Infaunal community composition and sediment grain size distribution, porosity, and organic content of sediment cores collected in the Northern Gulf of Mexico off the Alabama (USA) coast during 2020 and 2021 before and after Hurricane Sally

Website: https://www.bco-dmo.org/dataset/934897
Data Type: Other Field Results
Version: 1
Version Date: 2024-08-07

Project
» CAREER: Mechanisms of bioturbation and ecosystem engineering by benthic infauna (Bioturbation and Ecosystem Engineering)

Contributors	Affiliation	Role
Dorgan, Kelly	Dauphin Island Sea Lab (DISL)	Principal Investigator
Clemo, William Cyrus	University of South Alabama (USA)	Student
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset consists of infaunal community composition and sediment grain size distribution, porosity, and organic content of sediment cores in addition to bottom water salinity, dissolved oxygen, and temperature collected from 9 sites at 5, 12 and 20 meters depth in the Northern Gulf of Mexico off the Alabama (USA) coast before and after Hurricane Sally, which occurred in 2020.

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Coverage

Location: Coastal Alabama
Spatial Extent: **N**:30.24642 **E**:-87.98882 **S**:30.04793 **W**:-88.289
Temporal Extent: 2020-09-10 - 2021-05-26

Methods & Sampling

Sediment coring was carried out from the R/V E.O. Wilson, operated by Dauphin Island Sea Lab. Sediment cores (9.6-centimeters (cm) inner diameter) were collected with an Ocean Instruments MC-400 multicorer or via SCUBA diving at each site and timepoint. Four replicate cores were sieved (500 micrometers (µm) mesh) and retained contents were preserved in 95% ethanol with Rose Bengal tissue stain (0.05 grams per liter (g L^{-1})). Stained infauna were identified to family level and enumerated. Taxa that could not be reliably identified to family level were grouped into higher levels of classification (e.g., Nemertea). Infauna were also divided into size classes of body thicknesses of <1 millimeter (mm) and >1 mm. Body length and biomass could not be determined for a large number of specimens, especially annelids (the most abundant phylum), due to fragmentation during collection and preservation (only annelids with intact heads were counted). Body width was measured under a dissecting microscope with a ruler. Grain size was measured in the top 8-12 cm of sediment. 1-2 cores were sectioned into 1 cm increments and dried at 65 degrees Celsius (°C) for 48 hours. Dried samples were placed in a muffle furnace at 550 °C for 4 hours to combust sediment organic matter. Porosity and organic content were calculated from the sediment mass differences before and after drying and combusting, respectively. Combusted sediment was then placed in a 1% sodium hexametaphosphate solution for at least 3 weeks to deflocculate. After weeks of deflocculating, clumps of mud often remained intact in muddier samples, so all samples were gently rubbed with a gloved finger on a 63 µm sieve to break up mud clumps. The mud was then washed through the sieve and combined with the sand retained on the sieve. After breaking up clumps, we measured grain size distribution using a Malvern Mastersizer 3000. For each sample, 5 measurements were averaged and then analyzed using Gradistat (Kenneth Pye Associates, LTD.). Bottom water salinity and temperature (°C) were measured at each site and timepoint using a Seabird SBE 25 Sealogger CTD (conductivity, temperature, depth) instrument array. The CTD was deployed on a line by a winch that lowered the CTD to the bottom and then brought it back to the surface at each site.

Data Processing Description

For each sediment sample, 5 Malvern Mastersizer measurements were averaged and then analyzed using Gradistat v9.1 (Kenneth Pye Associates, LTD.). For each core or pair of cores from each site and time point, we then averaged sediment property values in the top 5 cm, or within distinct surface layers (e.g., sand sharply transitioning to mud) if the layers were less than 5 cm.

BCO-DMO Processing Description

- Imported original file "ClemoHurricaneSallyInfaunaSediment2020to2021.csv" into the BCO-DMO system.
- Converted date field to YYYY-MM-DD format.
- Rounded the infaunal taxa abundance columns to whole numbers (integers).
- Renamed fields to comply with BCO-DMO naming conventions.
- Corrected taxa names where needed to align with WoRMS-accepted names.
- Saved the final file as "934897_v1_infauna_and_sediment_data_hurricane_sally_2020_to_2021.csv".

Problem Description

Body length and biomass are not reported in this dataset because these measurements could not be determined for a large number of specimens, especially annelids (the most abundant phylum), due to fragmentation during collection and preservation (only annelids with intact heads were counted).

