Secondary metabolite profiles from study of sponge disease transmission in the Exuma Cays, Bahamas from 2009-2014 (Sponge Disease Model project)

Website: https://www.bco-dmo.org/dataset/641052
Data Type: experimental, Other Field Results
Version: 17 March 2016
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Project
» Developing a model for transmission of an infectious disease of marine sponges (Sponge Disease Model)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **Lat**:23.7898 **Lon**:-76.13788

Dataset Description

Secondary metabolite profiles from study of sponge disease transmission. Temporal changes in biochemical, physiological and microbiological associations in the *Aplysina cauliformis* holobiont over the course of transmission of *Aplysina* Red Band Disease (ARBS) were investigated in two experiments, one performed in July and one performed in January

Related datasets:
Sponge Disease Transmission - Chl-a Sponge Disease Transmission - HSP70 Sponge Disease Transmission - Total Protein Sponge Disease Transmission - T-REX

Methods & Sampling

Temporal changes in biochemical, physiological and microbiological associations in the *Aplysina cauliformis*

holobiont over the course of transmission of *Aplysina* Red Band Disease (ARBS) were investigated in two experiments, one performed in July and one performed in January. In both experiments, healthy and ARBS-affected sponges (n = 21-24 of each) were marked *in situ* at North Norman's reef in the Exuma Cays, Bahamas. Healthy sponges were collected, labeled and a subsample (10 cm) was removed into an individual resealable plastic bag underwater to serve as an "initial" sample. The remainder of each of these healthy sponges was randomly attached to either a healthy *in situ* sample or to the active red band on a diseased *in situ* sample using a cable tie. In July, randomly selected pairs of healthy-healthy and healthy-diseased sponges were collected on days 3, 6 and 9 to provide "final" samples. In January, randomly selected pairs of each type were collected on days 1, 3 and 9. Following final collection, all pairs were separated in the lab, and photographs were taken to confirm whether ARBS transmission had occurred.

Following collection of initial and final samples, the sponges were subsampled for several analyses. Only sections of healthy tissue were used, even from the ARBS-affected sponges (Gochfeld et al. 2012, Marine Ecology Progress Series; Gochfeld et al. 2012, Journal of Chemical Ecology; Olson et al. 2014). Subsamples were collected for measurement of chlorophyll a, total protein, secondary metabolite profiles, and microbial community analysis. In addition, in January, subsamples were also collected for heat shock protein 70 expression analysis.

Analytical methods followed those of Gochfeld et al. (2012, Marine Ecology Progress Series) for chlorophyll *a* and total protein, and Olson et al. (2014) for microbial community assemblages. Secondary metabolite profiles used similar methods to those described in Gochfeld et al. (2012, Journal of Chemical Ecology) except that the samples were extracted three times in methanol prior to generating chemical profiles using HPLC. Areas under the curve for peaks that were consistently found in either *in situ* healthy and/or *in situ* diseased sponges were quantified. Heat shock protein 70 expression analysis was performed following methods in Sarkis et al. (2005).

Data Processing Description

Chlorophyll-a and protein concentrations, areas under the curve of secondary metabolite peaks, and HSP70 band intensity from healthy sponges attached to either healthy or diseased *in situ* sponges were compared using repeated measures ANCOVA, with time (initial vs. final) and treatment (attached to a healthy or diseased sponge) as the main factors, and the number of days of attachment (3, 6, 9 in July; 1, 3, 9 in January) as the covariate. For the *in situ* sponges from which only final samples were collected, parameters were compared using a one-way ANCOVA with treatment (initially healthy or diseased) as the main factor and day collected (equivalent to number of days of attachment: 3, 6, 9 in July; 1, 3, 9 in January) as the covariate. Microbial community assemblage data were analyzed using T-REX and PRIMER, as described in Olson et al. (2014).

BCO-DMO Processing:
- Reorganized data into one table (rather than 2);
- Added "sample_type" column;
- Added location information provided on metadata form, converted lat/lon to decimal degrees;
- 2018-Nov-15: removed embargo on dataset.

