



Metadata Findings and Recommendations for the Inventory and Monitoring Division of the National Park Service

Natural Resource Report NPS/NRSS/IMD/NRR—2019/1956





ON THIS PAGE

Picture of the Chesapeake and Ohio Canal at sunrise.
National Park Service photo taken by Thomas Paradis

ON THE COVER

Picture of a red maple (*Acer rubrum*) in Rock Creek Park
National Park Service photo taken by Thomas Paradis

Metadata Findings and Recommendations for the Inventory and Monitoring Division of the National Park Service

Natural Resource Report NPS/NRSS/IMD/NRR—2019/1956

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4598 MacArthur Blvd., NW

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July 2019

U.S. Department of the Interior

National Park Service

Natural Resource Stewardship and Science

Fort Collins, Colorado

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Please cite this publication as:

Sanders, G. 2019. Metadata recommendation and implementation plan Inventory and Monitoring Division of the National Park Service. A report from the Metadata Working Group. Natural Resource Report NPS/NRSS/IMD/NRR—2019/1956. National Park Service, Fort Collins, Colorado.

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Executive Summary

The Long-term Data Management Task Force (LTDM TF) was established in 2016 to engage the program in developing a vision and plan for how the Inventory and Monitoring Division (IMD) would manage data and information far into the future. During the process of developing their recommendation, the LTMD TF evaluated numerous criteria and requirements and developed assumptions and activities for each of the alternatives. Some of these assumptions and activities related specifically to metadata, including the importance of metadata formatting and content requirements. Addressing metadata requirements was one of the recommended “first steps” in implementing the Remodeled Data Store. The Long-term Data Management Governance Board (LTDM GB) was formed in order to start implementing and developing the recommendations of the LTDM TF. The Governance Board assigned tasks to working groups to accomplish this.

The Metadata Working Group was the first group formed under the LTDM GB with the goal of researching and recommending an appropriate metadata standard or standards that will be adopted and implemented by IMD. The Remodeled Data Store will be designed to incorporate these recommendations. The group was composed of an interdisciplinary group of individuals from across the NPS. Group members collaborated to review existing standards, identify content requirements, research implementation approaches, and develop recommendations for the LTDM GB.

The working group reviewed existing metadata standards including the ISO Suite of standards, Ecological Metadata Language (EML) and Darwin Core. The group also consulted with outside agencies to gain perspective and input as well working with subject matter experts to help identify the most appropriate recommendations to make to the LTDM GB. In the end the Metadata Working Group made the following recommendations:

1. Adopt the ISO Suite of Standards as the official IMD metadata standard. This recommendation is based on input from subject matter experts and trends from other government agencies.
2. The NPS Data Store should manage metadata information in a flexible and standard-agnostic manner. Even though the working group recommends adopting the ISO suite of standards as the official standard for IMD, the group recognizes the value of sharing metadata in various formats, and recommends the ability to consume and produce metadata in formats (at least EML and the ISO suite) that support a variety of user communities.
3. Adopt the more consistent use of standard vocabularies for metadata generation in order to improve management and discoverability of data sets.

Acknowledgments

The Metadata Working Group was a collaborative effort that was successful due to the time and effort devoted by each of the group members.

We acknowledge and thank the following for being members of the Metadata Working Group: Katherine Beirne, Nell Conti, Hannah Dean, Fred Dieffenbach, Eric Dinger, Andy Duff, Alex Eddy, Mark Hart, Simon Kingston, Kelly Kozar, Jeff Lonneker, Gareth Rowell, Jenn Sieracki, Dennis Skidds, Helen Thomas, Carmen Thomson, and Sarah Wakamiya.

We also sincerely thank Jennifer Carlino for taking the time for numerous phone conversations and for presenting information to the working group. Her sage advice and perspective on evolving federal metadata standards, especially in the geospatial community, was invaluable.

We also would like to thank those who supervise and manage the group members for allowing them the time and flexibility to take part in this effort.

List of Terms

CSDGM: Content Standard for Digital Geospatial Metadata (1998) was a widely-used, but no longer current standard defining the information content for a set of digital geospatial data required by the US Federal Government. CSDGM was sponsored by the US Federal Geographic Data Committee. However, in September 2010 the FGDC endorsed ISO 19115 and began encouraging federal agencies to transition to ISO metadata.

Darwin Core (DwC): An extension of Dublin Core; A body of standards, including a glossary of terms (in other contexts these might be called properties, elements, fields, columns, attributes, or concepts) intended to facilitate the sharing of information about biological diversity by providing reference definitions, examples, and commentaries.

Data Store: One of the IRMA applications; NPS data clearinghouse providing access to documents, data sets and other types of information resources.

Dublin Core: A basic, metadata standard named for Dublin, Ohio where the standard was developed in 1995. It can be used to describe digital resources and physical resources, but is not tied to a particular subject area; this standard is easily understood and implemented, and as such is one of the best known and most widely used metadata standards.

EML: Ecological Metadata Language (EML) is a metadata specification developed for the ecology discipline. It is based on prior work done by the Ecological Society of America and associated efforts (Michener et al., 1997, Ecological Applications).

IMD: Inventory and Monitoring Division

IMDLT: Inventory and Monitoring Division Leadership Team

IRMA: Integrated Resource Management Applications; a suite of applications developed by IMD for management of IMD and other NPS data and delivery of that data and derived resource information to parks, partners, and the public. Those applications include Data Store, NPSpecies, the Research Permit and Reporting System (RPRS), and others.

ISO: International Organization for Standardization - an independent, non-governmental organization, the members of which are the standards organizations of the 168 member countries. It is the world's largest developer of voluntary international standards and facilitates world trade by providing common standards between nations. Over twenty thousand standards have been set covering everything from manufactured products and technology to food safety, agriculture and healthcare.¹

¹ From wikipedia (https://en.wikipedia.org/wiki/International_Organization_for_Standardization)

ISO 19115: An internationally adopted ISO schema for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.

- ISO 19115 (2003): Metadata - Replaced by 19115 - 1
- ISO 19115: 1 (2014) - Metadata Part 1 - Fundamentals
- ISO 19115: 2 (2009) - Metadata for Imagery and Gridded Data
- ISO 19115: 3 (in work)

LTDM: Long-term data management

LTDM GB: Long-term Data Management Governance Board; the body charged with implementation of the Remodeled Data Store; the LTDM GB is composed of a mix of IMD central office and network staff with data management, project management, technical, and science expertise

LTDM TF: Long-term Data Management Task Force

Metadata: Data that provides information about other data².

Metadata attribute: Storage container for a specific data field (e.g., data field within a data table).

Metadata entity: Entity is a container to store structured data (e.g., data table). Entities store a collection of attributes.

POD: [Project Open Data](#); Established by [OMB Policy Memo M-13-13](#), Project Open Data is a U.S. government initiative to manage information and data as an asset and make it available, discoverable, and usable

Remodeled Data Store: The alternative to manage IMD data for the long term that is based on the existing IRMA Data Store and was selected by the LTDM TF and recommended to the IMDLT. The IMDLT unanimously accepted the recommendation and the LTDM GB is charged with implementation of the Remodeled Data Store.

Schema: Generally, an organization or plan; a database schema refers to the structure of the database

² From Meriam-Webster (<https://www.merriam-webster.com/dictionary/metadata>)

Introduction

The common and often-used description of metadata is data or information about data. In essence, metadata represents a vital component of a data package by providing details about the *who*, *what*, *when*, *where*, *why* and *how* as they relate to data (Edwards et al. 2011). At the core level, metadata need to help data consumers discover and understand basic information about the data to facilitate data usage.

These principles are especially relevant for long-term ecological monitoring programs. The lifespan of long-term ecological data is measured on a decadal or longer scale and as such will outlive any one person collecting, managing or analyzing these data sets (Sutter et al. 2015). Staff turnover and methodological adjustments are inevitable through the life of long-term monitoring efforts. Understanding when and why these changes took place may be critical to understanding the data (Michener et al. 1997; Sutter et al. 2015). Without proper, comprehensive metadata, data may be discoverable 100 years from now, but the usability and confidence in the data may be unacceptably compromised.

The Inventory and Monitoring Division (IMD) invests many millions of dollars each year to collect, manage, analyze, and report data on ecological conditions in national parks across the country. These data represent valuable assets. To fully realize the value of these assets, the data need to be useful to broad audiences far into the future. Achieving this requires that data are accompanied by appropriate documentation (Obuch et al. 2018). Utilizing a formal structured metadata standard provides the flexibility to include general information, as well as very detailed aspects of the data in a broadly interpretable format (Sutter et al. 2015), and is the approach adopted by NPS. Proper documentation of data sets ensures that data are:

- Discoverable: Data users and consumers are able to find the data. Data that remain hidden have reduced value.
- Interpretable: Users are able to understand basic information about the data including its purpose and meaning to determine if it is relevant to them and to prevent misinterpretation.
- Usable: Data consumers are able to understand how to use the data including how to analyze it and integrate it with other data sets. Without the details of *who*, *what*, *when*, *where*, *why* and *how*, data may be unusable or used in inappropriate ways.
- Timeless (data sets have longevity): Data are a valuable resource and must be preserved for use far into the future.

In 2002, the Federal government published [OMB Circular A-16](#) (including A-16 Supplemental Guidance in 2010) and Executive Order 12906 describing standards and documentation requirements for geospatial data sets (FGDC 2018). Executive Order 13642 and Departmental Memorandum M-13-13 expanded these requirements by establishing Project Open Data (<https://project-open-data.cio.gov/>), which requires federal agencies to publish all data and data products. All of these policies include mandates for agencies to properly document the data sets to allow for data discovery and assure usability.

Two new documents were recently finalized that provide further guidance on how DOI agencies as well as agencies across the Executive Branch are expected to manage data. First, the DOI Data Resource Management Directive (OCIO Directive 2018-004) establishes a Data Governance Board as well as roles and responsibilities for personnel from the Department level down through the various bureaus. Specifically, Data Stewards are responsible for “maximizing the usefulness of data by producing formal metadata and documentation...” and Data Maintainers are responsible for “documenting all data collected or modified, and complying with existing metadata policies and guidance.”

The second of the two new policies is the Geospatial Data Act of 2018, which was signed into law on October 5, 2018. The scope of this document is much broader, applying to all executive branch agencies, and calls for a needs assessment relating to metadata standards. The act goes on to say that the standards “to the maximum extent practicable, shall be consistent with international standards and protocols.” The Federal Geographic Data Committee (FGDC) acts as the lead entity in the executive branch for the development, implementation, and review of policies, practices, and standards relating to geospatial data (Geospatial Data Act of 2018).

The NPS and IMD have always appreciated the importance of data documentation and standardization. Data Management Plans provide guidance and IMD developed tools to assist with the generation and management of metadata (National Park Service 2008). In addition, both IMD and the NPS Cultural Resource GIS Facility developed data standards intended to promote the generation of high-quality data and metadata that are managed consistently across the service. Data sets that meet these standards increase the opportunity for data integration and sharing (Frakes et al. 2015; Cultural Resource GIS Facility 2011). While the Cultural Resource Spatial Data Transfer Standards include details about metadata and documenting spatial data sets related to cultural resources, no specific standard is mentioned.

The focus and impetus for much of the existing federal guidance has been the importance of documenting geospatial data sets created or distributed by federal agencies but the intent goes beyond geospatial data sets. Metadata is an important component of all data sets, spatial and non-spatial, in order to ensure the discoverability, longevity and usability of the data. The current effort aims to identify a metadata standard as well as an approach to metadata management that will serve as the backbone for how IMD data are documented.