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Data Files

File
934897_v1_infauna_and_sediment_data_hurricane_sally_2020_to_2021.csv (Comma Separated Values (.csv), 72.55 KB) MD5:26573cf4c957ed4cd12c9c46778748b8 Primary data file for dataset ID 934897, version 1

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Related Publications

Clemo, W. C., Dorgan, K. M., Wallace, D. J., & Dzwonkowski, B. (2023). Effects of Hurricane Sally (2020) on

sediment structure and infaunal communities in coastal Alabama. In Coastal Sediments 2023: The Proceedings of the Coastal Sediments 2023 (pp. 1055-1068). https://doi.org/10.1142/9789811275135_0097
Results

Clemo, W. C., Dorgan, K. M., Wallace, D. J., & Dzwonkowski, B. (2024). Spatially and Temporally Variable Impacts of Hurricanes on Shallow Sediment Structure. Journal of Geophysical Research: Oceans, 129(7). Portico. https://doi.org/10.1029/2023jc020820
Results

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Related Datasets

IsRelatedTo

Clemo, W. C., Dorgan, K. (2023) **Sediment properties collected off the Alabama coast before and after Hurricane Sally, 2020-2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-12-07 doi:10.26008/1912/bco-dmo.916071.1 [view at BCO-DMO]
Relationship Description: The "Sediment Properties" datasets (916071) contains more detailed sediment grain size distribution data from the same sites and sampling.

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Parameters

Parameter	Description	Units
Site	Site name, includes transect (W: West, M: Middle, E: East) and depth (05: 5m, 12: 12m, 20: 20m) at which samples were collected	unitless
Latitude	site latitude	decimal degrees (N)
Longitude	site longitude	decimal degrees (E)
WaterDepth_m	site depth	meters (m)
Date	sampling date	unitless
TimeAfterSally_d	days after Hurricane Sally landfall	days
Rep	replicate	unitless
Actiniaria	infaunal taxa abundance	indivduals per core
Nemertea	infaunal taxa abundance	indivduals per core
Platyhelminthes	infaunal taxa abundance	indivduals per core

Aspidosiphonidae	infaunal taxa abundance	indivduals per core
Golfingiidae	infaunal taxa abundance	indivduals per core
Thalassematidae	infaunal taxa abundance	indivduals per core
Ampharetidae	infaunal taxa abundance	indivduals per core
Acoetidae	infaunal taxa abundance	indivduals per core
Amphinomidae	infaunal taxa abundance	indivduals per core
Capitellidae	infaunal taxa abundance	indivduals per core
Cirratulidae	infaunal taxa abundance	indivduals per core
Cossuridae	infaunal taxa abundance	indivduals per core
Eulepethidae	infaunal taxa abundance	indivduals per core
Eunicidae	infaunal taxa abundance	indivduals per core
Flabelligeridae	infaunal taxa abundance	indivduals per core
Glyceridae	infaunal taxa abundance	indivduals per core
Goniadidae	infaunal taxa abundance	indivduals per core
Hesionidae	infaunal taxa abundance	indivduals per core
Lumbrineridae	infaunal taxa abundance	indivduals per core
Magelonidae	infaunal taxa abundance	indivduals per core
Maldanidae	infaunal taxa abundance	indivduals per core
Nephtyidae	infaunal taxa abundance	indivduals per core

Nereididae	infaunal taxa abundance	indivduals per core
Oenonidae	infaunal taxa abundance	indivduals per core
Onuphidae	infaunal taxa abundance	indivduals per core
Opheliidae	infaunal taxa abundance	indivduals per core
Orbiniidae	infaunal taxa abundance	indivduals per core
Oweniidae	infaunal taxa abundance	indivduals per core
Paraonidae	infaunal taxa abundance	indivduals per core
Pectinariidae	infaunal taxa abundance	indivduals per core
Phyllodocidae	infaunal taxa abundance	indivduals per core
Pilargidae	infaunal taxa abundance	indivduals per core
Polynoidae	infaunal taxa abundance	indivduals per core
Spionidae	infaunal taxa abundance	indivduals per core
Serpulidae	infaunal taxa abundance	indivduals per core
Sigalionidae	infaunal taxa abundance	indivduals per core
Sternaspidae	infaunal taxa abundance	indivduals per core
Syllidae	infaunal taxa abundance	indivduals per core
Terebellidae	infaunal taxa abundance	indivduals per core
Annelida	infaunal taxa abundance	indivduals per core
Phoronida	infaunal taxa abundance	indivduals per core

