Habitat variables (mangrove, marsh, water) of Port Fourchon, LA dervied from drone imagery taken in spring 2023.

Website: https://www.bco-dmo.org/dataset/948112
Data Type: model results
Version: 1
Version Date: 2025-01-08

Project
» CAREER: Integrating Seascapes and Energy Flow: learning and teaching about energy, biodiversity, and ecosystem function on the frontlines of climate change (Louisiana E-scapes)

Contributors	Affiliation	Role
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Abstract

This dataset consists of drone-derived habitat data tables used to quantify fine-scale landscape metrics in an estuarine environment undergoing rapid climate-driven habitat change. The data were generated as part of a study evaluating the effects of mangrove encroachment and marsh loss on species-landscape relationships in coastal Louisiana. Habitat variables were derived for buffer zones ranging from 20 to 150 meters around 52 field sampling sites and edge zones 1, 3, and 5 meters from the water's edge, providing detailed metrics such as percent land cover, edge area, and proportional mangrove cover. The fine spatial resolution of the drone imagery allowed for precise identification of small-scale habitat features that are often missed in satellite-based analyses. The data were collected during the Spring 2023 sampling season in the region surrounding Port Fourchon, LA, an area experiencing significant landscape changes due to sea-level rise, subsidence, and the expansion of mangroves. This dataset enables testing of species-specific responses to habitat features at ecologically relevant fine scales, particularly for nekton species interacting with marsh edges and immediate surrounding areas. The primary purpose of this dataset is to inform ecological research focused on habitat suitability, landscape ecology, and the impacts of fine-scale habitat changes on estuarine species distributions. Researchers and resource managers can use these data to improve habitat suitability models, identify critical habitat features, and guide conservation strategies. The data were collected and interpreted by Herbert Leavitt, Dr. James Nelson, and Alex Thomas, with institutional affiliation at the time of collection being the University of Louisiana at Lafayette.

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Coverage

Location: Marshes surrounding Port Fourchon, Louisiana.
Spatial Extent: **N**:29.164671 **E**:-90.149744 **S**:29.092646 **W**:-90.269831
Temporal Extent: 2022-09-23 - 2022-09-29

Methods & Sampling

No raw data is included in this dataset. For information pertaining to the collection methods for the data used to generate this dataset, refer to methods sections of linked datasets

Data Processing Description

The data processing workflow combines a Bash script (*permutations_smallscale.sh*) and a Python script (*smallscale_permutations_241029.py*) to calculate habitat metrics and spatial relationships for sites sampled in Port Fourchon, LA. The workflow begins with the Bash script, which submits a job to UGA's Slurm-based high-performance computing cluster, Sapelo2, requesting 50 CPUs, 280 GB of memory, and a 5-hour time limit. The script sets up the required Python environment and executes the main Python script to process habitat shapefiles and site data.

The Python script prepares the input datasets, which include habitat shapefiles containing classifications like "Water," "Mangrove," and "Spartina," site data (*drop_field.csv*) with georeferenced sample points, and wind data (*CO-OPS_8761724_met.csv*) for calculating fetch distance (wind exposure). The spatial data is projected into the *EPSG:32615* coordinate system for accurate spatial analysis. Wind vectors (u, v components) are calculated from wind speed and direction, and the prevailing wind direction is determined for use in fetch calculations.

For each combination of *buffer distances* (20–150 m) and *edge distances* (1, 3, 5 m), the script calculates habitat metrics around the sampled sites. Circular buffers are created around each site, and habitat polygons are clipped to these buffers to calculate land-to-water ratios and percent edge area within edge distances. Mangrove and marsh edge proportions are calculated as *edge_l.mangrove* and *edge_l.marsh*, respectively. Sites are classified into categories ("mangrove," "marsh," or "mixed") based on threshold values for edge proportions. Fetch distances, representing the exposure of each site to wind, are also calculated using the prevailing wind direction.

To improve efficiency, the workflow leverages *parallel processing* with a *ProcessPoolExecutor* to simultaneously process multiple shapefiles across all buffer and edge distance combinations. Habitat metrics for each site and scale are saved as individual CSV files in the output directory, named in the format *shapefile_name_edge[distance]_buf[distance].csv*. Once processing is complete, the script merges results across shapefiles for each buffer and edge distance into combined CSV files.

