Eelgrass shoot density measurements taken during ecological field surveys along the eastern Pacific coast in June through August of 2019, 2020, and 2021.

Website: https://www.bco-dmo.org/dataset/879764
Data Type: Other Field Results
Version: 1
Version Date: 2022-10-13

Project
» Collaborative Research: The role of a keystone pathogen in the geographic and local-scale ecology of eelgrass decline in the eastern Pacific (Eelgrass disease)

Contributors	Affiliation	Role
Harvell, Drew	Cornell University (Cornell)	Principal Investigator
Duffy, J. Emmett	Smithsonian Environmental Research Center (SERC)	Co-Principal Investigator
Gomes, Carla P.	Cornell University (Cornell)	Co-Principal Investigator
Hawthorne, Timothy	University of Central Florida (UCF)	Co-Principal Investigator
Stachowicz, John J.	University of California-Davis (UC Davis)	Co-Principal Investigator
Aoki, Lillian	Cornell University (Cornell)	Scientist, Data Manager
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Abstract
These data were collected during ecological field surveys of eelgrass (Zostera marina) meadows along the eastern Pacific from southeastern Alaska to southern California. Parameters measured include seagrass morphology, meadow condition (e.g. shoot densities), and incidence and severity of eelgrass wasting disease. Data were collected within the intertidal area of 32 eelgrass meadows distributed in six regions (five-six meadows sampled in the regions of Alaska, British Columbia, Washington, Oregon, California - Bodega Bay, and California - San Diego). Surveys were conducted in between late June and early August in 2019, 2020, and 2021 by teams from six institutions. The influence of disease on seagrass dynamics is not well understood, and these data can further understanding of the environmental drivers of disease by connecting wasting disease with eelgrass condition across a broad geographic gradient.

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Coverage

Spatial Extent: **N**:55.739951 **E**:-117.10621 **S**:32.62535 **W**:-133.343143
Temporal Extent: 2019-07-01 - 2021-07-28

Methods & Sampling

Field surveys of eelgrass meadow sites were conducted at mid-summer low tides at field sites along the west coast of North America in the U.S. and Canada. Samples and data were collected within the intertidal area of 32 eelgrass meadows distributed in six regions (Alaska, British Columbia, Washington, Oregon, California - Bodega Bay, and California -San Diego). Surveys were conducted between late June and early August in 2019, 2020, and 2021 by teams from six institutions.

For each site, three 20 meter transects were laid parallel to the shore at the shoreward (upper edge) of continuous eelgrass, and three lower (intertidal) 20 meter transects were laid at least 4 meters closer to the water. Shoot density and canopy cover were measured at meters 4, 8, 12, and 16. At each meter, a PVC quadrat was placed on the upper (landward) side of the transect tape, aligning the lower left corner of the quadrat with the meter mark. The percent cover within the quadrat area was recorded for seagrass, bare sediment, and other (macroalgae unless noted otherwise). Shoot densities, categorized by the number of vegetative and flowering shoots, were then counted. Only shoots rooted in the quadrat were included in the density counts. Quadrats for shoot density range in size from 0.0625 to 0.36 square meters. Quadrats for cover ranged in size from 0.09 to 1 square meter. Quadrat size was determined by expert judgment of the practitioners at each field site.

Transect locations were recorded using a hand-held GPS (exact model varied between field locations). Salinity was measured at the time of sampling using a refractometer. Temperature loggers (HOBO MX 2201 and UA-001-64, Onset, Bourne, MA) were deployed at each eelgrass meadow site to provide a continuous record of in situ temperature. For HOBO data, see https://www.bco-dmo.org/dataset/877355 and Related Datasets section below.

~ For methodology details, see Aoki et al. (2022)
~ Additional details for the field surveys are available in the Eelgrass Disease Project Handbook.
~ For 16S rRNA amplicon sequencing of eelgrass associated bacteria, refer to NCBI BioProject PRJNA802566 in the Related Datasets section below.