Lingulida	infaunal taxa abundance	indivduals per core
Caecidae	infaunal taxa abundance	indivduals per core
Calyptraeidae	infaunal taxa abundance	indivduals per core
Cancellariidae	infaunal taxa abundance	indivduals per core
Columbellidae	infaunal taxa abundance	indivduals per core
Cylichnidae	infaunal taxa abundance	indivduals per core
Epitoniidae	infaunal taxa abundance	indivduals per core
Eulimidae	infaunal taxa abundance	indivduals per core
Haminoeidae	infaunal taxa abundance	indivduals per core
Nassariidae	infaunal taxa abundance	indivduals per core
Naticidae	infaunal taxa abundance	indivduals per core
Olividae	infaunal taxa abundance	indivduals per core
Olivellidae	infaunal taxa abundance	indivduals per core
Pyramidellidae	infaunal taxa abundance	indivduals per core
Terebridae	infaunal taxa abundance	indivduals per core
Tornidae	infaunal taxa abundance	indivduals per core
Turridae	infaunal taxa abundance	indivduals per core
Muricidae	infaunal taxa abundance	indivduals per core
Gastropoda	infaunal taxa abundance	indivduals per core

Arcidae	infaunal taxa abundance	indivduals per core
Corbulidae	infaunal taxa abundance	indivduals per core
Lasaeidae	infaunal taxa abundance	indivduals per core
Lucinidae	infaunal taxa abundance	indivduals per core
Lyonsiidae	infaunal taxa abundance	indivduals per core
Mactridae	infaunal taxa abundance	indivduals per core
Nuculidae	infaunal taxa abundance	indivduals per core
Nuculanidae	infaunal taxa abundance	indivduals per core
Pandoridae	infaunal taxa abundance	indivduals per core
Solenidae	infaunal taxa abundance	indivduals per core
Tellinidae	infaunal taxa abundance	indivduals per core
Ungulinidae	infaunal taxa abundance	indivduals per core
Veneridae	infaunal taxa abundance	indivduals per core
Verticordiidae	infaunal taxa abundance	indivduals per core
Bivalvia	infaunal taxa abundance	indivduals per core
Scaphopoda	infaunal taxa abundance	indivduals per core
Pantopoda	infaunal taxa abundance	indivduals per core
Bodotriidae	infaunal taxa abundance	indivduals per core
Diastylidae	infaunal taxa abundance	indivduals per core

Leuconidae	infaunal taxa abundance	indivduals per core
Nannastacidae	infaunal taxa abundance	indivduals per core
Cumacea	infaunal taxa abundance	indivduals per core
Ampeliscidae	infaunal taxa abundance	indivduals per core
Argissidae	infaunal taxa abundance	indivduals per core
Corophiidae	infaunal taxa abundance	indivduals per core
Haustoriidae	infaunal taxa abundance	indivduals per core
Ischyroceridae	infaunal taxa abundance	indivduals per core
Liljeborgiidae	infaunal taxa abundance	indivduals per core
Oedicerotidae	infaunal taxa abundance	indivduals per core
Photidae	infaunal taxa abundance	indivduals per core
Phoxocephalidae	infaunal taxa abundance	indivduals per core
Platyischnopidae	infaunal taxa abundance	indivduals per core
Stenothoidae	infaunal taxa abundance	indivduals per core
Synopiidae	infaunal taxa abundance	indivduals per core
Amphipoda	infaunal taxa abundance	indivduals per core
Tanaidacea	infaunal taxa abundance	indivduals per core
Albuneidae	infaunal taxa abundance	indivduals per core
Anthuridae	infaunal taxa abundance	indivduals per core

Ancinidae	infaunal taxa abundance	indivduals per core
Idotea	infaunal taxa abundance	indivduals per core
Isopoda	infaunal taxa abundance	indivduals per core
Mysidae	infaunal taxa abundance	indivduals per core
Aethridae	infaunal taxa abundance	indivduals per core
Pinnotheridae	infaunal taxa abundance	indivduals per core
Paguroidea	infaunal taxa abundance	indivduals per core
Porcellanidae	infaunal taxa abundance	indivduals per core
Portunidae	infaunal taxa abundance	indivduals per core
Raninidae	infaunal taxa abundance	indivduals per core
Callianassidae	infaunal taxa abundance	indivduals per core
Upogebiidae	infaunal taxa abundance	indivduals per core
Luciferidae	infaunal taxa abundance	indivduals per core
Caridea	infaunal taxa abundance	indivduals per core
Ophiuroidea	infaunal taxa abundance	indivduals per core
Holothuroidea	infaunal taxa abundance	indivduals per core
Clypeasteroida	infaunal taxa abundance	indivduals per core
Echinoidea	infaunal taxa abundance	indivduals per core
Enteropneusta	infaunal taxa abundance	indivduals per core

