Landscape fine-scale complexity of seagrass, fish and macroinvertebrate communities within Artificial Seagrass Units (ASU) in Back Sound, NC from July to September 2018

Website: https://www.bco-dmo.org/dataset/891652
Data Type: Other Field Results
Version: 1
Version Date: 2023-03-17

Project
» Collaborative Research: Habitat fragmentation effects on fish diversity at landscape scales: experimental tests of multiple mechanisms (Habitat Fragmentation)

Contributors	Affiliation	Role
Fodrie, F. Joel	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Principal Investigator
Yeager, Lauren	University of Texas - Marine Science Institute (UTMSI)	Co-Principal Investigator
Lopazanski, Cori	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Scientist
Poray, Abigail K.	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Scientist
Yarnall, Amy	University of North Carolina at Chapel Hill (UNC-Chapel Hill-IMS)	Scientist, Contact
Heyl, Taylor	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
To parse the ecological effects of habitat area and patchiness on faunal community structure and dynamics of estuarine nekton, we employed artificial seagrass unit (ASU) landscapes at a scale relevant to habitat fidelity of common fish and macroinvertebrates (days to weeks) in this temperate study system. We designed and deployed 25 unique, 234-meter squared (m2) landscapes, composed of a total of 2059 1-meter squared ASUs. These landscapes were designed along orthogonal axes of artificial seagrass area (i.e., percent cover of each landscape = 10-60 percent) and fragmentation per se (i.e., percolation probability; 0.1-0.59) to delineate their independent and interactive effects on seagrass fish and macroinvertebrate communities. We were also interested in the relative importance of landscape parameters versus fine-scale complexity metrics (i.e., artificial seagrass canopy height, epiphyte biomass) in influencing faunal density patterns within structured seagrass. Therefore, in July and September 2018, fine-scale habitat complexity metrics, including ASU canopy height and epiphyte biomass, were sampled along a transect from the edge to the center of the largest patch in each landscape. Fine-scale complexity samples were collected by Drs. F. Joel Fodrie and Amy H. Yarnall for the Estuarine Ecology Laboratory of the University of North Carolina at Chapel Hill's Institute of Marine Sciences.

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Coverage

Spatial Extent: **N**:34.707 **E**:-76.589 **S**:34.701 **W**:-76.603
Temporal Extent: 2018-07-03 - 2018-09-03

Methods & Sampling

In order to investigate the ecological effects of habitat area and patchiness on faunal community structure and dynamics of estuarine nekton, Artificial seagrass unit (ASU) landscapes were designed and deployed at a scale relevant to habitat fidelity of common fish and macroinvertebrates (days to weeks) in a temperate study system on the Oscar Shoal and an adjacent unnamed shoal (34°42′20" N to 34°41′60" N, 76°36′ 15" W to 76°35′17" W) in Back Sound, NC, USA during the summer of 2018. Both shoals were shallow (less than 0.5-meter depth at low tide) and historically supported expansive, ephemeral seagrass meadows (Peterson et al., 2001) that have been absent over the last decade. During 2018, these shoals had large expanses of sandy area speckled with small patches of seagrass (which were avoided during landscape siting) composed of a mixture of eelgrass, *Zostera marina* (Linnaeus 1753), and shoal grass, *Halodule wrightii* (Ascherson 1868) (Yeager et al., 2016). Both shoals were adjacent to deep boating channels between two large salt marsh complexes to the north (North River Marsh) and south (Middle Marsh).

The habitat features of ASUs have the potential to be modified by sediment burial or scouring after installation. Therefore, in July and September 2018, fine-scale habitat complexity metrics, including ASU canopy height and epiphyte biomass, were sampled along a transect from the edge to the center of the largest patch in each landscape. Along each transect, five ribbon clippings were taken per ASU and an additional five clippings were taken on the edge ASU, within 0.5 meters of the ASU-matrix interface. The number of ASUs sampled per landscape [mean of 6.81 ± 3.24 SD] differed based on percent cover and configuration. Each ASU ribbon was haphazardly selected and clipped at the sediment surface, then measured to the approximate above-sediment landscape canopy height. In the lab, epiphytes were scraped off each side of the ribbon, dried for 12 hours at 60 degrees C, then burned for 4 hours at 500 degrees C to determine ash content (Peterson and Heck, 2001). Ash-free dry epiphyte biomass (hereafter "epiphyte biomass") was calculated as dry weight minus ash weight, then divided by the surface area of the ribbon to obtain standardized epiphyte biomass (milligrams per square centimeter).

