Environmental Sensitivity Index Guidelines

Version 5.0

U.S. Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

National Ocean Service - Office of Response and Restoration (NOS OR&R)

Emergency Response Division (ERD)

Technical Memorandum NOS OR&R 57 MARCH 2026

DOI: 10.25923/fkqy-1m49

COVER

(upper left) Exposed rocky shores, Kayak Island, AK (source: Photo by Miles O. Hayes, who developed the original concept of the ESI).

(upper right) Kelp (source: U.S Department of the Interior Bureau of Ocean Energy Management (BOEM) OCS Study, BOEM 2021-048; http://www.boem.gov/Environmental-Studies-EnvData/).

(middle left) Piping Plover (source: U.S. Geological Survey; https://www.usgs.gov/media/images/piping-plover-0).

(middle) Bottlenose dolphins surface to breathe; (source: Photo by David Laist, CoastalReview.org; https://coastalreview.org/wp-content/uploads/2020/04/Bottlenose-dolphins-surface-to-breathe-Photo-David-Laist.jpg).

(middle left) Loggerhead hatchling (source: Photo by Barbara Bergwerf, S.C. Department of Natural Resources; https://www.dnr.sc.gov/marine/turtles/gallery/index.html).

(lower left) aerial view of the Dry Tortugas National Park (source: Photo by Maj. Brooke Cortez, U.S. Air Force https://www.homestead.afrc.af.mil/News/Article-Display/Article/700729/reservists-employ-innovation-to-modernize-majestic-national-park/).

(lower right) Support Fleet (source: U.S Department of the Interior Bureau of Ocean Energy Management (BOEM) OCS Study, BOEM 2021-048; http://www.boem.gov/Environmental-Studies-EnvData/).

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MARCH 2026

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Acknowledgments

We would like to acknowledge the contributions of several individuals who provided content and technical review in the development of Version 5.0 of the Environmental Sensitivity Index (ESI) guidelines. Reviewers included Amy MacFadyen (NOAA ESI Program Manager), Dan Dorfman, and Adam Rotert. Their review and feedback strengthened the quality and applicability of this document.

The suggested citation for this document is:

White, M. et al. 2026. Environmental Sensitivity Index Guidelines, Version 5.0. NOAA Technical Memorandum, NOS OR&R 57. DOI: 10.25923/fkqy-1m49.

NOAA's Office of Response and Restoration

NOAA's Office of Response and Restoration (OR&R) is a center of expertise in preparing for, evaluating, and responding to threats to coastal environments, including oil and chemical spills, releases from hazardous waste sites, and marine debris. To fulfill its mission of protecting and restoring NOAA trust resources, OR&R:

- Provides scientific and technical support to prepare for and respond to oil and chemical releases.
- Determines damage to natural resources from these releases.
- Protects and restores marine and coastal ecosystems, including coral reefs.
- Works with communities to address critical local regional coastal challenges.
- OR&R is comprised of four divisions: Emergency Response, Assessment and Restoration, Marine Debris Program, and the Disaster Preparedness Program.
- Collectively, OR&R provides comprehensive solutions to environmental hazards caused by oil, chemicals, and marine debris.

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Versions of the ESI Guidelines

Environmental Sensitivity Index (ESI) maps were originally developed as colored, hardcopy maps with limited distribution in 1979. In 1989, the development of Geographic Information System (GIS) software enabled the development of ESI data in a digitally reference geospatial dataset. With the development of ESI maps in Geographic Information Systems (GIS), it is important to describe the various components that make up an ESI and the underlying data schema.

The availability of geospatial data and access to resource experts along with the rapid advancement in GIS technology allowed for the expansion of ESI elements. This expansion has driven the need to update the ESI Guidelines over time.

ESI Guidelines Version 5.0 and the previous ESI guideline documents, listed below, help inform users of: 1) the basic ESI elements; 2) general guidance of data collection and compilation; and 3) the ESI data structure.

Version	Publication Date	Description
5.0	September 2025	**NOAA Technical Memorandum NOS OR&R 57** Version 5.0 of the Guidelines should be reference for ESI data sets published since Fall of 2020.
4.0	April 2019	**NOAA Technical Memorandum NOS OR&R 52** Version 4.0 of the Guidelines should be reference for ESI data sets developed from Hurricane Sandy funding, 2015 – Fall 2020.
3.0	March 2002	**NOAA Technical Memorandum NOS OR&R 11** Version 3.0 of the Guidelines should be reference for ESI data sets developed from 2002 through the publication of Version 4.0.
2.0	October 1997	**NOAA Technical Memorandum NOS ORCA 115** Version 2.0 of the Guidelines should be reference for ESI data sets developed from 1997 through the publication of Version 3.0.
1.0	October 1995	**NOAA Technical Memorandum NOS ORCA 92** Version 1.0 of the Guidelines should be reference for ESI data sets developed prior to 1997.

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CHAPTER 1

Introduction to ESI Mapping

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1 Introduction to Environmental Sensitivity Index (ESI) Maps and Data

Environmental Sensitivity Index (ESI) maps and data provide a concise summary of coastal resources at risk if an oil spill occurs (**Figure 1.1**). ESI maps are comprised of three types of information:

1. Shoreline Classification – ranked according to a scale relating to sensitivity, natural persistence of oil, and ease of cleanup.
2. Biological Resources – including oil-sensitive animals and rare plants, as well as habitats used by oil-sensitive species or that are themselves sensitive to oil spills, such as submerged aquatic vegetation and coral reefs.
3. Human-use (Socioeconomic) Resources – specific areas that have added sensitivity and value because of their use (such as beaches, parks, marine sanctuaries, water intakes, and archaeological sites), areas that may be useful in the event of a response (such as boat ramps and access points), jurisdictional boundaries, and resources that may themselves pose a risk.

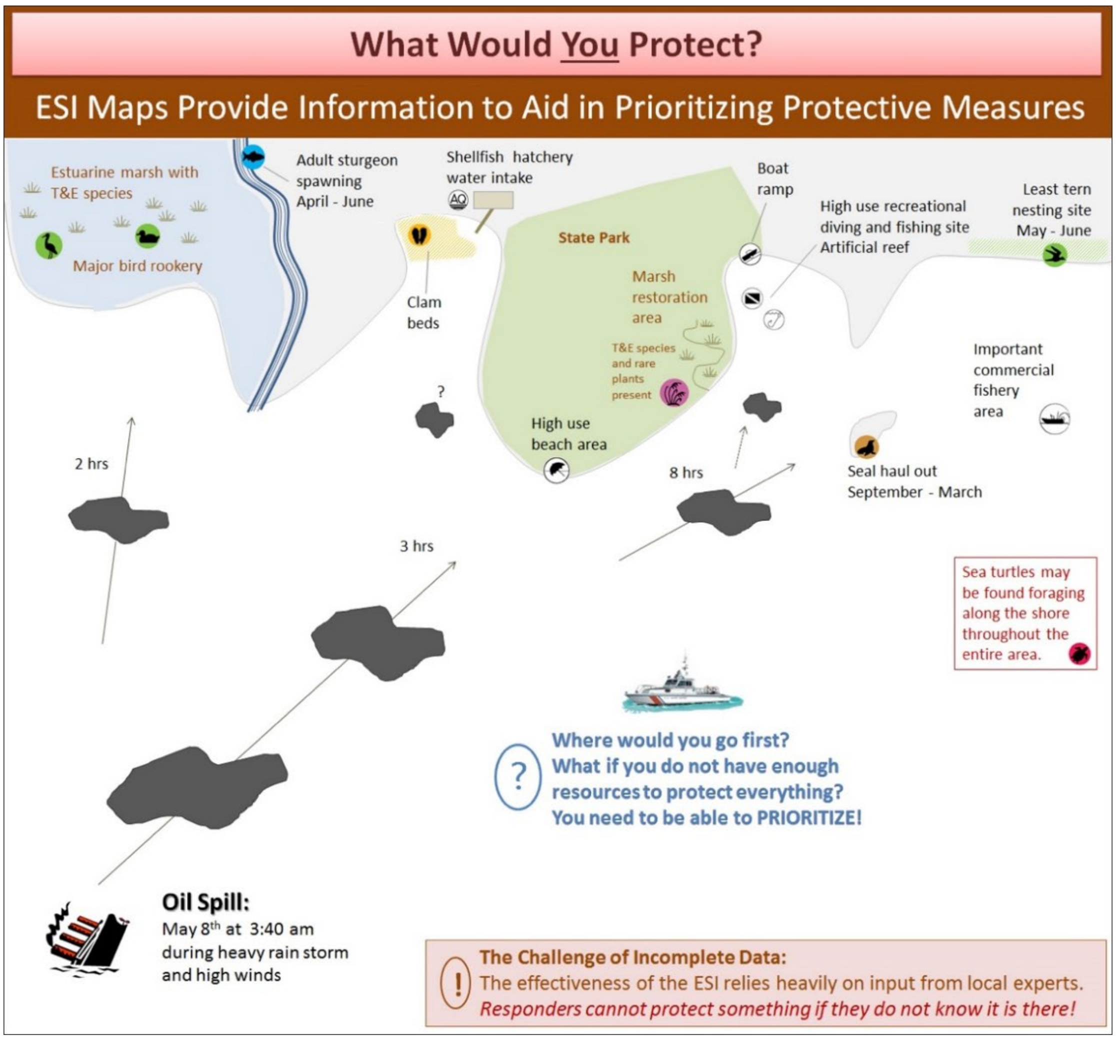

Figure 1.1: ESI maps and data help responders and planners determine protection priorities.

When an oil spill occurs, ESI data can help responders meet one of the main response objectives: reducing the environmental consequences of the spill and the cleanup efforts. Additionally, ESI data can be used by planners—before a spill happens—to identify vulnerable locations, establish protection priorities, and identify response strategies.

Although the primary audience for ESI maps and data are oil spill planners and responders, the information they contain provides excellent baseline information for a variety of coastal management and planning applications. Comprehensive, regional ESI data can be used for natural resource damage assessment (NRDA) and restoration project implementation, hurricane response, marine debris identification and removal actions, selection of marine sanctuary and conservation sites, environmental permitting and compliance, and vessel traffic routing.

1.1 Background

ESI maps have been an integral component of oil spill contingency planning and response since 1979, when the first ESI maps were prepared days in advance of the arrival of the oil slicks from the IXTOC 1 well blowout in the Gulf of Mexico. Since that time, ESI data have been compiled for all the U.S. coast, including Alaska, Hawaii, the Great Lakes, and the U.S. territories. Appendix F provides a list of ESI atlases and their publication dates.

Before 1989, the typical ESI product was a collection (atlas) of color paper maps, covering a coastal state or region. Since 1989, ESI data has been compiled using a Geographic Information System (GIS). The digital ESI data serves a broad audience, as they lend themselves well to targeted queries, integration with other regional data sets, and customized products. Despite this, there is still a high demand for printed soft- and hard-copy ESI maps, and NOAA continues to support that user community.

The objectives of this guide are to outline the basic elements of a sensitivity mapping system and provide guidance on what and how various components are mapped. Key topics include:

- The role shoreline type plays in the persistence and cleanup of spilled oil,
- The ties between shoreline habitats and biological occurrences,
- The ESI shoreline classification scheme and how it is applied,
- Collecting and synthesizing biological resource data,
- Collecting and synthesizing human-use (socioeconomic) data,
- Potential sources for biological and human-use data,
- The data structure for a digital ESI product,
- Guidance on QA/QC of the ESI data,
- Standard symbology to be shown on soft and hard copy maps; and
- Metadata requirements and standards.

1.2 The Need for Standardization

The spill contingency planning requirements of the Oil Pollution Act of 1990 (OPA 90) and similar legislation passed by many states require information on the location of sensitive resources to be used as the basis for establishing protection priorities and to guide cleanup operations. Digital databases developed to support oil spill planning and response functions are a subset of those needed for a wide range of natural resource management applications. Standardizing the basic elements for a spill application speeds the development of systems and facilitates their use by national response teams and organizations, such as the U.S. Coast Guard, industry response staff, and oil spill cooperatives. Data sharing and updates are greatly facilitated by a uniform data structure.

1.3 Guide Outline

This guide is intended primarily for developers of ESI data, whether as a contractor to NOAA, or independently for a state, region, country, or industry. It is divided into seven chapters, with several supporting appendices as listed below.

- Chapter 1 – Introduction to ESI Mapping
- Chapter 2 – ESI Shoreline Classification System
- Chapter 3 – ESI Shoreline Classification Methodology
- Chapter 4 – The ESI Biology Component: Steps to Collecting, Creating, and Compiling Biological Data and the ESI Biological Data Table Structure and Content
- Chapter 5 – Human-use (Socioeconomic) Resources; Collecting, Creating, and Compiling Human-use Data and the Human-use Data Table
- Chapter 6 – Database Compilation & Quality Control Procedures for ESI Data Deliverables to NOAA
- Chapter 7 – ESI Metadata
- Appendices:

  A: ESI Biological Elements and Subelements

  B: ESI Data Dictionary: Feature Layers, ESI Data Tables, Field Names, Descriptions, and Attribute Values

  C: ESI Data Table Structure and Associated Relationships

  D: Commonly Referenced Sources for ESI Data

  E: Taxonomic Sources for Common and Scientific Species Names

  F: Previously Published ESI Data with Publication Dates and Atlas Numbers

  G: ESI Map Production Presentation and Symbology

  H. Revision to the ESI Guidelines from Version 4.0 to Version 5.0

  I: Layout for Introductory Pages

  J: Step by Step Metadata Guide

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CHAPTER 2

ESI Shoreline Classification System

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2 The ESI Mapping System

2.1 Shoreline Classification

Shoreline habitats are at risk during spills because of the high likelihood of being directly oiled when floating slicks impact the shoreline. Oil fate and effects vary significantly by shoreline type, and many cleanup methods are shoreline specific. The concept of mapping coastal environments and ranking them on a scale of relative sensitivity originated in 1976 for Lower Cook Inlet, Alaska (Michel et al. 1978). Since that time, the ranking system has been refined and expanded to cover shoreline types for four environmental settings: estuarine, lacustrine, riverine, and palustrine. To facilitate data use and exchange, these shoreline types and ranks should be used on all sensitivity mapping projects (**Table 2.1**). The environmental settings in Table 2.1 are as follows:

- Estuarine (E): Shorelines adjacent to marine and coastal waters affected by tides
- Lacustrine (L): Shorelines along large lakes
- Riverine (R): Shorelines along large freshwater rivers
- Palustrine (P): Shorelines along small freshwater lakes

The classification scheme is based on an understanding of the physical and biological characteristics of the shoreline environment, not just the substrate type and grain size. Relationships among physical processes, substrate type, and associated biota produce specific geomorphic/ecologic shoreline types, sediment transport patterns, and predictable patterns in oil behavior and biological impact. The concepts relating natural factors to the relative sensitivity of coastline, mostly developed in the estuarine setting, were slightly modified for lakes and rivers. The sensitivity ranking is controlled by the following factors:

1. Relative exposure to wave and tidal energy
2. Shoreline slope
3. Substrate type (grain size, mobility, penetration and/or burial, and trafficability)
4. Biological productivity and sensitivity

All these factors and first-hand observations from spills were considered when developing the relative ESI rankings for shoreline types. Each of the natural factors is discussed in detail below.

2.1.1 Relative Degree of Exposure to Wave and Tidal Energy

Biologists have long recognized that the makeup of intertidal biological communities is correlated with relative degree of exposure. In *Between Pacific Tides*, Rickets et al. (1968) classified the coastal habitats of the central California coast as *exposed* and *sheltered*, differentiating between settings subject to intense pounding by the large waves on that coast and those sheltered by offshore rocks, barrier beaches, and other protective features. Studies at the *Metula*, *Urquiola*, and *Amoco Cadiz* oil spills showed that the level of impacts of oil spills is closely related to the relative degree of exposure of the shoreline (Hayes and Gundlach 1975; Gundlach and Hayes 1978; Gundlach et al. 1978; Michel et al. 1978).

Table 2.1: ESI shoreline classification.

ESI Code	Environment Code	Shoreline Classification Description
1A	E/L	1A: Exposed, Rocky Shores
1A	R	1A: Exposed, Rocky Banks
1B	E/L/R	1B: Exposed, Solid Man-Made Structures
1C	E/L/R	1C: Exposed, Rocky Cliffs w/Boulder Talus Base
2A	E	2A: Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)
2A	L	2A: Shelving Bedrock Shores
2A	R	2A: Rocky Shoals and Bedrock Ledges
2B	E	2B: Exposed Scarps and Steep Slopes (Clay)
3A	E/L	3A: Sand Beaches
3B	E/L/R	3B: Scarps and Steep Slopes (Unconsolidated Sediment)
3C	E	3C: Tundra Cliffs
4	R	4: Sand Bars and Gently Sloping Banks
5	E/L	5: Mixed Sand and Gravel Beaches
5	R	5: Mixed Sand and Gravel Bars and Gently Sloping Banks
6A	E/L	6A: Gravel Beaches
6A	R	6A: Gravel Bars and Gently Sloping Banks
6B	E/L/R	6B: Riprap
6B	E	6B: Cobble/Boulder Beaches
6C	E	6C: Boulder Rubble
7	E/L	7: Exposed Flats
8A	E/L/R	8A: Sheltered Rocky Shores and Sheltered Scarps in Mud/Clay
8B	E/L/R	8B: Sheltered, Solid Man-Made Structures
8D	E	8D: Sheltered, Rocky, Rubble Shores
8E	E	8E: Peat Shorelines
8F	R	8F: Vegetated, Steeply Sloping Bluffs
9A	E/L	9A: Sheltered Flats
9B	E/L/R	9B: Vegetated Low Banks
9C	E	9C: Hyper-Saline Flats
10A	E	10A: Salt and Brackish Water Marshes
10B	E/L/R	10B: Freshwater Marshes
10C	E/L/R	10C: Swamps
10D	E/L/R	10D: Scrub and Shrub Wetlands
10E	E	10E: Inundated Low Lying Tundra
10F	E	10F: Mangroves

Wave and tidal energy primarily determine the degree of exposure, also referred to as the *hydrodynamic energy level*, at the coastline. Where waves are typically large (e.g., heights more than 1 meter [m] occur frequently), the impact of oil spills on the exposed habitats is reduced because: 1) offshore-directed currents generated by waves reflecting off hard surfaces push the oil away from the shore; 2) wave-generated currents mix and rework coastal sediments, which are typically coarse-grained in these settings, rapidly removing stranded oil; and 3) organisms adapted to living in such a setting are accustomed to short-term perturbations in the environment.

Tidal energy is also important in determining the potential of oil-spill impacts on coastal habitats, although not as pervasive as wave energy. The most important considerations are the potential for strong tidal currents to remove stranded oil and to build and move intertidal sand and/or gravel bars that can bury oil. Tidal currents generally increase as tidal range increases.

Wave and tidal energy combine to produce a continuum of energy along a coastline. Within a mapping region, the degree of energy present on one shoreline segment is assessed relative to the overall energy levels in the region. As a general rule, high- and mixed-energy shorelines should not be mapped adjacent to low-energy shorelines unless there is a significant change in shoreline orientation or there is some offshore obstruction to wave energy.

2.1.2 Shoreline Slope

Shoreline slope is a measure of the steepness of the intertidal zone between maximum high and low tides. It can be characterized as steep (greater than 30 degrees), moderate (between 30 and 5 degrees), or flat (less than 5 degrees).

The importance of shoreline slope in exposed settings is its effect on wave reflection and breaking. Steep intertidal areas are usually subject to abrupt wave run-up and breaking, and even reflection in places, which enhances natural cleanup of the shoreline. Flat intertidal areas, on the other hand, promote dissipation of wave energy further offshore, which lets oil remain longer in the intertidal zone. Also, the broad intertidal areas typically have more spatially extensive areal biological communities (e.g., mussel beds, clam beds, and plant communities). In sheltered habitats, slope is a less important distinguishing factor with regard to oil-spill impacts, except that sensitive biological communities have more area to develop where the slopes are flatter.