Branchiostomidae	infaunal taxa abundance	indivduals per core
Lophotrochozoa	infaunal taxa abundance	indivduals per core
Abundance_core	total infaunal abundance	indivduals per core
less_than_1mm	infauna less than 1mm wide	indivduals per core
greater_than_1mm	infauna greater than 1mm wide	indivduals per core
SalBot	site bottom water salinity	PSU
TempCBot	site bottom water temperature	degrees Celsius
DOmgperLBot	site bottom water dissolved oxygen	milligrams per liter (mg L-1)
PorTop5cm	sediment porosity (top 5 cm average); reported as a unitless fraction	unitless
OCTop5cm	sediment organic content (top 5 cm average); reported as a unitless fraction (e.g., 0.00707 OC = 0.707 % OC).	unitless
MeanGSTop5cm_phi	mean grain size, phi scale (top 5 cm average)	unitless
SortingTop5cm_phi	grain size sorting, phi scale (top 5 cm average)	unitless
SkewnessTop5cm_phi	grain size skewness, phi scale (top 5 cm average)	unitless
KurtosisTop5cm_phi	grain size kurtosis, phi scale (top 5 cm average)	unitless
MudFracTop5cm	sample fraction consisting of mud-sized particles (top 5 cm average)	unitless

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Instruments

Dataset-specific Instrument Name	Malvern Mastersizer 3000
Generic Instrument Name	Malvern Mastersizer 3000/3000E laser diffraction particle size analyzer
Dataset-specific Description	Grain size analysis was done on a Malvern Mastersizer 3000 particle analyzer.
Generic Instrument Description	The Malvern Mastersizer 3000/3000E is a laser diffraction particle size analyzer available for both dry and wet dispersions of particles from nanometer to millimeter ranges. A laser beam passes through a dispersed particulate sample and the angular variation in intensity of the scattered light is measured. The angular scattering intensity data is then analyzed to calculate the size of the particles that created the scattering pattern using the Mie theory of light scattering. The particle size is reported as a volume equivalent sphere diameter. The instrument has an accuracy of 0.6%, operation temperatures of 5degC to 40degC (non-condensing), size of 10 nm - 3.5 mm (3000) or 0.1 - 1000 um (3000E).

Dataset-specific Instrument Name	dissecting microscope
Generic Instrument Name	Microscope - Optical
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	Ocean Instruments MC-400 multicorer
Generic Instrument Name	Ocean Instruments MC-400 Multi corer
Dataset-specific Description	Used for core collection.
Generic Instrument Description	The Ocean Instruments MC-400 {Hedrick/Marrs} multi-corer is a sediment multi-corer with a series of cores attached to one deployment frame. This model carries four sample tubes. It is designed to retrieve sediment and water samples in lakes and shelf waters. The sample tubes are sealed with a silicone rubber upper door gasket and a neoprene or carpet lower door seal. Each of the four sample tubes can be removed from the coring unit for immediate processing in the laboratory without exposing their contents to the surface environment. It is designed to recover undisturbed surface sediments and is therefore well-suited to study benthic processes. The multi-corer is disposed on a research vessel and is lowered into the water body by a cable. When the multi-corer touches the sediment the units ballast weight pushes the assembled cores into the substrate. Each of the tubes contains a unique sediment core. The multi-corer uses a unique hydrostatic damping system that slows the penetration rate down to approximately 1 cm/s. Provisions have been made to carry up to two 4-liter water bottles that actuate as the frame legs touch bottom. The overall sample tube length is 58 cm, with a maximum penetration of 34.5 cm. The tube diameter is 10 cm.

Dataset-specific Instrument Name	ruler
Generic Instrument Name	ruler
Generic Instrument Description	A device used for measuring or for drawing straight lines, consisting of an elongated piece of rigid or semi-rigid material marked with units for measurement. Device that allows one or more physical dimensions of a sample or specimen to be determined by visible comparison against marked graduations in units of measurement of dimension length.