Background

Sustaining the current model of 32 networks managing data in hundreds of different databases and data management systems presents challenges across IMD. The Long-term Data Management Task Force (LTDM TF) was formed to evaluate the issue and identify the best approach for managing (storing, archiving, disseminating) I&M data into the future. After a great deal of time and effort, the group recommended a remodeled version of the NPS Data Store to the IMD Leadership Team (IMDLT) and the IMDLT accepted the recommendation. The Remodeled Data Store will function as a more complete and flexible data repository, allowing networks more control over their data as well as improving access to data (Tucker et al. 2017).

In addition to recommending a long-term data management solution, the group also identified some “next steps” in the process. One of those was establishing a Long-term Data Management Governance Board (LTDM GB) to “oversee the initiative to define, prioritize and implement the LTDM Task Force recommendation of a Remodeled Data Store.” One function of the LTDM GB is to establish working groups to address individual components of the larger initiative. Identifying an appropriate metadata standard(s) for IMD was recognized by the LTDM TF as a high priority, as well as one that could be worked on early in the process (Tucker et al. 2017). Accordingly, the metadata working group was formed in October 2017.

Goal

The goal of the metadata working group was to review existing metadata standards and determine which standard or standards would best suit the needs of IMD. The recommended standard(s), if approved by the governance board, would be incorporated into the workflow and structure of the Remodeled Data Store. Even though the impetus for this group originated from an IMD initiative, information and recommendations should be shared widely. Likewise, this group took advantage of and learned from the experiences of other working groups from around the NPS and from other agencies.

Scope

IMD manages a wide variety of data types ranging from tabular ecological data (e.g., spreadsheets, delimited text files, and databases) to geospatial data (e.g., shapefiles, geodatabases, and remotely sensed data) to audiovisual data (e.g., photos, videos, and audio recordings) to museum collections (voucher specimens). The initial scope of this group focused on identifying standard(s) for tabular and spatial data sets. Metadata standards will need to accommodate a wider variety of data types, but tabular and geospatial data sets are the highest priority. Expanding scope to include other data types would have resulted in a much lengthier process.

Out-of-scope data types include photographs, audio files, video files, and natural resource museum collections information. There is a clear need and interest in broadening the metadata scope to include these other resource types in the future.

Existing Guidance

Current Federal Guidance

There are numerous guidelines, directives, policies, and laws that dictate how federal agencies, both within DOI and across the Executive Branch, manage data and the associated metadata (Table 1). The requirement to produce metadata originated with OMB Circular A-16 and was reinforced by Executive Order 12906 in 1993. More recently, Executive Order 13642 mandated that government data will be “managed as an asset throughout its life cycle to promote interoperability and openness....” The Geospatial Data Act of 2018 requires all federal agencies to “harmonize sources and data standards...including metadata” and the DOI Directive calls for all DOI agencies to “maximize the usefulness and sharing of data by producing formal metadata and documentation.”

Table 1. List of federal authorities requiring data set documentation.

Authority	Directives
OMB Circular A-16 revised	Established the FGDC All spatial data collected or derived directly or indirectly using federal funds will have FGDC metadata.
Executive Order 12906	Federal agencies will document all data sets based on FGDC-approved standard.
OMB Circular A-119 revised	Federal agencies are encouraged to adopt existing standards. Agencies should consider existing international standards
Executive Order 13642	Government assets shall be open and machine readable. Government information shall be managed as an asset throughout its life cycle to promote interoperability and openness. Data should be released in ways that make it easy to find, accessible, and usable.
Executive Memorandum M-13-13 - Open Data Policy	Establishes the framework for the Open Data initiative as required by Executive Order 13642 Create common core and extensible metadata for all new data sets
DOI OCIO Directive 2018-004 - DOI Data Resource Management	Provide discoverable, accessible, shareable, and secure data with documented quality and interoperability Establishes roles and responsibilities - Data Stewards will maximize the usefulness and sharing of data by producing formal metadata and documentation Data Maintainers are responsible for documenting all data collected or modified and complying with existing metadata policies and guidance.
Geospatial Data Act of 2018	Establish standards for metadata within the National Geospatial Data Asset data theme Be consistent with international standards and protocols.

These policies all, either directly or indirectly, call for federal agencies to properly document data sets. Some policies, such as OMB Circular A-16 (revised), go further by calling on agencies to adopt FGDC-approved standards though none explicitly specify which standard agencies should adopt; however, as previously stated, agencies are encouraged to adopt standards that are consistent with international standards and protocols. The FGDC has endorsed the CSDGM standard as well as the ISO suite of standards (hereafter the ISO suite), which include a series of standards relating to core information, methodology, data quality, and schemas. FGDC is strongly encouraging federal agencies to transition to using the ISO suite of standards for metadata creation (FGDC 2018) although no explicit timetable or deadline has been imposed on federal agencies to make this transition; however, agencies are encouraged to do so as soon as resources allow. Federal agencies can adopt a variety of standards based on their operational needs; however, in order to be in compliance agencies must adopt and support a standard endorsed by FGDC.

Current IMD Guidance

Every IMD network published a data management plan wherein each network outlined their approach for creating, managing, and sharing data and metadata. In addition, the National Data Management Plan published by IMD (National Park Service 2008) states that all IMD data will adhere to the content standards established by FGDC (CSDGM and includes descriptions of fully compliant and minimally compliant metadata files.

IMD has always required that data stewards post metadata along with their data files, but enforcing this has been difficult. A number of things can hinder the successful implementation of metadata policies, including lack of specific metadata requirements (Obuch et al. 2018). Various tools and templates have existed to assist with creation and editing of metadata, but a mechanism to audit or enforce the inclusion of anything beyond the minimum requirements has been lacking (National Park Service 2008). The latest iteration of the NPS Data Store continues to support creation of records from uploads of FGDC-STD-001-1998 documents, but no longer adheres to the explicit use of FGDC requirements established in the National Data Management Plan. Metadata attributes entered on a field-by-field basis through the NPS Data Store user interface currently align more closely with Dublin Core and reflect a bibliographic focus (Michael DiSibio pers. comm. 02 July 2018).

To Whom do these Recommendations Apply?

The authorities listed in Table 1 provide explicit requirements that all DOI agencies are expected to adhere to. However, the recommendations outlined herein are intended to focus on requirements and procedures associated with the Inventory and Monitoring Division as well as the NPS Data Store and eventually the *remodeled* Data Store. All I&M networks and data sets newly published to the NPS Data Store should adhere to the recommended standards, and when possible, the standards should be applied to legacy data sets. These requirements are intended to augment, not replace, requirements established by other programs (e.g., Cultural Resource GIS).

Approach

The Metadata Work Group began meeting in October 2017 and conducted monthly phone calls through July 2018. The group was composed of an interdisciplinary cadre of NPS staff representing various disciplines (e.g., GIS, data management, and ecology) and different backgrounds (e.g., parks, programs, and regions; Table 2). Throughout the process, smaller groups of two to three people often met separately to work on more focused efforts. Throughout the life of the work group members attended webinars and training courses, and consulted with other agencies as well as internal NPS staff who were not part of the working group to gain more information about the best approach to implementing a metadata management strategy.

Table 2. List of workgroup participants

Name	Program/Park	Title/Role
Geoffrey Sanders	National Capital Region Network	Program Manager (Group Lead)
Mark Hart	Great Lakes Network	Data Manager
Hannah Dean	George Washington Mem. Pkwy	GIS Specialist
Sarah Wakamiya	San Francisco Bay Network	Data Manager
Alex Eddy	Sierra Nevada Network	Data Manager
Dennis Skidds	Northeast Coastal and Barrier Network	Data Manager
Andrew Duff	Resource Information Services Division	Geospatial Data Architect
Katherine Beirne	North Coast and Cascades Network	GIS/Data Management
Kelly Kozar	Pacific Islands Network	Data Manager
Eric Dinger	Klamath Network	Ecologist
Jennifer Sieracki	Biological Resources Division	National Data Manager
Helen Thomas	Northern Colorado Plateau Network	Data Manager
Jeffrey Lonneker	Upper Columbia Basin Network	Data Manager
Simon Kingston	Inventory and Monitoring Division	Data Ranger
Fred Dieffenbach	Northeast Temperate Network/IMD	Monitoring Coordinator
Carmen Thomson	Midwest Region	Regional I&M Program Manager

The approach followed this general workflow:

1. Discuss and identify existing applicable standards and tools.
2. Compare standards (ISO suite and EML)
3. Consult with other agencies regarding their approaches to managing metadata
4. Evaluate required metadata fields

5. Report on findings and recommendations.

Initial calls focused on discussing background information and gaining input on how to approach the task of recommending an appropriate metadata standard or standards. Recognizing that a single standard may not suit both spatial and non-spatial data sets, the group was open to considering the adoption of multiple standards. Initial discussions focused on the various metadata standards currently being used as well as the various tools or applications associated with them. There are numerous metadata standards to choose from; some were found to be more applicable and appropriate than others.

The Long-term Data Management Task Force focused on the EML and the ISO suite of standards. This was, in part, based on the suitability of these standards to create comprehensive documentation for a wide variety of data sets especially those related to ecological and spatial data. The LTDM TF benefited from information gained from other ecological monitoring groups (both government and non-government) with regard to the metadata standards they adopted (Tucker et al. 2018). Darwin Core was also discussed because of its relevance to documenting and sharing biodiversity information, but more focus was placed on the other two standards.

EML

The Ecological Metadata Language (EML) was designed by the ecological sciences community, information managers, and software developers to meet the data documentation needs of ecological data sets as well as the needs of ecologists or natural resource management professionals (Fegarus et al. 2005). The working group found the standard to be divided into intuitive sections that strive to reduce ambiguity by using standard terms and definitions pertaining to ecological data. These aspects make it especially useful for those professionals who may not be intimately familiar with metadata.

ISO

The FGDC CSDGM, often referred to as the FGDC metadata standard, in accordance with OMB Circular A-119, was developed for the documentation of spatial data layers (raster and vector data layers). The ISO suite of standards was developed as a means of integrating the CSDGM with other international standards in an effort to evolve how geospatial data sets are documented and to promote consistency and the ability to share data and metadata more seamlessly. Currently, the core standard is ISO 19115-1 (2014), which includes the elements most common to geospatial data sets, but it has expanded with the creation of additional standards and components that allow for the documentation of a wider variety of data, including ecological data sets. Many of the components/elements found in the legacy CSDGM can be found in the ISO 19115 standard (FGDC 2018).

The International Organization for Standards (ISO) is a suite of standards that allow users to extend data documentation beyond the core standard (19115-1) depending on the user's needs. The ISO suite tends to cater more to the GIS community but is flexible enough to document non-geospatial data sets. The ISO suite of standards include (but are not limited to):

- ISO 19115-1: Core Standard, which includes content consistent with most data sets.
- ISO 19110: Methodology

- ISO 19111: Spatial Referencing
- ISO 19139: XML Schema
- ISO 19157: Data Quality Standard

Darwin Core

Darwin Core is a much less structured standard that focuses primarily on documenting and sharing biological diversity data including information about natural resource collections. The primary principles of Darwin Core are simplicity and flexibility; in its simplest form, it is a schema for documenting data with no structure other than field and attribute descriptions. While the simplicity and flexibility might be attractive, when deciding on a programmatic metadata standard having a certain degree of structure and requirements is helpful.