2.1.3 Substrate Type

Substrate types are classified as:

- *Bedrock*, which can be further divided into impermeable and permeable depending upon the presence of surficial deposits on top of the bedrock
- *Sediments*, which are divided by grain size as:
  - Mud, consisting of silt and clay, less than 0.06 millimeters (mm)
  - Fine- to medium-grained sand, ranging in size from 0.06-1 mm
  - Coarse-grained sand, ranging from 1-2 mm
  - Granule, ranging from 2-4 mm
  - Pebble, ranging from 4-64 mm

  - Cobble, ranging from 64-256 mm
  - Boulder, greater than 256 mm

- *Man-made materials*, such as:
  - Riprap, composed of broken rock or cement of various sizes, usually cobble or larger, that are permeable to oil penetration
  - Seawalls that are composed of solid material, such as concrete, wood, or steel, which are impermeable to oil penetration

The most important substrate distinction is between bedrock and unconsolidated sediments. In unconsolidated sediments, there is the potential for oil penetration and/or burial. Penetration and burial are mechanically different but, when either or both occur in sedimentary substrates, they increase the persistence of oil, lead to potential long-term biological impacts, and make cleanup much more intrusive.

Penetration occurs when oil stranded on the surface infiltrates into permeable sediments; the depth of penetration is controlled by the viscosity of the oil and the grain size of the substrate, as well as the sorting (range of grain sizes in the sediments). Deepest penetration is expected for coarse sediments (gravel) that are most uniform in grain size (well-sorted). On gravel beaches, heavy oil accumulations can penetrate up to 1 m. If the sediments are poorly sorted, such as on mixed-sand-and-gravel beaches, oil usually penetrates less than 50 centimeters (cm). Sand beaches also differ by permeability (fine- to medium-grained versus coarse-grained) and thus potential depths of penetration; however, it is difficult to determine grain size from aerial imagery. Therefore, it should be noted that in Version 5.0, all sand beaches are ranked as ESI =3, rather than ESI = 3 for fine- to medium-grained sand beaches and ESI = 4 for coarse-grained sand beaches. Muddy sediments have the lowest permeability and tend to be water-saturated, so oil penetration is very limited. However, where infauna burrow into the substrate or root cavities are present, these features can provide a mechanism for oil to penetrate an otherwise minimally impermeable substrate.

Burial occurs when clean sediments are deposited on top of oiled layers. The rate of burial can vary widely and can be as short as six hours (one-half of a tidal cycle) after the initial stranding of oil. The most rapid burial usually occurs on coarse-grained sand beaches, because they have the highest mobility under normal wave and tidal conditions. Storms can mobilize gravel berms or bars, burying oil in gravel beaches. Along shorelines with strong seasonal storm patterns, there can be annual erosion/deposition cycles in the beach profile and sediment distribution patterns. These shorelines have the greatest potential for burial, particularly if the oil is stranded at the beginning of the depositional period.

Of the man-made shoreline types, riprap is the most sensitive because deep penetration of oil between the blocks is likely, with oiling of associated debris. It can be difficult to remove the deeply penetrated oil and oily debris, and cleanup operations can be very labor intensive.

Substrate type also affects trafficability, or ability for people and machinery to maneuver during a cleanup effort. In general, highly trafficable shorelines are ranked lower on the ESI scale than those on which cleanup crews will have difficulty moving or, more importantly, where they can cause additional damage in their cleanup effort. For example, fine-grained sand beaches are typically compacted and hard with a lower chance of workers trampling oil deeper into the substrate. Therefore, they are generally the most trafficable of the sedimentary substrates. Coarse-grained beaches, on the other hand, tend to have moderate to steep slopes, are much less compacted, and have a high permeability, making walking difficult and more likely to drive any stranded oil deeper into the substrate. Gravel beaches are less trafficable still, due in part to multiple berms composed of cobbles and boulders. Lastly, wetland habitats, because of their muddy substrate, have very low trafficability. Using equipment on muddy substrates is not possible because of the substrates' innate softness. Any traffic in wetland habitats risks driving surface oil deeper into the muddy substrate, affecting both the plants and burrowing fauna, and increasing the persistence of the oil.

2.1.4 Biological Productivity and Sensitivity

The biological productivity of shoreline habitat is an integral component of the ESI ranking. Vegetated habitats, such as marshes and mangroves, have the highest ranking because of the potential for long-term impacts resulting from both exposure to oil and potential damage associated with cleanup activities in these kinds of habitats. Recovery of the ecological services can take decades in these most productive habitats. Both exposed and sheltered flats are ranked high on the ESI scale because of their high benthic productivity and importance as feeding areas for fish and birds. The presence of other sensitive resources on a specific shoreline segment, such as turtle nesting on a fine-grained sand beach, does not affect the ESI ranking. The seasonal presence of other resources on a shoreline segment is addressed by mapping the biological and human-use resources.

2.2 Definitions of ESI Ranking

Rank of 1: Exposed, Impermeable Vertical Substrates

The essential elements are:

- Regular exposure to high wave energy or tidal currents.
- Strong wave-reflection patterns are common.
- Substrate is impermeable (usually bedrock or cement) with no potential for oil penetration.
- Slope of the intertidal zone is 30 degrees or greater, resulting in a narrow intertidal zone.
- By the nature of the high-energy setting, attached organisms are hardy and accustomed to high hydraulic impacts and pressures.

Shoreline types that meet these elements include:

1A = Exposed, Rocky Shores; (estuarine and lacustrine) (**Figure 2.1**)

1A = Exposed, Rocky Banks; (riverine)

1B = Exposed, Solid, Man-Made Structures; (estuarine, lacustrine, and riverine) (**Figure 2.2**)

1C = Exposed, Rocky Cliffs with Boulder Talus Base; (estuarine, lacustrine, and riverine) (**Figure 2.3**)

These shoreline types are exposed to large waves, which tend to keep oil offshore by reflecting waves. The substrate is impermeable so oil remains on the surface where natural processes will quickly remove any oil that does strand. Also, any stranded oil tends to form a band along the high-tide line or splash zone, above the elevation of the greatest biological value. No cleanup is generally required or recommended.

Figure 2.1: Exposed, Rocky Shores with ESI rank of 1A. Outer Kenia Peninsula, Alaska.

Figure 2.2: Exposed, Solid, Man-Made Structures with ESI rank of 1B. New Hampshire.

Figure 2.3: Exposed, Rocky Cliffs with Boulder Talus Base with ESI rank of 1C. California.

Rank of 2: Exposed, Impermeable Substrates, Non-Vertical

The essential elements are:

- Regular exposure to high wave energy or tidal currents.
- Regular strong wave-reflection patterns.
- Substrate is impermeable with no potential for subsurface penetration over much of the intertidal zone, although there can be a thin, mobile veneer of sediment in patches on the surface.
- Slope of the intertidal zone is usually less than 30 degrees, resulting in a wider intertidal zone; it can be less than 5 degrees, and the intertidal zone can be up to hundreds of meters wide.
- Sediments can accumulate at the base of bedrock cliffs but are regularly mobilized by storm waves.
- By the nature of the setting, attached organisms are hardy and used to high hydraulic pressures.

Shoreline types that meet these elements include:

2A = Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay); (estuarine) (**Figure 2.4**)
2A = Shelving Bedrock Shores; (lacustrine) (**Figure 2.5**)
2A = Rocky Shoals and Bedrock Ledges; (riverine)
2B = Exposed Scarps and Steep Slopes (Clay); (estuarine)

Figure 2.4: Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay) with ESI rank of 2A. Cook Inlet, Alaska.

Figure 2.5: Shelving Bedrock Shores in lacustrine environments with ESI rank of 2A. Lake Superior.

These shorelines rank low because they are exposed to high wave energy. However, they have a flatter intertidal zone, sometimes with small accumulations of sediment at the high-tide line, where oil could persist for several weeks to months. When the sediments have been formed into a beach on a rocky platform, the ESI classification designates the beach as an additional shoreline type, for example 5/2A. Along coastal plain areas, the equivalent shoreline type consists of scarps in relict marsh clay.

Biological impacts can be immediate and severe, particularly if fresh oil slicks cover tidal pool communities on rocky platforms. However, the oil is usually removed quickly from the platform by tides and wave action. Cleanup is not necessary except for removing oiled debris and oil deposits at the high-tide line, in areas of high recreational use, or to protect a nearshore resource, such as bird nesting areas.

Rank of 3: Semi-Permeable Substrate, Lower Potential for Oil Penetration and Burial; infauna present but not usually abundant

The essential elements are:

- The substrate is semi-permeable (sand), with oil penetration usually less than 10 cm in fine- to medium grained sand; up to 25 cm in coarse-grained sand.
- Sediments are well-sorted and compacted.
- On sand beaches, the slope is very low, less than 5 degrees.
- The rate of sediment mobility is moderate to high, so there is the potential for rapid burial.
- Surface sediments are subject to regular reworking by waves and currents.
- There are relatively low densities of infauna.

Shoreline types that meet these elements include:

3A = Sand Beaches; (estuarine) (**Figures 2.6 and 2.7**)

3B = Scarps and Steep Slopes (Unconsolidated Sediment); (estuarine) (**Figure 2.8**)

3B = Scarps and Steep Slopes (Unconsolidated Sediment); (lacustrine) (**Figure 2.9**)

3B = Scarps and Steep Slopes (Unconsolidated Sediment); (riverine) (**Figure 2.10**)

3C = Tundra Cliffs; (estuarine) (**Figure 2.11**)

This shoreline rank includes sand beaches of all grain sizes, sandy scarps and steep slopes along lake and river shores, and tundra cliffs. Sand substrates minimize oil penetration, reducing the amount of oiled sediments to be removed. Fine-grained sand beaches generally accrete slowly between storms, reducing the potential for burial of oil by clean sand. On sheltered sand beaches, burial is seldom of concern because of the low wave energy. On exposed beaches, oil may be buried deeply if the oil stranded right after an erosional storm or at the beginning of a seasonal accretionary period. Coarse-grained sand beaches can undergo very rapid erosional and depositional cycles, with the potential for rapid burial of oil, even after only one tidal cycle. Cleanup on fine-grained sand beaches is simplified by the hard substrate that can support vehicle and foot traffic. Cleanup is more difficult on coarse-grained sand beaches, as equipment tends to grind oil into the substrate because of the loosely packed sediment. Also, cleanup techniques often must deal with multiple layers of oiled and clean sediments, increasing the amount of sediment for handling and disposal. Infaunal densities vary significantly both spatially and temporally.

Figure 2.6: Fine- to Medium-Grained Sand Beach with ESI rank of 3A. Kiawah Island, South Carolina.

Figure 2.7: Coarse-Grained Sand Beaches with ESI rank of 3A. Plum Island, Massachusetts.

Figure 2.8: Scarps and Steep Slopes in estuarine environments with ESI rank of 3B. May River, South Carolina.

Figure 2.9: Scarps and Steep Slopes in lacustrine environments with ESI rank of 3B. Lake Michigan.

Figure 2.10: Scarps and Steep Slopes in riverine environments with ESI rank of 3B. Hudson River, New York.

Figure 2.11: Tundra Cliffs with ESI rank of 3C. North Slope, Alaska.

Tundra cliffs are erosional features with tundra vegetation overlying peat and exposed ground ice or permafrost. The cliffs erode at rates of 0.5-4 m per year; thus, oil persistence would be short in most cases. Peat accumulates as fragmented and irregular blocks at the base of the cliff until they are reworked by waves during the ice-free season.

Rank of 4: Medium Permeability, Moderate Potential for Oil Penetration and Burial; infauna present but not usually abundant

The essential elements are:

- The substrate is permeable (coarse-grained sand), with oil penetration up to 50 cm possible.
- The slope is intermediate, between 5 and 15 degrees.
- Sediments are soft, with low trafficability.
- There are relatively low densities of infauna.

Shoreline types that meet these elements include:

4 = Sand Bars and Gently Sloping Banks; (riverine) (**Figure 2.12**)

Riverine sediments are often coarse-grained and thus have the potential for higher oil penetration and burial. Cleanup is more difficult, as equipment tends to grind oil into the substrate because of the loosely packed sediment. Also, cleanup techniques often must deal with multiple layers of oiled and clean sediments, increasing the amount of sediments for handling and disposal.

Figure 2.12: Sand Bars and Gently Sloping Banks in riverine environments with ESI rank of 4. Congaree River, South Carolina.

Rank of 5: Medium-to-High Permeability, High Potential for Oil Penetration and Burial; infauna present but not usually abundant

The essential elements are:

- Medium-to-high permeability (mixed sand and gravel; gravel can be composed of rock fragments, shells, or coral rubble) allows oil penetration up to 50 cm.
- Spatial variations in the distribution of grain sizes can be significant, with finer-grained sediments (sand to pebbles) at the high-tide line and coarser sediments (cobbles to boulders) in the storm berm and at the toe of the beach.
- The gravel component should comprise at least 20 percent of the sediments.
- The slope is intermediate, between 8 and 15 degrees.
- Sediment mobility is very high only during storms, thus there is a potential for rapid oil erosion and burial during and after storms.
- Sediments are soft, with low trafficability.
- Infauna and epifauna populations are low, except at the lowest intertidal levels.

Shoreline types that meet these elements include:

5 = Mixed Sand and Gravel Beaches; (estuarine and lacustrine) (**Figure 2.13**)
5 = Mixed Sand and Gravel Bars and Gently Sloping Banks; (riverine) (**Figure 2.14**)

Figure 2.13: Mixed Sand and Gravel Beaches with ESI rank of 5. South Central Alaska.

Figure 2.14: Mixed Sand and Gravel Bars and Gently Sloping Banks in riverine environments with ESI rank of 5. Columbia River, Oregon.

The gravel component can be composed of rock fragments, shell fragments, or coral rubble. Because of higher permeability, oil tends to penetrate deeply into sand and gravel beaches, making it difficult to remove contaminated sediment without causing erosion and waste disposal problems. These beaches may undergo seasonal variations in wave energy and sediment reworking, so natural removal of deeply penetrated oil may only occur during storms that occur just once or twice per year. Biological use is low in the upper and middle tidal zones, because of high sediment mobility and rapid drying during low tide.

These types of beaches range widely in relative degree of exposure. Sediment mobility can be inferred by the extent of attached fauna and macroalgae. Indicator species or assemblage coverages can be used to reflect the potential rate of sediment reworking. For example, in southeastern Alaska, the presence of greater than 20 percent attached algae, mussels, and barnacles indicates beaches that are relatively sheltered, with the more stable substrate supporting a richer biota. Pocket beaches can have microenvironments that are more protected from wave energy (called wave shadows) where natural removal may be much slower than the adjacent beach.

Rank of 6: High Permeability, High Potential for Oil Penetration and Burial

The essential elements are:

- The substrate is highly permeable (gravel-sized sediments), with penetration up to 100 cm.
- The slope is intermediate to steep, between 10 and 20 degrees.
- Rapid burial and erosion of shallow oil can occur during storms.
- There is high annual variability in degree of sediment mobilization by waves.
- Penetration can extend to depths below those of annual reworking.
- Sediments have the lowest trafficability of all beaches.
- Natural replenishment rate of sediments is the slowest of all beaches.
- Infauna and epifauna populations are low, except at the lowest intertidal levels.

Shoreline types that meet these elements include:

6A = Gravel Beaches; (estuarine and lacustrine) (**Figure 2.15**)

6A = Gravel Bars and Gently Sloping Banks; (riverine) (**Figure 2.16**)

6B = Riprap; (estuarine, lacustrine, and riverine) (**Figure 2.17**)

6B = Cobble/Boulder Beaches; (estuarine)

6C = Boulder Rubble; (estuarine)

Gravel beaches are ranked the highest of all beaches primarily because of the potential for very deep oil penetration and slow natural removal rates of subsurface oil. The slow replenishment rate of gravel makes removal of oiled sediment highly undesirable, thus cleanup of heavily oiled gravel beaches is particularly difficult. For many gravel beaches, significant wave action (meaning waves large enough to rework the sediments to the depth of oil penetration) occurs only every few years, leading to long-term persistence of subsurface oil. Shell and coral fragments can be the equivalent of gravel along semi-tropical and tropical beaches.

Fine-grained gravel beaches are composed primarily of pebbles and cobbles (from 4 to 256 mm), with boulders as a minor fraction. Little sand is evident on the surface, and there is less than 20 percent sand in the subsurface. There can be zones of pure pebbles or cobbles, with the pebbles forming berms at the high-tide line and the cobbles and boulders dominating the lower beachface. Sediment mobility limits the amounts of attached algae, barnacles, and mussels to low levels. The distinction can also be made on the basis of grain size and extent of rounding of the sediments on a shoreline. The gravel is rounded or well-rounded only on those beaches regularly mobilized during storms.

Coarse-grained gravel beaches have boulders dominating the lower intertidal zone. The amounts of attached algae and epifauna are much higher, reflecting the stability of the large sediments. A boulder-and-cobble armoring of the surface of the middle to lower intertidal zone is common on these beaches. Armor may have a very important effect on oil persistence in gravel beaches. Oil beneath an armored surface would tend to remain longer than would subsurface oil on an unarmored beach with similar grain size and wave conditions because of the higher velocities required to mobilize the armor (Hayes et al. 2010). Sub-rounded to sub-angular gravel is a very good indicator of these less mobile beaches. Boulder rubble is very angular, reflecting low rates of reworking by wave action.

Riprap is a man-made equivalent of this ESI class, with added problems because it is usually placed at the high-tide line where the highest oil concentrations are found and the riprap boulders are sized so that they are not reworked by storm waves. Flushing can be effective for removing mobile oil, but large amounts of residue can remain after flushing, particularly for heavy oils and oiled debris, leading to chronic sheening. Sometimes, the only way to clean riprap completely is to remove and replace it.

Figure 2.15: Gravel Beaches with ESI rank of 6A. Montauk Point, New York.

Figure 2.16: Gravel Bars and Gently Sloping Banks in riverine environments with ESI rank of 6A. Tangipahoa River, Louisiana.

Figure 2.17: Riprap with ESI rank of 6B. Central California.

Rank of 7: High Permeability, High Potential for Oil Penetration and Burial

The essential elements are:

- They are flat (less than 3 degrees) accumulations of sediment.
- The highly permeable substrate is dominated by sand, although there may be silt and gravel components.
- Sediments are water-saturated so oil penetration is very limited, except where animal burrows are present.
- Exposure to wave or tidal-current energy is evidenced by ripples in sand, scour marks around gravel, or presence of sand ridges or bars.
- Width can vary from a few meters to nearly one kilometer.
- Sediments are soft, with low trafficability.
- Infaunal densities are usually very high; these habitats are very important as feeding areas for birds and fish and loafing areas for birds and marine mammals such as sea lions.

Shoreline types that meet these elements include:

7 = Exposed flats; (estuarine and lacustrine) (**Figure 2.18**)

Exposed flats commonly occur with other shoreline types, usually marshes, on the landward edge of the flat. They can occur as offshore tidal flats separate from the shoreline, particularly at tidal inlets and in tidal rivers.

Figure 2.18: Exposed flats with ESI rank of 7. Parker River, Massachusetts.

Oil does not readily adhere to or penetrate the compact, water-saturated sediments of exposed flats. Instead, the oil is pushed across the surface and accumulates at the high-tide line. Even when large slicks spread over the flat at low tide, the tidal currents associated with the next rising tide pick up the oil and move it alongshore. However, oil can penetrate the tops of sand bars and burrows if they dry out at low tide. Because of the high biological use, impacts can be significant to benthic invertebrates exposed to the water-accommodated fraction or smothered. Cleanup is always difficult because of the potential for mixing the oil deeper into the sediment, especially with foot traffic.

Rank of 8: Sheltered Impermeable Substrate, Epibiota Usually Abundant

The essential elements are:

- They are sheltered from wave energy or strong tidal currents.
- Substrate is hard, composed of bedrock, man-made materials, or stiff clay; also includes peat shorelines.
- The type of bedrock can be highly variable, from smooth, vertical bedrock, to rubble slopes, which vary in permeability to oil.
- Slope in bedrock is generally steep (greater than 15 degrees), resulting in a narrow intertidal zone.
- There is usually a very high coverage of attached algae and fauna on hard substrates.

