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 Macroinvertebrate Belt Transects since 2010

1.2. Summary description of the data:

The Government of Guam's Comprehensive Long-term Monitoring at Permanent Sites in Guam project, also known as the Guam Long-term Coral Reef Monitoring Program (GLTMP), is a NOAA-funded project currently coordinated through the University of Guam Marine Laboratory. The program involves the regular, intensive collection of data for a suite of coral reef ecosystem health parameters at high priority reef areas (HPRAs) around Guam, as well as critical support for coral bleaching response and other activities carried out by the multi-partner Guam Coral Reef Response Team. The program currently utilizes a split-panel sampling approach, whereby a mix of permanent and non-permanent sampling stations (one sampling station = one transect) are visited within each HPRA. The HPRAs were selected by an advisory body comprised of reef managers, researchers, and technicians; these reef areas were not intended to be representative of Guam's reefs more broadly. The locations of the sampling stations within each HPRA are generated randomly using GIS software. Various coral reef surveys are carried out on an annual basis along the seaward slope between 7 and 15 m depth in the Tumon Bay Marine Preserve and in East Agana Bay, while surveys are carried out biennially within the Piti Bomb Holes Marine Preserve, the Achang Reef Flat Marine Preserve, and the eastern side of the Cocos Barrier Reef (Cocos-East). Surveys were also carried at along reef margin (1-2 m) and slope (2-15 m) of Western Shoals, in Apra Harbor, in 2011. The surveys, which are currently conducted by University of Guam Marine Laboratory biologists, and which were supported by NOAA PIRO through 2019, currently include benthic photo transects, stationary point count fish surveys, macroinvertebrate belt transects, and chain-length rugosity surveys. The GLTMP has conducted surveys at the Tumon and East Agana HPRAs since 2010, the Piti HPRA since 2012, and the Achang and Cocos-East HPRAs began in 2014. Surveys for Fouha Bay HPRA began in 2015 with data collections also occurring in 2019 and 2021, but the site has not been re-visited due to shifting management priorities. Baseline data is available for the Western Shoals HPRA from 2011 but this site has not been re-visited.

Macroinvertebrates are culturally, economically, and ecologically important resources for the people of Guam. In recognition of the value and importance of this resource, macroinvertebrate surveys are a key component of the Guam Long-term Coral Reef Monitoring Program. Macroinvertebrate surveys have been conducted at high priority reef areas around Guam since August 2010. The monitoring team counts the number of most commercially and ecologically important macroinvertebrate species within a 4 m x 30 m belt transect (4 x 25 m prior to 2017) at all sampling stations (except at the Western Shoals stations, where 4 m x 15 m belts were used). The longest dimension of Tridacna individuals is also recorded. These monitoring data on macroinvertebrate communities allow for the exploration of community structure by functional group and can be used to detect changes in macroinvertebrate communities over time.

IMPORTANT: Macroinvertebrate taxa consistently targeted by this survey since 2010 include Acanthaster planci (= A. cf. solaris), Actinopgya spp., Bohadschia spp., Charonia tritonis, Culcita novaeguineae, Diadema spp., Echinothrix spp., Holothuria spp., Lambis spp., Leiaster leachi, Linckia guildingi, L. laevigata, Octopus cyanea, Pearsonothuria graeffei, Stichopus spp., Tectus (= Rochia) spp., Thelenota ananas, Tridacna spp., and Tripneustes gratilla. Boring urchins (e.g., Echinometra spp. and Echinostrephus aciculatus) and small sea stars (Echinaster luzonicus, Fromia spp., Gomophia egyptiaca, Linckia multiflora) were dropped from the survey beginning in 2020, as it was clear that the survey method employed by the GLTMP was not appropriate for the consistent detection of these taxa. Anemones, crustaceans, and smaller molluscs (e.g., Cypraea spp., Turbo spp.) were not a focus of the survey and were recorded inconsistently between 2010 and 2019; these taxa were also officially omitted from the survey beginning in 2020. Observations of boring urchins, small sea stars, and these other small or cryptic taxa are included in the dataset archived with NCEI, but it is highly recommended that only larger, conspicuous macroinvertebrates be used to calculate total invertebrate density and invertebrate group density at the transect level, and that densities of the other taxa be utilized cautiously. It should also be noted that nocturnally active macroinvertebrates, such as Diadema spp., Echinothrix spp., Leister leachi, and some holothuroid taxa, were likely undercounted.

IMPORTANT: The 2010-2019 macroinvertebrate observations dataset initially archived with NCEI did not include zero count records, which could result in erroneous density values when averaging count or density values. Zero count records were added to the dataset using a custom R script, and updated datasets gave since been archived with NCEI.

