands, and placed at two experimental temperatures for seven days. For control tanks, temperature was maintained at a constant similar to that of local reef conditions (27.0±0.32°C), whereas for the stress tanks two peaks of high (31.1±0.58°C) and low (26.5±0.21°C) temperatures were simulated. Our results showed that under temperature stress *D. anchorata* had higher levels

of mortality and changes in pigmentation when compared to *A. cauliformis* and *C. delitrix*. However, a disease affected more fragments of *A. cauliformis* and *C. delitrix* under stress temperature. Tissue regeneration occurred for all three species under both treatments. This experimental study shows that temperature affects sponge species differently, and suggests that *C. delitrix* and *A. cauliformis* fragments better tolerate short fluctuations in seawater temperature than *D. anchorata*.

Geographic Variability in Antibacterial Chemical Defenses Among Branching Morphotypes of Caribbean *Aplysina*

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Sponges are susceptible to a diversity of abiotic and biotic stressors that may affect their ability to perform essential metabolic functions. Among these, the production of chemical defenses may be particularly affected. Chemical defenses provide protection against pathogens, predators and competitors, and qualitative or quantitative changes in the production of the secondary metabolites associated with these defenses may dramatically affect their efficacy and thus, the sponge's survival. Branching sponges of the genus *Aplysina* are among the most abundant sponges on Caribbean reefs, where they are susceptible to *Aplysina* Red Band Syndrome, a disease that differs in prevalence among *Aplysina* morphotypes and geographic locations, suggesting variability in resistance. This study assessed the chemical variability among healthy individuals of three distinct sponge morphotypes (*"Aplysina fulva", "Aplysina cauliformis"* thick, *"Aplysina cauliformis"* thin) across geographic regions in the Caribbean, including pristine sites in the Bahamas and four sites in St. Thomas that vary in their relative exposure to human impacts. Distinct chemical profiles were observed among the three morphotypes. Within morphotypes, there was overlap in chemical profiles of sponges from the Bahamas and St. Thomas, but there were significant differences among sites within St. Thomas, indicating finer-scale geographic variability in secondary metabolite production. Site-specific differences in chemical profiles varied among the three morphotypes. To determine whether morphotype- or site-specific variability in chemical profiles was associated with variability in antibacterial activity, extracts were tested against a panel of marine and human pathogens. The extracts showed selective activity against the test strains, resulting in variability among morphotypes, sites and bacterial strains. Differences in chemical profiles were associated with variability in antimicrobial activity, which may play a role in protection from disease. This study identified clear chemotaxonomic differences associated with branching morphotypes of *Aplysina* in the Caribbean, and supports the contention that anthropogenic stressors affect the production of chemical defenses by sponges. Although *Aplysina*- specific pathogens were not tested, this study identifies potential sources of variability in disease prevalence among sponge populations.

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Assessing the regional conservation status of sponges: the case of the Aegean ecoregion

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Despite their key role in marine ecosystems, sponges are among the less studied animal groups concerning their extinction risk and conservation status. This is because of the scarce and scattered information on their species populations and their distribution, which inhibits the application of IUCN criteria. Herein, an at-

tempt is made to provide a baseline for evaluating the regional conservation status of sponges in the Aegean ecoregion (eastern Mediterranean), one of the best studied for its sponge fauna in the Mediterranean. For this purpose, we compiled detailed distribution maps for 22 sponge species falling in three categories: i) species included in the list of endangered and threatened species (Annex II) of the Barcelona Convention, ii) species endemic in this ecoregion and iii) harvested bath sponge species. Different sources for potential data on the population trends of these species through time were examined. As a result, a total of 1551 species occurrences were collected, including unpublished observations made by the authors within the last decade (48%), data from scientific literature sources (43%), citizen science records (7%) and web sources (2%).

The most numerous occurrence data were available for the demosponge species *Sarcotragus foetidus* (436), *Aplysina aerophoba* (431) and *Axinella cannabina* (213), which are protected under the Barcelona Convention. All other species had less than 100 occurrence records with 10 endemic and rare species presenting less than 10 records. The assessment of the regional conservation status of the examined sponge species according to the IUCN Red List criteria, gave the following results: i) 10 of the examined species were assigned to the 'Least Concern (LC)' category under the broad geographical range criterion; ii) the limited information on the 8 endemic/rare species indicated their assessment status as 'Data Deficient (DD)'; iii) the 4 harvested bath sponge species were evaluated as belonging to the Threatened Category of the IUCN Red List, having suffered a massive population decline according to historical data on sponge fisheries. The present evaluation, besides providing scientific data for the regional protection and management of sponge populations, can form a basis for a wider assessment towards the conservation of Porifera.