Shoreline types that meet these elements include:

8A = Sheltered Rocky Shores and Sheltered Scarps in Mud/Clay; (estuarine, lacustrine, and riverine) (**Figure 2.19**)

8B = Sheltered, Solid Man-Made Structures; (estuarine, lacustrine, and riverine) (**Figure 2.20**)

8D = Sheltered, Rocky, Rubble Shores; (estuarine) (**Figure 2.21**)

8E = Peat Shorelines; (estuarine) (**Figure 2.22**)

8F = Vegetated, Steeply Sloping Bluffs; (riverine) (**Figure 2.23**)

Oil tends to coat rough rock surfaces in sheltered settings, and oil persists long-term because of the low-energy setting. Where appropriate, mapping should differentiate between solid rock surfaces, which are impermeable to oil, and permeable rocky shores and rocky rubble shores, which tend to trap oil beneath a veneer of coarse material. Sheltered rocky rubble shores most commonly occur in southern Alaska. All sheltered rocky shore types can have large amounts of attached organisms, supporting a rich and diverse community. Cleanup is often required because natural removal rates are slow, yet cleanup is often difficult and intrusive. Sheltered seawalls are the man-made equivalents, with similar oil behavior and persistence patterns. Usually, more intrusive cleanup is necessary for aesthetic reasons. Sheltered scarps in mud or clay can occur along tidal creeks and rivers, formed during episodic erosional events. In riverine and estuarine settings, terrestrial vegetation along the river bluff indicates low energy and thus slow natural removal rates. Peat shorelines include peat scarps, eroded peat, and peat slurries; this shoreline type is most common along the Bering Sea.

Figure 2.19: Sheltered Rocky Shores with ESI rank of 8A. Southeast Alaska.

Figure 2.20: Sheltered, Solid Man-Made Structures with ESI rank of 8B. Alabama.

Figure 2.21: Sheltered, Rocky, Rubble Shores with ESI rank of 8D. Kenai Peninsula, Alaska.

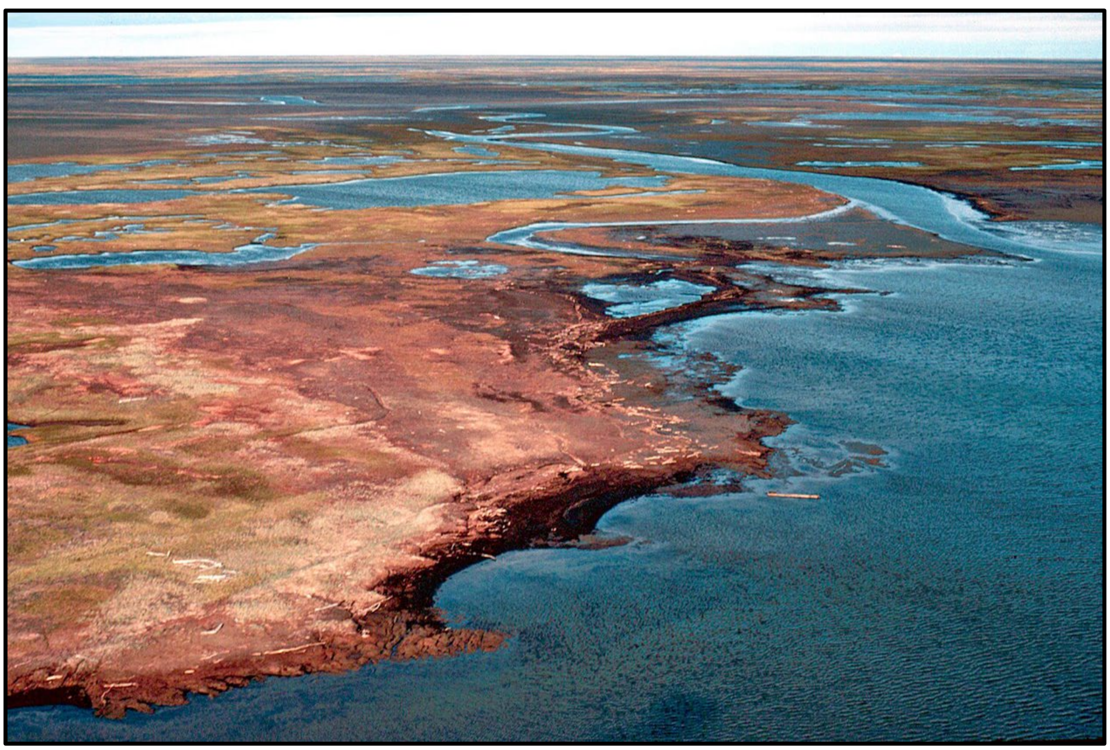

Figure 2.22: Peat Shorelines with ESI rank 8E. North Slope, Alaska.

Figure 2.23: Vegetated, Steeply Sloping Bluffs in riverine environments with ESI rank 8F. Lake Ontario, New York.

Rank of 9: Sheltered, Flat, Semi-Permeable Substrate, Soft; infauna usually abundant

The essential elements are:

- They are sheltered from exposure to wave energy or strong tidal currents.
- The substrate is flat (less than 3 degrees) and dominated by fine-grained sediments (sand/mud).
- The sediments are water-saturated, so permeability is very low, except where animal burrows are present.
- Width can vary from a few meters to nearly one kilometer.
- Sediments are often soft, with low trafficability.
- Low banks in areas with low or no tidal influence that are vegetated and often are composed of sand
- Infaunal densities are usually very high; these habitats are very important as feeding areas for birds and fish and loafing areas for birds

Shoreline types that meet these elements include:

9A = Sheltered Tidal Flats; (estuarine) (**Figure 2.24**)
9A = Sheltered Flats; (lacustrine) (**Figure 2.25**)
9B = Vegetated Low Banks; (estuarine, lacustrine, and riverine) (**Figure 2.26**)
9C = Hyper-Saline Flats; (estuarine) (**Figure 2.27**)

Figure 2.24: Sheltered Tidal Flats with ESI rank 9A. Florida Bay, Florida.

Figure 2.25: Sheltered Flats in lacustrine environments with ESI rank of 9A. Lake Ontario.

Figure 2.26: Vegetated Low Banks with ESI rank 9B. Georgia.

Figure 2.27: Hyper-Saline Flats with ESI rank of 9C. Puerto Rico.

The soft substrate and limited access make sheltered tidal flats almost impossible to clean. Usually, any cleanup efforts mix oil deeper into the sediments, delaying recovery. Once oil reaches these habitats, natural removal rates are very slow. They can be important feeding areas for birds and rearing areas for fish, making them highly sensitive to oil-spill impacts. In areas without a significant tidal range, such as the Great Lakes, sheltered flats are created by less-frequent variations in water level. These flats are unique in that low-water conditions can persist for weeks to months, providing a mechanism for sediment contamination in areas that can be subsequently flooded. Low riverine banks are often muddy, soft, and vegetated, making them extremely difficult to clean. Natural removal rates could be very slow, and depend on flooding frequency.

Rank of 10: Vegetated Emergent Wetlands

The essential elements are:

- The substrate is flat and can vary from mud to sand, though high organic, muddy soils are most common.
- Various types of wetland vegetation, including herbaceous grasses and woody vegetation, cover the substrate. Floating aquatic vegetation (FAV) and submersed aquatic vegetation (SAV) are treated separately from the ESI classification and are mapped as HABITAT (FAV) or BENTHIC (SAV) biological resources.
- The break between salt- and brackish-water marshes and freshwater marshes occurs at the inland extent of 0.5 parts per thousand salinity under average annual low-flow conditions (Cowardin et al. 1979).
- The difference between scrub-shrub wetlands (<6 m) and swamps (>6 m) is plant height (Cowardin et al. 1979). When present, mangroves are considered a specific habitat type and are not grouped with scrub-shrub vegetation.

Shoreline types that meet these elements include:

10A= Salt and Brackish Water Marshes; (estuarine) (**Figure 2.28**)

10B= Freshwater Marshes; (estuarine, lacustrine, riverine) (**Figure 2.29**)

10C= Swamps; (estuarine, lacustrine, riverine) (**Figure 2.30**)

10D= Scrub and Shrub Wetlands; (estuarine, lacustrine, riverine) (**Figure 2.31**)

10E= Inundated Low Lying Tundra; (estuarine) (**Figure 2.32**)

10F= Mangroves; (estuarine) (**Figure 2.33**)

Vegetated wetlands are the most sensitive habitats because of their high biological use and value, difficulty of cleanup, and potential for long-term impacts to many organisms. They occur along the high-water line, where oil often strands. Many factors influence how oil affects wetlands: oil type, extent of vegetation contamination, degree of sediment contamination, exposure to natural removal processes, time of year of the spill, and species types. Oil readily adheres to the vegetation. Medium to heavy oils do not readily adhere to or penetrate into the fine-grained wet soils, but can pool on the surface or in animal burrows and root cavities, and soak into accumulated organic matter. Oil persistence under these conditions can be very long term, and cleanup activities can damage the vegetation or mix the oil deeper into the soils. Therefore, natural removal is often the preferred response, particularly if the oiling is light or only on the vegetation. Refer to the joint NOAA/American Petroleum Institute job-aid “Oil Spills in Marshes: Planning and Response Considerations” (Michel et al. 2022).

Figure 2.28: Salt and Brackish Water Marshes with ESI rank 10A. Savannah River, South Carolina.

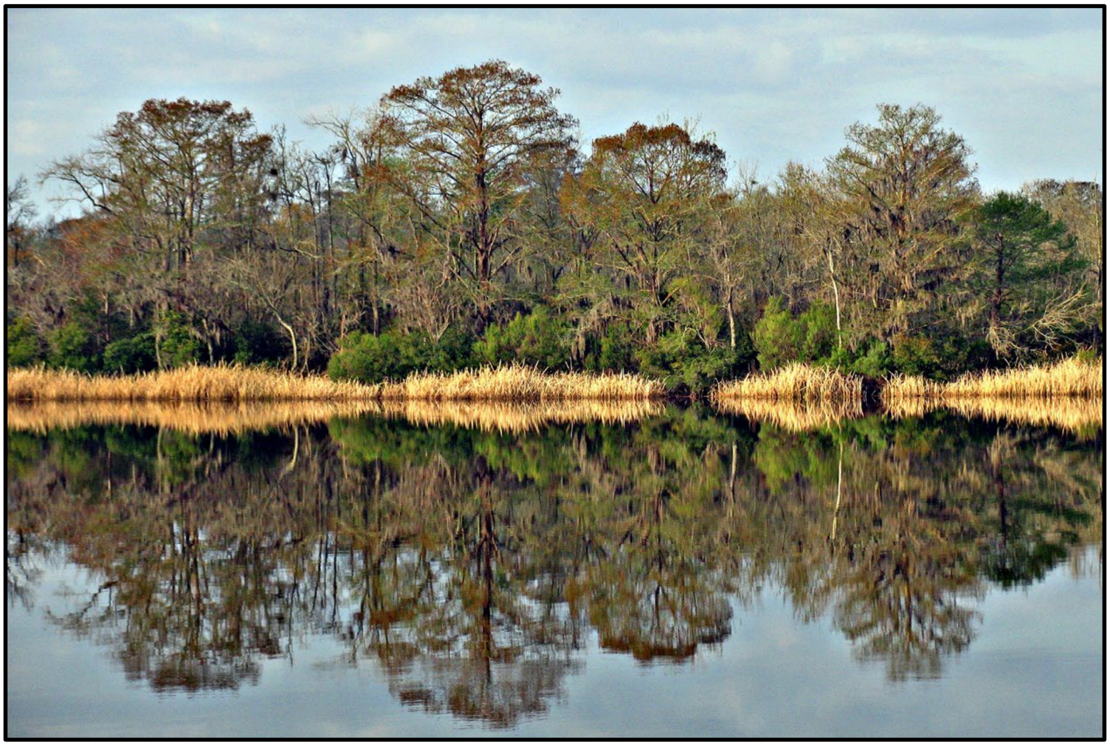

Figure 2.29: Freshwater Marshes with ESI rank 10B. Ogeechee River, Georgia.

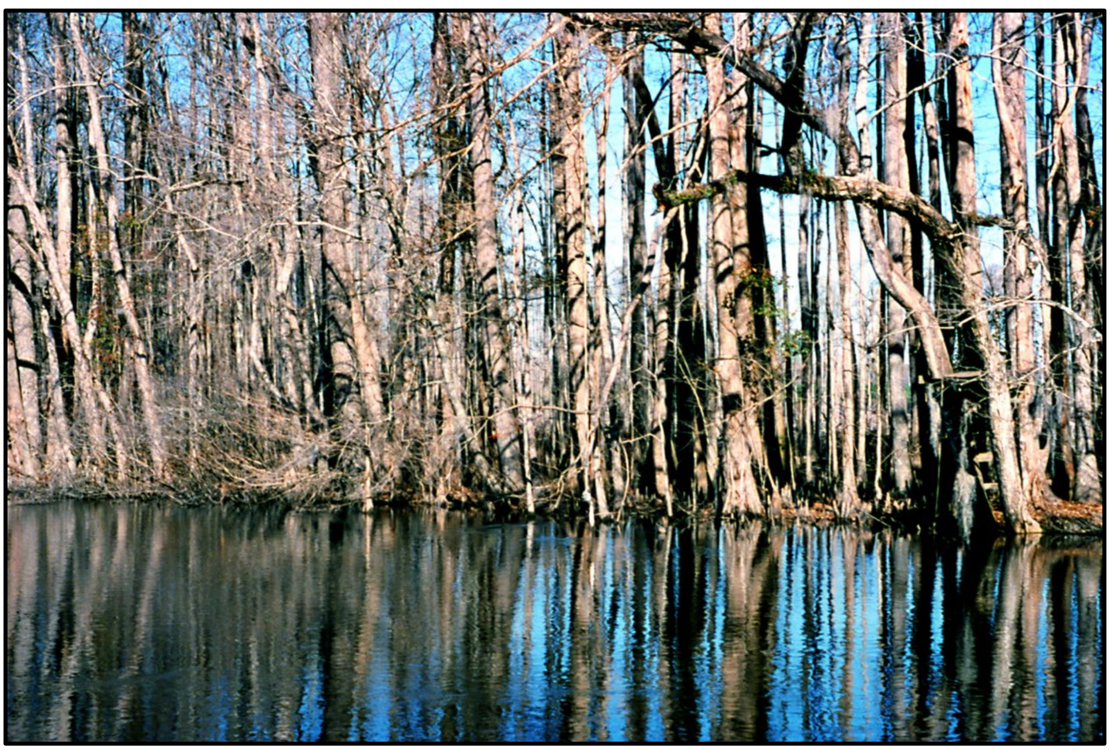

Figure 2.30: Swamps with ESI rank 10C. Edisto River, South Carolina.

Figure 2.31: Scrub and Shrub Wetlands with ESI rank 10D. Columbia River, Washington/Oregon.

Figure 2.32: Inundated Low Lying Tundra with ESI rank 10E. North Slope, Alaska.

Figure 2.33: Mangroves with ESI rank 10F. South Florida.

CHAPTER 3

ESI Shoreline Classification Methodology

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3 ESI Shoreline Classification Methodology

3.1 Introduction to the ESI Shoreline Dataset

The ESI scale, as described in Chapter 2, categorizes coastal shorelines and habitats in terms of their sensitivity to spilled oil, taking into consideration several natural physical and biological factors. The most sensitive habitats are vegetated wetlands (marshes, swamps, scrub-shrub wetlands, inundated tundra, and mangroves) (**Figure 3.1**) and sand and mud flats. It is especially important to capture these sensitive habitats when classifying the shoreline.

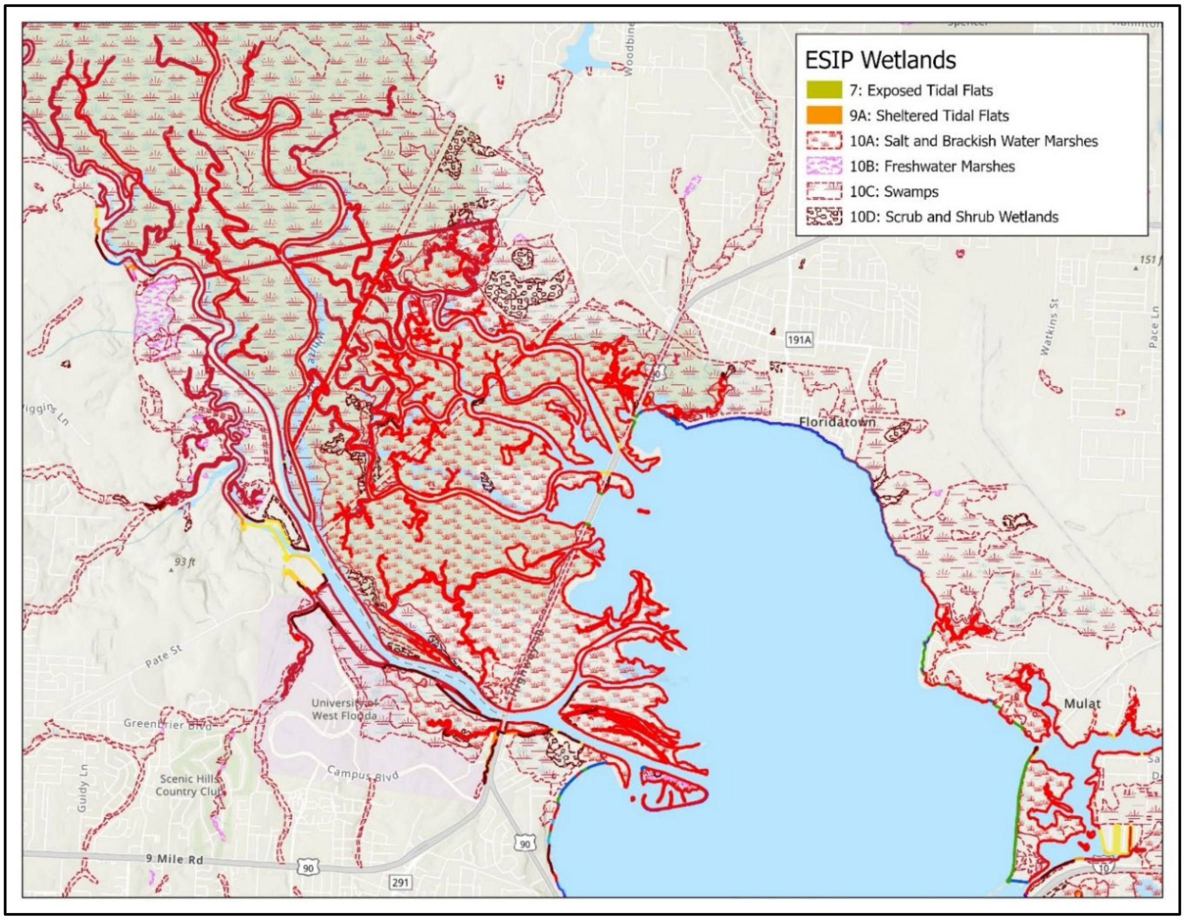

Figure 3.1: Map showing ESIP wetlands and ESIL shorelines in the 2021 Florida Panhandle ESI.

The ESI shoreline is composed of both the linear shoreline and polygonal datasets representing important habitats and includes five feature classes – ESIL, ESIP, HYDROL, HYDROP, and AOI/INDEX. ESIL is a line dataset representing the classified linear shoreline and ESIP is a polygonal dataset representing wetland habitats. HYDROL is an unclassified linear shoreline derived from the ESIL feature class, also called the land/water interface. HYDROP is also derived from ESIL and represents unclassified land and water polygons. More detailed descriptions of each feature class and its attributes are provided in the following sections. The attributes are also listed in the Base Layers section of the Data Dictionary (Appendix B).

3.2 Mapping and Classification Concepts

Some key concepts that are important to understand before compiling and classifying the ESI shoreline are defined here.

Mapping projection: The ESI shorelines and wetlands are developed using data layers from various federal and state sources. It is recommended that the ESI feature classes are compiled in an appropriate projected coordinate system for the area being mapped (e.g., State Plane, UTM). The final ESI dataset will be translated to geographic coordinates with NAD 83 as the horizontal datum to be delivered to the NOAA ESI Program Manager.

Exposed vs. sheltered: The ESI classes for some habitats vary by degree of exposure to waves and currents. Differentiation between exposed and sheltered rocky shores or man-made structures is based on shoreline orientation and wind fetch distances (the length of water over which a given wind has blown without obstruction). The grain size and roundness of sediments in front of rocky shores are also indicators of degree of exposure; rocky rubble or angular boulders indicate a sheltered setting, whereas rounded sediments that have been formed into berms indicate an exposed setting. In narrow water bodies with frequent boat traffic, boat wakes can be a source of increased exposure. For flats, sand and the presence of bedforms indicate an exposed setting, whereas mud often indicates a sheltered setting. Visible wave activity over large areas in imagery is often an indication of exposed shorelines. Physical data for helping determine the degree of exposure may be available from sources such as the NOAA National Centers for Environmental Information (NCEI), NOAA National DataBuoy Center, and ShoreZone.