Comparison and Application of Standards

The initial step taken to evaluate each standard was to compare them against each other by attempting to crosswalk fields from one standard to the other to determine if certain fields were represented in one standard but not the other. The focus was placed on comparing the ISO suite and EML, since these standards were considered the most applicable. The standards were divided into sections based on the CSDGM model (e.g., Core Information, Entity and Attributes, Methodology, and Data Quality). Fields from one standard were mapped to the comparable field in the other standard. This was relatively straightforward for some sections, such as Core Content. For instance, each standard has a Title, Abstract, etc.; however, crossover between standards became less intuitive as other sections were evaluated. It quickly became apparent that the ISO suite was much more complex than EML. Fully understanding the ISO suite of standards was further complicated by the lack of freely available information on the ISO suite of standards. Detailed documentation on the ISO suite must be purchased, which complicated the group's ability to easily obtain background information on the standard.

Comparing metadata fields between two standards was difficult without having actual metadata to use as an example and provide context. To address this, an existing well-documented FGDC-CSDGM metadata document available on the NPS Data Store was used as a starting point. The task was broken into sections with different group members documenting the starting point in FGDC and the translation to either EML or ISO 19115 for each section of metadata. A description for the metadata elements was provided for each standard followed by an example of the actual metadata applied to that standard. Examples of this work can be found in Appendices B (FGDC–EML) and C (FGDC–ISO).

Ecologists generally find EML to be more intuitive and more appropriate, which is unsurprising given that the EML standard was designed by ecologists. Conversely, the ISO standard was born from existing spatial metadata standards and originally designed for geospatial data sets. Even though the EML standard allows for the addition of metadata for spatial data sets, EML is not nearly as comprehensive as the ISO suite in this area. Therefore, the general consensus among GIS professionals is that ISO is more appropriate.

An Agnostic Approach

IMD consulted with other groups that have previously delved into determining the most appropriate metadata standard to use for their data. During this process, group members corresponded with staff from other agencies, specifically National Oceanographic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA), as well as internal NPS staff to discuss their approaches for collecting, managing, and disseminating metadata.

NOAA's National Marine Fisheries Service and NASA both have well-developed systems for capturing and managing metadata. These systems are designed much in the same way as the NPS Data Store. Data providers can import metadata (providing they format their import files appropriately) or enter metadata manually into the system. The [NOAA InPort](#) (NOAA 2018) repository and the [NASA Common Metadata Repository \(CMR\)](#) (NASA 2017) are examples of these applications.

Both applications were developed to reduce the burden on metadata providers and improve the quality and usability of the metadata. Instead of identifying a single standard, both NOAA and NASA identified the important information to capture and develop effective tools to allow for the relatively painless addition of metadata to their systems. Both the NASA and NOAA systems enforce the inclusion of certain fields and audit the metadata to ensure and report on completeness. By focusing on identifying the important and relevant information they want to capture they can store that information in back-end databases that do not correspond to any specific metadata standard. The systems are designed with the functionality to export metadata information into a variety of standards or formats depending on the end user's needs.

In some ways, the NPS Data Store is very similar. When users create a record in the Data Store, they are essentially entering metadata for that record. These fields are not defined as EML or ISO fields. They are simply fields that are necessary to adequately attribute the record. Once this information is stored it can essentially be transformed into any number of metadata formats as long as the relationship between the stored information and the fields in the various standards are defined. Conversely, Data Store records could be created by uploading metadata records as long as those records were formatted in a schema recognized by the NPS Data Store system.

NPS subject matter experts from the Resource Information Services Division (RISD) and IMD were also consulted. Staff from RISD who have experience working with FGDC provided input on metadata standards and advice on adopting a standard (J. Carlino pers. conv. 21 May 2018). Database developers and architects with IMD provided feedback and comments on implementing an agnostic approach similar to the ones used by NOAA and NASA (M. DiSibio pers. conv. 02 July 2018).

Evaluation of Metadata Elements and Required Fields

Optimal metadata requirements ensure essential information is captured efficiently (that is, without an arduous process). Time investment in metadata creation can be high in some cases, but this pays off in benefit to data consumers through well-documented data sets. Assuming care was taken to create a quality metadata record from the beginning, the value of the data set will increase (Michener et al. 1997), and subsequent annual updates should require less effort.

After consulting with other agencies and learning about how they approached metadata in an agnostic manner, as well as consulting with NPS developers to ensure that a similar approach could work for IMD, the group shifted focus away from evaluating specific standards and more to evaluating metadata components to determine what was important to include.

Documentation for all data sets published to the NPS Data Store must meet a certain set of minimum requirements established by Project Open Data and the associated Metadata Schema in order to make government data sets easier to find and use (Table 3). Data sets meeting these criteria can be discoverable on [Data.gov](https://data.gov). See Executive Memorandum M-13-13 for more information. Beyond the limited list of fields, Data.gov considers additional documentation to be optional.

Table 3. Metadata fields required by Data.gov including CSDGM fields and ISO 19115 crosswalk.

Data.gov Label	CSDGM Label	ISO 19115 Label
Title	title	title
Description	abstract	abstract
Tags	keywords (theme, place, stratum, temporal)	keywords (theme, place, stratum, temporal)
Last Update	publication date	1. resource maintenance frequency 2. data citation revision date 3. first data citation date available
Publisher Name	publisher/distributor/originator	1. data citedResponsibleParty with publisher roleCode 2. point of contact with publisher roleCode 3. distributor
Contact Name	point of contact/organization name	point of contact/organization
Contact Email	contact email	point of contact email
Unique Identifier	title	DOI or title
Public Access Level	POD default	1. resource constraints with codes of restricted, confidential, secret, or topSecret 2. resource constraints with codes of copyright, patent, patentPending, trademark, license, or intellectualPropertyRights 3. ISO codes do not specify 'public' as a constraint code
Bureau Code	Hardcoded into POD record	bureauCode
Program Code	Hardcoded into POD record or keyword	programCode

The documentation required by Data.gov is relatively limited but supports the primary goals of the system, which are to promote transparency and data discovery. Once the data are discovered, data consumers typically require more information about the data to ensure they are using it appropriately (Obuch et al. 2018).

Building on approaches the group took in the past, metadata elements were divided into sections and members provided their input on which fields should be *required* versus *required if applicable* or *optional*. To help facilitate the collection of this information Google surveys were created to provide group members a structured way of capturing this information, and Appendix A contains the results of some of the discussions the group had on metadata field requirements. Comments received through the surveys, as well as input from phone discussions, often called for requiring many metadata fields. This was especially true for fields related to data quality and usage.

Group members raised the issue of dealing with data sets where information needed for a required field might be unknown. This situation is especially common for legacy data sets. This led the group to either soften its stance on requiring certain fields or include a standard field description of “unknown.” The Cultural Resource Spatial Data Transfer Standards recommend including “unknown” when users do not have the information over leaving the value blank or null (Cultural Resource GIS Facility 2011).

Consideration should be given to potential future metadata needs, even if metadata components or fields may not be considered required or essential to meet the current needs of IMD. It would be prudent to include potential needs in the database now, so they can easily be incorporated into user workflows and application user interfaces once they are deemed critical or necessary in the future (Michael DiSibio, pers. comm. 02 July 2018).

Standard Keyword Vocabularies

The importance of standard keyword vocabularies was not originally included in the scope of this working group. However, in the process of discussing metadata applications and solutions with professionals from other agencies this topic was stressed as something important to consider. In addition to improved data discovery, one of the benefits of metadata is to improve the ability to identify and integrate similar data sets, which is made easier when data files are attributed with the same terms. Attributing data sets with common theme, temporal, place and taxonomic keyword libraries could add efficiency when documenting data sets and when trying to identify commonalities across data sets. Free form keywords are still an important component of a metadata record and should be maintained but there are clearly benefits to adopting standard keyword libraries.

Findings and Recommendations

The Metadata Working Group devoted a great deal of time to researching and evaluating existing metadata standards, as well as looking into the current and potential future DOI policy requirements. Even though there is no explicit mandate to adopt a specific standard, the information gathered by the working group through conversations with other agencies (NASA and NOAA), trainings attended (USGS) as well as the documentation posted by the FGDC, federal agencies are encouraged to adopt the ISO suite of metadata standards (FGDC 2018). This message was reinforced through conversations with subject matter experts who previously worked with USGS and FGDC. Based on their experience and knowledge they felt that the Department of the Interior will soon be requiring bureaus to adopt the ISO suite of standards as their standard for metadata (J. Carlino pers. conv. 21 May 2018).

That said, it is clear that the ecological user community believes that EML is a more intuitive standard and would be more appropriate for documenting ecological data sets. Conversely, the geospatial community recognizes the benefits of the ISO suite of standards to appropriately document spatial data sets. Given the emphasis that the NPS, especially IMD, places on ecological inventory and monitoring data sets as well as geospatial data it is important that the Remodeled Data Store support both the ISO suite and EML standards. Supporting these two (and potentially more) standards will allow the program to meet the forthcoming departmental requirements as well as the needs of a broad spectrum of data producer and consumer user communities.

Based on the evaluations performed by the members of the working group, and the recommendations received by both internal and external entities, the Metadata Working Group recommends the following:

1. Adopt the ISO suite of metadata standards: Based on industry trends, FGDC endorsement and recommendations from subject matter experts, the NPS Data Store should adopt the ISO 19115 metadata schema as its official standard. Currently, these are:
 - a. ISO 19115-1/19115-3
 - b. ISO 19110: Methodology
 - c. ISO 19111: Spatial Referencing
 - d. ISO 19139: XML Schema
 - e. ISO 19157: Data Quality Standard
2. Implement an agnostic metadata design: The NPS Data Store should manage metadata information in a flexible and standard-agnostic manner. Even though the working group recommends adopting the ISO suite of standards as the official standard for IMD, the group recognizes the value of sharing metadata in various formats, and recommends the ability to consume and produce metadata in formats (at least EML and the ISO suite) that support a variety of user communities. Such a flexible approach will increase capacity to integrate IMD data sets with those from other data producers.

3. Standardize vocabularies: Improve management and discoverability of data sets by adopting standard keyword vocabularies. The current NPS Data Store does this to some degree with subject category keywords and park/program units, but expanding this to include additional place and taxonomic keywords could be beneficial. Creating metadata is easier if standard vocabularies are used as much as possible. Reducing the amount of free-form keywords and forcing users to select from agreed upon standard keyword lists builds consistency (Edwards et al. 2011).

Long-term ecological monitoring data sets are valuable data assets that enable managers and scientists to understand ecological processes and provide management guidance. The value of these data sets are preserved when they are adequately documented, discoverable usable. Creating a system that enforces proper data documentation standards while simultaneously providing flexibility through an agnostic approach to metadata management will allow IMD to consume outside data sets, as well as allow IMD data to be more easily integrated with outside data producers.

Agencies within DOI are encouraged to develop metadata management plans based on agency mission as well as research and management needs (Obuch et al. 2018). Hopefully, the recommendations contained in this document can contribute to and inform the development of a more comprehensive IMD metadata policy.

Future Metadata Considerations

The purpose of this working group was to recommend an official metadata standard for IMD with a focus on standards that were appropriate for geospatial and ecological data sets. IMD and other programs across the service collect and manage a variety of other data types including photographs, video files, audio/acoustic files, and museum collections. The ISO suite may be sufficient to properly document these data types, but more effort should be placed on developing proper metadata requirements and standards for these data formats.

Recommendations provided in this report may require additional time and consideration prior to implementation. First and foremost, in order to ensure that IMD metadata requirements are implemented effectively and successfully time must be devoted to understanding user needs and developing the proper tools (e.g., user interface) that allow for the efficient creation of metadata records. IMD should engage user communities to identify the application needs of both the data producers and consumers to help ensure that the Remodeled Data Store will help promote the generation of metadata as well as the consumption of it.