Spatial variation in chemistry and microbial diversity of Philippine blue sponge, *Xestospongia* sp. in relation to some ecological factors

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Recent studies in the Philippines focus on the potential role of sponge-associated microorganism on sponge chemistry. Yet, few studies of sponge holobiont at ecosystems level given that ecological processes may play an important role on shaping sponge microbial communities and the secondary metabolites it produces. In this study, the renieramycin-producing Philippine blue sponge, *Xestospongia* sp were used to investigate the extent of variation in sponge-associated microbial community; its secondary metabolite production in relation to some biological and environmental factors. Biological samples were collected using SCUBA, and were transported to the laboratory for morphological and molecular (CO1 sequence) identification, chemical analysis and endosymbiotic community profiling. The diversity of microbial symbionts in the blue sponge *Xestospongia* sp. were initially investigated using a 16s rRNA gene-targeted metagenomic approach. Ecological surveys were performed on two collection sites, representing two Philippine marine biogeographic regions – in Oriental Mindoro located on the West Philippine Sea (WPS) and in Zamboanga del Sur located at Celebes Sea (CS).

Ethyl acetate extracts were subjected to thin layer chromatography (TLC), high performance liquid chromatography (HPLC) and MTT-based antiproliferative assay to confirm the presence of renieramycin M. Chemical profiling using HPLC was performed to compare renieramycin M content among samples obtained from different biogeographic regions. The blue sponges were found to be more abundant on the WPS than in CS sites. Both the benthic community and the fish community in Oriental Mindoro, WPS and Zamboanga del Sur, CS sites are characterized by high species diversity and abundance and very high biomass category. Environmental factors like depth and monsoonal exposure were also compared showing that wave exposure and depth are associated with the abundance and distribution of the sponges. Initial results showed a high microbial diversity and that significant numbers of taxa are considered to be unidentified. TLC and HPLC profiles of the extracts from WPS and from CS showed differences in the amount of Renieramycin M present. Differences

in the chemical components present in the extracts obtained from WPS and CS were also observed. Results in exploring the influence of ecological parameters on microbial and chemical diversity provide further impetus in pursuing studies into patterns and processes of the chemical diversity of the Philippine blue sponge, *Xestospongia* sp. and the chemical ecological significance of the coral triangle.

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Sponges in Space: Spiculous skeleton formation in *Ephydatia fluviatilis* under hypergravity conditions

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Successful dispersal of freshwater sponges depends on the formation of degenerative sponge bodies (gemmules) in adverse conditions. This allows the sponge to overcome critical environmental conditions, for example during wintertime, and to re-establish an active sponge when conditions are more favourable in spring. A key step in the construction of a fully-developed sponge from a gemmule is the formation of the spiculous skeleton[1]. Silica spicules form the structural support for the three-dimensional filtration system the sponge uses to filter food particles from ambient water. We studied spiculous skeleton formation of both fed (i.e. providing additional ^{13}C- and ^{15}N-labeled amino acids) and non-fed developing *Ephydatia fluviatilis* exposed to environmental stress, using different hypergravity forces (1, 2.5, 5, 10, and 20 *g* for 48 h) as stressor. Results show that freshwater sponges can withstand these prolonged periods of hypergravity and successfully construct their skeleton, even up to 20 *g*. Developing sponges take up and assimilate dissolved food before forming a functional filtering system, but the gemmule's intrinsic is responsible for skeleton construction. Additionally, non-fed sponges formed active filtration systems significantly more often than fed sponges, especially under higher *g*-force, suggesting that the formation of an active filtration system might be stimulated by food deprivation in environmentally stressful conditions. These findings indicate that the process of spiculous skeleton formation is very energy-efficient and highly flexible, and demonstrate that it plays an important role in how sponges can adapt their size and shape required for indeterminate growth and successful dispersal.

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Past and present scenario of the Western Atlantic sponge *Clathrina aurea* (Porifera, Calcarea)

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Sponges are known for their low dispersal capability and population studies have shown high levels of genetic