Tidal datum: A tidal datum (**Figure 3.2**) is a standard elevation defined by a certain phase of the tide. The ESI shoreline should represent sea level at the mean high water (MHW) tidal datum. However, ESI lines (ESIL) and polygons (ESIP) are classified to the mean lower low water (MLLW) tidal datum. In the case where the shoreline type at the MHW level varies from the shoreline composition in the intertidal zone, the ESI classification will consist of more than one value. Be aware that aerial and satellite imagery are captured at various phases of the tide; this variation should be taken into consideration when classifying the shoreline. The ESI metadata document should provide details regarding the tidal datum of each data source for all shoreline layers used.

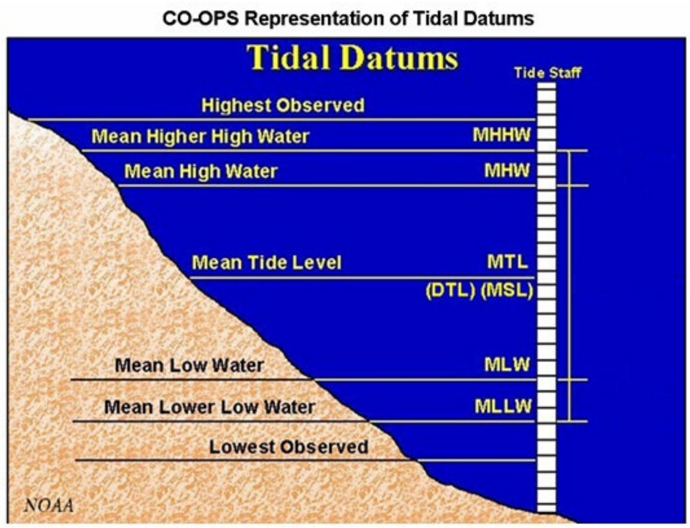

Figure 3.2: Tidal Datums chart modified from NOAA's Tides and Currents website.

Flats: Flats are sand or mud surfaces without vegetation. In estuarine environments, flats are intertidal surfaces and are thus referred to as tidal flats. Polygonal tidal flats should be mapped on the seaward side of exposed sand beaches fronting open ocean or gulf waters only when adjacent to tidal inlets. Exceptions to this rule are areas with a very large tidal range (>3 m) such as Bristol Bay, Alaska or where there is a wide low-tide terrace seaward of the beach, such as along parts of the Pacific Northwest coast and in New Hampshire and Maine. Some wetland data sources may contain flat locations, though it may be necessary to hand digitize flats from current imagery. Exposed flats are classified as ESI type 7 and sheltered flats are classified as ESI type 9A.

Minimum mapping unit: The concept of the minimum mapping unit (MMU) was created to provide a standard for ensuring visibility of features on printed maps at a target scale. However, the MMU for an ESI dataset is no longer tied to the printed scale of the ESI map as specified in Version 4.0 of the ESI Guidelines and thus is no longer a requirement. Contractors responsible for creating ESI datasets should have an understanding of basic GIS principles to include topology, managing slivers, and processing geospatial data from various sources. MMUs may be established by contractors to organize and simplify spatial data.

Crosswalk: A crosswalk is the one-to-one or many-to-one mapping of one set of attribute values to another. This method is used to obtain ESI values from attributes of source datasets where possible. A one-to-many mapping may also be useful if there are other datasets available to help refine it.

3.3 ESI Mapping Boundary: Area of Interest (AOI)

Before any shoreline feature classes (ESIP, ESIL, HYDROP, HYDROL) can be created, the regional ESI area boundary, also known as the Area of Interest (AOI), must be defined. The extent is determined under close consultation with the ESI Program Manager and must be coincident with adjacent ESI regions, if applicable. The typical inland extent is based on a 5-mile buffer around the shoreline up to the head of tidal excursion in coastal rivers. The seaward extent is most often derived using the 12-nautical mile offshore extent of U.S. Territorial waters. For the Great Lakes, the extent of the AOI is based on a 5-mile inland buffer around the shoreline and extends offshore to the international border. After the initial AOI is drawn, the polygon should also be reviewed by regional GIS managers, analysts, biologists, and geologists to verify and/or refine the AOI to include areas specifically requested. The NOAA ESI Program Manager should be consulted to ensure the AOI meets the minimum requirements and includes special areas such as sanctuary boundaries that may extend more than 12 nautical miles offshore.

Some common datasets used to determine ESI regional boundaries are:

- Previously completed ESI shoreline for the area, typically used for creating the 5-mile inland buffer;
- ESI AOIs from adjacent regions to assure continuity;
- BOEM offshore administrative boundaries; and
- NOAA managed resource areas.

There are no attributes associated with this layer.

3.4 Shoreline Polylines (ESIL)

The ESIL feature class is composed of lines representing the physical shoreline classified based on the habitats in the intertidal zone up to the MHW line.

3.4.1 ESIL Attributes

Data attributes (also known as ‘fields’) and valid values for this line feature class are enumerated in Appendix B under ESIL (ESI LINES). The primary attributes are ESI, LINE, ENVIR, SOURCE_ID, and ESI_SOURCE. The following fields are generated from the ESI attribute: MOST_SENSITIVE, LANDWARD_SHORETYPE, SEAWARD_SHORETYPE1, SEAWARD_SHORETYPE2, GENERAL_SYMBOL, and GENERALIZED_ESI_TYPE. A brief description of each attribute is provided below.

ESI

The ESI field is populated during the classification process and contains a numeric or alphanumeric coded description of the shoreline characteristics for each shoreline segment. See Table 2.1 in Chapter 2 for a list of acceptable ESI code components. As mentioned previously, where the shoreline type at the MHW level varies from the shoreline composition in the intertidal zone, the ESI classification will consist of more than one and up to three values. Multiple codes are separated by a forward slash and listed in order of occurrence starting with the landward shoreline type. For example, in **Figure 3.3**, a saltwater marsh fringed by a sheltered mud flat and then water would be coded as 10A/9A (10A: Salt and Brackish Water Marshes/9A: Sheltered Flats). Another example in Figure 3.3 is a saltwater marsh fronted by a gravel beach with an exposed tidal flat beyond the beach and is coded as 10A/6A/7 (10A: Salt- and Brackish Water Marshes/6A: Gravel Beaches/7: Exposed Flats). In **Figure 3.4**, a sand beach with an exposed tidal flat beyond the beach is coded as 3A/7 (3A: Sand Beaches/7: Exposed Flats).

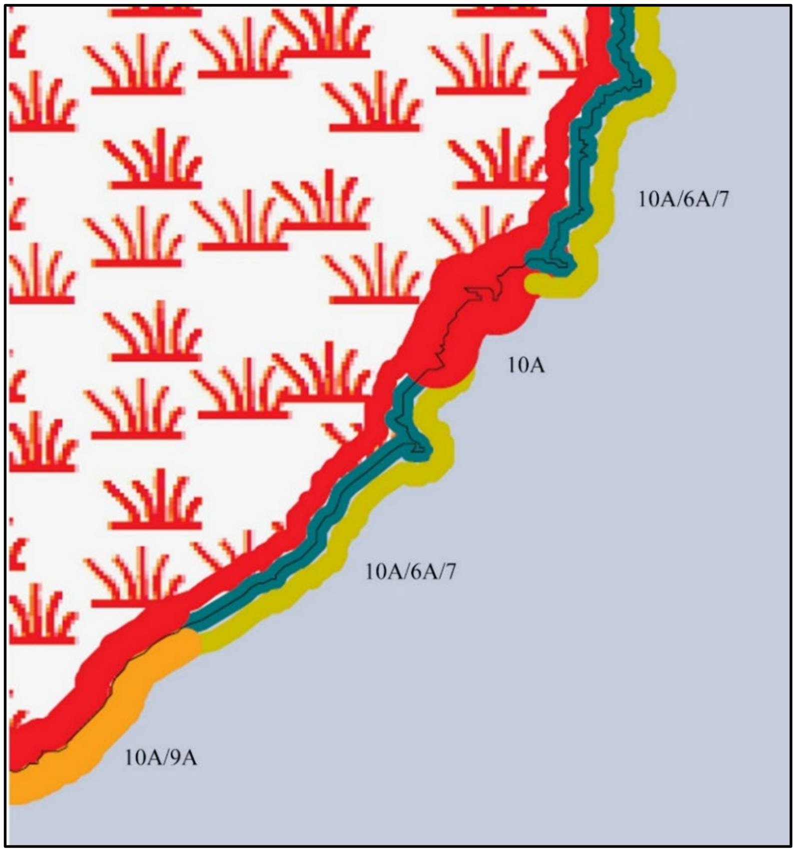

Figure 3.3: Example of multiple shoreline classification. Double and triple shorelines attributed from landward shoretype to seaward shoretype1 and seaward shoretype2.

Figure 3.4: Example of multiple shoreline classification ESI 3A/7 in coastal Georgia.

LINE

The LINE field describes the type of water/land interface. All line segments that serve as a shoreline boundary between open water or Great Lakes main bodies and land are attributed with a value of S. All shoreline hydrography not associated with the main body of water, such as smaller lakes, ponds, and reservoirs, are attributed with a value of H. Man-made structures that are not mapped as a part of the contiguous water/land interface are attributed with one of the following values: B, D, FN, G, GR, J, or P. See Appendix B for the definitions of these coded values. Note: when features are represented in both the ESIL layer and the HYDROL layer, the attribute used to populate the LINE field will be the same in both feature classes.

ENVIR

The ENVIR field describes the type of environment where the classified shoreline segment is located. Acceptable values are E-estuarine, R-riverine, and L-lacustrine (see descriptions in Section 2.1 in Chapter 2). P-palustrine shorelines are typically not classified in the ESIL layer. The entire area mapped for an ESI will typically contain a single type of environment, but it is possible to have a combination of environments (e.g., when an estuarine or lacustrine ESI area includes significant sections of a river). As described in Chapter 2, the shoreline definition may vary based on the type of environment where the shoreline is located.

SOURCE_ID

The SOURCE_ID is a numerical value that links to the SOURCES table where specifics about the source used to create each shoreline line segment are recorded. A line feature's SOURCE_ID will be the same in the ESIL and HYDROL feature classes. It is useful to assign unique values to each source before classification begins. SOURCE_ID values in the range of 1-100 have been designated for shoreline sources. A single ESI atlas does not contain 100 shoreline sources, but this range allows for consistency between atlases for commonly used sources as well as inclusion of sources that are not used across all atlases. **Table 3.1** lists values for the most commonly used shoreline sources. The SOURCE_ID will be concatenated with the atlas ID to assure source IDs are unique across atlases.

Table 3.1: SOURCE_IDs for common ESI shoreline sources.

SOURCE_ID	Dataset Name
1	Previous ESI atlases
2	NOAA Continually Updated Shoreline Product (CUSP)
3	NOAA U.S. Great Lakes Hardened Shorelines Classification 2019
4	USGS 3D Hydrography Program (3DHP)
5	USFWS National Wetlands Inventory
6	NOAA Coastal Change Analysis Program (C-CAP) Regional Land Cover
7	ESRI Basemap World Imagery
8	Microsoft BING Aerial Imagery
9	Microsoft BING Bird's Eye
10	Google Earth Imagery

ESI_SOURCE

The ESI_SOURCE is a numerical value that links to the SOURCES table where specifics about the source used to identify the numeric or alphanumeric ESI classification code for each line segment in the ESIL are recorded. There may be shared sources for creating and classifying the shoreline; thus the shoreline ESI_SOURCE values share the same range of values as the SOURCE_ID, 1 – 100. The ESI_SOURCE will be concatenated with the atlas ID to assure source IDs are unique across atlases. It is useful to assign unique values to each source before classification begins.

MOST_SENSITIVE

If multiple shoreline types appear in the ESI classification, MOST_SENSITIVE represents the highest value (most sensitive type) and will be followed by a plus (+) sign to indicate there is more than one shoreline type in the ESI field; otherwise it is the same value as the ESI field. This field is commonly used for symbolization such as in NOAA's Environmental Response Management Application (ERMA®) online mapping tool.

LANDWARD_SHORETYPE

The LANDWARD_SHORETYPE field is populated with the numeric/alphanumeric representation and the physical description of the leftmost (first or only) code of the line segment's ESI type.

SEAWARD_SHORETYPE1

If there is more than one code in the ESI attribute, the SEAWARD_SHORETYPE1 is populated with the numeric/alphanumeric representation and the physical description of the second code (to the right of the landward shore type code) of the line segment's ESI type.

SEAWARD_SHORETYPE2

If there are three codes in the ESI attribute, the SEAWARD_SHORETYPE2 is populated with the numeric/alphanumeric representation and the physical description of the rightmost (third) code of the line segment's ESI type.

GENERAL_SYMBOL

GENERAL_SYMBOL is a generalized classification scheme used for symbolizing the ESI shoreline. If multiple shoreline types appear in the ESI classification, this field will only contain the generalized classification for the MOST_SENSITIVE shoreline type. See Appendix B for the ESI to GENERAL_SYMBOL crosswalk.

GENERALIZED_ESI_TYPE

GENERALIZED_ESI_TYPE is populated with the numeric/alphanumeric representation and the physical description of the generalized ESI shoreline type. If multiple shoreline types appear in the ESI classification, there will be more than one value in this field listed in the same order as the ESI codes they represent separated by a forward slash.

3.4.2 Compiling ESIL

The shoreline used for a particular ESI project is often dictated by the shoreline the State and/or Federal agencies are using for other regional mapping efforts. It is not unusual to use more than one source to create the final shoreline within the AOI. Regardless of the source, any changes in shoreline position noted during the classification phase (i.e., eroded shorelines, new man-made features, inlets that have migrated, etc.) are incorporated into the final product. It is key that the shoreline be finalized prior to proceeding with mapping of other data layers, as it will frequently be used as a coincident boundary. For example, polygons for shorebirds are created as a buffer around the shoreline and sea turtle nesting beaches are often represented by buffers around certain sand beaches.

Shoreline Data Sources (SOURCE_ID)

Often a combination of different sources is used to create the wetland and shoreline feature classes, and many of the sources can also be used for classification. Selection of a source should take the following into consideration:

- When it was mapped, particularly in regions prone to coastal change;
- The scale at which it was mapped – datasets coarser than 1:24,000 are not recommended;
- If it was mapped at a specific tide level, preference should be given to tidally controlled (mean high water) shoreline data when of equal quality; and
- If selected by State agencies for other regional mapping efforts, it should be prioritized.

The most common data sources for the shoreline lines are:

- Previously completed ESI shoreline for the area (ESIL) – adjacent regions should be consulted at the onset of any new ESI update process to ensure region to region continuity;
- NOAA Continually Updated Shoreline Product (CUSP) and NOAA National Shoreline;
- NOAA Office of Coastal Management U.S. Great Lakes Hardened Shorelines Classification;
- NOAA Fisheries Alaska ShoreZone Coastal Imaging and Mapping;
- USGS 3D Hydrography Program (3DHP) – replaces NHD and NHDPlus;
- Datasets provided by State agencies and other end-users;
- Current satellite and aerial imagery; and
- Imagery collected as part of the ESI update effort.

Features Included in the ESIL

Natural and man-made features along the shoreline in the intertidal zone (up to the MHW tidal line) should be included, and as mentioned previously, it is especially important to capture the vegetated wetlands.

Some man-made structures, such as major piers, breakwaters, groins, and jetties, may be mapped as noncontiguous lines in the ESIL dataset. Piers and docs such as those that are sometimes captured in CUSP are largely impermanent structures and are not significant. They will still need to be cleaned if oiled but capturing them in the shoreline dataset is not important. Larger, more permanent piers with concrete structures are usually captured in the shoreline. These features are often oriented perpendicular to the predominant shoreline. As such, they are not included in the polygonal shoreline feature class (HYDROP) but rather captured and stored in both the ESIL and the HYDROL feature classes. They are classified in the same manner as the rest of the shoreline.

Crosswalk to ESI Scale

Some of the source datasets used to create ESIL, such as CUSP, may have attribute values that can be crosswalked to the ESI scale. Those ESI values can then be used for a “first pass” classification of the shoreline, also known as preclassification. The crosswalk should be completed before stitching together datasets and verified during the classification process. The CUSP to ESI crosswalk is shown in T**able 3.2**. Not all ESI values can be derived from CUSP attributes, and some have one-to-many choices that might be resolved using ancillary datasets or checked individually. For all other dataset crosswalks, the contractor should consult with the ESI Program Manager.

Table 3.2: CUSP to ESI Crosswalk.

ATTRIBUTE	ESI EXPOSED	ESI SHELTERED	COMMENTS
Breakwater.Bare	6B	6B	Breakwater in CUSP is not always permeable
Groin.Bare	6B	6B	
Jetty.Bare	1B or 6B	8B or 6B	If there aren’t many, check individually
Man-made	1B or 6B	8B or 6B	If there aren’t many, check individually
Man-made.Bulkhead Or Sea Wall	1B	8B	
Man-made.Bulkhead Or Sea Wall.Ruins	1B or 6B	8B or 6B	Ruins may appear more like riprap
Man-made.Canal.Navigable	1B	8B	These may have vegetation growing on them
Man-made.Drydock.Permanent	1B	8B	
Man-made.Ramp	1B	8B	
Man-made.Rip Rap	6B	6B	
Man-made.Slipway	1B	8B	
Man-made.Wharf Or Quay	1B	8B	
Man-made.Wharf Or Quay.Ruins	1B or 6B	8B or 6B	Ruins may appear more like riprap
Natural.Apparent.Marsh Or Swamp	10A, 10B, 10C, or 10D	10A, 10B,10C, or 10D	In Alaska, these are marshes (10A or 10B)
Natural.Apparent.Mangrove Or Cypress	10C or 10F	10C or 10F	

Integrating Datasets and Compiling the Shoreline

When integrating datasets, the most current dataset is most often the primary shoreline to which all other datasets are appended. Polygonal datasets should be converted to lines and all datasets transformed into the selected mapping projection before integrating datasets. Unique numerical SOURCE_ID values should be assigned to each source, and any applicable attributes should be crosswalked to the ESI scale before the datasets are patched together. All lines that have been crosswalked to the ESI scale should have ESI_SOURCE = SOURCE_ID.

The resulting shoreline must be continuous, except where it meets the AOI boundary. Special attention must be given to matching edges where the datasets meet to ensure continuity. After piecing together all available datasets, there may still be gaps in the shoreline. These gaps should be filled using other current, readily available datasets or by digitizing from the most current imagery available.

Significant structures perpendicular to the shoreline as mentioned in the previous section (major piers, breakwater, groins, and jetties) should also be included in the ESIL data layer. These features should be digitized from current imagery if not present in the source datasets.

The continuous shoreline(s) in ESIL will have LINE values of ‘S’. Boundaries around inland water features such as reservoirs, lakes, and ponds that are not connected to the main body of water (ocean, Great Lake, or major river) are assigned a LINE value of ‘H’. All other lines in the ESIL will have one of the other values (B, FN, G, GR, J) as listed under ESIL (ESI LINES) in Appendix B. Only those lines with a LINE value of ‘S’ will be classified unless directed otherwise by the ESI Program Manager.

3.4.3 Classifying ESIL

Applying the ESI scale to a shoreline requires personnel skilled in coastal dynamics and geomorphology that may be specific to the region mapped. Close consultation with regional experts, data stewards, and the NOAA SSC is also recommended during this process. Estuarine, riverine, and/or lacustrine shorelines within the boundary of the area being mapped will be classified. Palustrine shorelines are not typically classified because they are, by definition, shorelines along small freshwater lakes and are thus given a LINE value of ‘H’.

Lines should be split wherever the ESI class changes but avoid creating “sliver” segments (less than 1 m or a specified MMU in length). Whenever there is more than one ESI class per shoreline segment, the ESI codes should be listed in order from land to water starting with the landward ESI code first and separating codes with a forward slash as was described in Section 3.4.1 under the ESI attribute.

Various circumstances can affect the accuracy of the classification. For example, inaccuracies in, or discrepancies between, different source datasets may be encountered. Other challenges occur due to lack of high-resolution imagery. Some of the more common challenges and considerations are:

- The shape of the shoreline may have changed since the base shoreline dataset was collected. If shoreline discrepancies are discovered based on direct observation or imagery that is more current than the shoreline source data, the shoreline shape should be modified.

