

Please provide the following information, and submit to the NOAA DM Plan Repository.

Reference to Master DM Plan (if applicable)

As stated in Section IV, Requirement 1.3, DM Plans may be hierarchical. If this DM Plan inherits provisions from a higher-level DM Plan already submitted to the Repository, then this more-specific Plan only needs to provide information that differs from what was provided in the Master DM Plan.

URL of higher-level DM Plan (if any) as submitted to DM Plan Repository:

1. General Description of Data to be Managed

1.1. Name of the Data, data collection Project, or data-producing Program:

Coral Bleaching & Recovery Observations using Structure-from-Motion (SfM) Models from Main Hawaiian Islands Fixed Sites Surveyed from 2019 to 2021

1.2. Summary description of the data:

Coral adult demographic data described in this dataset are derived from the GIS analysis of benthic photomosaic imagery. This data includes coral species identification, bleaching extent and severity, colony diameter, perimeter, and planar size. The source imagery was collected using a Structure from Motion (SfM) approach during in-water surveys conducted by divers and is documented and described separately. The data was collected by the NOAA Pacific Islands Fisheries Science Center (PIFSC) Ecosystem Sciences Division (ESD; formerly the Coral Reef Ecosystem Division) and [on Hawaii Island] in partnership with State of Hawaii Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) during the 2019 bleaching event in the Main Hawaiian Islands, and in subsequent years (2020, 2021) to assess recovery. The SfM surveys were conducted at fixed sites ranging in depth from 18-52'. Sites were photographed using underwater cameras for later processing using one of two SfM approaches: using a spiral swim pattern (where divers take images continuously in a circular pattern covering a circle of 12m diameter), or within a defined box where divers swam back and forth to cover a 10 x 10m area. The photographs were processed using Agisoft Metashape software to generate orthomosaic images that were analyzed in ArcGIS for adult coral colony demographic metrics. Data was collected for each site within at least 10 randomly generated 0.49m² quadrats. Additional quadrats were analyzed if necessary until the sample sizes per species of interest were met. If a species had very low density at a given site (< 10 patches recorded within the first 10 quadrats), it was dropped from further observations. However, the data for these patches remains in the raw data in order to provide presence/absence data. Therefore, data should be carefully analyzed to ensure accurate species density calculations are done. Two datasets are provided: an annotations file which provides coral demographic information of 6 target species at 12 fixed sites across 3 years, as well as a site metadata file which describes the site and surveys which were used to generate models for which annotation data was derived.

Six species were assessed: *Montipora capitata* (MCAP), *Montipora patula* (MPAT), *Porites lichen* (PLIC), *Porites lobata* (PLOB), *Porites lutea* (PLUT), and *Pocillopora meandrina* (PMEA). Annotations included coral species identification, maximum diameter measurement, planar area measurement, morphology, and, for sites surveyed in 2019, bleaching extent and bleaching severity. Each coral was annotated at the patch level, and patches composing individual colonies, also known as genet, were assigned a unique genet ID number. The same coral patches were tracked over each time point, unless mortality of a coral patch occurred.

Note an update in methodology: The data was collected in two stages. During the first stage of data collection that was completed in 2021, for each coral patch, (≥ 5 cm in diameter), maximum diameter, ID (to lowest taxonomic level), morphology, bleaching extent (% of the patch with reduced pigmentation), and bleaching severity (1-3 from least to most severe) were recorded. In 2023 the methodology was updated for the second stage of data collection; the updated dataset includes measures of planar area and a "genet" (colony) identification column. The 2023 dataset was also collected following an update to the model process methodology (see Lineage). Users should refer to the most updated dataset published in 2023.

1.3. Is this a one-time data collection, or an ongoing series of measurements?

One-time data collection

1.4. Actual or planned temporal coverage of the data:

2019-10-08 to 2021-07-20

1.5. Actual or planned geographic coverage of the data:

W: -158.0667, E: -155.830367, N: 21.47959, S: 19.42335

Main Hawaiian Islands (MHI), including Hawaii, Maui, Oahu, and Lanai.

1.6. Type(s) of data:

(e.g., digital numeric data, imagery, photographs, video, audio, database, tabular data, etc.)
Table (digital)

1.7. Data collection method(s):

(e.g., satellite, airplane, unmanned aerial system, radar, weather station, moored buoy, research vessel, autonomous underwater vehicle, animal tagging, manual surveys, enforcement activities, numerical model, etc.)

1.8. If data are from a NOAA Observing System of Record, indicate name of system:

1.8.1. If data are from another observing system, please specify:

2. Point of Contact for this Data Management Plan (author or maintainer)

2.1. Name:

Lori H Luers

2.2. Title:

Metadata Contact

2.3. Affiliation or facility:

2.4. E-mail address:

lori.luers@noaa.gov

2.5. Phone number:

3. Responsible Party for Data Management

Program Managers, or their designee, shall be responsible for assuring the proper management of the data produced by their Program. Please indicate the responsible party below.

3.1. Name:

Morgan S Winston

3.2. Title:

Data Steward

4. Resources

Programs must identify resources within their own budget for managing the data they produce.