Additional work will need to be devoted to developing controlled vocabularies and standard keyword libraries for use when documenting data sets. A future workgroup could focus on researching and developing standard lists and vocabularies for use in the NPS Data Store. Additional work could build from the field requirements created by this group, such as creating metadata publishing standards.

As mentioned above, this working group focused on the needs of the Inventory and Monitoring Division but metadata guidance and requirements extend beyond IMD. Other programs and disciplines within the NPS could benefit from the findings and recommendations of this working group and potentially start thinking more broadly by pursuing an NPS-wide metadata policy as opposed to tackling this issue division by division.

Other groups, such as the NPS GIS Council (GISC), have already started considering this. The GISC provides leadership and strategic planning for the NPS GIS community from the national to regional to park level. The GISC strategic plan contains a number of goals, objectives, and actions that identify the need for improved data stewardship and management as well as call for a NPS Director's Order to address geospatial data requirements which would presumably include metadata. Moving forward it would be wise when dealing with topics like metadata, that impact all divisions and levels of the NPS, to find partners and champions from other disciplines to help develop a consistent policy and approach. Therefore, IMD should consider working across divisions collaborate and contribute to the development of an NPS-wide metadata policy.

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Appendix A

Table A 1. Core Information

Field Name	Field Description	Requirement Level	Comments
Title	Title of the dataset	Yes	–
Description	Description of the dataset	Yes	–
Purpose	Purpose of the dataset	Yes	Needs to be included but this could also be included in the description. Need to make sure to allow for “unknown”
Supplemental Information	Additional information	No	–
Identifier	Data set identifier (DOI)	Yes	Should be required once Data Store can accommodate
Access Level	Access level of the data set (public vs internal)	Yes	Could be redundant with fields in the data distribution section.
Bureau Code	–	Yes	–
Program Code	–	Yes	–
Keyword	–	Yes	Included in separate keyword section
Publisher	–	Yes	Include with separate contact information.
Contact Point	–	Yes	–
License	–	If applicable	–
Rights	–	–	–
Spatial	The range of spatial applicability of a dataset. Could include a spatial region like a bounding box or a named place.	Yes	Important for machine searchability. Allows spatial searches on metadata bounding box would perhaps be more useful than a place name

Table A 1 (continued). Core Information

Field Name	Field Description	Requirement Level	Comments
Temporal	The range of temporal applicability of a dataset (i.e., a start and end date of for the data).	Yes	It seems like this should be required - even though the date when last modified will be included, often jobs change hands. I have utility data for example - I know when it was last touched - but it could have been legacy data at the time it was created - and therefore out of date.
Distribution	A container for the array of distribution objects.	If applicable	If this is a container that contains all of the related distribution fields then yes this needs to be required. If this is duplicative of related distribution fields then no.
Issued	Date of formal issuance	Yes	Should be auto-populated by system

Table A 2. Entity and Attribute metadata field requirements

Field Name	Field Description	Requirement Level	Comments
Entity/Attribute Overview	General description of the data tables	Yes	This information could be duplicated elsewhere in the metadata – avoid redundancy.
Table Name	Name of the data table	Yes	–
Table Description	Description of the data table	Yes	–
Table Constraints	–	–	–

.Table A 2 (continued). Entity and Attribute metadata field requirements

Field Name	Field Description	Requirement Level	Comments
Related Entity	Defines relationships between tables or entities	If applicable	Very useful when trying to figure out the structure of a relational database Yes if applicable. It would be good for showing relationships between tables. If we're documenting a dataBASE, then I think we should be including this. If we're documenting a dataSET, then a related entity might be a whole separate dataSET with its own metadata and should be documented differently (e.g., with a citation to that dataset/metadata). Depending on what is being distributed there may not be any related items. Make it optional.
Attribute/Field Name	Name of the data field	Yes	–
Attribute Data Type/Definition	Explanation of the contents of the attribute	–	Helps the end user properly interpret the data for each attribute.
Units	Units of measure	If applicable	Not every field will have a unit of measure.
Precision	Precision of the data	If applicable	–
Required	Is the data required	If applicable	This would not be hard to include
Null Value	Are null values allowed	If applicable	This would not be hard to include Could be important information for an end user to have.
Validation Rules	—	If applicable	–

Table A 3. Methodology Metadata

Field Name	Field Description	Requirement Level	Comments
Lineage	General description of the data collection and processing steps	If applicable	I can't envision a dataset this wouldn't be applicable for. I'd like to see this, but am on the fence about whether it should be required. It could be covered by a citation to the protocol. I would like to see this required although I can see this turning into an copy/paste exercise. In cases where we are dealing with legacy data sets that we just don't know makes me think this should be required if applicable.
Process Step	Description of the specific method component. There will likely be multiple process steps describing the collection and analysis of the data.	If applicable	I can't envision a dataset this wouldn't be applicable for. Important information for duplicating results, but could be a burden preventing the uploading of data. SMW: Agree, important but would likely prevent data uploads unless we could reference something (e.g. protocol) - also we would need to define at what level constitutes a process step? Should be optional, but highly recommended. This could be included in metadata or be a citation to SOP(s). If applicable I think this is especially important for data values that have already been summarized or synthesized in some way. The process for deriving that value should be described.
Lineage Source	Information or link to the source of the sampling/analysis procedures.	If applicable	Information or link to the source of the sampling/analysis procedures.
Software	Software used to process/analyze the data	If applicable	Important information for duplicating results.

Table A 4. Data quality metadata

Field Name	Field Description	Requirement Level	Comments
Scope	Information about the scope of the data quality evaluation	Yes	If required there needs to be an option to indicate “unknown”
Report	Information about the quality of the data specified by the scope.	No - optional	Important but could be incorporated into Scope. Also could exist as a sidecar data quality report.
Level	The level of the data set that the quality control steps were applied (e.g. record level, table level)	No - optional	This field generated confusion.
Lineage	Description of the steps taken evaluate the data	If applicable	This is important information to capture but it could reference an associated report. QA steps need to be documented in some way. Either “Lineage” or “Specification” should be required.
Specification	Link to citation or user requirement (QAP)	If applicable	Allow for “not assessed” Should be required for protocols with DQS or QAPs or data quality SOPs
Attribute Accuracy	Description of the outcome from evaluating values against a set of acceptable values.	If applicable	Would be hard to make this required. Could create undue burden. Allow for “not assessed”
Currentness Reference	The Currentness Reference element requires the producer to identify if the Time Period of Content dates and times refer to the ground condition, derived from some source, or refer to some later time when the information was recorded, published, etc.	Yes	–
Horizontal Positional Accuracy	–	If applicable	Important for geospatial data sets

Table A 4 (continued). Data quality metadata

Field Name	Field Description	Requirement Level	Comments
Vertical Positional Accuracy	–	If applicable	Important for geospatial data sets
Analytical Accuracy	–	If applicable	–
Quantification Limits	–	If applicable	–
Completeness	Describes the status of the dataset (e.g. complete, on going)	Yes	–

Table A 5. Distribution metadata fields.

Field Name	Field Description	Requirement Level	Comments
Access URL	URL to access the data set via another API like NPS Data Store. (e.g. a pointer to the Data Store Reference).	Yes	Important for restricted sets where access to the data may be restricted but access to the reference is public.
Conforms to	Identification of a specific standard that the distribution conforms to	No	–
Download URL	URL to directly access the dataset	Yes	
Byte Size	Size in bytes of the data set	Yes	System should be able to auto-harvest this information.

Table A 5 (continued). Distribution metadata fields.

Field Name	Field Description	Requirement Level	Comments
Described By	This is used to specify a data dictionary or schema that defines fields or column headings in the distribution. If this is a machine readable file the media type should be specified with describedByType - otherwise it's assumed to be a human readable HTML webpage.	No	–
Description	Human readable description of the distribution	Yes	–
Format	Human readable description of the format	No	–
Access URL	–	–	–
Title	Useful title for the distribution URL	No	–
Liability	Liability statement	Yes	Should be boilerplate language that is automatically included.
Security Classification	Field indicating the sensitivity level of the data set	Yes	–
Use Constraints	–	Yes	Need to allow for “unknown”
Maintenance Frequency	Description of the update frequency of the data set	Yes	Could be redundant with accrualPeriodicity

Appendix B - Migrating CSDGM Core Information to EML

FGDC to EML – Core/Citation

- Using FGDC - PACN benthic fish metadata example from Kelly Kozar

Core/Citation (CSDGM)

Identification Information (metadata > idinfo >)

- Contains the following Core/Citation sections:
 - Citation (citation)
 - Description (descript)
 - Time Period of Content (timeperd)
 - Status (status)
 - Point of Contact (ptcontac) – optional

Citation (metadata > idinfo > citation)

- The recommended reference to be used for the data set. Includes:
 - Originator - the name of an organization or individual that developed the data set (origin).
 - Publication Date - the date when the data set is published or otherwise made available for release (pubdate).
 - Title - the name by which the data set is known (title).
 - Edition - the version of the title (edition).
 - Publication Information - publication details for published data sets (pubinfo).
 - Publication Place - the name of the city (and state or province, and country, if needed to identify the city) where the data set was published or released (pubPlace)
 - Publisher - the name of the individual or organization that published the data set (publish).
 - Online Linkage - the name of an online computer resource that contains the data set (onlink).
 - Geospatial Data Presentation Form - the mode in which the geospatial data are represented (geoform).

```
<metadata>
  <citation>
    <citeinfo>
      <origin>Eric Brown </origin>
      <origin>Sheila McKenna </origin>
      <origin>Tim Clark </origin>
      <origin>Bert Fuiva </origin>
      <origin>Ariel Halperin </origin>
      <origin>Amanda McCutcheon </origin>
```

```

<origin>Kazuki Kageyama </origin>
<origin>Sylvester Lee </origin>
<origin>Lindsey Kramer </origin>
<origin>Kimberly Tice </origin>
<origin>Chris Rillahan </origin>
<origin>Senifa Annandale </origin>
<pubdate>20180301</pubdate>
<title>Pacific Island Network Benthic Marine and Marine Fish Monitoring
Dataset</title>
<pubinfo>
  <pubplace>Hawaii National Park, HI </pubplace>
  <publish>NPS </publish>
</pubinfo>
<onlink>https://irma.nps.gov/DataStore/DownloadFile/598698</onlink>
<geoform>MS Access database</geoform>
</citeinfo>
</citation>
</metadata>

```

Description (metadata > idinfo > descript)

- Description - a characterization of the data set, including its intended use and limitations. Includes:
 - Abstract - a brief narrative summary of the data set (abstract).
 - Purpose - a summary of the intentions with which the data set was developed (purpose).
 - Supplemental Information - other descriptive information about the data set (supplinf).

```

<metadata>
  <descript>
    <abstract>The benthic marine community in the Pacific Island Network (PACN) is a
    complex ecologic system and a diverse taxonomic environment, including algae and
    corals and other invertebrates. Reef-building corals are the primary architectural
    organism and are sensitive to environmental degradation; therefore, they are a good
    indicator of overall health for nearshore park's marine ecosystems. Primary stressors
    to coral reefs include disease, bleaching, sedimentation, eutrophication, storms, and
    global climate change. The United Nations Environment Programme (UNEP) has proposed
    using coral reefs as a worldwide indicator ecosystem for global climate change
    (Spalding et al. 2004). For these reasons, the PACN has chosen to implement long term
    monitoring of benthic marine communities. Benthic marine communities is most closely
    linked with marine fish, and monitoring efforts will be conducted at the same time and
    location to maximize data value</abstract>
    <purpose>To store long term monitoring data for benthic marine communities and
    marine fish. </purpose>
    <supplinf>Benthic Marine Community data includes substrate point count
    identifications from image analysis for the following parks: KALA (2006 - 2016), KAHO
    (2008-2010 and 2014-2017), NPSA (2009-2017), WAPA (2008-2011, 2014-2017); metadata for
    fixed and temporary transects and rugosity for the following parks: KALA (2006 -
    2017), KAHO (2007-2011, 2014-2017), NPSA (2007-2017), WAPA (2008-2010, 2014-2017); and
    settlement data for KALA (2006 - 2017). Marine Fish data includes taxonomic
    identification, abundance, and size estimations from fish belt transects for KALA
    (2006 - 2017), KAHO (2007 - 2011, 2014-2017), NPSA (2010 - 2017) and WAPA (2008 -
    2012, 2014-2017); and metadata for fixed and temporary transects which are co-located