- Satellite and aerial imagery are captured during varying phases of the tide. Other input datasets, such as CUSP and 3DHP, reference a mean high water (MHW) shoreline. Shoreline is classified to mean lower low water (MLLW). Thus, the location of the shoreline and the appearance of features such as tidal flats may vary among datasets and will need to be reconciled.
- When only nadir (vertical) imagery is available, the shoreline may be obscured by vegetation, and it may not be possible to determine the slope of the shoreline or accurately attribute the ESI type. Whenever possible, supplementary oblique imagery and/or direct observation should be used to improve visibility of the shoreline. Photos displayed in Google Earth or found on Internet sites (including real estate listings) and Google Maps Street View may also provide useful information.
- It is sometimes difficult to differentiate between wetland types such as scrub-shrub, swamps, and mangroves, especially at the upper reaches of creeks and rivers. In this case, ancillary data should be referenced when available.
- Distinguishing between the different types of beaches in imagery can be difficult. Fine-grained sand beaches tend to be wider and flatter (Figure 2.6 in Chapter 2). Coarse-grained sand beaches are usually narrower in width and often steeper than finer-grained beaches (Figure 2.7 in Chapter 2). As described in Chapter 2, sand beaches have been combined into one ESI class (3A). Gravel (6A) and mixed sand and gravel (5) beaches have distinct textures that are much more detectable in aerial imagery than other beach types. See Figure 2.13 in Chapter 2 for an example of a mixed sand and gravel beach. Beaches composed mostly or entirely of shell are also classified as gravel beaches. It may be necessary to consult other sources for the general grain size of sand beaches in the AOI such as publications by the USGS, state geological offices, the U.S. Army Corps of Engineers, and academia. When time and budget allow, field verification by the mapping team and/or regional SSC is also encouraged.
- When a flat is present along the shoreline, it is typically the most seaward shoreline class; an exception would be on very wide wave-cut platforms where the flat occurs landward of the outmost edge of the rock platform.
- As mentioned previously, there may be more than one classification environment (ENVIR) reflected in a single ESI atlas. Descriptions of the ESI classes vary with the environment, and this should be taken into consideration during classification. See Appendix B, ESI Data Dictionary, for more information.

Classification Data Sources (ESI_SOURCE)
High-resolution satellite and aerial imagery are the most common classification sources. Some states or agencies may provide recently acquired aerial imagery. Otherwise, publicly available imagery via services such as Esri World Imagery and Google Earth is usually sufficient as long as only the most recent imagery is used. It is important to check the date of the imagery being used if possible. Some guidelines for choosing classification datasets are as follows:

- Where available, previous ESI data for the study area should always be considered. Very early shoreline mapping was done by experienced coastal geologists during aerial overflights and ground surveys, where they were able to make the distinctions between grain sizes on beaches, obtain good oblique views of the shoreline, and make other observations that were key to accurate shoreline classification.
- Existing low-altitude aerial imagery (both oblique and vertical) is the preferred source. Oblique imagery is essential for shorelines covered by overhanging vegetation and for vertical shorelines. Esri World Imagery, Google Earth, Bing, ShoreZone (where available), and other recent Federal and State imagery sources are readily available.
- Coastal habitat maps and literature may be important sources of information on beach grain size.
- Datasets provided by state agencies and other end-users should always be considered.

3.5 Wetland Polygons (ESIP)

The ESIP feature class is composed of polygons representing habitats covering an expanse of the intertidal or supratidal zone. Typically, these include vegetated wetlands and flats (both sheltered and exposed). Vegetated wetlands are mapped because they are the most sensitive habitats and are very important for their biological value. Flats are also biologically important. In rocky regions, where wide intertidal zones may be found, it is appropriate to include exposed wave-cut platforms (ESI 2A) in the ESIP layer.

The compilation and classification of the ESIP layer should be completed before beginning classification of the ESIL shoreline so that it can be used to guide the classification process. In Version 4.0 of the ESI Guidelines, shoreline segments in ESIL that shared a boundary with a wetland polygon in ESIP had to carry the code for that wetland in the ESI sequence. Having this requirement resulted in hundreds to thousands of small shoreline “slivers” (tiny line segments usually less than a centimeter in length) that bottlenecked the QA/QC process. Additionally, Version 4.0 required that small, alongshore sliver polygons had to be mitigated between the ESIP and ESIL layers. Eliminating the alongshore sliver polygons increased the project level of effort and project cost. Thus, this is no longer a requirement and ESIL and ESIP are considered decoupled.

3.5.1 ESIP Attributes

Data attributes and valid values for this polygon feature class are enumerated in Appendix B under ESIP (ESI POLYGONS). The attributes are ESI, WATER_CODE, ENVIR, ESI_DESCRIPTION, SOURCE_ID, and ESI_SOURCE. A brief description of each attribute is provided below.

ESI

The ESI field contains a numeric or alphanumeric coded description of the wetland, flat, or other classified polygon type. Wetland polygons are assigned only one ESI code each.

WATER_CODE

The WATER_CODE field indicates whether an ESIP polygon is land (L) or water (W). Vegetated wetland polygons are coded with L (land), whereas flat polygons are typically coded with W (water). However, flats can be coded as L (land) when the flats are found distributed inland within ESIP polygons such as hypersaline flats found in South Florida (**Figure 3.5**).

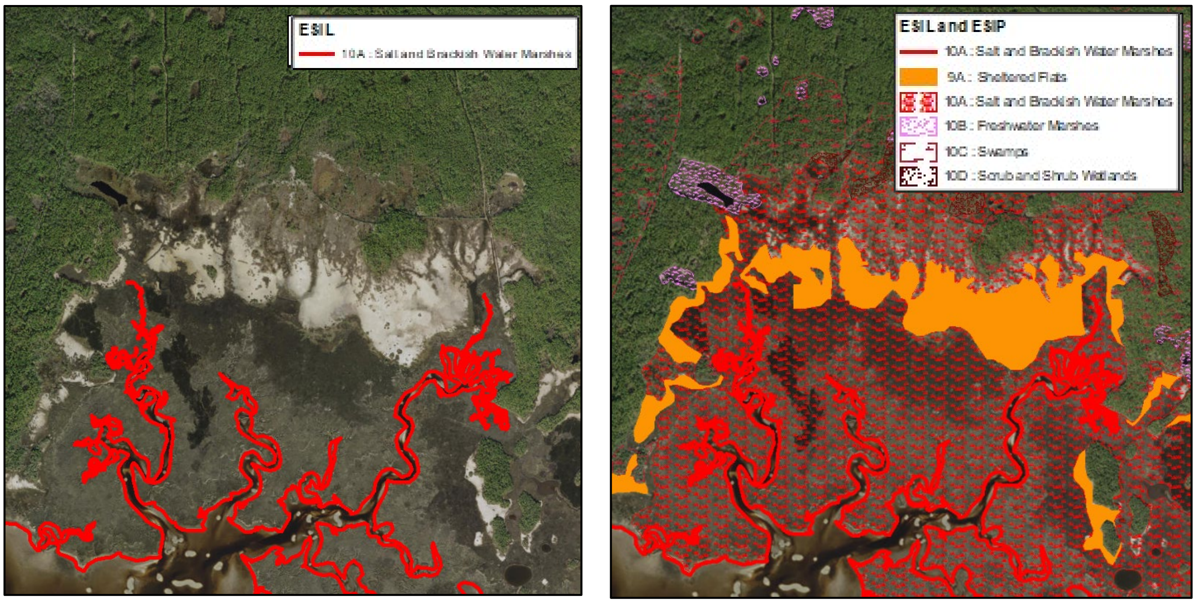

Figure 3.5: Map showing 9C: Hyper-Saline Flats (orange polygons) attributed with a WATER_CODE = L in the 2021 Florida Panhandle ESI.

ENVIR

The ENVIR field describes the physiographic type of environment where the polygon is located. Acceptable values are estuarine (E), lacustrine (L), or palustrine (P). If using the NWI dataset as a source for wetland polygons, the environment for each polygon can be derived directly from the first character in the ATTRIBUTE field.

ESI_DESCRIPTION

ESI_DESCRIPTION is populated with the numeric/alphanumeric representation and the physical description of the polygon's ESI type.

SOURCE_ID

The SOURCE_ID is a numerical value that links to the SOURCES table where specifics about the source used to create each wetland polygon are recorded. The wetland polygons (ESIP) are considered a shoreline dataset and so share the same range of values, 1-100, for SOURCE_ID. The SOURCE_ID will be concatenated with the atlas ID to assure source IDs are unique across atlases. ESIL and ESIP may share some sources.

ESI_SOURCE
The ESI_SOURCE is a numerical value that links to the SOURCES table where specifics about the source used to identify the numeric or alphanumeric ESI classification code for each polygon in the ESIP are recorded. The wetland ESI_SOURCE values share the same range of values as the SOURCE_ID, 1 – 100. It is useful to assign unique values to each source before classification begins. The ESI_SOURCE will be concatenated with the atlas ID to assure source IDs are unique across atlases.

3.5.2 Compiling ESIP

Wetland boundaries are usually obtained from one or more sources and verified, modified, and/or amended during the shoreline classification process. Each dataset is assigned a unique numerical SOURCE_ID value before integration. Additionally, if any source is in raster format, it must be converted to polygons and integrated into the ESIP feature class. Smoothing of raster data during the conversion to polygons is recommended.

Wetland Data Sources (SOURCE_ID)
The most common data sources for the wetland polygons are:

- Previously completed ESI wetlands for the area (ESIP) – adjacent regions should be consulted at the onset of any new ESI update process to ensure region to region continuity;
- U.S. Fish and Wildlife Service National Wetlands Inventory (NWI);
- NOAA Coastal Change Analysis Program (C-CAP) raster land cover;
- USGS Gap Analysis Program national land cover; and
- Datasets provided by State agencies and other end-users.

Wetland polygons will be given ESI values if not already included in the attributes. Thus, the dataset must include at least one attribute that describes the wetland type or composition sufficiently to be crosswalked the ESI scale. After the source datasets are crosswalked and pulled together, they can be used to guide the classification process.

3.5.3 Classifying ESIP

Crosswalk to ESI Scale
The valid ESI values for the ESIP polygons are as follows:

<u>Wetlands</u>
10A: Salt and Brackish Water Marshes
10B: Freshwater Marshes
10C: Swamps
10D: Scrub and Shrub Wetlands
10F: Mangroves

<u>Flats</u>
9A: Sheltered Flats
9C: Hyper-Saline Flats
7: Exposed Flats
2A: Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)

The ESIP classification process is simplified by the availability of wetland datasets that have classification schemes that can be directly crosswalked to the ESI scale. For example, the National Wetlands Inventory (NWI) has the fields WETLAND_TYPE and ATTRIBUTE (**Table 3.3**) and NOAA's Coastal Change Analysis Program (C-CAP) has land cover classifications (**Figure 3.6**). Note that C-CAP does not distinguish mangrove wetlands from scrub-shrub wetlands. Wetland locations and classifications should be verified with imagery and/or observation during the shoreline classification process.

Table 3.3: NWI to ESI Crosswalk.

WETLAND TYPE	ATTRIBUTE	ESI
Estuarine and Marine Wetland	E2EM*	10A
Estuarine and Marine Wetland	E2FO*	10C
Estuarine and Marine Wetland	E2SS3*	10F or 10D
Estuarine and Marine Wetland	E2SS*	10D
Freshwater Emergent Wetland	PEM*	10B
Freshwater Emergent Wetland	PML*	10B
Freshwater Forested/Shrub Wetland	PSS*	10D
Freshwater Forested/Shrub Wetland	PFO*	10C
Riverine	R1EM2*	10B
Riverine	R2EM2*	10B
Riverine	R3EM2*	10B

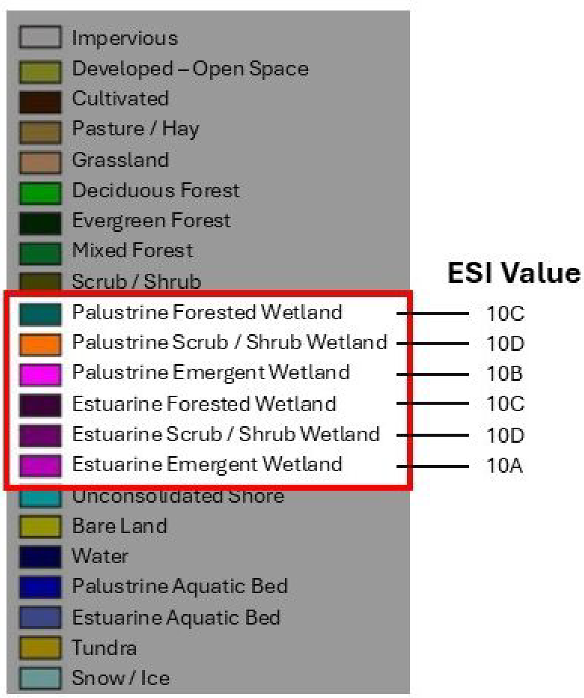

Figure 3.6: C-CAP legend showing values that can be crosswalked to ESI values.

Wetland datasets usually specify whether a habitat is saltwater or freshwater, and this information is taken into consideration when reclassifying wetland attributes to the ESI scale. However, if this information is not available, it may be difficult to determine where salt- and brackish water marshes end and freshwater marshes begin, especially when using satellite and aerial imagery. Regional salinity information may be helpful in making the determination regarding the appropriate ESI wetland classification.

If flats are visible in the imagery they should be digitized and added to the ESIP feature class. Smaller flats can be added to the ESI code sequence in the ESIL layer (e.g., 10A**/**9A)**.** Many tidal channels in wetlands have muddy banks that are relatively steep that should not be mapped as flats (see Figure 2.28 in Chapter 2). Flats are typically mapped as polygons are water features (WATER_CODE = 'W’) with the exception noted above and have an ESI classification of ‘7’ for exposed (see Figure 2.18 in Chapter 2) or ‘9A’ for sheltered (see Figure 2.24 in Chapter 2). Because of the mobility of exposed tidal flats and the nature of the method used to map them, their location on an ESI map should be considered approximate.

In regions where impermeable platforms composed of bedrock, mud, and/or clay commonly host large intertidal areas, ESI type 2A (exposed wave-cut platforms) is included in the ESIP layer. These polygon extents will typically need to be hand digitized from imagery. Maine and Alaska are the regions best known for shoreline of this type.

3.6 Hydrography Polygons (HYDROP) and Polylines (HYDROL)

The HYDROP polygons serve as the foundation for all subsequent ESI data layers. Many human-use and biological resource polygons are derived from polygons in this layer. For example, fish and other water-based polygonal features that extend into nearshore coastal waters will incorporate the HYDROP shoreline boundaries when defining their extent. Polygons for other biological features, such as shorebirds and sea turtles, may be generated by buffering the relevant land bodies. Political and jurisdictional boundaries should incorporate the HYDROP polygons as their definitive boundary for the purposes of the ESI.

The HYDROP layer is generated by snapping the ESIL line features with a LINE value of ‘S’ or ‘H’ to the regional AOI, creating closed land and water features. The lines are then converted to polygons. HYDROP has only one attribute, WATER_CODE, with values of ‘L’ for land and ‘W’ for water.

A very complex shoreline will often result in very large, complex polygons in the HYDROP feature class that contain millions of vertices. These large polygons significantly slow down drawing, editing, and geoprocessing. This can sometimes be handled by working on a computer with a large amount of RAM and a very fast processor. Otherwise, it may be necessary to temporarily split the largest polygons into smaller, manageable polygons until all processing has been completed and then integrating them back into the original HYDROP polygon prior to final delivery.

HYDROL contains all lines that are part of the water/land boundary and is created by aggregating features in the ESIL feature class, retaining the LINE and SOURCE_ID attributes. Other linear features that are not part of the water/land boundary, such as jetties and groins, are also retained in the HYDROL feature class. A full list of feature attributes and acceptable values is provided in Appendix B under HYDROL (HYDRO LINES).

In Version 4.0 of the ESI Guidelines, HYDROL represented linear features such as docks, piers, breakwaters, and groins. The HYDROL layer created based on Version 4.0 was not a true representation of the land/water interface. Version 5.0 requires the HYDROL layer to be a true, continuous shoreline that represents the land/water interface.

3.7 Quality Assurance and Quality Control (QA/QC)

Following the completion of the shoreline classification, the geologist will need to look at a list of all ESI values and determine which are valid for the geographic area being classified. This will be followed by a rigorous QA/QC process. Some common items to check for include:

- Gaps (dangles) and other errors (self-intersecting or self-overlapping lines) in the ESIL shoreline;
- Illogical or invalid shoreline sequences, including improperly mixing sheltered and exposed types (e.g., 6B/9A, 8B/7) or combining vegetated low banks with marshes (9B/10A or 9B/10B);
- Shoreline segments that share a boundary with a wetland polygon usually contain the ESI code for that polygon (10A-10F) in their classification sequence, though since the wetlands (ESIP) can now be decoupled from the classified shoreline (ESIL), this is no longer a requirement (see Section 3.5);
- No null attribute values in ESIP, ESIL, HYDROP, and HYDROL (see Appendix B for a list of valid values for all attributes); and
- Proper orientation of all classified ESIL shoreline segments (LINE = ‘S’) for visualization – lines must be directionally mapped to have land on the right, water on the left.

3.7.1 Topology Rules

Topology checks are useful for finding gaps and other errors in the shoreline and wetland polygons and for verifying ESIL lines are properly represented by polygon boundaries in HYDROP. The ESIL shoreline should be checked for gaps and errors prior to classification. Useful rules are listed in **Table 3.4** (as they are called in Esri ArcGIS Pro).

Table 3.4: Topology rules in Esri ArcGIS Pro used for QA/QC of the ESI dataset.

Feature Class 1	Rule	Feature Class 2	Use	Exceptions
ESIL	Must Not Have Dangles		Check for gaps in shoreline	Lines that end at the AOI boundary
ESIL	Must Not Self Intersect		Checks for features that self-intersect	None
ESIL	Must Not Self Overlap		Checks for features that self-overlap	None
ESIL	Must Not Intersect		Checks for intersecting features	None
ESIL	Must Not Overlap		Checks for overlapping features	None
HYDROP	Must Not Have Gaps		Check for missing polygons	Polygons that share a partial boundary with the AOI
ESIL	Must Be Covered By Boundary Of	HYDROP	Checks for shoreline not covered by a hydro polygon	Shoreline with LINE values of B, D, FN, G, GR, J, or P
HYDROP	Boundary Must Be Covered By	ESIL	Checks for hydro polygon not covered by shoreline	None

There is no need to check for overlapping and intersecting features in HYDROP if it is built by converting ESIL lines to polygons.

3.8 Preparing ESI Datasets for Final Delivery

The final ESIP polygons cannot overlap polygon boundaries in HYDROP or the land/water boundary as represented by the true shoreline in HYDROL. The simplest way to ensure this is to clip ESIP polygons that have WATER_CODE = 'L' to the HYDROP land (WATER_CODE = 'L') and clip ESIP polygons that have WATER_CODE = 'W' to the HYDROP water (WATER_CODE = 'W').

All attributes must be populated appropriately in all feature classes (see Appendix B) with no NULL values. All feature classes must be contained completely within the AOI boundary.

Refer to Chapter 6 Database Compilation & Quality Control Procedures for ESI Data Deliverables to NOAA for additional processing steps for the final ESI Feature Dataset deliverable.

CHAPTER 4

ESI Biological Resources

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4 ESI Biological Resources

4.1 Introduction to ESI Biological Resources

There are many animals, plants, and habitats potentially at risk from oil spills and other hazards; however, the intent of the Environmental Sensitivity Index (ESI) data is to focus on populations that are at the *greatest* risk. The primary target users of the ESI are oil spill planners and responders who may need to assess an area quickly and are often limited in the amount of protection they can provide. Responders, and hence, the ESIs, need to focus on the species that are particularly vulnerable to spilled oil, the most sensitive life history stages and the habitats where these species occur. Habitat plays an important role in the persistence of oil and species exposure to oil.

For these reasons, the ESI biology content is comprised of:

- Species that are federally and/or state listed as threatened, endangered, or of special concern.
- Occurrences where large numbers of individuals concentrate in a relatively small area.
- Areas where sensitive life-history stages or activities (e.g., nesting, pupping, foraging, or molting) occur.
- Species/habitats that may be impacted by cleanup activities or treatment of oil.
- Species of commercial, recreational, and/or ecological importance.

Emphasizing the inclusion of species, populations, and life history stages that meet the above criteria will ensure the ESI serves the primary users and will help focus the data collection efforts.