This workflow plays a critical role in calculating *fine-scale habitat metrics* needed to evaluate relationships between species abundance and habitat structure. By processing spatial data across multiple scales, it allows for scale-dependent analyses that identify the optimal spatial extents for modeling species-habitat relationships. Key metrics, such as edge proportions, land-to-water ratios, and fetch distances, serve as predictors in species distribution models, supporting the broader project goals of understanding habitat suitability in rapidly changing estuarine environments. The code environment for this analysis will be added to files in this dataset.

BCO-DMO Processing Description

* created zip files per phase: processing & output files

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Data Files

File

output_drone_variables.zip

(ZIP Archive (ZIP), 75.11 KB)
MD5:92b1b923bf22fe8b246ba01fdf77b834

scale at which the data in the file is measured is shown in the naming convention of the file. For example, combined_edge1_buf20 corresponds to combined data from all drone flights where edge habitat was defined as being within 1 meter of the waters edge, and the habitat buffer around each site was 20 meters.

Calculated habitat metrics around sampled sites for each combination of buffer distances (20–150 m) and edge distances (1, 3, 5 m). Scale at which the data in the file is measured is shown in the naming convention of the file. For example, combined_edge1_buf20 corresponds to combined data from all drone flights where edge habitat was defined as being within 1 meter of the waters edge, and the habitat buffer around each site was 20 meters.

Each file contains the following parameters:

Column Name,Column Description [Include meaning of any codes or flags used in data column as well as detection limits.],Units of measurement,missing data/no data value
site_date_key,unique identifier for sampling event (site and location) ,unitless ,blank = missing data
Mangrove ,Fraction of total circle area classified as mangrove habitat within range of waters edge,unitless,blank = missing data
Manmade,Fraction of total circle area classified as manmade habitat within range of waters edge,unitless,blank = missing data
Saltmarsh ,Fraction of total circle area classified as saltmarsh habitat within range of waters edge,unitless,blank = missing data
edge_man,"redundant column, identical to Mangrove",unitless,blank = missing data
edge_mar ,"redundant column, identical to Saltmarsh",unitless,blank = missing data
edge_l.mangrove ,calculated as edge_man/(edge_man + edge_mar) to get the % of edge habitat classified as mangrove (excluding man-made habitats which were negligible) ,unitless,blank = missing data
edge_l.marsh ,calculated as edge_mar/(edge_man + edge_mar) to get the % of edge habitat classified as marsh (excluding man-made habitats which were negligible) ,unitless,blank = missing data
land_water_ratio,"the % of the circle area classified as either marsh, mangrove, or manmade over the total area of the circle (% Land) ",unitless,blank = missing data
fetch_ddistance ,"Calculation of distance wind, traveling in the prevailing direction over the month of september, would travel over water before passing over the site",meters,blank = missing data
site_type,"classification of this site (marsh ifedge_l.marsh >.75 , mixed if between .25 and .75, mangrove if edge_l marsh <.25)",unitless ,blank = missing data

processing_drone_variables.zip

(ZIP Archive (ZIP), 35.15 MB)
MD5:8d5668a50f3bc356c7ef6cfe93161cec

Zip file contains 1 folder and 2 files to calculate habitat metrics and spatial relationships for sites sampled in Port Fourchon, LA.

* fourchonenv: folder with code Environment used for High Performance Computing Cluster runs generating this dataset.
* permutations_smallscale.sh: SLURM Batch submission code for smallscale_permutations_241029.py. Submitted to UGA's Sapelo2 high performance computing cluster to individually run each habitat scale permutation and combine data from separate drone flights (each flight encompasses a handful of sites)
* smallscale_permutations_241029.py: Small Scale Permutation Code. Runs analysis on permutation of edge distance and buffer radius, then merges results from different drone flights.

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Related Datasets

IsDerivedFrom

Leavitt, H., Thomas, A., Nelson, J. (2025) **Habitat classification (mangrove, marsh, water) based on drone imagery taken in spring 2023 in Port Fourchon, LA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-04-07 doi:10.26008/1912/bco-dmo.947918.1 [view at BCO-DMO]
Relationship Description: The dataset "Classified drone-based imagery of Port Fourchon, LA during Spring 2023" contains the shapefiles used to generate the tables in this dataset.