```

with Benthic Marine Community Protocol. Locations where threatened or endangered species were detected have generalized location information in order to protect the sensitive species.</supplinf>
 </descript>
 </metadata>

Time Period (metadata > idinfo > timeperd)

- The time period(s) for which the data set corresponds to the currentness reference. Includes:
 - Currentness Reference - the basis on which the time period of content information is determined (current).

```
<metadata>
  <timeperd>
    <timeinfo>
      <rngdates>
        <begdate>20060425 </begdate>
        <enddate>20171003</enddate>
      </rngdates>
    </timeinfo>
    <current>publication date </current>
  </timeperd>
</metadata>
```

Status (metadata > idinfo > status)

- The state of and maintenance information for the data set. Includes:
 - Progress - the state of the data set (progress)
 - Maintenance and Update Frequency - the frequency with which changes and additions are made to the data set after the initial data set is completed (update).

```
<metadata>
  <status>
    <progress>Complete </progress>
    <update>Annually </update>
  </status>
</metadata>
```

Point of Contact (metadata > idinfo > ptcontac)

- Identity of, and means to communicate with, person(s) and organization(s) associated with the data set.

```
<ptcontac>
  <cntinfo>
    <cntorgp>
      <cntorg>PACN Inventory & Monitoring Program, National Park Service
    </cntorg>
    <cntper>Kelly Kozar </cntper>
  </cntorgp>
  <cntpos>Data Manager </cntpos>
  <cntaddr>
```

```

    <addrtype>mailing </addrtype>
    <address>PO Box 52 </address>
    <city>Hawaii National Park </city>
    <state>HI </state>
    <postal>96718 </postal>
  </cntaddr>
  <cntvoice>(808) 985-6186 </cntvoice>
  <cntfax>(808) 985-6111 </cntfax>
  <cntemail>kelly_kozar@nps.gov </cntemail>
</cntinfo>
</ptcontac>
</metadata>

```

Metadata Reference Information (metadata > metainfo)

- Information on the currentness of the metadata information, and the responsible
- party.
- Contains the following sections:
 - Metadata Date - the date that the metadata were created or last updated (metd).
 - Metadata Review Date - the date of the latest review of the metadata entry (metrd). – optional
 - Metadata Contact - the party responsible for the metadata information (metc).
 - Metadata Standard Name - the name of the metadata standard used to document the data set (metstdn).
 - Metadata Standard Version - identification of the version of the metadata standard used to document the data
 - set (metstdv).
 - Metadata Extensions - a reference to extended elements to the standard which may be defined by a metadata producer or a user community (metextns). – mandatory in applicable

```

<metadata>
  <metainfo>
    <metd>20100917 </metd>
    <metrd>20180301</metrd>
    <metc>
      <cntinfo>
        <cntorgp>
          <cntorg>PACN Inventory & Monitoring Program, National Park Service
        </cntorg>
        <cntper>Kelly Kozar </cntper>
      </cntorgp>
      <cntpos>Data Manager </cntpos>
    </cntinfo>
    <cntaddr>
      <addrtype>mailing </addrtype>
      <address>PO Box 52 </address>
      <city>Hawaii National Park </city>
      <state>HI </state>
    </cntaddr>
  </metainfo>
</metadata>

```

```

        <postal>96718 </postal>
    </cntaddr>
    <cntvoice>(808) 985-6186 </cntvoice>
    <cntfax>(808) 985-6111 </cntfax>
    <cntemail>kelly_kozar@nps.gov </cntemail>
</cntinfo>
</metc>
<metstdn>FGDC Content Standard for Digital Geospatial Metadata</metstdn>
<metstdv>FGDC-STD-001-1998</metstdv>
<metextns>
    <onlink>http://nrddata.nps.gov/profiles/NPS_Profile.xml</onlink>
    <metprof>NPS NR and GIS Metadata Profile </metprof>
</metextns>
</metainfo>
</metadata>

```

Core/Citation (EML)

Citation (eml:eml > dataset > title and eml:eml > dataset > creator and eml:eml > dataset > pubDate and eml:eml > dataset > publisher and eml:eml > dataset > pubPlace)

- The <title> field provides a description of the resource being documented that is long enough to differentiate it from other similar resources.
- A <creator> is a structure for representing the owner of the data. A <creator> can be a person, an organization, or an organizational role.
- The year of public release of data online should be listed as the <pubDate> element.
- The <publisher> is publisher of this data set. At times this is a traditional publishing house, but it may also simply be an institution that is making the data available in a published (ie, citable) format.
- The <pubPlace> field is the location where the resource was published, which may be different from where the resource was created.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <title>Pacific Island Network Benthic Marine and Marine Fish Monitoring
Dataset</title>
    <creator>
      <individualName>
        <givenName>Eric</givenName>
        <surName>Brown </surName>
      </individualName>
      <organizationName>Kalaupapa National Historical Park, National Park
Service</organizationName>
      <positionName>Marine Ecologist</positionName>
      <electronicMailAddress>eric.brown@nps.gov</electronicMailAddress>
    </creator>
    <pubDate>2018-03-01</pubDate>
    <publisher>
      <organizationName>Pacific Island Inventory and Monitoring Network, National Park
Service</organizationName>
      <onlineURL>https://irma.nps.gov/DataStore/DownloadFile/598698</onlineURL>
    </publisher>
    <pubPlace>https://irma.nps.gov/Portal</pubPlace>
  </dataset>
</eml:eml>

```

```

</dataset>
</eml:eml>

```

Description (eml:eml > dataset > abstract and eml:eml > dataset > purpose and eml:eml > dataset > additionalInfo)

- The <abstract> is useful for describing the general nature of the research being documented, especially when the data is being designed for use with a search engine.
- The <purpose> is A description of the purpose of this dataset.
- <additionalInfo> is a text field for any material that cannot be characterized by the other elements for the data type. It can be used here to include any supplemental information about the dataset.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <abstract>
      <para>The benthic marine community in the Pacific Island Network (PACN) is a complex ecologic system and a diverse taxonomic environment, including algae and corals and other invertebrates.
    </para>
    </abstract>
    <additionalInfo>
      <section>
        <title>Other descriptive Information about the data set</title>
        <para>Benthic Marine Community data includes substrate point count identifications from image analysis for the following parks: KALA (2006 - 2016), KAH0 (2008-2010 and 2014-2017), NPSA (2009-2017), WAPA (2008-2011, 2014-2017); metadata for fixed and temporary transects and rugosity for the following parks: KALA (2006 - 2017), KAH0 (2007-2011, 2014-2017), NPSA (2007-2017), WAPA (2008-2010, 2014-2017); and settlement data for KALA (2006 - 2017). Marine Fish data includes taxonomic identification, abundance, and size estimations from fish belt transects for KALA (2006 - 2017), KAH0 (2007 - 2011, 2014-2017), NPSA (2010 - 2017) and WAPA (2008 - 2012, 2014-2017); and metadata for fixed and temporary transects which are co-located with Benthic Marine Community Protocol. Locations where threatened or endangered species were detected have generalized location information in order to protect the sensitive species.</para>
      </section>
    </additionalInfo>
  </dataset>
</eml:eml>

```

Time Period (eml:eml > dataset > coverage > temporalCoverage)

- The <temporalCoverage> element of a dataset represents the period of time the data were collected, not the year the study was put together if it uses retrospective or historical data.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <coverage>
      <temporalCoverage>
        <rangeOfDates>
          <beginDate>

```

```

        <calendarDate>2006-04-25</calendarDate>
    </beginDate>
    <endDate>
        <calendarDate>2017-10-03</calendarDate>
    </endDate>
</rangeOfDates>
</temporalCoverage>
</coverage>
</dataset>
</eml:eml>

```

Status (eml:eml > dataset > maintenance)

- The dataset/maintenance/description element should be used to document changes to the data tables or metadata, including update frequency. The change history can also be used to describe alterations in static documents.
- The <maintenanceUpdateFrequency> field documents the frequency with which changes and additions are made to the dataset after the initial dataset is completed. The values for this field must come from the enumeration MaintUpFreqType.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <maintenance>
      <description>
        <section>
          <title>Progress</title>
          <para>Complete </para>
        </section>
      </description>
      <maintenanceUpdateFrequency>Annually</maintenanceUpdateFrequency>
    </maintenance>
  </dataset>
</eml:eml>

```

Point of Contact (eml:eml > dataset > contact)

- A <contact> is a structure for representing the person, organization, or organizational role to contact regarding the use of the data.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <contact>
      <organizationName>Pacific Island Inventory and Monitoring Network, National Park Service</organizationName>
      <individualName>
        <givenName>Eric</givenName>
        <surName>Brown </surName>
      </individualName>
      <positionName>Data Manager </positionName>
      <address>
        <deliveryPoint>PO Box 52 </deliveryPoint>
        <city>Hawaii National Park </city>
        <administrativeArea>HI </administrativeArea>
      </address>
    </contact>
  </dataset>
</eml:eml>

```

```

        <postalCode>96718 </postalCode>
    </address>
    <phone phonetype="voice">(808) 985-6186 </phone>
    <electronicMailAddress>kelly_kozar@nps.gov </electronicMailAddress>
</contact>
</dataset>
</eml:eml>

```

Metadata Provider (eml:eml > dataset > metadataProvider)

- The <metadataProvider> element lists the person or organization responsible for producing or providing the metadata content.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <metadataProvider>
      <individualName>
        <givenName>Kelly</givenName>
        <surName>Kozar</surName>
      </individualName>
      <organizationName>Pacific Island Inventory and Monitoring Network, National Park
Service</organizationName>
      <positionName>Data Manager </positionName>
      <address>
        <deliveryPoint>PO Box 52 </deliveryPoint>
        <city>Hawaii National Park </city>
        <administrativeArea>HI </administrativeArea>
        <postalCode>96718 </postalCode>
      </address>
      <phone phonetype="voice">(808) 985-6186 </phone>
      <electronicMailAddress>kelly_kozar@nps.gov </electronicMailAddress>
    </metadataProvider>
  </dataset>
</eml:eml>

```

Associated Party (eml:eml > dataset > associatedParty)

- List other people who were involved with the data in some way (field technicians, students, assistants, etc.) as <associatedParty>. All <associatedParty> trees require a <role> element.

```

<eml:eml xmlns:eml="eml://ecoinformatics.org/eml-2.1.0">
  <dataset>
    <associatedParty>
      <individualName>
        <givenName>Kelly</givenName>
        <surName>Kozar</surName>
      </individualName>
      <organizationName>National Park Service, Pacific Island Network Inventory and
Monitoring Program</organizationName>
      <positionName>Data Manager</positionName>
      <address>
        <deliveryPoint>PO Box 52</deliveryPoint>
        <deliveryPoint>1 Crater Rim Drive, Quarters 16</deliveryPoint>
        <city>Hawaii National Park</city>
        <administrativeArea>HI</administrativeArea>