4.1. Have resources for management of these data been identified?

Yes

4.2. Approximate percentage of the budget for these data devoted to data management (specify percentage or "unknown"):

Unknown

5. Data Lineage and Quality

NOAA has issued Information Quality Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information which it disseminates.

5.1. Processing workflow of the data from collection or acquisition to making it publicly accessible

(describe or provide URL of description):

Lineage Statement:

Benthic imagery was collected at permanent sites and generated into 3D dense point clouds (DPCs) using Agisoft Metashape software. DPCs from the same site, but different collection dates were converted into 2D orthomosaics and scaled, oriented and aligned together. Orthomosaics were sub-sampled by randomly distributing quadrats throughout the orthomosaic. Quadrat location was conserved across all orthomosaics associated with the same permanent site. Target coral species were identified within each quadrat and their perimeters were annotated until a sufficient sample size of each

species was recorded. Annotations included coral species identification, maximum diameter measurement, planar area measurement, morphology, and, for sites surveyed in 2019, bleaching extent and bleaching severity. Each coral was annotated at the patch level, and patches composing individual colonies, also known as genets, were assigned a unique genet ID number. The same coral patches were tracked over each time point, unless mortality of a coral patch occurred.

Process Steps:

- SfM benthic surveys were conducted at fixed sites in the Main Hawaiian Islands during the 2019 bleaching event and during follow-up surveys in 2020 (Oahu only) and 2021. Imagery was collected using a digital camera in an underwater housing and white balance settings were adjusted in situ using a gray card. Prior to image collection, each site was set up by placing at least two scale bars of known length, with ground control points (GCPs) at the end of each bar, 2-3 m away from the center of the survey area. At many sites, rebar caps with GCPs were also placed on the reference pins (36 in tall stainless steel rods used to mark the site). During plot set up, one diver drew a diagram of the plot, marking the location of each scale bar, reference pin, and distinctive benthic features. The depth and identification numbers of each scale bar were recorded in the diagram as well. Divers swam ~1m off the seafloor, collecting enough photographs to produce 60%-80% image overlap and complete two full passes of the site. (Citation: Rodriguez C, Amir C, Gray A, Asbury M, Suka R, Lamirand M, Couch C, Oliver T. 2021. Extracting Coral Vital Rate Estimates at Fixed Sites Using Structure-from-Motion Standard Operating Procedures. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, 80 p. p. doi: <https://doi.org/10.25923/a9se-k649>)
- Images for each site were evaluated for image quality and images deemed unsatisfactory (e.g. overexposed, images of blue water or images of divers, or images not taken perpendicular to the reef) were removed from the image set. Following image quality control, each set of raw images were imported, aligned separately in Agisoft Metashape and used to build 3D dense point clouds (DPCs) following parameters described by Suka et al. (2019). Data collected before 2022 was only done for surveys conducted in 2019, and a subset of the metrics described in the Lineage Statement were collected. Different steps were also taken to prepare models for data collection. This pre-2022 collected data used DPCs that were imported into Viscore, a custom visualization software (Petrovic et al., 2014), where all DPCs from the same site, but from different time points, were scaled, oriented and aligned together using the GCP information. Each DPC was converted into a 2D orthorectified image (orthoprojection) and an identical top-down view of all orthoprojections of the same site but different time points were exported from Viscore. For data collected beginning in 2022, all scaling, orienting, alignment and 2D model creations were completed using Agisoft Metashape. (Citation: Rodriguez C, Amir C, Gray A, Asbury M, Suka R, Lamirand M, Couch C, Oliver T. 2021. Extracting Coral Vital Rate Estimates at Fixed Sites Using Structure-from-Motion Standard Operating Procedures. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, 80 p. p. doi: <https://doi.org/10.25923/a9se-k649>)

- Due to the labor-intensive and time-consuming nature of annotation, in 2022 we used a randomized sub-sampling strategy that provided enough colony-level data across a wide range of size classes to fit robust demographic models. To sub-sample each site, we selected the region where there was the most spatial overlap across all orthomosaics of the same site. Next, 10-30 2.5m² quadrats were generated at random throughout the selected area and each labeled in numerical order. Within the first 10 quadrats, all coral species on the target coral species list were annotated if their centroid fell within the quadrat. Corals were annotated by tracing the full perimeter of live coral tissue patches. During annotation, the original JPEG imagery was viewed alongside the orthomosaic to see fine scale colony details, observe colonies from multiple angles and locate colonies not visible in the orthomosaic (e.g. under ledges). Following Rodriguez et al. (2021), if a coral species per site was found less than 10 times in the first 10 quadrats, the species was subsequently not recorded in future analyzed quadrats. Therefore, this data should be carefully analyzed and species density should not be calculated for these species with low sample size. If a species had low density at a given site, 20-40 patches were annotated. If a species was abundant at the site, at least 40 patches were annotated. See Rodriguez et al. (2021) for further information. Unique identifying numbers were assigned to each patch of live coral tissue to link coral patches across time and to track fission/fusion events. (Citation: Rodriguez C, Amir C, Gray A, Asbury M, Suka R, Lamirand M, Couch C, Oliver T. 2021. Extracting Coral Vital Rate Estimates at Fixed Sites Using Structure-from-Motion Standard Operating Procedures. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, 80 p. p. doi: <https://doi.org/10.25923/a9se-k649>)

- Annotations created in ArcGIS Pro were quality controlled using a multi-stage process. Data was exported from ArcGIS and quality controlled in R with specific queries to identify and correct data entry errors (e.g. misspelled species names, data in incorrect columns, bleaching >100%). Coral patches composing the same colony or genet were assigned unique genet ID numbers.