Leavitt, H., Thomas, A., Nelson, J. (2025) **Meteorological observations from NOAA station 8761724, Grande Isle, LA from September 20, 2022, to September 29, 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-02-19 doi:10.26008/1912/bco-dmo.953856.1 [view at BCO-DMO]
Relationship Description: The dataset "Meteorological observations from NOAA station 8761724, Grande Isle, LA from Spetember 20, 2022, to September 29, 2024" contains the meterological data used to generate the

tables in this dataset.

Leavitt, H., Thomas, A., Nelson, J. (2025) **Species counts, site-level information and environmental context sampled near Port Fourchon, Louisiana from September 23 - 29, 2022.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-04-07 doi:10.26008/1912/bco-dmo.947784.1 [view at BCO-DMO]
Relationship Description: The dataset "Drop-sampling site data collected from Fall 2022 in Port Fourchon, Louisiana from September 23, 2022 to September 29, 2022" contains the latitude and longitude of sampling sites in this dataset, which are imported and used to define the habitat characteristics around each site.

IsSourceOf

Leavitt, H., Thomas, A., Nelson, J. (2025) **Habitat scale model output of Port Fourchon, LA dervied from drone and satellite imagery taken in fall and spring 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-01-08 doi:10.26008/1912/bco-dmo.948167.1 [view at BCO-DMO]

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

CAREER: Integrating Seascapes and Energy Flow: learning and teaching about energy, biodiversity, and ecosystem function on the frontlines of climate change (Louisiana E-scapes)

Website: http://www.nelsonecolab.net/career

Coverage: Saltmarsh ecosystem near Port Fourchon, LA

NSF Award Abstract:
Coastal marshes provide a suite of vital functions that support natural and human communities. Humans frequently take for granted and exploit these ecosystem services without fully understanding the ecological feedbacks, linkages, and interdependencies of these processes to the wider ecosystem. As demands on coastal ecosystem services have risen, marshes have experienced substantial loss due to direct and indirect impacts from human activity. The rapidly changing coastal ecosystems of Louisiana provide a natural experiment for understanding how coastal change alters ecosystem function. This project is developing new metrics and tools to assess food web variability and test hypotheses on biodiversity and ecosystem function in coastal Louisiana. The research is determining how changing habitat configuration alters the distribution of energy across the seascape in a multitrophic system. This work is engaging students from the University of Louisiana Lafayette and Dillard University in placed-based learning by immersing them in the research and local restoration efforts to address land loss and preserve critical ecosystem services. Students are developing a deeper understanding of the complex issues facing coastal regions through formal course work, directed field work, and outreach. Students are interacting with stakeholders and managers who are currently battling coastal change. Their directed research projects are documenting changes in coastal habitat and coupling this knowledge with the consequences to ecosystems and the people who depend on them. By participating in the project students are emerging with knowledge and training that is making them into informed citizens and capable stewards of the future of our coastal ecosystems, while also preparing them for careers in STEM. The project is supporting two graduate students and a post-doc.

The transformation and movement of energy through a food web are key links between biodiversity and ecosystem function. A major hurdle to testing biodiversity ecosystem function theory is a limited ability to assess food web variability in space and time. This research is quantifying changing seascape structure, species diversity, and food web structure to better understand the relationship between biodiversity and energy flow through ecosystems. The project uses cutting edge tools and metrics to test hypotheses on how

the distribution, abundance, and diversity of key species are altered by ecosystem change and how this affects function. The hypotheses driving the research are: 1) habitat is a more important indirect driver of trophic structure than a direct change to primary trophic pathways; and 2) horizontal and vertical diversity increases with habitat resource index. Stable isotope analysis is characterizing energy flow through the food web. Changes in horizontal and vertical diversity in a multitrophic system are being quantified using aerial surveys and field sampling. To assess the spatial and temporal change in food web resources, the project is combining results from stable isotope analysis and drone-based remote sensing technology to generate consumer specific energetic seascape maps (E-scapes) and trophic niche metrics. In combination these new metrics are providing insight into species' responses to changing food web function across the seascape and through time.

This project is jointly funded by Biological Oceanography and the Established Program to Stimulate Competitive Research (EPSCoR).

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.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2418012