```

```

        <postalCode>96718</postalCode>
        <country>USA</country>
    </address>
    <phone phonetype="voice">(808) 985-6186</phone>
    <electronicMailAddress>kelly_kozar@nps.gov</electronicMailAddress>
    <role>Custodian</role>
</associatedParty>
</dataset>
</eml:eml>

```

Conversion from CSDGM to EML:

Citation

What	CSDGM source	EML target
Citation Wrapper	<i>metadata > idinfo > citation</i>	<i>eml:eml > dataset</i>
Title (Mandatory)	<i>metadata > idinfo > citation > citeinfo > title</i>	<i>eml:eml > dataset > title</i>
Originator	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>eml:eml > dataset > creator</i>
Publication Date (Citation Date/Edition Date)	<i>metadata > idinfo > citation > citeinfo > pubDate</i>	<i>eml:eml > dataset > pubDate</i>
Edition	<i>metadata > idinfo > citation > edition</i>	<i>eml:eml > ? > citation > book > edition</i> Refers to book citation, not dataset citation
Publisher	<i>metadata > idinfo > citation > citeinfo > pubinfo > publish</i>	<i>eml:eml > dataset > publisher > organizationName</i> Optional under <i>publisher</i> - <i>address</i> , <i>phone</i> , <i>electronicMailAddress</i>
Publisher Place	<i>metadata > idinfo > citation > citeinfo > pubinfo > pubplace</i>	<i>eml:eml > dataset > pubPlace</i>
Online link	<i>metadata > idinfo > citation > citeinfo > onlink</i>	<i>eml:eml > dataset > publisher > onlineURL</i>

Description

What	CSDGM source	EML target
Description wrapper	<i>metadata > idinfo > descript</i>	<i>eml:eml > dataset</i>
Abstract	<i>metadata > idinfo > descript > abstract</i>	<i>eml:eml > dataset > abstract</i>
Language	<i>None</i>	<i>eml:eml > dataset > language</i>
Purpose	<i>metadata > idinfo > descript > purpose</i>	<i>eml:eml > dataset > purpose</i>
Supplemental Information	<i>metadata > idinfo > descript > supplinf</i>	<i>eml:eml > dataset > additionalInfo > section > title</i>

Time Period

What	CSDGM source	EML target
Time Period wrapper	<i>metadata > idinfo > timeperd</i>	<i>eml:eml > dataset > coverage > temporalCoverage ></i>
Beginning Date	<i>metadata > idinfo > timeperd > timeinfo > rngdates > begdate</i>	<i>eml:eml > dataset > coverage > temporalCoverage > rangeOfDates > beginDate</i>
End Date	<i>metadata > idinfo > timeperd > timeinfo > rngdates > enddate</i>	<i>eml:eml > dataset > coverage > temporalCoverage > rangeOfDates > endDate</i>
Single Date	<i>metadata > idinfo > timeperd > timeinfo > sngdate</i>	<i>eml:eml > dataset > coverage > temporalCoverage > singleDateTime</i>

Status

What	CSDGM source	EML target
Status wrapper	<i>metadata > idinfo > status</i>	<i>eml:eml > dataset > maintenance</i>
Progress	<i>metadata > idinfo > status > progress</i>	<i>eml:eml > dataset > maintenance > description > section > title</i> [the title has a value of "progress"]
Update	<i>metadata > idinfo > status > update</i>	<i>eml:eml > dataset > maintenance > maintenanceUpdateFrequency</i>

Point of Contact

What	CSDGM source	EML target
Contact wrapper	<i>metadata > idinfo > ptcontac</i>	<i>eml:eml > dataset > contact</i>
Contact Organization	<i>metadata > idinfo > ptcontac > cntinfo > cntorgp > cntorg</i>	<i>eml:eml > dataset > contact > organizationName</i>
Contact Person	<i>metadata > idinfo > ptcontac > cntinfo > cntorgp > cntper</i>	<i>eml:eml > dataset > contact > IndividualName [givenName, surName]</i>
Contact Position	<i>metadata > idinfo > ptcontac > cntinfo > cntpos</i>	<i>eml:eml > dataset > contact > positionName</i>
Contact Address	<i>metadata > idinfo > ptcontac > cntinfo > cntaddr</i> Address type: <i>addrtype</i> Address: <i>address</i> City: <i>city</i> State: <i>state</i> Postal code: <i>postal</i> Country: not provided	<i>eml:eml > dataset > contact > address</i> Address type: NA Address: <i>deliveryPoint</i> City: <i>city</i> State: <i>administrativeArea</i> Postal code: <i>postalCode</i> Country: <i>country</i>
Contact Phone	<i>metadata > idinfo > ptcontac > cntinfo > cntvoice</i>	<i>eml:eml > dataset > contact > phone</i>
Contact Email	<i>metadata > idinfo > ptcontac > cntinfo > cntemail</i>	<i>eml:eml > dataset > contact > electronicMailAddress</i>

Other Contacts

What	CSDGM source	EML target
Owner	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>eml:eml > dataset > associatedParty > role</i>
Data Steward/Custodian	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>eml:eml > dataset > associatedParty > role</i>
Principal Investigator	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>eml:eml > dataset > associatedParty > role</i>
Metadata Contact	<i>metadata > idinfo > metainfo > metc > cntinfo</i>	<i>eml:eml > dataset > metadataProvider</i>
Author	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>eml:eml > dataset > creator</i>

Metadata Information

- `<additionalMetadata>` is a flexible field for including any other relevant metadata that pertains to the resource being described.
- The `<metadata>` element is a container for the additional metadata. The contents can be any valid XML.
- The metadata creation and update date is not accounted for anywhere else in the EML standard, so can be included in the `<additionalMetadata>` element.
- “metadataDate” and “metadataUpdate” were added as text for the `<metadata>` field.

What	CSDGM source	EML target
Metadata Date	<i>Metadata > metainfo > metd></i>	<i>eml:eml > additionalMetadata > metadata > “metadataDate”</i>
Metadata Update Date	<i>Metadata > metainfo > metrd</i>	<i>eml:eml > additionalMetadata > metadata > “metadataUpdate”</i>
Metadata Contact	<i>metadata > idinfo > metainfo > metc > cntinfo</i>	<i>eml:eml > dataset > metadataProvider</i>

Appendix C – Migrating CSDGM Core Information to the ISO Suite

CSDGM to ISO – Core/Citation

- 4/12/2018 – Helen Thomas
- Using CSDGM - PACN benthic fish metadata example from Kelly Kozar

Core/Citation (CSDGM)

Identification Information (metadata > idinfo >)

- Contains the following Core/Citation sections:
 - Citation (citation)
 - Description (descript)
 - Time Period of Content (timeperd)
 - Status (status)
 - Point of Contact (ptcontac) – optional

Citation (metadata > idinfo > citation)

- The recommended reference to be used for the data set. Includes:
 - Originator - the name of an organization or individual that developed the data set (origin).
 - Publication Date - the date when the data set is published or otherwise made available for release (pubdate).
 - Title - the name by which the data set is known (title).
 - Edition - the version of the title (edition).
 - Publication Information - publication details for published data sets (pubinfo).
 - Publication Place - the name of the city (and state or province, and country, if needed to identify the city) where the data set was published or released (pubPlace)
 - Publisher - the name of the individual or organization that published the data set (publish).
 - Online Linkage - the name of an online computer resource that contains the data set (onlink).
 - Geospatial Data Presentation Form - the mode in which the geospatial data are represented (geoform).

```
<metadata>
  <citation>
    <citeinfo>
      <origin>Eric Brown </origin>
      <origin>Sheila McKenna </origin>
      <origin>Tim Clark </origin>
```

```

    <origin>Bert Fuiva </origin>
    <origin>Ariel Halperin </origin>
    <origin>Amanda McCutcheon </origin>
    <origin>Kazuki Kageyama </origin>
    <origin>Sylvester Lee </origin>
    <origin>Lindsey Kramer </origin>
    <origin>Kimberly Tice </origin>
    <origin>Chris Rillahan </origin>
    <origin>Senifa Annandale </origin>
    <pubdate>20180301</pubdate>
    <title>Pacific Island Network Benthic Marine and Marine Fish Monitoring
Dataset</title>
    <pubinfo>
        <pubplace>Hawaii National Park, HI </pubplace>
        <publish>NPS </publish>
    </pubinfo>
    <onlink>https://irma.nps.gov/DataStore/DownloadFile/598698</onlink>
    <geoform>MS Access database</geoform>
    </citeinfo>
</citation>
</metadata>

```

Description (metadata > idinfo > descript)

- Description: A characterization of the data set, including its intended use and limitations. Includes:
 - Abstract: A brief narrative summary of the data set (abstract).
 - Purpose : A summary of the intentions with which the data set was developed (purpose).
 - Supplemental Information: Other descriptive information about the data set (supplinf).

```

<metadata>
    <descript>
        <abstract>The benthic marine community in the Pacific Island Network (PACN) is a
complex ecologic system and a diverse taxonomic environment, including algae and
corals and other invertebrates. Reef-building corals are the primary architectural
organism and are sensitive to environmental degradation; therefore, they are a good
indicator of overall health for nearshore park's marine ecosystems. Primary stressors
to coral reefs include disease, bleaching, sedimentation, eutrophication, storms, and
global climate change. The United Nations Environment Programme (UNEP) has proposed
using coral reefs as a worldwide indicator ecosystem for global climate change
(Spalding et al. 2004). For these reasons, the PACN has chosen to implement long term
monitoring of benthic marine communities. Benthic marine communities is most closely
linked with marine fish, and monitoring efforts will be conducted at the same time and
location to maximize data value</abstract>
        <purpose>To store long term monitoring data for benthic marine communities and
marine fish. </purpose>
        <supplinf>Benthic Marine Community data includes substrate point count
identifications from image analysis for the following parks: KALA (2006 - 2016), KAHO
(2008-2010 and 2014-2017), NPSA (2009-2017), WAPA (2008-2011, 2014-2017); metadata for
fixed and temporary transects and rugosity for the following parks: KALA (2006 -
2017), KAHO (2007-2011, 2014-2017), NPSA (2007-2017), WAPA (2008-2010, 2014-2017); and
settlement data for KALA (2006 - 2017). Marine Fish data includes taxonomic
identification, abundance, and size estimations from fish belt transects for KALA

```

(2006 - 2017), KAHO (2007 - 2011, 2014-2017), NPSA (2010 - 2017) and WAPA (2008 - 2012, 2014-2017); and metadata for fixed and temporary transects which are co-located with Benthic Marine Community Protocol. Locations where threatened or endangered species were detected have generalized location information in order to protect the sensitive species.</supplinf>

</descript>
</metadata>

Time Period (metadata > idinfo > timeperd)

- The time period(s) for which the data set corresponds to the currentness reference. Includes:
 - Currentness Reference - the basis on which the time period of content information is determined (current).

```
<metadata>
  <timeperd>
    <timeinfo>
      <rngdates>
        <begdate>20060425 </begdate>
        <enddate>20171003</enddate>
      </rngdates>
    </timeinfo>
    <current>publication date </current>
  </timeperd>
</metadata>
```

Status (metadata > idinfo > status)

- The state of and maintenance information for the data set. Includes:
 - Progress: The state of the data set (progress)
 - Maintenance and Update Frequency: The frequency with which changes and additions are made to the data set after the initial data set is completed (update).

```
<metadata>
  <status>
    <progress>Complete </progress>
    <update>Annually </update>
  </status>
</metada.ta>
```

