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:
Guam Long-term Coral Reef Monitoring Program Benthic Images since 2010

1.2. Summary description of the data:
The data products described herein document the status and trends for benthic cover and composition at the monitoring sites mentioned above. Benthic cover and coral and algal generic diversity are currently assessed using digital photo transects. The still images provide a permanent record of the transects and are quantitatively analyzed using Coral Point Count with Excel extensions (CPCe; Kohler and Gill, 2006) point sampling software to obtain benthic cover estimates. Power analyses support the methodological approach, whereby statistically sound benthic cover estimates can be successfully derived. Benthic percent cover is calculated at the sampling station level (= one 25 m transect) for data derived from benthic images.

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:

1.5. Actual or planned geographic coverage of the data:
W: 144.789408, E: 144.798507, N: 13.517207, S: 13.510711
These bounding coordinates pertain to the Tumon Bay site boundaries modified after the 2010 survey effort and prior to the 2012 survey effort; these are the current boundaries for the Tumon Bay monitoring site.
W: 144.784502, E: 144.795528, N: 13.512988, S: 13.508506
These bounding coordinates pertain to the original Tumon Bay site surveyed in 2010. The site boundaries were modified prior to the 2012 surveys; the coordinates of the modified site boundaries are presented in a separate Geographic Area above.

W: 144.758065, E: 144.766983, N: 13.491396, S: 13.483792
These bounding coordinates pertain to the current boundaries for the East Agana Bay site, which has been monitored since 2010.

These bounding coordinates pertain to the Western Shoals monitoring site in Apra Harbor. The Western Shoals site has not been re-surveyed since 2011 due to a shift in management priorities.

W: 144.683913, E: 144.697634, N: 13.47632, S: 13.468317
These bounding coordinates pertain to the Piti (Tepungan) Bay site, which has been surveyed since 2012.

These bounding coordinates pertain to the current Achang monitoring site boundaries, which were established in 2014.

W: 144.674888, E: 144.685944, N: 13.23992, S: 13.235939
These bounding coordinates pertain to the current Cocos-East site, which was established in 2014.

W: 144.653677, E: 144.656082, N: 13.305903, S: 13.303514
These bounding coordinates pertain to the current Fouha Bay monitoring site, which was established in 2015.

1.6. Type(s) of data:
(e.g., digital numeric data, imagery, photographs, video, audio, database, tabular data, etc.)
Image (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:
2.2. Title: Metadata Contact

2.3. Affiliation or facility:

2.4. E-mail address: burdickd@triton.uog.edu

2.5. Phone number: 671-735-2175

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: David R Burdick

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:
The Benthic Photo Transect Survey methodology, employed by the Guam Long-term Coral Reef Monitoring Program since 2010

Process Steps:
- Benthic photo transect surveys are carried out at all sampling stations. All sampling stations have been selected in hard-bottom habitats using a stratified random sampling design, and the stations have been designed using the split-panel
approach (combination of fixed and non-fixed transects).

- Each sampling station is located using a GPS receiver. Upon reaching a given station, a small weight and line tied to a buoy is carefully lowered to the ocean floor. In optimal situations where four divers are available, two divers enter the water first to carry out the fish surveys. Starting at the weight tied to the buoy, a 30 m transect is laid out [25 m-long transects were used prior to 2017]. The transect is laid out in a clockwise direction relative to the island, following the depth contour if it is readily determined; if the area is relatively flat and a depth contour is not readily discernible the transect is laid at an angle parallel to the reef margin (which is determined prior to entering the water). Compact digital point and shoot cameras and housings are used by individual observers to document unknown organisms, incidences of coral disease, and species/behaviors of special interest. For the initial establishment of fixed sampling stations, 24 inch rebar is installed at the beginning of the transect and 12 inch rebar is installed at the center and end of the transect. For the Western Shoals site, rebar was not used and instead a small PVC float was tied to dead coral with a line at the beginning of the transect and large zip ties were placed at the beginning, middle, and end of the transect. To minimize diver disruptions, the two divers conducting the benthic surveys enter the water approximately 20-30 minutes after the divers conducting the fish surveys, once the fish team has finished enumerating fish. In situations where only three divers are available, all three divers enter the water at the same time and remain as a three-person buddy team to ensure diver safety throughout the survey. A fish diver partners with a benthic diver when two fish divers are not available. In this situation, the fish diver lays the transect and conducts the first SPC at 22.5 m while the benthic diver works from 0-15 m; they then switch positions along the transect.