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:

2012-09-05 to 2012-11-19, 2014-09-03 to 2014-09-09, 2015-06-23 to 2015-07-01, 2017-04-10 to 2017-05-17, 2010-08-04 to 2010-09-03, 2018-10-23 to 2018-11-15, 2019-07-02 to 2019-08-30, 2020-07-23 to 2020-10-13, 2021-06-23 to 2021-08-18, 2022-08-05 to 2022-09-28, 2023-05-11 to 2023-06-29, 2024-07-10 to 2024-08-16, 2010-09-07 to 2010-11-26, 2012-11-16 to 2012-11-28, 2014-09-10 to 2014-09-16, 2016-02-16 to 2016-04-05, 2017-07-12 to 2017-07-20, 2018-

11-15 to 2018-11-29, 2019-09-05 to 2019-09-06, 2020-10-13 to 2020-11-24, 2021-08-04 to 2021-09-03, 2022-09-29 to 2022-10-27, 2023-08-16 to 2023-09-13, 2024-08-16 to 2024-11-19, 2011-07-11 to 2011-08-19, 2012-07-23 to 2012-08-31, 2014-09-17 to 2014-11-13, 2017-11-15 to 2017-12-15, 2018-03-01 to 2018-03-09, 2020-06-30 to 2020-07-16, 2022-05-22 to 2022-08-04, 2024-09-26 to 2024-11-08, 2014-10-22 to 2014-10-27, 2018-07-26 to 2018-09-27, 2021-04-21 to 2021-05-14, 2023-06-30 to 2023-08-25, 2014-10-27 to 2014-10-28, 2018-08-24 to 2018-09-25, 2021-04-30 to 2021-06-10, 2023-10-19 to 2023-11-08, 2015-05-06 to 2015-10-27, 2019-05-09 to 2019-06-04, 2021-05-19 to 2021-06-11

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
W: 144.653292, E: 144.656443, N: 13.454042, S: 13.449599
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.
W: 144.69765, E: 144.712233, N: 13.242611, S: 13.239282
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.)
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:
David R Burdick

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 Macroinvertebrate Survey methodology, employed by the Guam Long-term Coral Reef Monitoring Program since 2010

Process Steps:

- Macroinvertebrate belt transect surveys are carried out at all sampling stations within a monitoring site when program capacity is sufficient to do so. 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; four-inch concrete nails are installed in at least two of the corners of each quadrat used for coral size and condition surveys. For the Western Shoals site, rebar and concrete nails were 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. Two small zip ties were used to mark two corners of each permanent quadrat location. [Note that due to capacity limitations coral quadrat surveys were eliminated beginning in 2020; the nails for quadrats at some sampling stations have been maintained opportunistically] To minimize diver disruptions, the two divers conducting the benthic surveys enter the water after 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 so that the fish diver can carry out the second SPC. Beginning in 2020, most surveys have been conducted by a single pair of divers. After deploying the transect tape the two divers would simultaneously carry out a reef fish SPC survey replicate (if both observers were trained and calibrated) or if only one of the divers was trained and calibrated this individual would carry out both replicates,

one after the other. Following the completion of the reef fish survey replicates, one diver would carry out the benthic photo transect survey while the other carried out the macroinvertebrate belt transect survey and the rugosity survey.
- The macroinvertebrate belt transect survey is usually carried out by the same person who carries out the benthic photo transect, but may be carried out by the coral quadrat diver or by a diver dedicated wholly to the macroinvertebrate survey. A set of commercially and ecologically important macroinvertebrates are counted within a 4 m x 30 m belt (4 m x 25 m prior to 2017, 4 m x 15 m belt at Western Shoals site) centered on the transect tape placed by the fish team. The diver carries out the survey by counting macroinvertebrates along one side of the transect tape (a 2 m belt) and returning along the other side (another 2 m belt), being careful not to double count species near the transect tape or which may have moved from one side to the other. A meter-long PVC pipe is used by the diver to ensure that their estimate of belt width is accurate. Macroinvertebrate taxa surveyed include large echinoids, holothuroids, edible mollusks (Tridacna spp., Charonia tritonis, Trochus/ Tectus spp., Lambis spp., Octopus spp.), and large seastars (e.g., Acanthaster, Linkcia). Tridacna spp. are measured to the nearest centimeter.
- Raw data include individual records for each observed macroinvertebrate taxa, along with corresponding methodological information and physical data that reflect the description of the site. An individual record for each observed macroinvertebrate taxa includes species/genus identification, count, and taxonomic group (e.g., sea urchin, edible shell, sea star, etc.). The maximum length of Tridacna are also recorded during the survey but are not currently entered into the database. These measurements are available upon request. The physical and methodological data for all records includes the following: site, station, station type, date (day, month, year), latitude (dd), longitude (dd), station type (fixed, unfixed), transect number, transect length, transect width (m), depth (m), habitat

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):
All observations entered into the database through the online data entry system are compared against observations recorded on the raw data sheet. Once all database records are verified the quality control process is marked as complete for all observations associated with a given station/sampling period. It should also be noted that the data management system employs hard and soft validation to minimize data entry errors.

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/47782

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:
https://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.