4.2 Biology Data Components/Structure

ESI biology data consists of spatial data (feature classes within the ESI Geodatabase stored in the BIOLOGY feature dataset) and related tabular data. The ESI biology data are organized into eight *ELEMENTS*, which correspond to the feature classes (biological groupings based on taxonomy or habitat):

BENTHIC

BIRDS

FISH

HABITATS

HERPETOFAUNA (abbreviated as HERP)

INVERTEBRATES (abbreviated as INVERT)

MARINE MAMMALS (abbreviated as M_MAMMAL)

TERRESTRIAL MAMMALS (abbreviated as T_MAMMAL)

ELEMENTS are divided into *SUBELEMENTS,* which represent groupings of species that share similar characteristics such as habitat preference, life history, and/or behavior relative to oil spill vulnerability and sensitivity. Appendix A provides a complete list of SUBELEMENTS and identifies some of their unique characteristics. Values for ELEMENT and SUBELEMENT must be included for each biological entry in the ESI database. In most cases, a species name is also included. See **Figure 4.1** for an example of ESI biology data classification. The following sections describe details about the spatial and tabular components of ESI biology data.

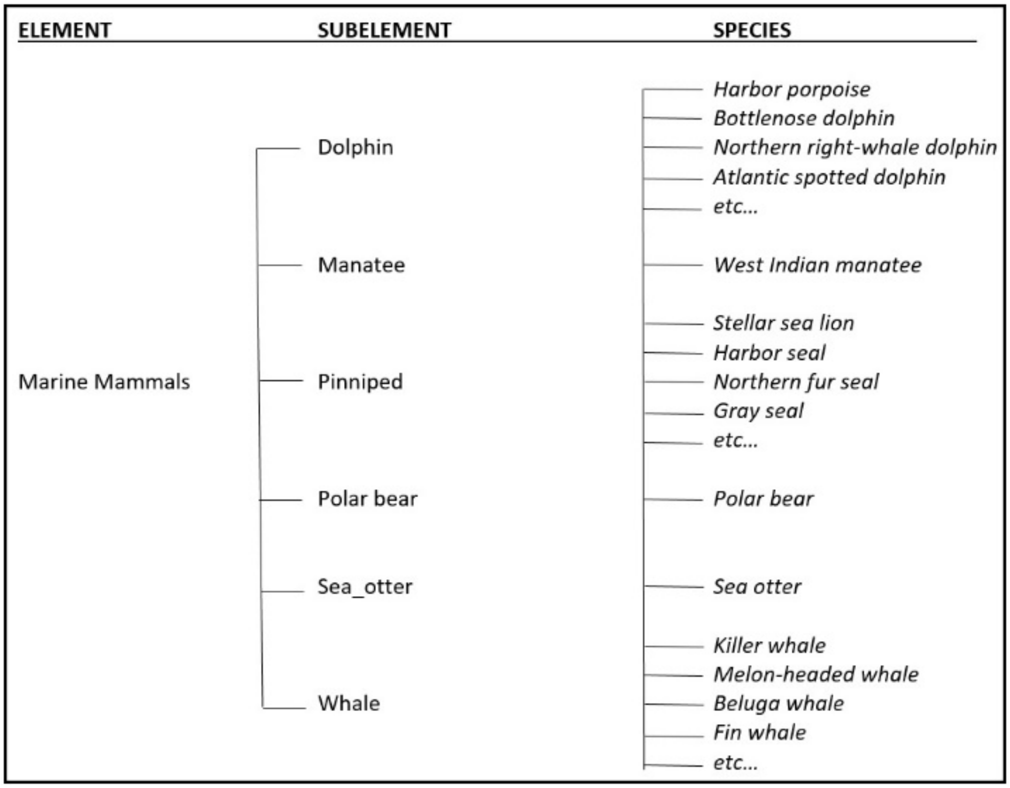


Figure 4.1: Example of ESI biology data classification.

4.2.1 Biology Spatial Data Components

In the ESI geodatabase, all biological data are stored in a feature dataset named BIOLOGY. Feature classes, which correspond to map layers, represent a single element and geometry type. Species/habitat occurrences may be mapped as points, lines, and/or polygons. This means there can be up to three feature classes for a single element. For most distributions, polygonal representation is most appropriate. Polygons have the advantage of showing the extent of a resource occurrence and lend themselves well to GIS analysis. However, points or lines may be preferred to represent specific types of records (e.g., bird nests, pinniped haul-out sites). Section 4.3 – Creating ESI Biological Content provides more specific guidance on biological mapping considerations, including which type of feature class to use for various types of data.

Feature Class Attributes

Each biological feature class has one attribute (**Table 4.1**), which provides a link to additional information in the standalone data table.

Table 4.1: Biological feature class attribute.

Field Name	Storage	Sample Values
RARNUM	Long	28300001

RARNUM

The Resource At Risk Number or RARNUM, is the direct link from the feature class to the attribute tables. Multiple species often share the same geography and feature in the ESI geodatabase, and the RARNUM is a unique numerical identifier that represents a unique combination of species (of the same element), with identical species attribute values for concentration, seasonality, life-history information (i.e., breeding), and G-source. Because the same assemblage of species may occur in several locations across the mapped area, identical tabular information and, therefore identical RARNUMs, are often shared across multiple features. Thus, RARNUM provides a many-to-many relationship between the feature class and the associated attribute tables and eliminates repetition of attribute information in the data tables and hard/soft-copy ESI map products. **Figure 4.2** illustrates the RARNUM link from the spatial data to the BIOCOMB data table, and the many-to-many relationship between the map objects and the biology attribute tables.

RARNUM is stored as a long integer in the database, and it is unique across elements as well as across ESI atlases. It is a nine-digit number where the first three digits reflect the atlas number (Appendix F lists atlas numbers for each ESI atlas), and the last six digits represent the unique group of species and associated tabular information within the atlas. Some examples include:

234000001 ➔ atlas #234 | species group 1

222000001 ➔ atlas #222 | species group 1

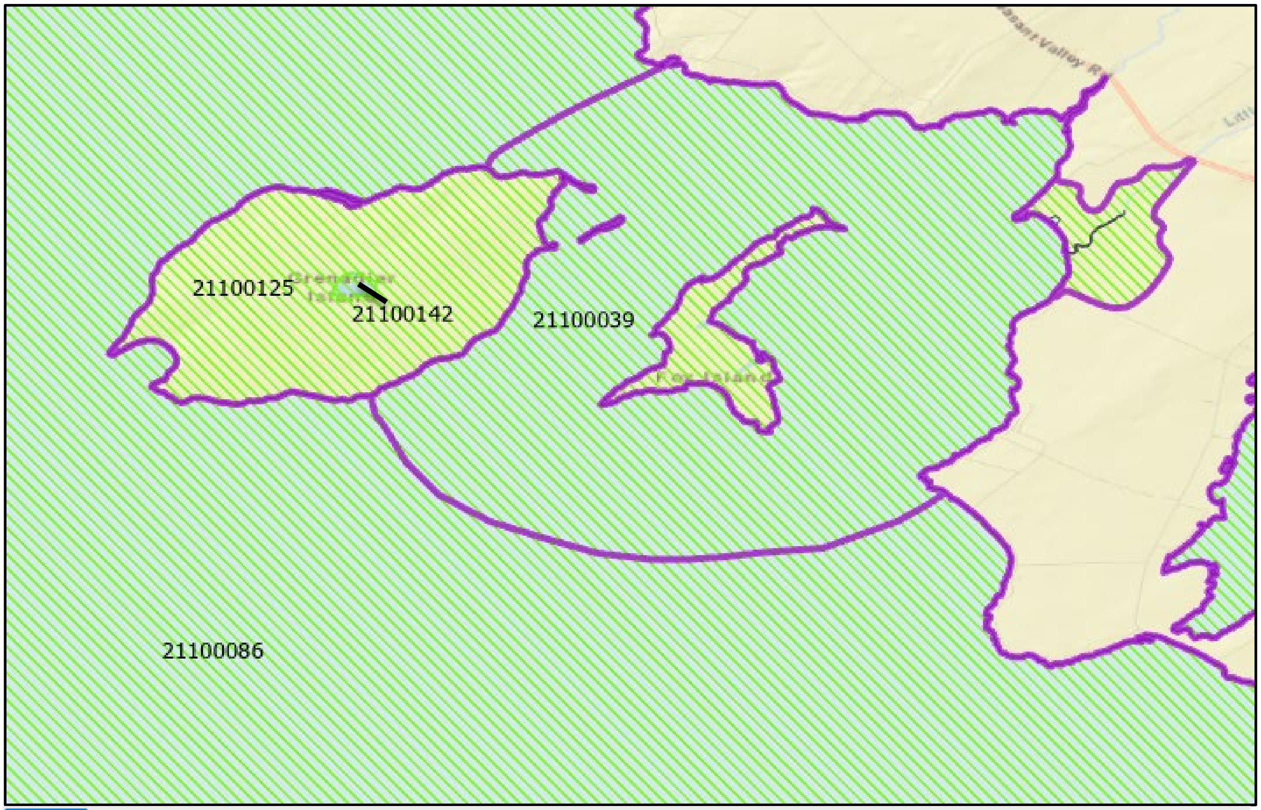
In this example, the South Carolina atlas (atlas #234) and the East Florida atlas (atlas #222) have the same species group number (1), but the RARNUM remains unique because the atlas number is embedded. This ensures that there is no RARNUM duplication when viewing multiple atlases at the same time.

4.2.2 Biology Data Tables and Attributes

All biology information associated with the spatial data is organized in a series of relational database tables that form the deliverable tables BIOCOMB and SOURCES.

BIOCOMB Table

The BIOCOMB table (**Table 4.2**) can be linked directly to the RARNUM in each of the geographic layer's attribute data tables. Items in the table include: ELEMENT, SUBELEMENT, RARNUM, MAPRAR, SEASON_ID, SPECIES_ID, NAME, GEN_SPEC, S, F, STATE, S_DATE, F_DATE, CONC, G_SOURCE, JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC, NESTING, MIGRATING, MOLTING, HATCHING, SPAWNING, EGGS, LARVAE, JUVENILES, ADULTS, MATING, CALVING, and PUPPING.



biocomb

	OBJECTID *	ELEMENT	SUBELEMENT	RARNUM *	MAPRAR	SEASON_ID	NAME	GEN_SPEC	S	F	STATE	S_DATE	F_DATE	CONC	G_SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NESTING
30	618	BIRD	shorebird	21100125	125	1	Shorebirds	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	100S	21100405					X		X	X	X	X			-
31	619	BIRD	raptor	21100125	125	1	Short-eared owl	Asio flammeus	E	<Null>	NY	52023	<Null>	-	21100402	X	X	X	X								X	-
32	620	BIRD	gull_tern	21100125	125	1	Terns	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	100S	21100405			X	X	X	X	X	X	X	X			-
33	621	BIRD	wading	21100125	125	1	Wading birds	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	100S	21100405				X	X	X	X	X	X	X			-
34	659	BIRD	gull_tern	21100142	142	1	Black tern	Chlidonias niger	E	<Null>	NY	52023	<Null>	-	21100402			X	X	X	X	X	X	X				-
35	660	BIRD	diving	21100142	142	1	Pied-billed grebe	Podilymbus podiceps	T	<Null>	NY	62023	<Null>	-	21100402	X	X	X	X	X	X	X	X	X	X	X	X	MAR-NOV

Figure 4.2: Illustration of the RARNUM's relationship to the BIOCOMB table.

Table 4.2: Fields in BIOCOMB table.

Field Name	Storage	Sample Values
ELEMENT	Text (10)	BIRD, FISH
SUBELEMENT	Text (10)	gull_tern, shorebird
RARNUM	Long	28300001
MAPRAR	Long	1
SPECIES_ID	Long	1
NAME	Text (35)	Least tern, Black skimmer
GEN_SPEC	Text (45)	*Sternula antillarum*
S	Text (1)	E, T, C, X, S
F	Text (1)	E, T, C, X, S

Field Name	Storage	Sample Values
STATE	Text (2)	VA, TX, WA
S_DATE	Long	2012, 202404, 20190101
F_DATE	Long	2012, 202404, 20190101
CONC	Text (20)	High, Potential, 100s
G_SOURCE	Long	283000201
JAN	Text (1)	X or (blank)
FEB	Text (1)	X or (blank)
MAR	Text (1)	X or (blank)
APR	Text (1)	X or (blank)
MAY	Text (1)	X or (blank)
JUN	Text (1)	X or (blank)
JUL	Text (1)	X or (blank)
AUG	Text (1)	X or (blank)
SEP	Text (1)	X or (blank)
OCT	Text (1)	X or (blank)
NOV	Text (1)	X or (blank)
DEC	Text (1)	X or (blank)
NESTING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
MIGRATING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
MOLTING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
HATCHING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
SPAWNING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
EGGS	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
LARVAE	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
JUVENILES	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
ADULTS	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
MATING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
CALVING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '
PUPPING	Text (15)	MAY-MAY AUG-OCT, MAY-JUL, or '- '

ELEMENT
Described in Section 4.2 and Appendix A, the ELEMENT field contains the ELEMENT of each record in the atlas. As described above, eight ELEMENTS (biological groupings based on taxonomy or habitat) exist within the ESI: BENTHIC, BIRDS, FISH, HABITATS, HERP, INVERT, M_MAMMAL, and T_MAMMAL.

SUBELEMENT
Described in Section 4.2 and Appendix A.

RARNUM
As described above, the RARNUM provides the link from the spatial features to the related attribute table.

MAPRAR
An identifier that is used in map production for legibility. This number is the same as RARNUM without the atlas specific prefix.

SPECIES_ID
SPECIES_ID is a unique species number assigned within each element.

NAME
The NAME field contains common names for mapped species. In some cases, a generalized or more inclusive taxon name may be used instead of the species name. These names might represent a grouping of species (sometimes at the subelement level) such as 'Gulls' or 'Shorebirds', or a name intended to mask the exact species, such as 'Threatened bird' or 'Rare gull'. There are a few instances in the master species list where a particular species is listed more than once, each with a unique SPECIES_ID. In some cases, the same common name is used in different geographic regions for different species (e.g., pink shrimp occur on both the east and west coast but are different species). Some species are listed more than once because they belong to populations with different Endangered Species Act (ESA) listings that need to be mapped as different species because they occur in the same atlas (e.g., west coast salmonid species, such as those that occur in Evolutionarily Significant Units [ESUs]). Multiple entries are necessary to assign these records the appropriate listing status and seasonality. In these cases, contact the NOAA ESI Program Manager for additional guidance and request a copy of the ESI master species list.

GEN_SPEC
The GEN_SPEC field provides the genus and species of mapped species. When the NAME field denotes a group of species that are not monophyletic (i.e., Gulls), this field is left blank. Genus names may be included if the common name refers to species within a genus. The names should be entered as they appear in the master species list, with the first letter of the genus name capitalized and all other letters in lower case.

S (State Listing Status)
State governmental agencies are responsible for maintaining a list of state species that are considered threatened, endangered, or of conservation concern. This may be the responsibility of a single agency or

more than one agency. For example, the Oregon Department of Fish and Wildlife maintains the listings for endangered animals, while the Oregon Department of Agriculture maintains the listings for plants. The S field contains the abbreviation for the state status. Acceptable values are E (Endangered), T (Threatened), C (Species of Concern), X (Experimental essential population), or S (Threatened or endangered due to similarity of appearance).

F (Federal Listing Status)
The U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries maintain lists of all federally listed species (https://ecos.fws.gov/ecp/ and https://www.fisheries.noaa.gov/species-directory/threatened-endangered) as determined by those agencies. The F field contains the abbreviation for the federal status. As with the state, these values may be E (Endangered), T (Threatened), C (Species of Concern), X (Experimental essential population), or S (Threatened or endangered due to similarity of appearance).

STATE
This field holds the 2-letter state abbreviation. If an ESI region covers multiple states where the species is listed, each state will have its own record in the **BIOCOMB** table.

S_DATE
The S_DATE field is used to indicate when the state status was checked/verified by the contractor in preparation for the final data delivery. Often this check is done for all species at the same time, so it is not unusual to have the same value in all fields, a date close to the time of the ESI publication. The format of the number should be recorded as YYYYMM; for example, 202401 would represent January 2024.

F_DATE
The F_DATE field is used to indicate when the federal status was checked/verified by the contractor in preparation for the final data delivery. Often this check is done for all species at the same time, so it is not unusual to have the same value in all fields, a date close to the time of publication. The format of the number should be recorded as YYYYMM; for example, 202401 would represent January 2024.

CONC
The CONC field provides concentration information for a particular species occurrence. Concentration values can be qualitative, such as HIGH, MEDIUM or LOW, a percent coverage, or numeric counts or ranges. Section 4.3.6 provides guidance on assignment of concentration values.

G_SOURCE
G_SOURCE (geographic source) provides a link for each record from the **BIOCOMB** table to the **SOURCE** table, where source information is provided. Biological source numbers within each atlas range from 301-99,999. This value is then added to the atlas number * 100,000 to generate a source number that is unique across all ESI atlases. For example, the Lake Ontario atlas (atlas number 211) will have biological source IDs beginning with 21100301. G_SOURCE contains source information for geographic location, species, concentration, and seasonality information for each record in the atlas. There is no longer the

need to produce the Seasonal Source (S_Source) table, but rather any additional sources that are used to compile seasonality information for the atlas are reported in the atlas' introductory pages.

JAN-DEC
These fields represent species presence or absence for the associated month. X = present; Blank = not present.

NESTING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, FISH, INVERT, HABITAT, M_MAMMAL, or T_MAMMAL elements.

MIGRATING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, FISH, HABITAT, HERP, INVERT, M_MAMMAL, or T_MAMMAL elements.

MOLTING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, FISH, INVERT, HABITAT, HERP, or T_MAMMAL elements.

HATCHING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, FISH, INVERT, HABITAT, M_MAMMAL, or T_MAMMAL elements.

SPAWNING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.

EGGS
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, HABITAT, M_MAMMAL, or T_MAMMAL elements.

LARVAE
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.

JUVENILES
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, HABITAT, M_MAMMAL, or T_MAMMAL elements.

ADULTS
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BENTHIC, HABITAT, T_MAMMAL, BIRD, or M_MAMMAL elements.

MATING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, FISH, HABITAT, HERP, T_MAMMAL elements.

CALVING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, FISH, INVERT, HABITAT, HERP, T_MAMMAL elements.

PUPPING
Month range where this life history stage or activity type is occurring. Activity represented varies by element. Values will show month or range of months (e.g., JAN-MAY). The value of "-" indicates that life stage or activity is not present or not reported. The value of "N/A" indicates that the breed category is not used or not appropriate for the element referenced. This attribute is not used for BIRD, BENTHIC, FISH, INVERT, HABITAT, HERP, and T_MAMMAL elements.

The life history (breed) categories described above are shown in **Table 4.3**. There are no life history stage activities for BENTHIC, HABITATS, or T_MAMMALS.

Table 4.3: Life history categories by species groups.

LIFE HISTORY	BIRD	FISH	HERP	INVERT	M_MAMMAL
NESTING	X		X		
MIGRATING	X				
MOLTING	X				X
HATCHING			X		
SPAWNING		X		X	
EGGS		X		X	
LARVAE		X		X	
JUVENILES		X	X	X	
ADULTS		X	X	X	
MATING					X
CALVING					X
PUPPING					X

Please note that the MAPPING_QUALIFIER attribute, which was present in ESI Atlases published from 2014 to 2024, has been removed as of 2025 and will not be included in any future published ESI Atlases. Mapping Qualifier was used to determine which RARNUMs should be shown on hardcopy maps versus described in 'Present Throughout' or 'PTO' boxes on hardcopy maps. The tabular information displayed in the Mapping Qualifier attribute was determined to be redundant with life history categories and was removed to increase efficiency in all phases of the ESI process.

Additionally, the life history category INTERNESTING, which was present in ESI Atlases published from 1995 and 2025, has been removed as of late 2025 and will not be included in any future published ESI Atlases. INTERNESTING was previously included as a life history category for the HERP element, but it was very rarely used, was variable among individuals of the mapped species, and overlapped with the months in the NESTING life history category (herpetofauna internesting periods are defined as the periods between successive nesting events within a nesting season, during which females rest in nearshore waters). This attribute was removed to reduce redundancy in the ESI tabular data.