Data Processing Description

BCO-DMO Processing:
- Imported data from source file "meter_level_density.csv" into the BCO-DMO data system. Data file imported using missing data identifier "NA". Converted date to year-month-day format
- Imported data from source file "combined_site_metadata.csv". Converted coordinates to decimal degrees, made LocationNames consistent.
- Joined shoot metrics data with the revised combined site metadata
- Added conventional header with dataset name, PI name, version date.
- Modified parameter (column) names to conform with BCO-DMO naming conventions.

Parameters/Fields for Supplemental Files
(The following parameter descriptions are for the Supplemental File titled "Eelgrass study site metadata". For this dataset's fields, please see the heading "Parameters" below).

- ***SampleCollectionDate***: Date when samples were collected in the field
- ***Region***: Two-letter identifier for the geographic region where the sample was collected (AK=Alaska, BC=British Columbia, WA=Washington, OR=Oregon, BB=Bodega Bay in California, SD=San Diego in California)
- ***SiteCode:*** One-letter identifier for site within a geographic region where the sample was collected (A, B, C, D, E, F)
- ***LocationName***: Full name of each sampling site (eelgrass meadow) where samples were taken
- ***TidalHeight***: Single letter indicating the tidal height at which samples were collected. U = upper tidal height; L = lower tidal height
- ***Transect***: Integer indicating the transect at which samples were collected. Upper transects = 1, 2, 3; Lower transects = 4, 5, 6.
- ***SampleProcessingDate***: Date when samples were processed in the lab
- ***Depth***: Depth relative to MLLW (mean lower low water)
- ***Salinity***: Salinity of surface water at the time of sampling (point measurement made with refractometer or probe)

- ***LocationComments***: Comments describing location including changes between sampling year
- ***TransectBeginDecimalLatitude***: Latitudinal coordinate for the beginning (meter 0) of the transect
- ***TransectBeginDecimalLongitude***: Longitudinal coordinate for the beginning (meter 0) of the transect
- ***TransectEndDecimalLatitude***: Latitudinal coordinate for the end (meter 20) of the transect
- ***TransectEndDecimalLongitude***: Longitudinal coordinate for the end (meter 20) of the transect
- ***Year***: Year in which samples were collected

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Data Files

File
shoot_density.csv (Comma Separated Values (.csv), 299.11 KB) MD5:6ab64b348a29e8bf323f210216709604 Primary data file for dataset ID 879764

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Supplemental Files

File
Eelgrass study site metadata filename: eelgrass_study_revised_site_metadata.csv (Comma Separated Values (.csv), 50.38 KB) MD5:e17548ddde013aa9a344b97a16e3dfaf Combined site metadata for eelgrass wasting disease study sites on the western coast of the U.S. and Canada SampleCollectionDate: Date when samples were collected in the field Region: Two-letter identifier for the geographic region where the sample was collected (AK=Alaska, BC=British Columbia, WA=Washington, OR=Oregon, BB=Bodega Bay in California, SD=San Diego in California) SiteCode: One-letter identifier for site within a geographic region where the sample was collected (A, B, C, D, E, F) LocationName: Full name of each sampling site (eelgrass meadow) where samples were taken TidalHeight: Single letter indicating the tidal height at which samples were collected. U = upper tidal height; L = lower tidal height Transect: Integer indicating the transect at which samples were collected. Upper transects = 1, 2, 3; Lower transects = 4, 5, 6. SampleProcessingDate: Date when samples were processed in the lab Depth: Depth relative to MLLW (mean lower low water) Salinity: Salinity of surface water at the time of sampling (point measurement made with refractometer or probe) LocationComments: Comments describing location including changes between sampling year TransectBeginDecimalLatitude: Latitudinal coordinate for the beginning (meter 0) of the transect TransectBeginDecimalLongitude: Longitudinal coordinate for the beginning (meter 0) of the transect TransectEndDecimalLatitude: Latitudinal coordinate for the end (meter 20) of the transect TransectEndDecimalLongitude: Longitudinal coordinate for the end (meter 20) of the transect Year: Year in which samples were collected
NSF Eelgrass Disease Project 2019 Handbook filename: eelgrass_disease_project_handbook_v1.2.pdf (Portable Document Format (.pdf), 1.38 MB) MD5:f8f77aaf781cc5170a168012c938be31 NSF Eelgrass Disease Project 2019 Handbook v1.2 from MarineGEO

