

*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:**

Structure from Motion (SfM) Coral Vital Rates Annotations derived from Fixed Site Imagery across the U.S. Pacific since 2014

### **1.2. Summary description of the data:**

The data described here are coral planar area measurements derived from the analysis of benthic photomosaic imagery collected at fixed sites across Pacific Island regions since 2014. The source imagery was collected using a Structure from Motion (SfM) approach during in-water surveys conducted by divers. Imagery archival is documented separately here: <https://www.fisheries.noaa.gov/inport/item/63091>. All sites were surveyed at least twice and image collection intervals ranged from a few minutes (for error estimation) to 5 years apart. In situ surveys, post-processing, and analysis were funded by NOAA Coral Reef Conservation Program (CRCP) and Ocean Acidification Program (OAP). Data collection was conducted by the NOAA Fisheries, Ecosystem Sciences Division (ESD).

Survey sites consisted of sites previously established by collaborators from Scripps Institution of Oceanography, starting as far back as 2014, and new sites established in 2019 by NOAA ESD. During each survey, physical markings which identify each permanent survey site were either established or found using GPS coordinates previously collected. During image collection, the diver swam at a constant distance from the bottom of the reef while continuously capturing overlapping photographs, capturing approximately 100 m<sup>2</sup> of reef habitat. 3D dense point clouds (DPCs) and 2D orthorectified images (orthoprojections) derived from these photographs were used to measure changes in coral vital rates (e.g. recruitment, mortality, growth) over time.

Due to the labor-intensive and time-consuming nature of coral annotation, 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. Each site was sub-sampled by randomly distributing a minimum of 10 0.5 m<sup>2</sup> quadrats throughout each orthoprojection. All corals whose centroid fell within the quadrat were annotated until a sufficient number of corals were annotated ( $n \geq 30$  for each target coral species). The target taxa species consisted of two genera - Pocillopora and Porites.

In total, this dataset currently includes planar area and associated vital rates measurements for 5 coral species in 2 genera (Pocillopora and Porites) at 14 sites throughout the Hawaiian Archipelago and 3 genera (Pocillopora, Porites and Acropora) at 10 sites throughout the Mariana Archipelago.

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

Ongoing series of measurements

**1.4. Actual or planned temporal coverage of the data:**

2014-01-27 to Present

**1.5. Actual or planned geographic coverage of the data:**

W: 144.618287, E: -154.806789, N: 28.455623, S: -14.373615

**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:**

Corinne Amir

**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 orthoprojections and scaled, oriented and aligned together. Next, the orthoprojections were exported for annotation.

Orthoprojections were sub-sampled by randomly distributing quadrats throughout the orthoprojection. Quadrat location was conserved across all orthoprojections 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. The changes in coral planar area of each coral colony was tracked by linking annotations of the same live coral across each time point. All statistics and figures were performed in R.

Process Steps:

- 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. Measuring Coral Vital Rates Using Structure-from-Motion Photogrammetry at Fixed Sites: Standard Operating Procedures and Error Estimates. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, <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). For the Hawaiian Archipelago dataset, DPCs were then 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 the Mariana Archipelago dataset, 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. Measuring Coral Vital Rates Using Structure-from-Motion Photogrammetry at Fixed Sites: Standard Operating Procedures and Error Estimates. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, <https://doi.org/10.25923/a9se-k649>)

- Due to the labor-intensive and time-consuming nature of annotation, 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 orthoprojections of the same site. Next, 10-30 0.5m<sup>2</sup> quadrats were generated at random throughout the selected area and each labelled 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 orthoprojection to see fine scale colony details, observe colonies from multiple angles and locate colonies not visible in the orthoprojection (e.g. under ledges). If one or several coral species on the target list did not reach n = 30 live patches within the first 10 quadrats. These species were identified and annotated in additional quadrats, and sometimes outside the quadrats, until a higher sample size could be reached. Unique identifying numbers were assigned to each patch of live coral tissue 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. Measuring Coral Vital Rates Using Structure-from-Motion Photogrammetry at Fixed Sites: Standard Operating Procedures and Error Estimates. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, <https://doi.org/10.25923/a9se-k649>)

- Annotations were exported and quality controlled in R with specific queries to identify and correct data entry errors (e.g. misspelled species names, missing coral unique identifier, data in incorrect columns). Before analysis, all corals patches < 19 cm<sup>2</sup> and corals that were not present in both the initial and final time point were removed from the dataset. For the Hawaiian archipelago dataset, absolute change in coral patch area (cm<sup>2</sup>) was calculated in R. (Citation: Rodriguez C, Amir C, Gray A, Asbury M, Suka R, Lamirand M, Couch C, Oliver T. 2021. Measuring Coral Vital Rates Using Structure-from-Motion Photogrammetry at Fixed Sites: Standard Operating Procedures and Error Estimates. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-120, <https://doi.org/10.25923/a9sek649>)

**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):**

During coral annotation, the original JPEG imagery was viewed alongside the orthoprojection using the Viscore Image View feature to see fine scale colony details, observe colonies from multiple angles and locate colonies not visible in the orthoprojection. Annotations were quality controlled in R with specific queries to identify and correct data entry errors (e.g. misspelled species names, missing or duplicated coral colony ID, data in incorrect columns).

## 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/63093>

**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](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/0282457>

<https://accession.nodc.noaa.gov/0257945>

<https://repository.library.noaa.gov/view/noaa/32739>

### 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.*