ESI MASTER SPECIES LIST

The ESI MASTER SPECIES list, a Microsoft Excel spreadsheet, contains a comprehensive list of species mapped in the ESIs and is available at https://response.restoration.noaa.gov/esi_specieslist. The current master species list has over 5,000 species or species groupings/generalizations. This list contains the SPECIES_ID values and the element, subelement, scientific (when applicable), and common names of the species/groupings they represent. See **Table 4.4** for the attributes included in the ESI master species spreadsheet. If a mapped species is not already included in the master species list, contact the NOAA ESI Program Manager to get a SPECIES_ID assigned and the record added to the master species list. A list of preferred taxonomic sources is provided in Appendix E. Submit the species information to NOAA for verification and a unique SPECIES_ID will be added to the master species list, along with all relevant species information.

Table 4.4: ESI master species list spreadsheet format and attributes.

Field Name	Storage	Sample Values
SPECIES_ID	Long	76
NAME	Text (35)	Bald eagle
GEN_SPEC	Text (45)	Haliaeetus leucocephalus
ELEMENT	Text (10)	BIRD
SUBELEMENT	Text (10)	raptor
GRANK	Text (8)	G5
GRANKDATE	Long	201703
EL_SPE	Text (6)	B00076

SPECIES_ID
SPECIES_ID is a unique species number assigned within each element.

NAME
Described in BIOCOMB table section above.

GEN_SPEC
Described in BIOCOMB table section above.

ELEMENT and SUBELEMENT
Described in Section 4.2 and BIOCOMB table above.

GRANK
GRANK reflects the conservation status ranking as defined by NatureServe (https://help.natureserve.org/biotics/content/record_management/Element_Files/Element_Tracking/E

TRACK_Definitions_of_Heritage_Conservation_Status_Ranks.htm). Standard values applicable to the ESI data range from G1-G5, with lower numerical rankings indicative of greater peril. There are also variant ranks and ranking qualifiers described by NatureServe. These values are reported in the master ESI species list, though it is a good idea to verify that statuses remain current using NatureServe Explorer (https://explorer.natureserve.org/).

GRANKDATE

GRANKDATE provides the most recent date that the global status was reviewed by NatureServe for currency. The format of the number should be recorded as YYYYMM. For example, 202401 would represent January 2024.

EL_SPE

EL_SPE is a unique identifier representing the species ELEMENT (EL) and SPECIES_ID (SPE). The letters in parentheses are used to designate each ELEMENT in the EL_SPE: *BENTHIC* (X), *BIRDS* (B), *FISH* (F), *HABITATS* (H), *HERPETOFAUNA* (R), *INVERTEBRATES* (I), *MARINE MAMMALS* (M), and *TERRESTRIAL MAMMALS* (T). This attribute is part of the ESI master species list only.

SOURCES table

All ESI feature classes – the biology, human-use, and the base ESI and HYDRO layers – share the SOURCES table (**Table 4.5**). This table contains bibliographic information for all data records in the ESI atlas. In addition to providing citation information, the SOURCES table can help users identify regional experts.

Table 4.5: Fields in SOURCES table.

Field Name	Storage	Sample Values
SOURCE_ID	Long	23400322, 23700003
ORIGINATOR	Text (255)	NOAA FISHERIES SERVICE
DATE_PUB	Long	2019, 202308
TITLE	Text (255)	CRITICAL HABITAT LEATHERBACK SEA TURTLE
DATA_FORMAT	Text (80)	VECTOR DIGITAL DATA, DOCUMENT
PUB_PLACE	Text (255)	FEDERAL REGISTER, SILVER SPRING, MD
PUBLISHER	Text (255)	DEPARTMENT OF INTERIOR, NOAA
PUBLICATION	Text (255)	FEDERAL REGISTER VOL 69
LINK	Text (255)	https://www.fws.gov/program/national-wetlands-inventory/wetlands-mapper
SCALE	Text (20)	1:24,000, VARIES, UNKNOWN
TIME_PERIOD	Text (34)	2007-2008, 202205, 2024

SOURCE_ID
The SOURCE_ID field provides a link to the **BIOCOMB** and **SOC_DAT** tables, as well as the **HYDROL, ESIL,** and **ESIP** feature classes. The number is constructed as follows in **Table 4.6**.

Table 4.6: Source_ID number ranges for each feature type in the SOURCES Table.

BASE NUMBER RANGE	FEATURE TYPE/TABLE
1-100	ESIL, ESIP, HYDROL feature classes
101-300	SOC_DAT table
301-99,999	BIOCOMB table

The base source number is added to the atlas number (see Appendix F)* 100,000, making the SOURCE_ID unique across atlases. The corresponding field in the **BIOCOMB** table is G_SOURCE; in the SOC_DAT table the field is also G_SOURCE; and in the HYDRO and ESI feature classes the link is to SOURCE_ID and ESI_SOURCE.

ORIGINATOR
The ORIGINATOR field contains the name of the agency or organization that provided the information/data, followed by the name(s) of the individual provider(s) if appropriate. All text is upper case.

DATE_PUB
For published sources, the DATE_PUB field contains the publication date. If the source is not published, DATE_PUB should reflect the data collection date, or the date of the interview. DATE_PUB should follow the format YYYY, YYYYMM, or YYYYMMDD, where Y is the numeric year, M is the numeric month, and D is the numeric date.

TITLE
The TITLE field contains the name of the publication or dataset, or an identifying summary of the contents received from expert knowledge. All text is upper case.

DATA_FORMAT
The DATA_FORMAT field contains information on how the data were delivered to the ESI contractor. Common values include EXPERT KNOWLEDGE, DOCUMENT, VECTOR DIGITAL DATA, SPREADSHEET, and HARDCOPY TEXT. All text is upper case.

PUB_PLACE
The PUB_PLACE field contains the publication location. When applicable, the city and two-letter state abbreviation should be included. All text is upper case.

PUBLISHER
When applicable, the PUBLISHER field contains the name of the data publisher. For unpublished sources, this field is left blank. All text is upper case.

PUBLICATION
When applicable, the PUBLICATION field contains a citation of the source. For unpublished sources, this field is left blank. All text is upper case.

LINK
The LINK field contains a URL to the original data, if it is publicly available online. If not, this field should contain a link to the providing agency's website, preferably a webpage that provides additional detail about the data used in the ESI. The URL should be copied as it appears in the address bar. It must be fully qualified (include the https://portion) and should not include any "<" or ">" characters.

SCALE
The SCALE field describes the scale of the original data. Values may be numeric or descriptive. Examples are '1:24,000','24,000' (denominator of scale only), UNKNOWN', or 'VARIES'. All text is upper case. If the source does not have a scale associated with the content, a value of 'N/A' is assigned.

TIME_PERIOD
The TIME_PERIOD field contains the period when the data were collected. A single date or a beginning and end date of collection may be used. Ranges of dates should be separated by a dash (-). Examples include '2007', 200702', or '200507-200602'.

Additional information for all tables and attribute fields is provided in the Data Dictionary (Appendix B). Appendix C provides a schematic of tables and fields and diagrams the relationships between tables. Appendix F provides a list of the ESI atlas numbers.

4.3 Creating ESI Biology Data/Content

The goal of an ESI is to present the most current, accurate, and comprehensive information on sensitive resources. The primary end users of the ESI data products are oil spill planners and responders, who often need to assess an area very quickly and are limited in the amount of protection they can provide. Therefore, the task of ESI biologists is to collect and present data in the most accurate and precise way while ensuring that primary stakeholders and the end use of the products are kept in mind. Collection and compilation of biological data are perhaps the most challenging tasks in producing a quality ESI dataset. Active stakeholder engagement and targeted outreach are two of the most important factors that drive successful data collection and compilation efforts and ultimately lead to a relevant and usable ESI product.

4.3.1 Identifying Partners, Resource Experts, and Relevant Datasets

NOAA Scientific Support Coordinator Role

The NOAA regional Scientific Support Coordinator (SSC) is an invaluable resource when identifying appropriate resource experts. In the early stages of the project, the NOAA SSC will likely spread the word of an ESI update to their regional constituents, many of whom may become data providers and/or supervise those who can provide data. The SSC regularly participates in Regional Response Team and Area Committee meetings, which provide an excellent opportunity for them to reach a broad audience regarding the status of ESI work in their region. The SSC should be kept engaged in all stages of the data collection and review process as a working partner and advocate for the ESI product.

NOAA ESI Program Manager Role

In addition to the NOAA SSC, the NOAA ESI Program Manager may be able to assist in making initial contacts and resolving any issues that arise when communicating with data providers throughout the ESI process. NOAA has prepared a letter to potential data providers summarizing the ESI product and process; see an example letter in Appendix K. This letter, along with a map or shapefile of the area of interest, should accompany all requests for data. Some providers may be reluctant to work with contractors, and this letter may help pave the way. In all cases, if a data provider has questions about the use of their data, they should be referred to the ESI Program Manager and/or the regional SSC.

Federal, State, Tribal, and Other Agency Roles

Federal, State, Tribal, university, and NGO fish and wildlife organizations often have local field biologists, researchers, and species experts with vast knowledge of distribution, life history, seasonality, breeding, and protection priorities for regional flora, fauna, and habitats. The ESI contractor is responsible for contacting all stakeholders in the area to request data for the atlas. Some states have dedicated oil spill response personnel that may also assist in identifying ESI resources. The introductory pages and sources table of previously published ESIs contain names of experts who have supported ESI updates in the past, and agency websites can provide names of experts who currently occupy positions helpful to ESI data collection efforts. These experts can assist in identifying datasets and individuals willing to share their expertise, as well as help with reviewing draft data products.

As resource experts are identified, record the species and taxa that match their interest and expertise. Continually update and refine this list while progressing through data collection and review. This list of contacts and their expertise, with the permission of the experts, will become part of the introductory materials that accompany the ESI map products; data providers will also be credited in the GIS digital sources table. In the event of a spill, easy access to this source information will ensure that responders can verify and update species information, and that the appropriate field agencies are made aware of potential response actions.

Use of Online Data Sources

In addition to talking to local resource experts, data searches on GIS clearinghouses may lead to relevant data sources. When using information sourced from a third party it is important, whenever possible, to go back to the originating office or individual to make sure the data is the most current and that its use in the ESI is appropriate. Many national and regional datasets are relevant to multiple ESI regions and should be considered. A list of these datasets is presented in Appendix D.

4.3.2 What to Map – Species and Data Inclusion and Exclusion

Threatened and Endangered Species

Sensitive resources will vary from region to region but will always include coastal-dependent species that are federally and/or state listed as threatened or endangered. Because these species have legal protections that must be considered during a response, ESI data collection for these species should be the top priority. Identifying the listed species in an ESI region can be done by referring to sources such as the USFWS IPaC application (ipac.ecosphere.fws.gov), USFWS Critical Habitat for Threatened & Endangered Species mapper (https://fws.maps.arcgis.com), NMFS National Endangered Species Act (ESA) Critical Habitat Mapper (https://www.fisheries.noaa.gov/resource/map/national-esa-critical-habitat-mapper), NMFS regional (Greater Atlantic Region, Southeast Region, West Coast Region) Section 7 mappers, and previous ESI atlases. For ESI regions with recently updated atlases, the previous species list and those of adjacent regions may help to identify which listed species are in the area, but keep in mind that listing statuses change over time. Local and regional listed species experts from USFWS, Ecological Services Division; NOAA Fisheries; and state Natural Heritage Programs (NHP; often under state fish and wildlife divisions) should be contacted to obtain current datasets of listed species in an ESI region.

Determining a Species List

ESI databases are not exhaustive inventories of all species present in the region, rather they are concise lists of at-risk resources. In addition to federally and state listed species, the focus should be on mapping species that have an increased vulnerability due to life stages or activities occurring in environments likely to be oiled. Additional consideration should be given to any species that may be harvested for consumption or may have other economic impacts if affected by a spill. As with listed species, previous ESI species lists from the region may be helpful when determining which species to map. Preliminary species lists will help target which local and regional species experts are needed, and previous sources and source agencies are available from the *SOURCES* table, metadata, and introductory pages.

Appendix A provides a complete list of elements to be mapped and, for each element, contains details on:

- Subelement: e.g., coral (benthic), pelagic (birds), turtle (herp).
- Areas/Sites to be Mapped: e.g., beds or forests of kelp (kelp), rookeries (diving birds), wintering/rafting areas (alcid), harvest areas (bivalve), pupping areas (pinniped).
- Unique Characteristics: e.g., occur in offshore waters and on islands or cliffs where they nest (pelagic birds); typically mapped using a 100-m buffer (onshore and offshore) along sand and gravel beaches (shorebirds), etc.

While Appendix A provides the complete list of available subelements, not all subelements will be used in each atlas. Additionally, several subelements (in the FISH, HABITAT, and INVERT elements) that were used in ESI Atlases published through 2025 have been removed as of late 2025 to reduce unnecessary complexity in the ESI database and avoid redundancy where multiple subelements may apply to a single species. Appendix A documents all currently and previously available subelements.

There are ESI mapping conventions to follow for some elements/subelements. For example, for the HABITAT element, typically only state and/or federally listed plants are included, with the notable exception of the pelagic habitat-forming *Sargassum*. Similarly, for the T_MAMMAL element and the insect subelement (within the INVERT element), typically only state and/or federally listed species are mapped. Any questions about which species/resources to include in an ESI database should be directed to the ESI Program Manager.

The above guidance for creating an ESI species list must be communicated to local and regional resource experts, and the final species list should be a collaboration between the ESI biologists and resource experts. For instance, we focus on the fish species list (often a very speciose element) by identifying species that are state and/or federally listed, commercially or recreationally important, or species that aggregate in large numbers to reproduce in the region during conversations with local and regional fish biologists. Also consider focusing on early life history stages (eggs and larvae), as these life stages are when fish are most vulnerable to oil toxicity.

4.3.3 Stakeholder Engagement

There are multiple ways resource experts can be approached and engaged; however, it is important to recognize that data providers often receive numerous requests for their data and knowledge in addition to their other job obligations. Simplifying the data collection and review process and maintaining cooperative partnerships are key factors in developing strong relationships within the spill response and data sharing community.

Initiating Contact

Meetings with data providers are essential to ensure an ESI product contains the most current and best available information and is a complete and accurate reflection of the data provided. First, an initial scheduled call with the data provider to explain the ESI and data needs is conducted before scheduling follow-up meetings or workshops (either in-person or virtual). During the initial call, ESI biologists communicate which species or taxa are relevant to the update, what information they are seeking, and the geographic extent of the Area of Interest (AOI). When determining which species to include in an ESI, some key considerations include: Are the species listed as threatened or endangered? Are they coastally dependent species? Do the species reproduce in the AOI? Do the species congregate in large numbers during discrete time periods or life events?

In some cases, data providers may be prepared to send (usually via email) data to the ESI biologists following the initial call. In these cases, ESI biologists and data providers should discuss a mapping plan for how to incorporate the data into the ESI during the call and follow up with any questions or clarifications after the data have been received.

Data Collection Workshops

For data-rich elements (e.g., BIRDS, FISH), workshops with groups of resource experts may be the most efficient way to communicate with all resource stakeholders from appropriate jurisdictions. Planning these workshops should occur during or shortly after initial calls/contact with resource experts. Whenever possible, data collection workshops should be conducted in person, with the ESI biologists traveling to the ESI region. However, in recent years, virtual ESI workshops have become more common and have successfully been used to collect the data and information needed to map biological resources.

It is useful to plan workshops for groups of experts with similar expertise so that data sources and mapping strategies for the target species can be addressed in fewer discussions. Topics may be as general as “fish” or may be grouped by ESI subelement, such as “shorebirds” or “sea turtles.” Workshops typically last 2-4 hours with each group of experts and involve discussing which species to include, available datasets, and mapping strategies, as well as identifying other resource experts to contact. In some cases, resource experts may provide digital datasets in advance, allowing the ESI biologists to display the data in an ArcGIS project for discussion at the workshop. For data that is not currently in a digital format, it is useful to have base maps prepared so that experts can identify areas of species occurrence and/or concentration; another option is to use GIS software to capture location and attribute information during the workshops.

Data Collection Workshop Tips and Protocols

During data collection workshops, keep in mind that the resource experts are the authoritative source on the species they study and manage; however, the ESI biologists must provide guidance on the types of data appropriate for inclusion in an ESI. Careful prep work is needed to maintain the focus and forward momentum of the data collection meetings. Clearly articulating the intent of the ESI and sharing previous ESI maps and data, examples of digital datasets, and preliminary species lists can be very helpful.

It is also important to discuss data that are captured in the ESI attribute tables with resource experts, including life-history and seasonality information and how to assign concentration values. For threatened and endangered species, it is critical that the resource experts review the listing status for all species. They should be the source for the most up-to-date reference documents, and they are typically the most knowledgeable source for some of the more difficult listing status questions (e.g., those related to subspecies listings, geographical differences between listing status, and Evolutionarily Significant Units).

Some experts may be resistant to sharing data because of the sensitive nature of a particular resource. ESI biologists should be prepared to find approaches that will work for the data providers while still serving the objective of the ESI. It may help to remind them that if a responder is unaware of the location of a sensitive resource, protection may be delayed. ESIs are a tool used in the early hours of a response, before resource experts may be contacted, particularly when a spill occurs after hours, on weekends, or on holidays. There are multiple ways a species name or location can be obscured while still providing necessary information for spill responders (see Other Data Creation Considerations section).

ESI Data Review Meetings

A second set of in-person or virtual meetings with data providers should be held to review the draft ESI geodatabase. These review meetings should ensure that the data were accurately represented based on discussions during data collection meetings and that no security or sensitivity concerns were violated. It is imperative to provide interim products for feedback to make sure the data is being represented as intended. Conducting these review meetings with the same groups of experts who attended the data collection workshops is preferred.

During review meetings, the ESI biologists should 'walk the resource experts through' the draft geodatabase so they can see how their data are represented and integrated with data from other sources. Experts should provide feedback and identify gaps in the data and/or source information. Additional data can still be added to draft geodatabases during this phase of the project. The review meetings add great value to the ESI by ensuring that resources are mapped appropriately and by solidifying the ESI product as a reputable, vetted source of the most up-to-date data applicable to oil spill planning and response.

4.3.4 Data Compilation

Why ESIs are a Compiled Product

Data compilation is an important part of ESI biology data production, as data from multiple sources must be compiled to present a clear view of species distribution. Data that are collected and incorporated into an ESI may be provided in numerous formats, such as vector digital data sets (points, lines, and polygons), expert knowledge, reports, published papers, gray literature, maps, spreadsheets, and other tabular formats. One key aspect of creating the most diverse, usable, and up-to-date final product is to be flexible on how the data is presented. Integrating data from a variety of sources into a compiled product sets the ESI apart from many common 'layered' GIS products, where attributes differ between datasets, multiple datasets obscure each other, etc. Expert knowledge and ancillary information are valuable sources of information for oil spill planners and responders when captured and presented in the ESI. As data are gathered, it is useful to chart what species, species groups, and geographies have been covered, and to flag species that still need coverage. One way to compile this information is in a data received matrix (**Table 4.7**). This table helps visualize data coverage and identify where additional outreach and data are needed.

Table 4.7. Example data received matrix for ESI biology data collection and compilation.

Element	Dataset	Currentness	Source	Format	Contact Name	Date Received
Birds	Piping plover survey on Apostle Islands	2015-2022	NPS	pdf	F. Cuthbert	5/2/2025
Herps	Herps of Grand Portage National Monument	2017	NPS	spreadsheet	B. Dunlap	6/11/2025
Inverts	Mussel survey and population assessment on Apostle Islands	2017	NPS	pdf	T. Lafrancois	5/1/2025
Fish	Fish assemblage data collected within Pictured Rocks National Lakeshore, Michigan	2023	USGS	csv	J. Roberts	6/30/25

Element	Dataset	Currentness	Source	Format	Contact Name	Date Received
Habitat	Arctic and alpine rare plant population dynamics at Isle Royale National Park	2019	NPS	pdf	G. Caspar	6/5/2025
M_ mammal	Manatee synoptic survey locations	2022	FWC	https://geodata.myfwc.com/datasets	H. Edwards	2/2/2022
Benthic	FL Unified Reef Map data, version 2	2025	FWC	gdb	N. Alcatraz	3/3/2025

Importance of a Mapping Strategy

It is often necessary to follow up with data providers, via phone and/or email, to acquire all data discussed at the data collection meetings and to finalize a mapping plan. It is not uncommon to acquire data from more than one source for the same species or species groups, and it may be necessary to revisit the mapping strategy if additional data for a species or resource in similar habitats are presented by other data providers. For instance, often there are federal, state, university, non-governmental organizations (NGOs), and other partners with the same resource concerns and priorities who maintain datasets of resources of concern for varying geographies. This is the primary reason why meeting with resource experts from multiple agencies at the same time is critical. When this is not possible, it is important to consider all data received but be able to make decisions on which datasets best serve the purpose of the ESI and should be prioritized in data compilation. Possible approaches for compiling multiple datasets for a single resource include using the maximum count or concentration across datasets for features/geographies or using datasets from different agencies for different geographies. For instance, when meeting with National Park Service land managers or USFWS refuge managers, it is very likely that they will provide more detailed data on their primary focus species within the geographies they manage than a state partner that is providing a statewide dataset.