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Data Files

File	
sponge_disease_secmetab.csv	(Comma Separated Values (.csv), 19.23 KB) MD5:423755c1852fb8300c314174095e8b2a
Primary data file for dataset ID 641052	

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Related Publications

A SIMPLE TRANSPORT PROCEDURE FOR JUVENILE CALICO SCALLOPS, ARGOPECTEN GIBBUS (LINNAEUS, 1758). (2005). Journal of Shellfish Research, 24(2), 377–380. doi:10.2983/0730-

8000(2005)24[377:astpfj]2.0.co;2 https://doi.org/10.2983/0730-8000(2005)24[377:ASTPFJ]2.0.CO;2
Methods

Gochfeld, D. J., Kamel, H. N., Olson, J. B., & Thacker, R. W. (2012). Trade-Offs in Defensive Metabolite Production But Not Ecological Function in Healthy and Diseased Sponges. Journal of Chemical Ecology, 38(5), 451–462. doi:10.1007/s10886-012-0099-5
Methods

Gochfeld, D., Easson, C., Freeman, C., Thacker, R., & Olson, J. (2012). Disease and nutrient enrichment as potential stressors on the Caribbean sponge Aplysina cauliformis and its bacterial symbionts. Marine Ecology Progress Series, 456, 101–111. doi:10.3354/meps09716
Methods

Olson, J. B., Thacker, R. W., & Gochfeld, D. J. (2013). Molecular community profiling reveals impacts of time, space, and disease status on the bacterial community associated with the Caribbean spongeAplysina cauliformis. FEMS Microbiology Ecology, 87(1), 268–279. doi:10.1111/1574-6941.12222
Methods

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Parameters

Parameter	Description	Units
month	Month when experiment was conducted.	dimensionless
location	Location where experiment was conducted.	dimensionless
lat	Latitude of experiment location.	decimal degrees
lon	Longitude of experiment location.	decimal degrees
sample_type	Description of experiment/sample type: attached sponges or in-situ.	dimensionless
treatment	Treatment type. For attached sponges: 1=attached to healthy; 2=attached to diseased. For in-situ sponges: 1=healthy; 2=diseased.	coded/dimensionless
sponge	Sponge identifier.	dimensionless
day_final_collected	Final collection day. 1=final collected on day 1; 3=final collected on day 3; 6=final collected on day 6; 9=final collected on day 9.	coded/dimensionless
initial_peak_1	Initial peak 1. rt=12.7 min.	area under the curve ("absorbance units")
final_peak_1	Final peak 1. rt=12.7 min.	area under the curve ("absorbance units")
initial_peak_2	Initial peak 2. rt=14.3 min.	area under the curve ("absorbance units")

final_peak_2	Final peak 2. rt=14.3 min.	area under the curve ("absorbance units")
initial_peak_3	Initial peak 3. rt=15.5 min.	area under the curve ("absorbance units")
final_peak_3	Final peak 3. rt=15.5 min.	area under the curve ("absorbance units")
initial_peak_4	Initial peak 4. rt=19.7.	area under the curve ("absorbance units")
final_peak_4	Final peak 4. rt=19.7.	area under the curve ("absorbance units")
initial_peak_5	Initial peak 5. rt=34.8 min.	area under the curve ("absorbance units")
final_peak_5	Final peak 5. rt=34.8 min.	area under the curve ("absorbance units")

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Deployments

Bahamas_Gochfeld

Website	https://www.bco-dmo.org/deployment/640645
Platform	Gochfeld_lab
Start Date	2009-05-01
End Date	2014-07-01
Description	In Bahamas, the Big Point quadrat was surveyed 8 times (May 2009, May 2010, May/July/September 2011, June 2012, August 2013, July 2014) and the Rainbow Gardens quadrat was surveyed 6 times (May 2010, July/September 2011, June 2012, August 2013, July 2014). Experiments conducted at North Norman's reef in the Exuma Cays, Bahamas involved the marking of healthy and ARBS-affected sponges (n = 21-24 of each) in situ to examine the temporal changes in biochemical, physiological and microbiological associations in the Aplysina cauliformis holobiont over the course of transmission of Aplysina Red Band Disease (ARBS).