5.1.1. If data at different stages of the workflow, or products derived from these data, are subject to a separate data management plan, provide reference to other plan:

5.2. Quality control procedures employed (describe or provide URL of description):

Prior to generating the 3D dense point clouds and 2D orthomosaics, the JPEG imagery was evaluated for image quality and images deemed unsatisfactory (e.g. overexposed, images of blue water or images of divers, or images not taken perpendicular to the reef) were removed from the image set. During annotation in ArcMap, the original JPEG imagery was viewed alongside the orthomosaic using Agisoft or Viscore Image View feature to see fine scale colony details, observe colonies from multiple angles and locate colonies not visible in the orthomosaic. Annotations created in ArcMap were quality controlled using a multi-stage process. Data were quality controlled in R with specific queries to identify and correct data entry errors (e.g. misspelled species names, missing

segments, data in incorrect columns, % bleaching >100%).

6. Data Documentation

The EDMC Data Documentation Procedural Directive requires that NOAA data be well documented, specifies the use of ISO 19115 and related standards for documentation of new data, and provides links to resources and tools for metadata creation and validation.

6.1. Does metadata comply with EDMC Data Documentation directive?

No

6.1.1. If metadata are non-existent or non-compliant, please explain:

Missing/invalid information:

- 1.7. Data collection method(s)

6.2. Name of organization or facility providing metadata hosting:

NMFS Office of Science and Technology

6.2.1. If service is needed for metadata hosting, please indicate:

6.3. URL of metadata folder or data catalog, if known:

<https://www.fisheries.noaa.gov/inport/item/65764>

6.4. Process for producing and maintaining metadata

(describe or provide URL of description):

Metadata produced and maintained in accordance with the NOAA Data Documentation Procedural Directive: https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC_PD-Data_Documentation_v1.pdf

7. Data Access

NAO 212-15 states that access to environmental data may only be restricted when distribution is explicitly limited by law, regulation, policy (such as those applicable to personally identifiable information or protected critical infrastructure information or proprietary trade information) or by security requirements. The EDMC Data Access Procedural Directive contains specific guidance, recommends the use of open-standard, interoperable, non-proprietary web services, provides information about resources and tools to enable data access, and includes a Waiver to be submitted to justify any approach other than full, unrestricted public access.

7.1. Do these data comply with the Data Access directive?

Yes

7.1.1. If the data are not to be made available to the public at all, or with limitations, has a Waiver (Appendix A of Data Access directive) been filed?

7.1.2. If there are limitations to public data access, describe how data are protected from unauthorized access or disclosure:

7.2. Name of organization of facility providing data access:

National Centers for Environmental Information - Silver Spring, Maryland (NCEI-MD)

7.2.1. If data hosting service is needed, please indicate:**7.2.2. URL of data access service, if known:**

<https://accession.nodc.noaa.gov/0283598>

<https://accession.nodc.noaa.gov/0283598>

<https://accession.nodc.noaa.gov/0283598>

<https://accession.nodc.noaa.gov/0244392>

<https://accession.nodc.noaa.gov/0244392>

<https://accession.nodc.noaa.gov/0209239>

7.3. Data access methods or services offered:

Data can be accessed online via the NOAA National Centers for Environmental Information (NCEI) Ocean Archive.

7.4. Approximate delay between data collection and dissemination:

Unknown

7.4.1. If delay is longer than latency of automated processing, indicate under what authority data access is delayed:**8. Data Preservation and Protection**

The NOAA Procedure for Scientific Records Appraisal and Archive Approval describes how to identify, appraise and decide what scientific records are to be preserved in a NOAA archive.

8.1. Actual or planned long-term data archive location:

(Specify NCEI-MD, NCEI-CO, NCEI-NC, NCEI-MS, World Data Center (WDC) facility, Other, To Be Determined, Unable to Archive, or No Archiving Intended)

NCEI_MD

8.1.1. If World Data Center or Other, specify:**8.1.2. If To Be Determined, Unable to Archive or No Archiving Intended, explain:****8.2. Data storage facility prior to being sent to an archive facility (if any):**

Pacific Islands Fisheries Science Center - Honolulu, HI

8.3. Approximate delay between data collection and submission to an archive facility:

Unknown

8.4. How will the data be protected from accidental or malicious modification or deletion prior to receipt by the archive?

Discuss data back-up, disaster recovery/contingency planning, and off-site data storage

relevant to the data collection

NOAA IRC and NOAA Fisheries ITS resources and assets.

9. Additional Line Office or Staff Office Questions

Line and Staff Offices may extend this template by inserting additional questions in this section.