Dataset-specific Instrument Name	Seabird SBE 25 Sealogger CTD
Generic Instrument Name	Sea-Bird SBE 25 Sealogger CTD
Generic Instrument Description	The Sea-Bird SBE 25 SEALOGGER CTD is battery powered and is typically used to record data in memory, eliminating the need for a large vessel, electrical sea cable, and on-board computer. All SBE 25s can also operate in real-time, transmitting data via an opto-isolated RS-232 serial port. Temperature and conductivity are measured by the SBE 3F Temperature sensor and SBE 4 Conductivity sensor (same as those used on the premium SBE 9plus CTD). The SBE 25 also includes the SBE 5P (plastic) or 5T (titanium) Submersible Pump and TC Duct. The pump-controlled, TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and in calm waters allows slower descent rates for improved resolution of water column features. Pressure is measured by the modular SBE 29 Temperature Compensated Strain-Gauge Pressure sensor (available in eight depth ranges to suit the operating depth requirement). The SBE 25's modular design makes it easy to configure in the field for a wide range of auxiliary sensors, including optional dissolved oxygen (SBE 43), pH (SBE 18 or SBE 27), fluorescence, transmissivity, PAR, and optical backscatter sensors. More information from Sea-Bird Electronics: http:www.seabird.com.

Dataset-specific Instrument Name	SCUBA diving
Generic Instrument Name	Self-Contained Underwater Breathing Apparatus
Generic Instrument Description	The self-contained underwater breathing apparatus or scuba diving system is the result of technological developments and innovations that began almost 300 years ago. Scuba diving is the most extensively used system for breathing underwater by recreational divers throughout the world and in various forms is also widely used to perform underwater work for military, scientific, and commercial purposes. Reference: https://oceanexplorer.noaa.gov/technology/technical/technical.html

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Project Information

CAREER: Mechanisms of bioturbation and ecosystem engineering by benthic infauna (Bioturbation and Ecosystem Engineering)

Coverage: Dauphin Island Sea Lab, Dauphin Island, AL

NSF Award Abstract:
Marine sediments are important habitats for abundant and diverse communities of organisms that are important as food sources for higher trophic levels, including commercially important species. Through burrowing, constructing tubes, and feeding on sediments, these animals modify their physical and chemical environments to such an extent that they are considered ecosystem engineers. Bioturbation, the mixing of sediments by animals, is important in regenerating nutrients and transporting pollutants and carbon bound to mineral grains. Despite its importance, our ability to predict bioturbation rates and patterns from the community structure is poor, largely due to a lack of understanding of the mechanisms by which animals mix sediments. This project builds on earlier work showing that animals extend burrows through muddy sediments by fracture to test the hypothesis that the mechanical properties of sediments that affect burrowing mechanics also affect sediment mixing. More broadly, this project examines the relative contributions of (i) the functional roles of the organisms in the community, (ii) the mechanical properties of sediments, and (iii) factors that might increase or decrease animal activity such as temperature and food availability to bioturbation rates. Burrowing animals modify the physical properties of sediments, and this project quantifies these changes and tests the hypothesis that these changes are ecologically important and affect community succession following a disturbance. In addition to this scientific broader impact, this project involves development of instrumentation to measure sediment properties and includes a substantial education plan to introduce graduate, undergraduate, and middle school students to the important role that technology plays in marine science.

Through burrowing and feeding activities, benthic infauna mix sediments and modify their physical environments. Bioturbation gates the burial of organic matter, enhances nutrient regeneration, and smears the paleontological and stratigraphic record. However, current understanding of the mechanisms by which infaunal activities mix sediments is insufficient to predict the impacts of changes in infaunal community structure on important sediment ecosystem functions driven by bioturbation. This project tests specific hypotheses relating infaunal communities, bioturbation, and geotechnical properties with the ultimate goal of understanding the dynamic changes and potential feedbacks between infauna and their physical environments. This project integrates field and lab experiments to assess the relative importance of infaunal community structure and activities to bioturbation rates. Additionally, this project builds on recent work showing that muddy sediments are elastic gels through which worms extend burrows by fracture to propose that geotechnical properties of sediments mediate bioturbation by governing the release of particles from the sediment matrix during burrow extension. Finite element modeling determines how the release of particles by fracture during burrowing depends on the fracture toughness (cohesion) and stiffness (compaction) of sediments and complements laboratory experiments characterizing the impact of geotechnical properties on burrowing behaviors. The proposed research also aims to determine whether impacts of infauna on geotechnical properties are ecologically important. Changes in infaunal communities and geotechnical properties following an experimental physical disturbance address the hypothesis that ecosystem engineering of bulk sediment properties facilitates succession.

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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1844910

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