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Project Information

Developing a model for transmission of an infectious disease of marine sponges (Sponge Disease Model)

Coverage: Exuma, Bahamas; Carrie Bow Cay, Belize; St. Thomas, USVI

Description from NSF award abstract:
Diseases of marine invertebrates have been shown to be primary causes of the accelerating destruction of Caribbean coral reef systems. Diseases affecting natural populations threaten biodiversity, resilience and the ecological balance of communities, as well as the ecosystem services they provide. To date, most studies of diseases on reefs have focused on corals, however, reports of sponge diseases have also increased across the globe. On Caribbean reefs, sponges are often a dominant component of the reef biomass,and thus play an important role in the ecology of these ecosystems. The most well described disease affecting Caribbean sponges is Aplysina Red Band Syndrome (ARBS), which affects sponges of the genus Aplysina, resulting in reduced growth, tissue necrosis and breakage at the site of the lesion, particularly during storm events. Understanding how diseases emerge and are transmitted within marine ecosystems is critical for maintaining a healthy level of biodiversity, particularly if we are to gain any predictive power in a rapidly-changing environment. Testing models of disease transmission using extensive field observations and laboratory analyses will contribute to a better understanding of disease processes and developing a transmission model for ARBS requires detailed knowledge about the pathogen-host interaction and pathogen reservoirs in the environment. While a large body of information regarding the ecology and physiology of ARBS-infected sponges is available it is recognized that modeling the transmission dynamics requires a more focused and collaborative approach. This project will develop and test a model of marine disease processes that includes the role of polymicrobial infections, sources and sinks of the pathogen(s), and the ontogeny of this disease within a model host sponge species (*Aplysina cauliformis*).

This novel approach is a high-risk venture (i.e., a timely idea lacking requisite results) with high pay-off potential (i.e., the results will fundamentally enhance our understanding of disease transmission within marine sponges). In this respect, the proposal is appropriate for EAGER funding. The principal investigators will use modern techniques such as high throughput sequencing and incorporate these approaches as a new tools in their laboratories as well as in their undergraduate and graduate courses. Graduate and undergraduate students will also be provided with multidisciplinary hands-on research experiences and will participate in sponge disease surveys to test the newly developed transmission model. Public seminars will be presented to discuss the implications of marine diseases coral reefs and to highlight the potential utility of disease models for the effective management of marine resources. Results from the proposed research will further our knowledge of disease transmission dynamics and enhance our understanding of the role of diseases in the ecology of coral reef ecosystems.

Selected publications related to this research:
Olson JB, Thacker RW, Gochfeld DJ (2014) Molecular community profiling reveals impacts of time, space, and disease status on the bacterial community associated with the Caribbean sponge *Aplysina cauliformis*. FEMS Microbiology Ecology 87:268-279. doi:10.1111/1574-6941.12222

Easson CG, Slattery M, Momm HG, Olson JB, Thacker RW, Gochfeld DJ (2013) Exploring individual- to population-level impacts of disease on coral reef sponges: using spatial analysis to assess the fate, dynamics, and transmission of *Aplysina* Red Band Syndrome (ARBS). PLoS One 8(11): e79976. doi:10.1371/journal.pone.0079976

Gochfeld DJ, Easson CG, Freeman CJ, Thacker RW, Olson JB (2012) Disease and nutrient enrichment as potential stressors on the Caribbean sponge *Aplysina cauliformis* and its bacterial symbionts. Marine Ecology Progress Series 456:101-111. doi:10.3354/meps09716

Gochfeld DJ, Kamel HN, Olson JB, Thacker RW (2012) Trade-offs in defensive metabolite production but not ecological function in healthy and diseased sponges. Journal of Chemical Ecology 38:451-462. doi:10.1007/s10886-012-0099-5

Gochfeld DJ, Schlöder C, Thacker RW (2007) Sponge Community Structure and Disease Prevalence on coral reefs in Bocas del Toro, Panama. In: Custódio MR, Lôbo-Hajdu G, Hajdu E, Muricy G (eds) *Porifera Research: Biodiversity, Innovation, and Sustainability*. Série Livros 28. Museu Nacional, Rio de Janeiro. Pp 335-343. URL: http://hdl.handle.net/10088/12017

Olson J, Gochfeld D, Slattery M (2006) *Aplysina* red band syndrome: a new threat to Caribbean sponges. Diseases of Aquatic Organisms 71:163-168. doi:10.3354/dao071163

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1214303

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