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Related Publications

Aoki, L. R., Rappazzo, B., Beatty, D. S., Domke, L. K., Eckert, G. L., Eisenlord, M. E., Graham, O. J., Harper, L., Hawthorne, T. L., Hessing-Lewis, M., Hovel, K. A., Monteith, Z. L., Mueller, R. S., Olson, A. M., Prentice, C., Stachowicz, J. J., Tomas, F., Yang, B., Duffy, J. E., … Harvell, C. D. (2022). Disease surveillance by artificial intelligence links eelgrass wasting disease to ocean warming across latitudes. Limnology and Oceanography, 67(7), 1577–1589. Portico. https://doi.org/10.1002/lno.12152
Related Research

Rappazzo, B. H., Eisenlord, M. E., Graham, O. J., Aoki, L. R., Dawkins, P. D., Harvell, D., & Gomes, C. (2021). EeLISA: Combating Global Warming Through the Rapid Analysis of Eelgrass Wasting Disease. Proceedings of the AAAI Conference on Artificial Intelligence, 35(17), 15156-15165. Retrieved from https://ojs.aaai.org/index.php/AAAI/article/view/17779
Methods

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Related Datasets

IsSupplementedBy

Harvell, D., Gomes, C. P., Hawthorne, T., Stachowicz, J. J., Duffy, J. E., Aoki, L. (2022) **In situ temperature measurements from eelgrass meadow field sites along the west coast of North America recorded from July 2019 to July 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-14 doi:10.26008/1912/bco-dmo.877355.1 [view at BCO-DMO]

University of California, Davis. 16S rRNA amplicon sequencing of eelgrass associated bacteria. 2022/02. In: BioProject [Internet]. Bethesda, MD: National Library of Medicine (US), National Center for Biotechnology Information; 2011-. Available from: http://www.ncbi.nlm.nih.gov/bioproject/PRJNA802566. NCBI:BioProject: PRJNA802566.

IsRelatedTo

Harvell, D., Gomes, C. P., Hawthorne, T., Stachowicz, J. J., Duffy, J. E., Aoki, L. (2022) **Eelgrass disease metrics from ecological field surveys along the eastern Pacific coast in June through August of 2019, 2020, and 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-13 doi:10.26008/1912/bco-dmo.879780.1 [view at BCO-DMO]

Harvell, D., Gomes, C. P., Hawthorne, T., Stachowicz, J. J., Duffy, J. E., Aoki, L. (2022) **Eelgrass shoot metrics from ecological field surveys in six regions along the eastern Pacific coast in June through August of 2019, 2020, and 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-10-13 doi:10.26008/1912/bco-dmo.878857.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Sample_Date	Date when samples were collected in the field	unitless
Sample_Id	Unique code identifying field samples based on the region, site, transect, tidal height, and sample replicate	unitless