Point of Contact (metadata > idinfo > ptcontac)

- Identity of, and means to communicate with, person(s) and organization(s) associated with the data set.

```
<ptcontac>
  <cntinfo>
    <cntorgp>
      <cntorg>PACN Inventory & Monitoring Program, National Park Service
    </cntorg>
    <cntper>Kelly Kozar </cntper>
  </cntorgp>
```

```

    <cntpos>Data Manager </cntpos>
    <cntaddr>
      <addrtype>mailing </addrtype>
      <address>PO Box 52 </address>
      <city>Hawaii National Park </city>
      <state>HI </state>
      <postal>96718 </postal>
    </cntaddr>
    <cntvoice>(808)985-6186 </cntvoice>
    <cntfax>(808)985-6111 </cntfax>
    <cntemail>kelly_kozar@nps.gov </cntemail>
  </cntinfo>
</ptcontac>
</metadata>

```

Metadata Reference Information (metadata > metainfo)

- Information on the currentness of the metadata information, and the responsible
- party.
- Contains the following sections:
 - Metadata Date: The date that the metadata were created or last updated (metd).
 - Metadata Review Date: The date of the latest review of the metadata entry (metrd). – optional
 - Metadata Contact: The party responsible for the metadata information (metc).
 - Metadata Standard Name: The name of the metadata standard used to document the data set (metstdn).
 - Metadata Standard Version: Identification of the version of the metadata standard used to document the dataset (metstdv).
 - Metadata Extensions: A reference to extended elements to the standard which may be defined by a metadata producer or a user community (metextns). – mandatory in applicable

```

<metadata>
  <metainfo>
    <metd>20100917 </metd>
    <metrd>20180301</metrd>
    <metc>
      <cntinfo>
        <cntorgp>
          <cntorg>PACN Inventory & Monitoring Program, National Park Service
        </cntorg>
        <cntper>Kelly Kozar </cntper>
      </cntorgp>
      <cntpos>Data Manager </cntpos>
      <cntaddr>
        <addrtype>mailing </addrtype>
        <address>PO Box 52 </address>
        <city>Hawaii National Park </city>

```

```

        <state>HI </state>
        <postal>96718 </postal>
    </cntaddr>
    <cntvoice>(808) 985-6186 </cntvoice>
    <cntfax>(808) 985-6111 </cntfax>
    <cntemail>kelly_kozar@nps.gov </cntemail>
</cntinfo>
</metc>
<metstdn>FGDC Content Standard for Digital Geospatial Metadata</metstdn>
<metstdv>FGDC-STD-001-1998</metstdv>
<metextns>
    <onlink>http://nrddata.nps.gov/profiles/NPS_Profile.xml</onlink>
    <metprof>NPS NR and GIS Metadata Profile </metprof>
</metextns>
</metainfo>
</metadata>

```

Core/Citation (ISO)

Citation (MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > title; MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > date; MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty)

- The CI_Citation element provides bibliographic information to reference the resource (e.g., dataset). Elements included:
 - Title: Name by which the cited resource is known.
 - Date: Reference date for the cited resource; reference date and event used to describe it (creation, publication, or revision). See example below for publication date.
 - citedResponsibleParty: Identification of the contact for the resource (e.g., dataset). Supports several different roles for contacts (e.g., originator, publisher, custodian, pointOfContact). See example below for originator. Although this element could be used to represent the dataset publisher, the EPA Metadata Editor v 5.0 (EME5) combines the dataset point of contact and publisher (it generates a pointOfContact element with role = publisher). See the Point of Contact section below for more details.

```

<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
<identificationInfo>
    <MD_DataIdentification>
        <citation>
            <CI_Citation>
                <title>
                    <gco:CharacterString>Pacific Island Network Benthic Marine and Marine Fish
Monitoring Dataset</gco:CharacterString>
                </title>
                <date>

```

```

    <CI_Date>
      <date>
        <gco:Date>2018-03-01</gco:Date>
      </date>
      <dateType>
        <CI_DateTypeCode>
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateType
Code" codeListValue="publication"
codeSpace="ISOTC211/19115">publication</CI_DateTypeCode>
        </dateType>
      </CI_Date>
    </date>
    <citedResponsibleParty>
      <CI_ResponsibleParty>
        <individualName>
          <gco:CharacterString>Sheila McKenna</gco:CharacterString>
        </individualName>
        <organisationName>
          <gco:CharacterString>Pacific Island Inventory and Monitoring Network,
National Park Service</gco:CharacterString>
        </organisationName>
        <positionName>
          <gco:CharacterString>Marine Ecologist</gco:CharacterString>
        </positionName>
        <contactInfo>
          <CI_Contact>
            <phone>
              <CI_Telephone>
                <voice>
                  <gco:CharacterString>(808) 985-6188</gco:CharacterString>
                </voice>
              </CI_Telephone>
            </phone>
            <address>
              <CI_Address>
                <deliveryPoint>
                  <gco:CharacterString>PO Box 52</gco:CharacterString>
                </deliveryPoint>
                <city>
                  <gco:CharacterString>Hawaii National
Park</gco:CharacterString>
                </city>
                <administrativeArea>
                  <gco:CharacterString>HI</gco:CharacterString>
                </administrativeArea>
                <postalCode>
                  <gco:CharacterString>96718</gco:CharacterString>
                </postalCode>
                <country>
                  <Country>
codeList="http://www.iso.org/iso/country_codes/iso_3166_code_lists.htm"
codeListValue="US" codeSpace="ISO3166-1">US</Country>
                </country>
                <electronicMailAddress>

```

```

<gco:CharacterString>sheila_mckenna@nps.gov</gco:CharacterString>
  </electronicMailAddress>
    </CI_Address>
  </address>
</CI_Contact>
</contactInfo>
<role>
  <CI_RoleCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#CI_RoleCode
" codeListValue="originator" codeSpace="ISOTC211/19115">originator</CI_RoleCode>
  </role>
</CI_ResponsibleParty>
</citedResponsibleParty>
</CI_Citation>
</citation>
</MD_DataIdentification>
</identificationInfo>
</MD_Metadata>

```

**Description (MD_Metadata > identificationInfo > MD_DataIdentification > abstract;
MD_Metadata > identificationInfo > MD_DataIdentification > purpose; MD_Metadata >
identificationInfo > MD_DataIdentification > supplementalInformation; MD_Metadata >
identificationInfo > MD_DataIdentification > language)**

- abstract: Brief narrative summary of the dataset's contents.
- purpose: Summary of the intentions for which the dataset was developed.
- supplementalInformation: Other descriptive information about the dataset.
- language: Languages of the dataset using standard ISO three-letter codes.

```

<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <identificationInfo>
    <MD_DataIdentification>
      <abstract>
        <gco:CharacterString>The benthic marine community in the Pacific Island
Network (PACN) is a complex ecologic system and a diverse taxonomic environment,
including algae and corals and other invertebrates. Reef-building corals are the
primary architectural organism and are sensitive to environmental degradation;
therefore, they are a good indicator of overall health for nearshore park's marine
ecosystems. Primary stressors to coral reefs include disease, bleaching,
sedimentation, eutrophication, storms, and global climate change. The United Nations
Environment Programme (UNEP) has proposed using coral reefs as a worldwide indicator
ecosystem for global climate change (Spalding et al. 2004). For these reasons, the
PACN has chosen to implement long term monitoring of benthic marine communities.
Benthic marine communities is most closely linked with marine fish, and monitoring
efforts will be conducted at the same time and location to maximize data
value.</gco:CharacterString>
      </abstract>

```

```

    <purpose>
      <gco:CharacterString>To store long term monitoring data for benthic marine
communities and marine fish.</gco:CharacterString>
    </purpose>
    <language>
      <LanguageCode codeList="http://www.loc.gov/standards/iso639-
2/php/code_list.php" codeListValue="eng" codeSpace="ISO639-2">eng</LanguageCode>
    </language>
    <supplementalInformation>
      <gco:CharacterString>Benthic Marine Community data includes substrate point
count identifications from image analysis for the following parks: KALA (2006 - 2016),
KAHO (2008-2010 and 2014-2017), NPSA (2009-2017), WAPA (2008-2011, 2014-2017);
metadata for fixed and temporary transects and rugosity for the following parks: KALA
(2006 - 2017), KAHO (2007-2011, 2014-2017), NPSA (2007-2017), WAPA (2008-2010, 2014-
2017); and settlement data for KALA (2006 - 2017). Marine Fish data includes taxonomic
identification, abundance, and size estimations from fish belt transects for KALA
(2006 - 2017), KAHO (2007 - 2011, 2014-2017), NPSA (2010 - 2017) and WAPA (2008 -
2012, 2014-2017); and metadata for fixed and temporary transects which are co-located
with Benthic Marine Community Protocol. Locations where threatened or endangered
species were detected have generalized location information in order to protect the
sensitive species.</gco:CharacterString>
    </supplementalInformation>
  </MD_DataIdentification>
</identificationInfo>
</MD_Metadata>

```

Time Period (MD_Metadata > identificationInfo > MD_DataIdentification > extent > EX_Extent > temporalElement > EX_TemporalExtent)

- EX_TemporalExtent: Time period covered by the content of the dataset.

```

<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <identificationInfo>
    <MD_DataIdentification>
      <extent>
        <EX_Extent>
          <temporalElement>
            <EX_TemporalExtent>
              <extent>
                <gml:TimePeriod gml:id="ID0E24CI">
                  <gml:beginPosition>2006-04-25T00:00:00</gml:beginPosition>
                  <gml:endPosition>2017-10-03T00:00:00</gml:endPosition>
                </gml:TimePeriod>
              </extent>
            </EX_TemporalExtent>
          </temporalElement>
        </EX_Extent>
      </extent>
    </MD_DataIdentification>
  </identificationInfo>
</MD_Metadata>

```

Status (MD_Metadata > identificationInfo > MD_DataIdentification > status; MD_Metadata > identificationInfo > MD_DataIdentification > resourceMaintenance)

- status: The development phase of the dataset.
- resourceMaintenance: Describes the frequency, scope, and responsible party for the updating of the dataset.

```
<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <identificationInfo>
    <MD_DataIdentification>
      <status>
        <MD_ProgressCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#MD_Progress
Code" codeListValue="completed" codeSpace="ISOTC211/19115">completed</MD_ProgressCode>
      </status>
      <resourceMaintenance>
        <MD_MaintenanceInformation>
          <maintenanceAndUpdateFrequency>
            <MD_MaintenanceFrequencyCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#MD_Maintena
nceFrequencyCode" codeListValue="annually"
codeSpace="ISOTC211/19115">annually</MD_MaintenanceFrequencyCode>
          </maintenanceAndUpdateFrequency>
        </MD_MaintenanceInformation>
      </resourceMaintenance>
    </MD_DataIdentification>
  </identificationInfo>
</MD_Metadata>
```

Point of Contact (MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact)