Known Issues:
Instrumental error in mass measurements results in some samples having negative weights when tin weights are subtracted from the dry weight or ash weight.

Several samples were lost partway through processing. A small number of sample labels were lost therefore the site from which they came is unknown. There is one set of samples that came from site 60 percent-0.59, but it is unknown which site replicate they came from (i.e., A or B).

Data Processing Description

All data were entered electronically into an Excel spreadsheet.

BCO-DMO Processing Description:
- Added "Latitude" and "Longitude" columns and rounded to three decimal places
- Converted date columns to format: YYYY-MM-DD
- Removed "%" symbol from data cells

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Data Files

File	
asu_frag_landscape_complexity.csv	(Comma Separated Values (.csv), 139.29 KB) MD5:ef2d397bbc9525a2a7e66bbcdecab147
Primary data file for dataset 891652, version 1.	

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Related Publications

Peterson, B., & Heck, K. (2001). An experimental test of the mechanism by which suspension feeding bivalves elevate seagrass productivity. Marine Ecology Progress Series, 218, 115–125. https://doi.org/10.3354/meps218115
Methods

Peterson, B., Thompson, K., Cowan, J., & Heck, K. (2001). Comparison of predation pressure in temperate and subtropical seagrass habitats based on chronographic tethering. Marine Ecology Progress Series, 224, 77–85. https://doi.org/10.3354/meps224077
Methods

Yarnall, A. H., Yeager, L. A., Lopazanski, C., Poray, A. K., Morley, J. M., Hurlbert, A., and Fodrie, F.J. Habitat area more consistently affects seagrass faunal communities than fragmentation per se.
Results

Yeager, L. A., Keller, D. A., Burns, T. R., Pool, A. S., & Fodrie, F. J. (2016). Threshold effects of habitat fragmentation on fish diversity at landscapes scales. Ecology, 97(8), 2157–2166. doi:10.1002/ecy.1449
Methods

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Related Datasets

IsRelatedTo

Yarnall, A., Fodrie, F. J. (2024) **Data from minnow traps deployed to accompany scallop survival assays conducted as part of a larger concurrent study with Artificial Seagrass Units (ASU) in NC from July to September 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-10-11 doi:10.26008/1912/bco-dmo.939600.1 [view at BCO-DMO]
Relationship Description: Datasets collected concurrently as part of the same study in Back Sound, NC.

Yarnall, A., Fodrie, F. J. (2024) **Data from scallop survival assays conducted as part of a larger concurrent study of fragmentation effects on estuarine faunal communities with Artificial Seagrass Units (ASU) in Back Sound, NC from July to September 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-10-04 doi:10.26008/1912/bco-dmo.939581.1 [view at BCO-DMO]
Relationship Description: Datasets collected concurrently as part of the same study in Back Sound, NC.

Yarnall, A., Fodrie, F. J., Lopazanski, C., Poray, A. K., Yeager, L. (2023) **Landscape parameters of seagrass, fish and macroinvertebrate communities within Artificial Seagrass Units (ASU) in Back Sound, NC from July to September 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-27 doi:10.26008/1912/bco-dmo.891670.1 [view at BCO-DMO]
Relationship Description: Datasets collected concurrently as part of the same study in Back Sound, NC.

Yarnall, A., Fodrie, F. J., Lopazanski, C., Poray, A. K., Yeager, L. (2023) **Settlement rates of fishes and crab megalopa within Artificial Seagrass Units (ASU) in Back Sound, NC from June to August 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-20 doi:10.26008/1912/bco-dmo.891835.1 [view at BCO-DMO]

Yarnall, A., Fodrie, F. J., Lopazanski, C., Poray, A. K., Yeager, L. (2023) **Squidpop consumption probability within Artificial Seagrass Units (ASU) in Back Sound, NC from October to November 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-15 doi:10.26008/1912/bco-dmo.891794.1 [view at BCO-DMO]

Yarnall, A., Fodrie, F. J., Morley, J., Yeager, L. (2023) **Fish densities sampled by Dual Frequency Identification Sonar (DIDSON) within Artificial Seagrass Units (ASU) in Back Sound, NC from June to October 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-13 doi:10.26008/1912/bco-dmo.891779.1 [view at BCO-DMO]