Region	Two-letter identifier for the geographic region where the sample was collected (AK=Alaska, BC=British Columbia, WA=Washington, OR=Oregon, BB=Bodega Bay in California, SD=San Diego in California)	unitless
Site_Code	One-letter identifier for the site within a geographic region where the sample was collected (A, B, C, D, E, F)	unitless
Location	Full name of each sampling site (eelgrass meadow) where samples were taken	unitless
Tidal_Height	Single letter indicating the tidal height at which samples were collected. U = upper tidal height; L = lower tidal height	unitless
Depth	Depth relative to MLLW (mean lower low water)	meters (m)
Salinity	Salinity of surface water at the time of sampling (point measurement made with refractometer or probe)	ppt
Transect	Integer indicating the transect at which samples were collected. Upper transects = 1, 2, 3; Lower transects = 4, 5, 6.	unitless
Meter	Exact meter along the transect where an individual sample was collected (m4, m8, m12, m16, m20)	unitless
Density_Quadrat_Size	Size (area) of quadrat used to measure seagrass shoot densities in the field	square meters (m^2)
Total_Shoots	Total count of seagrass shoots (flowering and non-flowering) counted in the quadrat	unitless
Flowering_Shoots	Number of flowering shoots within the quadrat	unitless
Cover_Quadrat_Size	Size (area) of quadrat used to measure seagrass and macroalgae cover in the field	square meters (m^2)
Percent_Seagrass	Percent of quadrat area covered by seagrass canopy, from 0-1	unitless
Percent_Bare	Percent of quadrat area covered by bare sediment, from 0-1	unitless
Percent_Other	Percent of quadrat area covered by non-seagrass (e.g. macroalgae), from 0-1	unitless

Density_Shoots	Seagrass shoot density	shoots per square meter (shoots/m^2)
TransectBeginDecimalLatitude	Latitudinal coordinate for the beginning (meter 0) of the transect	decimal degrees
TransectBeginDecimalLongitude	Longitudinal coordinate for the beginning (meter 0) of the transect	decimal degrees
TransectEndDecimalLatitude	Latitudinal coordinate for the end (meter 20) of the transect	decimal degrees
TransectEndDecimalLongitude	Longitudinal coordinate for the end (meter 20) of the transect	decimal degrees
Notes	Comments from field and lab	unitless

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Instruments

Dataset-specific Instrument Name	handheld GPS
Generic Instrument Name	Global Positioning System Receiver
Dataset-specific Description	Transect locations were recorded using a hand-held GPS (exact model varied between field locations).
Generic Instrument Description	The Global Positioning System (GPS) is a U.S. space-based radionavigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis. The U.S. Air Force develops, maintains, and operates the space and control segments of the NAVSTAR GPS transmitter system. Ships use a variety of receivers (e.g. Trimble and Ashtech) to interpret the GPS signal and determine accurate latitude and longitude.

Dataset-specific Instrument Name	Epson Perfection V550 scanner
Generic Instrument Name	Image scanner
Dataset-specific Description	Cleaned eelgrass blades were imaged at high resolution (600 dpi) using an Epson Perfection V550 scanner.
Generic Instrument Description	An electronic device that generates a digital representation of an image for data input to a computer. OR a receiver designed to search for a signal within a specified frequency range. [Definition Source: NCI]

Dataset-specific Instrument Name	HOBO MX2201 temperature logger
Generic Instrument Name	Onset HOBO Pendant MX2201 temperature logger
Generic Instrument Description	The Onset HOBO MX2201 is an in-situ instrument for wet or underwater applications. It supports soil temperature, temperature, and water temperature. A one-channel logger that records up to approximately 96,000 measurements or internal logger events with 8K bytes memory. It has a polypropylene housing case. Uses Bluetooth to transmit data. Can be used with a solar radiation shield. Measurement range: -20 deg C to 70 deg C. Accuracy: +/- 0.50 deg C from 0 deg C to 50 deg C. Water depth rating: 30.5 m

Dataset-specific Instrument Name	HOBO UA-001-064 temperature logger
Generic Instrument Name	Onset HOBO Pendant Temperature/Light Data Logger
Generic Instrument Description	The Onset HOBO (model numbers UA-002-64 or UA-001-64) is an in-situ instrument for wet or underwater applications. It supports light intensity, soil temperature, temperature, and water temperature. A two-channel logger with 10-bit resolution can record up to approximately 28,000 combined temperature and light measurements with 64K bytes memory. It has a polypropylene housing case. Uses an optical USB to transmit data. A solar radiation shield is used for measurement in sunlight. Temperature measurement range: -20 deg C to 70 deg C (temperature). Light measurement range: 0 to 320,000 lux. Temperature accuracy: +/- 0.53 deg C from 0 deg C to 50 deg C. Light accuracy: Designed for measurement of relative light levels. Water depth rating: 30 m.