- At the start of a benthic survey, one of the divers begins the photo transect and captures non-overlapping digital photos every 0.5 meters along the left side of a 30-meter transect, for a total of 30 images; prior to 2017 the diver would return along the right side of a 25 m transect (for a total of 50 images). Beginning in 2017, images are obtained using a 20 megapixel Sony Cybershot RX-100 digital point and shoot camera (in a Nauticam NA-RX100 housing with a red filter) mounted on a PVC monopod. Prior to 2017, several different cameras in underwater housings were mounted to PVC frame such that a 0.5 m x 0.5 m quadrat at the base of the frame is visible within each image. Please refer to the Data Quality/Comparability section in this record for detailed information about the PVC monopod and frame as well as the camera models used for the benthic photo transect surveys.

- Beginning in 2016 images are retrieved from the camera's memory card using Adobe Lightroom and are attributed with keywords according to date, site, station, and transect. The white balance of a single representative image for a given transect is adjusted and the settings synced with the rest of the images from that transect. The images are then exported as high quality jpegs to the appropriate folder within a well-defined hierarchical directory structure. The original, unedited RAW files retrieved by Lightroom from the memory card are stored in a separate folder and are organized only by date. Prior to 2016, images were copied from the
camera’s memory card and placed directly within the hierarchical directory structure. A batch color correction action was applied to all images within a given folder (= one transect), with the resulting edited image saved to a sub-folder separate from the location of the original unedited images. A free application called File Renamer (http://www.webxpace.com) was then used to rename all of the color-corrected image files within a given folder (= one transect) using a batch renaming action. Images are named using the following template: SIT-ST_YEARMMDD_T_S.jpg, where SIT = three letter side code, ST = sampling station number, YEARMMDD = date, T = transect number, and S = transect side (e.g., TUM-36_20170924_1_L). Beginning in 2016, the re-named images were added to Lightroom to reflect the new location of the edited jpeg files. The original and color-corrected/renamed images obtained prior to 2016 were added to Lightroom in 2016.

All images are automatically backed up to cloud storage on a regular basis.

- Percent cover is estimated from quantitative analysis of the benthic still images using Coral Point Count with Excel extensions (CPCe; Kohler and Gill, 2006), a software application developed by Nova Southeastern Universitys National Coral Reef Institute. Images are opened within the CPCe program and the area for image analysis is set for those images obtained using the PVC quadrat; the image area does not need to be defined for those images obtained using the monopod (beginning in 2017). Initially, each frame was analyzed using 25 random points stratified with a 5 x 5 grid. After conducting a series of tests using various combinations of images and points in an effort to maximize accuracy while minimizing effort, it was determined that 16 random points stratified using a 4 x 4 grid would provide the desired accuracy and efficiency. The use of 16 points per frame began with the 2014 images. The benthic feature falling directly underneath each point is identified to the lowest taxonomic level possible. The taxonomic level can be divided into four tiers: Tier 1 (function group-broad-e.g., hard coral, soft coral, macroalgae, turf algae, etc.); Tier 2 (functional group-specific-e.g., Hard Coral = massive, branching, foliose, encrusting, etc.; Macroalgae = fleshy erect macroalgae, adherent macroalgae); Tier 3 (genus-e.g., Hard Coral = Acropora, Montipora, Pocillopora, etc.; Macroalgae = Padina, Dictyota, Dictosphaeria, etc.); and Tier 4 (species and species-groups- Hard Coral = Porites rus, massive Porites spp., etc.). Hard corals are identified to genus or species for the vast majority of points and only on rare occasion are they identified at the Tier 2 or Tier 1 level. A "note" is added to points that fall on recently dead or diseased corals; the note indicates the likely cause of the mortality or the name of the disease. However, a note is only provided if the point falls directly on an area of recently dead tissue or disease activity. If a point falls precisely on the border between two benthic categories (e.g., coral-algae), the benthic category occupying the greatest area within symbol (circle wrapping the cross-hairs) is classified. Additionally, if the two benthic categories occupy equal space within the symbol, the benthos falling on the top left quadrant within the point symbol is classified. The category Shadow is used when the point falls on an area that is dark and the nature of the benthos cannot be assessed due to diminished light. The categories Tape and Frame are used when the point falls on a transect line/tape measure or
photo quadrat frame. Percent cover is calculated at the sampling station level.

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):
Quality control is carried out by the Monitoring Program Coordinator or the full-time technical support staff and involves reviewing CPCe output files for all images for at least 25% of the total number of sampling stations for each monitoring site. If a significant number of misidentifications are encountered the original photo analyst is asked to undergo additional training and then re-analyze the images; alternatively, the monitoring program coordinator or technical support staff will re-analyze all the images for the site(s) in question. CPCe output files generated through an analysis of images carried out by the monitoring program coordinator do not undergo a quality control check.

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)
- 7.2. Name of organization of facility providing data access
- 7.2.1. If data hosting service is needed, please indicate

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/47788

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:

7.2.1. If data hosting service is needed, please indicate:

7.2.2. URL of data access service, if known:
http://accession.nodc.noaa.gov/accession#

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):
   University of Guam Marine Laboratory - Mangilao, GU

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
   University of Guam Marine Lab 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.