- pointOfContact: Identification and means to contact people/organizations associated with the dataset.
- As mentioned above, EME5 combines the dataset point of contact and publisher. It generates a pointOfContact element with role = publisher. It requires individual name, email, phone, and address for this publisher/POC element. EME5 imported the CSDGM point of contact (*ptcontact*) elements into the publisher/POC elements by default.

```
<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <identificationInfo>
    <MD_DataIdentification>
      <pointOfContact>
```

```

<CI_ResponsibleParty>
  <individualName>
    <gco:CharacterString>Kelly Kozar</gco:CharacterString>
  </individualName>
  <organisationName>
    <gco:CharacterString>Pacific Island Inventory and Monitoring Network,
National Park Service</gco:CharacterString>
  </organisationName>
  <positionName>
    <gco:CharacterString>Data Manager</gco:CharacterString>
  </positionName>
  <contactInfo>
    <CI_Contact>
      <phone>
        <CI_Telephone>
          <voice>
            <gco:CharacterString>(808) 985-6186</gco:CharacterString>
          </voice>
          <facsimile>
            <gco:CharacterString>(808) 985-6111</gco:CharacterString>
          </facsimile>
        </CI_Telephone>
      </phone>
      <address>
        <CI_Address>
          <deliveryPoint>
            <gco:CharacterString>PO Box 52</gco:CharacterString>
          </deliveryPoint>
          <city>
            <gco:CharacterString>Hawaii National Park</gco:CharacterString>
          </city>
          <administrativeArea>
            <gco:CharacterString>HI</gco:CharacterString>
          </administrativeArea>
          <postalCode>
            <gco:CharacterString>96718</gco:CharacterString>
          </postalCode>
          <electronicMailAddress>
            <gco:CharacterString>kelly_kozar@nps.gov</gco:CharacterString>
          </electronicMailAddress>
        </CI_Address>
      </address>
    </CI_Contact>
  </contactInfo>
  <role>
    <CI_RoleCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodetlists.xml#CI_RoleCode
" codeListValue="publisher" codeSpace="ISOTC211/19115">publisher</CI_RoleCode>
    </role>
  </CI_ResponsibleParty>
</pointOfContact>
</MD_DataIdentification>
</identificationInfo>
</MD_Metadata>

```

Metadata Information (MD_Metadata)

- Root entity that defines information about metadata. Contains the following elements:
 - fileIdentifier: A unique phrase or string which uniquely identifies the metadata file. This can be generated by EME5.
 - language: Language of the metadata composed of an ISO639-2/T three-letter language code and an ISO3166-1 three-letter country code.
 - characterSet: Character coding standard in the metadata.
 - hierarchyLevel: Level to which the metadata applies.
 - contact: The responsible party for the metadata content.
 - dateStamp: Metadata creation date.
 - metadataStandardName: Name of the metadata standard/profile used.
 - metadataStandardVersion: Version of the metadata standard/profile used.
 - metadataMaintenance: Information about metadata updates, including:
 - maintenanceAndUpdateFrequency: Frequency of changes and additions made to the resource after the initial completion. EME5 set this to Unknown by default, presumably since there is no CSDGM equivalent.
 - maintenanceNote: Information regarding specific requirements for maintaining the resource. EME5 populated this with the last metadata review date (CSDGM *metrd* – see example below).

```
<MD_Metadata xmlns="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco"
xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:srv="http://www.isotc211.org/2005/srv" xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <fileIdentifier>
    <gco:CharacterString>6C6C70B2-10BD-446B-8623-1B5AF7D4343B</gco:CharacterString>
  </fileIdentifier>
  <language>
    <LanguageCode codeList="http://www.loc.gov/standards/iso639-2/php/code_list.php"
codeListValue="eng" codeSpace="ISO639-2">eng</LanguageCode>
  </language>
  <characterSet>
    <MD_CharacterSetCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#MD_Characte
rSetCode" codeListValue="utf8" codeSpace="ISOTC211/19115">utf8</MD_CharacterSetCode>
  </characterSet>
  <hierarchyLevel>
    <MD_ScopeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#MD_ScopeCod
e" codeListValue="dataset" codeSpace="ISOTC211/19115">dataset</MD_ScopeCode>
  </hierarchyLevel>
  <contact>
    <CI_ResponsibleParty>
```

```

<individualName>
  <gco:CharacterString>Kelly Kozar</gco:CharacterString>
</individualName>
<organisationName>
  <gco:CharacterString>Pacific Island Inventory and Monitoring Network, National
Park Service</gco:CharacterString>
</organisationName>
<positionName>
  <gco:CharacterString>Data Manager</gco:CharacterString>
</positionName>
<contactInfo>
  <CI_Contact>
    <phone>
      <CI_Telephone>
        <voice>
          <gco:CharacterString>(808) 985-6186</gco:CharacterString>
        </voice>
        <facsimile>
          <gco:CharacterString>(808) 985-6111</gco:CharacterString>
        </facsimile>
      </CI_Telephone>
    </phone>
    <address>
      <CI_Address>
        <deliveryPoint>
          <gco:CharacterString>PO Box 52</gco:CharacterString>
        </deliveryPoint>
        <city>
          <gco:CharacterString>Hawaii National Park</gco:CharacterString>
        </city>
        <administrativeArea>
          <gco:CharacterString>HI</gco:CharacterString>
        </administrativeArea>
        <postalCode>
          <gco:CharacterString>96718</gco:CharacterString>
        </postalCode>
        <electronicMailAddress>
          <gco:CharacterString>kelly_kozar@nps.gov</gco:CharacterString>
        </electronicMailAddress>
      </CI_Address>
    </address>
  </CI_Contact>
</contactInfo>
<role>
  <CI_RoleCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#CI_RoleCode
" codeListValue="pointOfContact"
codeSpace="ISOTC211/19115">pointOfContact</CI_RoleCode>
  </role>
</CI_ResponsibleParty>
</contact>
<dateStamp>
  <gco:Date>2018-04-11</gco:Date>
</dateStamp>
<metadataStandardName>

```

```

    <gco:CharacterString>NAP - Metadata</gco:CharacterString>
  </metadataStandardName>
  <metadataStandardVersion>
    <gco:CharacterString>1.2</gco:CharacterString>
  </metadataStandardVersion>
  <metadataMaintenance>
    <MD_MaintenanceInformation>
      <maintenanceAndUpdateFrequency>
        <MD_MaintenanceFrequencyCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodeLists.xml#MD_Maintena
nceFrequencyCode" codeListValue="annually"
codeSpace="ISOTC211/19115">annually</MD_MaintenanceFrequencyCode>
        </maintenanceAndUpdateFrequency>
        <maintenanceNote>
          <gco:CharacterString>Last metadata review date: 20180301</gco:CharacterString>
        </maintenanceNote>
      </MD_MaintenanceInformation>
    </metadataMaintenance>
  </MD_Metadata>

```

Conversion from CSDGM to ISO:

Citation

What	CSDGM source	ISO target
Citation Wrapper	<i>metadata > idinfo > citation</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation</i>
Title (Mandatory)	<i>metadata > idinfo > citation > citeinfo > title</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > title</i>
Originator	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (originator)</i>

Citation (continued)

What	CSDGM source	ISO target
Publication Date (Citation Date/Edition Date)	<i>metadata > idinfo > citation > citeinfo > pubDate</i>	<i>Publication Date: MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > date > CI_Date (dateType = "publication")</i> <i>Edition Date: MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > editionDate</i>
Edition	<i>metadata > idinfo > citation > edition</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > edition</i>

What	CSDGM source	ISO target
Publisher	<i>metadata > idinfo > citation > citeinfo > pubinfo > publish</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (publisher)</i> or <i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > Role (publisher)</i>
Publisher Place	<i>metadata > idinfo > citation > citeinfo > pubinfo > pubplace</i>	<i>NA; Information captured in publisher address: MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > contactInfo > CI_Contact > address</i>
Online link	<i>metadata > idinfo > citation > citeinfo > onlink</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > contactInfo > CI_Contact > onlineResource</i>

Description

What	CSDGM source	ISO target
Description wrapper	<i>metadata > idinfo > descript</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification</i>
Abstract	<i>metadata > idinfo > descript > abstract</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > abstract</i>
Language	<i>None</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > language</i>

Description (continued)

What	CSDGM source	ISO target
Purpose	<i>metadata > idinfo > descript > purpose</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > purpose</i>
Supplemental Information	<i>metadata > idinfo > descript > supplinf</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > supplementalInformation</i>

Time Period

What	CSDGM source	ISO target
Time Period wrapper	<i>metadata > idinfo > timeperd</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > extent > EX_Extent > temporalElement</i>
Beginning Date	<i>metadata > idinfo > timeperd > timeinfo > rngdates > begdate</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > extent > EX_Extent > temporalElement > EX_TemporalExtent > extent > gml:TimePeriod > gml:beginPosition</i>
End Date	<i>metadata > idinfo > timeperd > timeinfo > rngdates > enddate</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > extent > EX_Extent > temporalElement > EX_TemporalExtent > extent > gml:TimePeriod > gml:endPosition</i>
Single Date	<i>metadata > idinfo > timeperd > timeinfo > sngdate</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > extent > EX_Extent > temporalElement > EX_TemporalExtent > extent > gml:TimeInstant</i>

Status

What	CSDGM source	ISO target
Status wrapper	<i>metadata > idinfo > status</i>	<i>No exact equivalent; MD_Metadata > identificationInfo > MD_DataIdentification > resourceMaintenance provides a wrapper for maintenance information.</i>
Progress	<i>metadata > idinfo > status > progress</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > status</i>
Update	<i>metadata > idinfo > status > update</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > resourceMaintenance > MD_MaintenanceInformation > maintenanceAndUpdateFrequency</i>

Point of Contact

What	CSDGM source	ISO target
Contact wrapper	<i>metadata > idinfo > ptcontac</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact</i>
Contact Organization	<i>metadata > idinfo > ptcontac > cntinfo > cntorgp > cntorg</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > organizationName</i>
Contact Person	<i>metadata > idinfo > ptcontac > cntinfo > cntorgp > cntper</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > individualName</i>
Contact Position	<i>metadata > idinfo > ptcontac > cntinfo > cntpos</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > positionName</i>
Contact Address	<i>metadata > idinfo > ptcontac > cntinfo > cntaddr</i> Address type: <i>addrtype</i> Address: <i>address</i> City: <i>city</i> State: <i>state</i> Postal code: <i>postal</i> Country: not provided	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > contactInfo > CI_Contact > address > CI_Address</i> Address type: NA Address: <i>deliveryPoint</i> City: <i>city</i> State: <i>administrativeArea</i> Postal code: <i>postalCode</i> Country: <i>country</i>
Contact Phone	<i>metadata > idinfo > ptcontac > cntinfo > cntvoice</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > contactInfo > CI_Contact > phone</i>
Contact Email	<i>metadata > idinfo > ptcontac > cntinfo > cntemail</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > pointOfContact > CI_ResponsibleParty > contactInfo > CI_Contact > address > CI_Address > electronicMailAddress</i>

Other Contacts

What	CSDGM source	ISO target
Owner	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (owner)</i>
Data Steward/Custodian	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (custodian)</i>
Principal Investigator	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (principalInvestigator)</i>
Metadata Contact	<i>metadata > idinfo > metainfo > metc > cntinfo</i>	<i>MD_Metadata > contact</i>
Author	<i>metadata > idinfo > citation > citeinfo > origin</i>	<i>MD_Metadata > identificationInfo > MD_DataIdentification > citation > CI_Citation > citedResponsibleParty > CI_ResponsibleParty > Role (author)</i>

Metadata Information. The metadata update date is not accounted for anywhere else in the ISO standard, so it can be included as a *maintenanceNote* in the *metadataMaintenance* element.

What	CSDGM source	ISO target
Metadata Date	<i>Metadata > metainfo > metd></i>	<i>MD_Metadata > dateStamp</i>
Metadata Update Date	<i>Metadata > metainfo > metrd</i>	<i>MD_Metadata > metadataMaintenance > MD_MaintenanceInformation > maintenanceNote</i>
Metadata Contact	<i>metadata > idinfo > metainfo > metc > cntinfo</i>	<i>MD_Metadata > contact</i>

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 999/156375, July 2019

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

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