Dataset-specific Instrument Name	refractometer
Generic Instrument Name	Refractometer
Dataset-specific Description	Salinity was measured at the time of sampling using a refractometer.
Generic Instrument Description	A refractometer is a laboratory or field device for the measurement of an index of refraction (refractometry). The index of refraction is calculated from Snell's law and can be calculated from the composition of the material using the Gladstone-Dale relation. In optics the refractive index (or index of refraction) n of a substance (optical medium) is a dimensionless number that describes how light, or any other radiation, propagates through that medium.

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Project Information

Collaborative Research: The role of a keystone pathogen in the geographic and local-scale ecology of eelgrass decline in the eastern Pacific (Eelgrass disease)

Coverage: West coast of North America, from San Diego to Alaska

This project is part of the Marine Global Earth Observatory (MarineGEO), directed by the Smithsonian's Tennenbaum Marine Observatories Network (TMON); a global network of partners focused on understanding how coastal marine ecosystems work—and how to keep them working https://marinegeo.si.edu/

NSF Abstract:

Pathogens may be unrecognized key species in many ecosystems, causing massive impacts on other species and habitats despite the microscopic size of disease-causing organisms. Yet the triggers to disease epidemics likely involve complex interactions among changing environmental conditions and associated biological communities. In the ocean, understanding disease outbreaks has been hindered by inadequate knowledge of how these various influences interact to determine susceptibility and resilience to disease. This project integrates research in community and disease ecology with microbial genomics, geospatial analysis, and state-of-the-art computational approaches toward an unprecedented understanding of the causes and consequences of wasting disease in eelgrass, an important vegetation type supporting coastal and estuarine ecosystems throughout the northern hemisphere. The research advances frontiers in understanding the growing but poorly appreciated threat of marine diseases, how disease ecology interacts with environmental change, and its consequences for the extensive ecosystems and coastal communities that depend on eelgrass, across 23 degrees of latitude along the Pacific coast of North America. The research will inform better management of threatened seagrass ecosystems, which provide important services including fisheries habitat, erosion control, carbon storage, and capture of nutrient runoff. The research will foster integrative approaches in the next generation, including high school students, undergraduates, graduate students, and postdocs working on the project, and each investigator's institution will work to recruit participants from under-represented groups. Best practices developed under this award, including the Eelisa disease app and drone mapping, will be disseminated for broader surveillance of seagrass disease and coastal habitat quality by both professional and citizen scientists in coordination with the Global Ocean Observing System's (GOOS) develpoment of seagrass extent as an Essential Ocean Variable.

The triggers to marine disease epidemics are likely complex, and progress in understanding them has been hindered by a poor understanding of the multifaceted ecological context of the host-disease interaction. This project's overarching goal is to disentangle the web of direct and indirect interactions by which changing climate mediates prevalence of eelgrass wasting disease, and its consequences for threatened but important eelgrass ecosystems. The centerpiece is a comparative, cross-scale survey of eelgrass community composition, microbiome, and disease prevalence along thermal gradients of latitude and exposure to the ocean, providing the first coast-wide picture of disease dynamics in response to environmental change. In situ sampling will be linked to dynamics of eelgrass at landscape scales using unmanned aerial systems (drones) to quantify high-resolution changes in eelgrass extent and habitat quality. Experiments will test how the diverse biological community mediates impacts of the pathogen on eelgrass ecosystems.

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-1829890
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829922
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829921
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829992

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