

# Habitat variables (mangrove, marsh, water) of Port Fourchon, LA dervied from satellite imagery taken in fall 2022

**Website:** <https://www.bco-dmo.org/dataset/947975>

**Data Type:** model results

**Version:** 1

**Version Date:** 2025-01-06

## 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)

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## Abstract

This dataset consists of satellite-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 150 to 600 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 greater spatial coverage of the satellite imagery allowed for larger habitat scales to be encompassed in the analysis. Satellite images used in this analysis were all taken during the year 2022, within a few months of our sampling season, in the region surrounding Port Fourchon, LA. 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 satellite-scale habitat data processing workflow uses a combination of Bash and Python scripts to calculate habitat metrics and spatial relationships across multiple scales. Designed for use on a Slurm-based high-performance computing cluster, the workflow efficiently handles large spatial datasets through parallelized processing. It is divided into two main phases: preprocessing and scale-specific calculations.

The preprocessing phase, managed by the *preprocess\_satscale.sh* Bash script and executed through the *satscale\_preprocessing\_241022.py* Python script, prepares habitat shapefiles and site data for subsequent analyses. Habitat polygons from *google2022.shp* are reprojected to EPSG:32615 and assigned numerical identifiers for efficient processing. Water and mudflat polygons are consolidated into a single "Water" multipolygon for streamlined analyses. The processed habitat polygons are saved as GeoPackage files (*habitat\_poly.gpkg*, *water\_poly.gpkg*), while site data from *drop\_field.csv* is georeferenced, reprojected, and saved as *pffw\_sites.gpkg*. Wind data from *CO-OPS\_8761724\_met.csv* is used to calculate fetch distances for each site based on the prevailing wind direction, determined from average wind vectors. These fetch distances are then integrated into the site dataset.

The scale-specific calculations phase, managed by the *permutations\_satscale.sh* Bash script and the *satscale\_permutations\_241022.py* Python script, calculates habitat metrics for various combinations of buffer distances (100–1000 meters) and edge distances (1, 3, 5 meters). Buffers are generated around each site, and habitat polygons are clipped to these buffers to calculate land-to-water ratios, edge proportions (e.g., mangrove and marsh edge lengths), and classifications of sites into "mangrove," "marsh," or "mixed" categories based on habitat thresholds. Fetch distance is also included as a metric for wind and wave exposure. The outputs for each buffer and edge combination are saved as CSV files in the *output/satscale* directory, with filenames structured as *google2022\_edge[distance]\_buf[distance].csv*.

To improve efficiency, the workflow employs a Slurm job array, enabling parallel processing of multiple scale permutations. The Python scripts utilize *geopandas* for spatial processing and implement memory management to handle large datasets effectively. This workflow plays a critical role in calculating fine-scale habitat metrics required for analyzing species-habitat relationships in estuarine environments. The calculated metrics, including edge proportions, land-to-water ratios, and fetch distances, serve as key predictors for ecological models, supporting analyses of habitat suitability and the impacts of habitat changes such as mangrove encroachment. By optimizing calculations across scales, the workflow ensures accurate and efficient processing, making it integral to the project's success.

## BCO-DMO Processing Description

\* created zip files per phase: preprocessing phase, calculations and output files.

## Problem Description

Computation time and memory was a barrier in this analysis. For this reason, although we originally intended to perform calculations out to 1000m we limited our analysis to 600m. We do not believe this altered our final results in any way.

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## Data Files

File	
<b>01_preprocessing_phase.zip</b>	(ZIP Archive (ZIP), 115.07 MB) MD5:733e5666d447d3b117fc69138decce48
Zip package contains the following files:	
* preprocess_satscale.sh: SLURM Batch submission code for satscale_preprocessing_241022.py. Submitted to UGA's Sapelo2 high performance computing cluster to run pre-processing routine	
*satscale_preprocessing_241022.py: Preprocesssing routine . Runs scale-independent pre-processing routine to minimize compute in the permutation step	
*habitat_poly.gpkg: Output of preprocessing routine. geopanda files exported by preprocessing routine - used by permutation files later.	
*pffw_sites.gpkg: geopanda files exported by preprocessing routine - used by permutation files later.	
*terhab.gpkg: Output of preprocessing routine. geopanda files exported by preprocessing routine - used by permutation files later.	
*water_poly.gpkg: Output of preprocessing routine. geopanda files exported by preprocessing routine - used by permutation files later.	
<b>02_scale_specific_calc.zip</b>	(ZIP Archive (ZIP), 2.51 KB) MD5:cfdc87adeea255cf5e401a105f208d40
Zip package contains the following files:	
* satscale_permutations_241022.py: Satellite Scale Permutation Code. Runs analysis on permutation of edge distance and buffer radius.	
* permutations_satscale.sh: SLURM Batch submission code for satscale_permutations_241022.py. Submitted to UGA's Sapelo2 high performance computing cluster to individually run each habitat scale permutation	
<b>03_habitat_output_files.zip</b>	(ZIP Archive (ZIP), 135.72 KB) MD5:cd20e8898f29ef8a2614cd4729e6a06c
Zipped file contains 28 .csv files. Scale at which the data in the file is measured is shown in the naming convention of the file. For example, google2022_edge1_buf100 corresponds to satellite data (from google earth) where edge habitat was defined as being within 1 meter of the waters edge, and the habitat buffer around each site was 100 meters. Edge can have following numbers: edge* being 1,3 or 5. Buf can have following numbers: 100, 150, 200, 250, 300, 400, 500 or 600.	

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## Related Publications

Broussard, W., Suir, G., & Visser, J. (2018). Unmanned Aircraft Systems (UAS) and satellite imagery collections in a coastal intermediate marsh to determine the land-water interface, vegetation types, and Normalized Difference Vegetation Index (NDVI) values. Engineer Research and Development Center (U.S.).

<https://doi.org/10.21079/11681/29517>  
*Methods*

Zhao, J., Fang, Y., Zhang, M., & Dong, Y. (2020). Identification of Remote Sensing-Based Land Cover Types Combining Nearest-Neighbor Classification and SEaTH Algorithm. Journal of the Indian Society of Remote Sensing, 48(7), 1007–1020. <https://doi.org/10.1007/s12524-020-01131-6>

## Related Datasets

### IsDerivedFrom

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Leavitt, H., Thomas, A., Nelson, J. (2025) **Habitat classification (mangrove, marsh, water) based on satellite imagery taken in fall 2022 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.947958.1 [[view at BCO-DMO](#)]

*Relationship Description: The dataset "Classified satellite imagery of Port Fourchon, LA from 2022." contains the shapefiles used to generate the tables in this dataset. Habitat variables were calculated based on these files.*

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 September 20, 2022, to September 29, 2024" contains the meteorological 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

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Leavitt, H., Thomas, A., Nelson, J. (2025) **Habitat scale model output of Port Fourchon, LA derived 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](#)]

## Parameters

*Parameters for this dataset have not yet been identified*

## 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.nelsoncolab.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 place-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.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-2418012</a>

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