Yarnall, A., Fodrie, F. J., Morley, J., Yeager, L. (2023) **Fish measurements sampled by Dual Frequency Identification Sonar (DIDSON) within Artificial Seagrass Units (ASU) in Back Sound, NC from July**

to September 2018. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-10 doi:10.26008/1912/bco-dmo.891686.1 [view at BCO-DMO]

References

Yarnall, A., Fodrie, F. J., Lopazanski, C., Poray, A. K., Yeager, L. (2023) **Epibenthic faunal densities sampled from within Artificial Seagrass Units (ASU) in Back Sound, NC from June to October 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-15 doi:10.26008/1912/bco-dmo.891859.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Site_ID	Artificial seagrass unit (ASU) landscape name (Percent cover value-Percolation probability value)	unitless
Latitude	Latitude North (South is negative) of sampling site	decimal degrees
Longitude	Longitude East (West is negative) of sampling site	decimal degrees
Per_cov	Percent cover of ASUs in 234 square meter landscape footprint (10, 22.5, 35, 47.5, 60)	percent (%)
Frag	ASU landscape fragmentation per se indexed by percolation probability (0.1, 0.225, 0.35, 0.475, 0.59)	unitless
Cell_coord	Cell coordinates designate a grid position within the ASU landscape. Each landscape was designed as a grid of 15 x 15 cells, each of which may or may not be occupied by an ASU. Landscape cell coordinates are identified by C (column; out of 15) number and R (row; out of 15) number.	unitless
Date_collected	Date of ASU ribbon collection	unitless
Height	Length of ASU ribbon	millimeters (mm)
Date_scraping	Date of ASU ribbon epiphyte scraping	unitless
Tin_wt	Weight of tin for epiphyte scraping	grams (g)
Date_dried	Date of ASU ribbon epiphyte scraping was dried for 12 hours in oven at 60 degrees C	unitless
Dry_wt	Weight of tin and epiphyte scraping after drying	grams (g)
Date_burned	Date of ASU ribbon epiphyte scraping was burned for 4 hours in oven at 500 degrees Celsius	unitless
Ash_wt	Weight of tin and epiphyte scraping after burning	grams (g)
notes	Notes primarily on missing data	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	Ohaus H-5276
Generic Instrument Name	scale or balance
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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Project Information

Collaborative Research: Habitat fragmentation effects on fish diversity at landscape scales: experimental tests of multiple mechanisms (Habitat Fragmentation)

Coverage: North Carolina

Amount and quality of habitat is thought to be of fundamental importance to maintaining coastal marine ecosystems. This research will use large-scale field experiments to help understand how and why fish populations respond to fragmentation of seagrass habitats. The question is complex because increased fragmentation in seagrass beds decreases the amount and also the configuration of the habitat (one patch splits into many, patches become further apart, the amount of edge increases, etc). Previous work by the investigators in natural seagrass meadows provided evidence that fragmentation interacts with amount of habitat to influence the community dynamics of fishes in coastal marine landscapes. Specifically, fragmentation had no effect when the habitat was large, but had a negative effect when habitat was smaller. In this study, the investigators will build artificial seagrass habitat to use in a series of manipulative field experiments at an ambitious scale. The results will provide new, more specific information about how coastal fish community dynamics are affected by changes in overall amount and fragmentation of seagrass habitat, in concert with factors such as disturbance, larval dispersal, and wave energy. The project will support two early-career investigators, inform habitat conservation strategies for coastal management, and provide training opportunities for graduate and undergraduate students. The investigators plan to target students from underrepresented groups for the research opportunities.

Building on previous research in seagrass environments, this research will conduct a series of field experiments approach at novel, yet relevant scales, to test how habitat area and fragmentation affect fish diversity and productivity. Specifically, 15 by 15-m seagrass beds will be created using artificial seagrass units (ASUs) that control for within-patch-level (~1-10 m2) factors such as shoot density and length. The investigators will employ ASUs to manipulate total habitat area and the degree of fragmentation within seagrass beds in a temperate estuary in North Carolina. In year one, response of the fishes that colonize these landscapes will be measured as abundance, biomass, community structure, as well as taxonomic and functional diversity. Targeted ASU removals will then follow to determine species-specific responses to habitat disturbance. In year two, the landscape array and sampling regime will be doubled, and half of the landscapes will be seeded with post-larval fish of low dispersal ability to test whether pre- or post-recruitment processes drive landscape-scale patterns. In year three, the role of wave exposure (a natural driver of seagrass fragmentation) in mediating fish community response to landscape configuration will be tested by deploying ASU meadows across low and high energy environments.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635950

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