Incorporation of Edits into Final Deliverable

Upon completion of review meetings with data providers, ESI biologists must incorporate all necessary edits from the review meetings into the final deliverable. It is critical to maintain a record of all suggested edits, whether they were incorporated into the final database, or otherwise resolved with no significant editing required. At this stage of the process, ESI biologists should revisit the mapping strategy across all elements to ensure that all edits and data additions and deletions that occurred throughout the process result in a seamless and concise final deliverable.

4.3.5 Creating ESI Feature Classes

Key Considerations for Inclusion of Polygonal Biological Features

All biological features should be congruent with adjacent features and edge-matched to the shoreline when appropriate (such as for fully aquatic or terrestrial life histories). To ensure this, the ESI shoreline and polygons must be completed prior to mapping any biology data. In addition to being required for polygon delineation, the classified ESI shoreline and polygons are used to map biological occurrences specific to a particular shoreline habitat (e.g., mangrove or sandy beach dependent species). See Chapters 2 and 3 for more information on shoreline creation.

When manipulating biological features for inclusion in the ESI database, polygons may be clipped to appropriate geographic features, such as tidal flats or marshes; they may be bound by appropriate bathymetric or topographic contours; or they may be created by buffering points or lines (e.g., the shoreline). Determining common biologically relevant boundaries and buffer sizes beforehand will help focus the compilation effort, keep the data manageable, and minimize topologic issues such as slivers and small polygons. Additionally, when resource experts provide polygonal data, all polygons used in the ESI must be reviewed and potentially modified to match the ESI shoreline and other polygonal features. For example, data received from providers A, B, and C, all of which provided information about species dependent on tidal flats, should be mapped to the same polygon features – the ESI polygons representing tidal flats that were captured during the shoreline creation and compilation task. These steps are essential to ensure a clean, cohesive ESI database.

When appropriate, uniform buffers should be used both within and between feature datasets (elements). For example, nesting beaches for turtles and migratory stopovers for shorebirds might be provided as lines and points along the coastal regions. After consultation with the data providers, it may be decided that a buffer along the shoreline best represents both the nesting habitat for sea turtles and migratory or staging areas for shorebirds. These resulting features will clearly represent to responders that the buffered shoreline is important to protect when these species are present.

Habitat associations are often conveyed by data providers during data collection meetings and can be used as the basis for placement of the biology features. For example, horseshoe crabs and the shorebirds that feed on their eggs are closely associated with sand beaches and adjacent flats along the eastern seaboard. This habitat association can be represented in the final ESI product by buffering sand beaches with known occurrences of these animals and merging these polygons with adjacent tidal flats to create polygonal features.

Benthic habitats, such as reefs and submerged aquatic vegetation, are important for a wide variety of species. Therefore, benthic habitat data, usually provided in a digital vector format, can be used to create features for the species that are dependent on these habitats. When using features with many small polygons, such as submerged aquatic vegetation or oyster reefs, it might be appropriate to buffer these features, merge the resultant layer, and remove small, isolated patches or voids within larger patches, to reduce the complexity (and vertex count) of the final feature class. A buffered feature that captures the habitat associated with the at-risk species may better serve the ESI end user than the more detailed original data set as provided by the resource expert.

Key Considerations for Inclusion of Point and Line Biological Features

Point features are most often used to represent features that would be too small to display on an ESI map, such as bird nests and pinniped haul-out sites. Chapter 6 presents guidance on the minimum mapping unit considerations for ESI data. Lines are typically reserved for features that represent streams, such as anadromous fish runs, native stream species, or federally/state listed mussels. When mapping anadromous fish that migrate up freshwater rivers and streams to spawn, ensure that inland distributions of spawning fish are mapped to either the HYDROL or HYDROP layer to prevent fish from being represented on land without reference to a water body, where possible. However, even in this case, if features provided as line data correspond to rivers and/or streams represented as polygons in the hydro layer, the preference is to convert the lines to polygon features that match the ESI shoreline.

Some resource experts may be resistant to sharing precise locational data because of the sensitive nature of a particular resource, and this may influence how a feature is mapped. For example, a data provider may have highly accurate point data for bald eagle nest sites, but they are reluctant to share the data for concern the ESI will be used outside of the spill context, posing potential risk of harm to the birds or nests. In these cases, the points may be randomly offset and buffered, resulting in polygons that include the nest sites, but do not pinpoint the exact locations. These processing steps should be documented in the introductory pages and metadata. For more information, see the Obscuring Sensitive Resources section.

4.3.6 Creating Data Tables

The ESI biology data tables provide information related to each geographic feature in the ESI. Species, concentration, seasonality, and source information for each record are contained in the tables, and key considerations for populating these attributes are below.

Capturing Seasonality

It is crucial to accurately portray the months each species in the ESI is present in the mapped areas. Many of the biological resource polygons represent seasonal use areas, thus sensitive life history stages (e.g., nesting, spawning, or pupping) may occur in these locations. This information is extremely important to add to the BIOCOMB table, as biological activity in most areas varies considerably with seasons. Evaluating resources at risk involves examining both spatial and temporal data, which the ESI provides. If a spill occurs in February, the responders may encounter a different suite of species and life-history stages than if a spill happens in the same area in July.

Assigning Concentration Values

Concentration (CONC) values may be quantitative, qualitative, or left blank. When source data supports the usage of the concentration field, it can provide information that could allow responders to prioritize certain areas where counts, densities, percent coverage, etc. are higher than in surrounding areas.

Because ESI databases are not frequently updated, ESI biologists should use CONC values that integrate multiple years of data to illustrate concentrations of organisms that *may* be present. For example, the ESI biologist should obtain the most recent several years of count data for each species for each waterbird colony in the ESI region. Each colony will be mapped with a single feature (often a point), and the RARNUM could contain CONC values for each species that report the maximum count from the recent years of data collected (e.g., “Up to 37 pairs”). Other examples of useful quantitative CONC values include: “27 nests”, “>50% cover”, “100s”, and “10 indiv per sq km”.

Qualitative CONC values can be difficult to assign from quantitative data, and a thorough discussion with the data provider is necessary to ensure the qualitative terms chosen are appropriate representations of the data (i.e., define which values qualify as CONC = “High”). In some cases, reporting the ranges of quantitative values in the CONC field may be preferred (e.g., creating three ranges of density values and reporting the CONC as “<3 per sq km”, “3 to 10 per sq km”, or “>10 per sq km”). However, when used appropriately and in collaboration with data providers, qualitative terms can distill complex datasets into the concise level of information that is useful in an ESI. Qualitative CONC values are also useful to capture expert knowledge of concentration areas when quantitative data does not exist. The ESI Data Dictionary (Appendix B) contains a list of some common qualitative CONC values. A detailed explanation of what a particular CONC value reflects for a specific species/region should be recorded in the atlas introductory pages and metadata.

Number of Species Per RARNUM

While there are no set rules about the number of species records an RARNUM can contain, there are some things to consider if the number of records starts getting “large”. This is a relative concept, but if the final, compiled data have RARNUMs containing more than approximately 30 species, the ESI biologists should re-evaluate if data are being mapped in line with the ESI approach. In some cases, these large record counts may be warranted, but consider the following:

1) Historically, approximately 90% of all RARNUMs have fewer than 30 species, with approximately 50% of the RARNUMs having 1-9 species records.
2) Does the complexity of the data provide information that will help the responder, or does it inadvertently deemphasize the species’ occurrences of greatest concern?
3) Monthly seasonality and breed activities can be reflected in the BIOCOMB table of the same species record, even if there are two distinct seasons.
4) Consider combining records that have similar spatial extents into a single polygon and RARNUM where possible to avoid multiple overlapping polygons with similar boundaries.
5) In certain circumstances, generalizing multiple species with similar life history traits can also help simplify the final ESI products. It may be appropriate to lump gulls together and attribute the group as “Gulls” rather than list each individual species by name.
6) Unless a unique life history trait is most accurately represented by mapping a state-listed (T/E) plant species by its common name, it is often appropriate to group state-listed plant species by their status (e.g., “State threatened plant”). Conversely, federally listed plant species should be mapped individually using common names when possible.
7) In all cases, conveying where and when state and/or federally protected species are present is a high priority. The presence of these species triggers required consultation with species experts/trustees,

in part to determine if there are any Best Management Practices that should be implemented during response or clean-up activities.

8) Whenever data has been modified or simplified into broader groupings, record this information in both the introductory pages and the metadata lineage section.

4.3.7 Other Data Creation Considerations

Obscuring Sensitive Resources

For a variety of reasons, a data provider may request that sensitive species locations presented in the ESI be altered so that either the exact location and/or species name is obscured from the public. This most often occurs for threatened or endangered populations or species that are prized by collectors or subject to overharvest at aggregation areas.

Locations can be obscured in many ways; however, the most common is applying a procedural buffer around the known location of the sensitive resource. ESI biologists should work with the data provider to determine an appropriate buffer distance and method. In some cases, a random shift and a buffer is appropriate, and the ESI biologist should ensure that the “true” location of the resource is still within the buffered feature. When appropriate and if approved by the data provider, the final feature can be clipped to either land or water if the life history trait that is being represented with the feature is exclusively terrestrial or aquatic in nature.

Species names can also be generalized and still provide valuable information to the ESI end user. The ESI master species list (https://response.restoration.noaa.gov/esi_specieslist) has many options available. ESI biologists should work with the resource experts to determine the appropriate level of masking. For example, if the data provider is concerned that an endangered turtle species will be targeted for collection, it might not be appropriate to mask the common name with “Endangered turtle” if there is only one endangered turtle species that occurs in the region. In this case, further obscuring the resource by either using “Endangered reptile” or even “Endangered herpetofauna” may be appropriate. Masked species names can also be modified with numbers to distinguish between multiple listed species in the ESI region (e.g., “Endangered reptile 1”, “Endangered reptile 2”, etc.) if needed (i.e., if attribute information differs and the geographic representation overlaps). As always, work with the data provider to ensure that the methods used to obscure sensitive resources are acceptable and appropriate for each individual case.

CHAPTER 5

Human-Use (Socioeconomic) Resources
Collecting, Creating, and Compiling Human-Use Data
and the Human-Use Data Tables

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5 Introduction to Human-Use (Socioeconomic) Resources

Human-use (or socioeconomic) resources, such as parks, marinas, water intakes, and cultural sites, that are sensitive to oil or useful during response operations are included in the ESI. For the purposes of ESI mapping, socioeconomic refers to the overarching SOCECON feature dataset stored in the ESI geodatabase, while human-use refers to the features being mapped within that feature dataset as described in this chapter.

5.1 Mapping Human-use Resources

The ESI focus is on resources that warrant protection from oiling and/or response operations, resources that may pose a threat, and resources that may be utilized for an effective response. Human-use resources may be impacted by spilled oil and other natural and/or man-made disasters. Awareness of jurisdictional and management boundaries is also important to ensure responders contact the proper regional authorities during an event. Spills and response activities can also result in serious economic consequences, notably by impacting recreational and commercial fisheries. These are the type of resources mapped in the human-use portion of the ESI. Human-use resources that are most likely to be affected in the event of an oil spill, as well as those resources that support response activities may include, but are not limited to, the following:

- Political/Jurisdictional Boundaries
  - EPA, FEMA, USCG, International, and State Boundaries
- Resource Management Features
  - Aquaculture Sites, Artificial Reefs, Commercial/Recreational Fishing Locations, Critical Habitats, Subsistence Areas/Fishing, and Water Intakes
- Parks and Managed Areas
  - Wildlife Refuges, State Parks, Nature Conservancy Lands, National Parks, National Forests, National Marine Sanctuaries, and National Estuarine Research Reserves
- Navigational and Marine Features
  - Access Locations, Anchorages, Marinas, Boat Ramps, Ferry Locations/Routes, and Ports
- Socioeconomic Features
  - Abandoned Vessels, Historic Wrecks, Airports, Archaeological Sites, Recreational Beaches, USCG and EPA Facilities, Historical Sites, and NOAA Facilities

There are numerous human-use “types” used in the ESI products, and not all are appropriate for every ESI mapped region (see Appendix B for a full list of types). Human-use resources typically include the following categories: 1) Recreation Areas and Access Locations (beaches, boat ramps, marinas, etc.); 2) Management Areas (Critical habitats, National Wildlife Refuges, etc.); 3) Resource extraction (aquaculture sites, commercial fishing areas, water intakes, etc.); and 4) Cultural Resources (archaeological/historical sites, abandoned vessels, etc.). More detail on required human-use features, and mapping considerations for these features are presented in Section 5.2.

5.1.1 Human-Use Data Components

The ESI human-use data are divided into five *ELEMENTS* that are feature classes stored in the SOCECON feature dataset, which is shown in **Table 5.1**.

Table 5.1: Five ELEMENTS used for ESI human-use data.

ELEMENT	FEATURE TYPES
POLITICAL	Political/Jurisdictional
RESOURCE	Resource Management
SOCECON	Human-use (Socioeconomic)
MANAGED	Parks/Managed Areas
NAV_MARINE	Navigation/Marine

As with the biological elements, each human-use element allows point, line, and/or polygon features. Each feature-type/element combination corresponds to a single feature class layer; collectively these feature classes are housed within the SOCECON feature dataset.

The ESI Data Dictionary (Appendix B) specifies to which ELEMENT and feature type each human-use type corresponds. There are also two supplementary sections in the ESI Data Dictionary, *Human-Use Features – Grouping of Types*, and *Human-Use Type Explanations*, that provide additional guidance. The Type explanations are particularly useful for understanding the intent of each human-use Type and indicating which types are required, desired, and should be considered for regional inclusion if appropriate. Types featured in Version 4.0 of the ESI Guidelines that are no longer included in the ESI product are highlighted in Appendix H.

5.1.2 Human-Use Attributes and the ESI Data Tables

The data schema for the human-use deliverable to NOAA and the final public distribution format are virtually the same, because there is only one primary related attribute table, the **SOC_DAT** table. A brief description of the human-use feature attribute data table is shown in **Table 5.2**.

Table 5.2: Human-use feature class attributes.

Feature Class Attributes		
Field Name	**Storage**	**Sample Values**
TYPE	Text (4)	A, WR, BR, WI
HUNUM	Long	28300001

Feature Class Attributes

The human-use feature class table has two attributes, TYPE and HUNUM. These attributes provide a link to additional information in the standalone data table, **SOC_DAT**.

TYPE

The TYPE field is populated with an abbreviation reflecting what a feature represents. In the sample values above, for instance, type A = airport; WR = Wildlife Refuge; BR = boat ramp; WI = water intake. All standard type abbreviations can be found in the ESI Data Dictionary. The complete TYPE information (i.e., "airport") is spelled out in the corresponding record found in the **SOC_DAT** table. This field is also used for symbolization of human-use features.

HUNUM

The human-use feature number (HUNUM) is the direct link from the human-use feature classes and the **SOC_DAT** table. Unlike the RARNUM, it is uncommon for a HUNUM to be associated with multiple records in the **SOC_DAT** table. If a single point feature, for instance an archaeological site, has two names, only the one determined to be the primary name is included. Likewise, if resource information came from multiple sources, only the most definitive source (and feature) should be retained.

SOC_DAT table

The **SOC_DAT** table contains all attributes pertaining to the human-use features, as well as links to the **SOURCES** table with feature-level source information (**Table 5.3**). The human-use feature classes link directly to the **SOC_DAT** table through the HUNUM.

Table 5.3: Fields in SOC_DAT table.

Field Name	Storage	Sample Values
HUNUM	Long	28300001
ELEMENT	Text (10)	POLITICAL, NAV_MARINE
TYPE	Text (35)	AIRPORT, BEACH
NAME	Text (50)	CROATAN NATIONAL FOREST
CONTACT	Text (50)	U.S. FOREST SERVICE
PHONE	Text (12)	XXX-XXX-XXXX
LINK	Text (255)	https://www.fs.fed.us/
G_SOURCE	Long	283000101, 283000299

HUNUM

Previously described, this provides the link from the human-use mapped features to the related attributes.

ELEMENT

The ELEMENT field is populated with one of five values describing the primary category of the feature (Feature class). These are POLITICAL, MANAGED, RESOURCE, NAV_MARINE, and SOCECON. These elements, together with the feature type (point, line, polygon), correspond to the feature class name.

TYPE

TYPE spells out the abbreviated human-use TYPE found in the feature classes. Acceptable attribute values and the corresponding abbreviations are listed in the ESI Data Dictionary (Appendix B) under the **SOC_DAT** table description.

NAME

If applicable, this field holds the actual name of the feature, for example “DEEP BAY OYSTER SANCTUARY”, and “CROATAN NATIONAL FOREST”. If the feature is not associated with a unique name, a brief description, such as “MUSSEL WATCH SITE” and “BOAT RAMP” may be used.

CONTACT

This field contains the name of the person or agency responsible for the resource (not necessarily the data provider). This information is not always applicable and/or available, but whenever possible this field should be populated.

PHONE

The phone number of the person or agency referenced in the CONTACT field, if available.

LINK

If the resource information was downloaded from a data portal or other website, that URL should be referenced here. Easy access to these sites is especially useful for resources where information may be updated after the ESI publication. If resource information was obtained through personal communication, or if it is not publicly available for download from the agency, this field may contain a link to the agency website or directed to the specific office responsible for mapping or oversight of the associated resource. The URL should be copied as it appears in the address bar of your web browser. The address needs to be fully qualified (include the http:// portion) and should not include any “<” or “>” characters.

G_SOURCE

G_SOURCE (geographic source) provides a link from the **SOC_DAT** table to the **SOURCES** table, where feature level source information is provided. Human-use source numbers range from 101-300. This value is then added to the atlas number (see Appendix F) * 100,000 to generate a number that is unique across all ESI atlases. For example, the Long Island Sound atlas (atlas number 287) will have human-use source ids beginning with 28700101.

SOURCES Table

All ESI feature classes – biology, socio-economic, and the base layers (ESI Line, ESI Polygon, and Hydro Line), share the SOURCES table. The SOURCES table contains feature-specific information and contact details. In addition to providing citations for the ESI data, the SOURCES table can help users to identify regional experts. This table is explained in detail in Section 4.2.2, Table 4.5, and attribute values and descriptions are provided in the ESI Data Dictionary.

The human-use data allows overlapping polygons. A single HUNUM may, however, be associated with multiple geographic features. Therefore, in all but the rarest of cases, correspondence between the feature class and the associated attribute tables is considered to be many-to-one.

5.2 Creating ESI Socio-economic Content

Creating spatial data sets for the human-use component of the ESI is an exercise in mapping regionally important resources for the purposes of spill planning and response. Not all human-use types are necessary or provide useful information for every region. Consultation with the regional NOAA SSC and other local spill responders and stakeholders is necessary to ensure that each ESI product best serves the local community

5.2.1 Identifying Relevant Datasets and Resource Experts

As introduced in the previous section, the socio-economic feature dataset contains information on jurisdictional resources (POLITICAL, MANAGED), economic, cultural, and response resources (RESOURCE, SOCECON), and marine and navigational resources (NAV_MARINE).

The ESI jurisdictional features include state boundaries and in some cases county boundaries, Coast Guard Sectors, and National Park boundaries, among others. Appendix D provides a list of authoritative sources for most jurisdictional boundaries. To maintain consistency across atlases, these are the sources that should be used for these features. Standard sources also help ensure accurate and congruent boundaries between adjacent ESI regions.

State and local managed lands, such as state parks, Audubon sanctuaries, and Nature Conservancy lands, should be included in all ESI datasets as response decisions will need to be closely coordinated with these local land managers. In addition to mapping their boundaries, appropriate attribution, including contact information, is required when available.

Economically and culturally important resources (commercial and recreational fishing areas, aquaculture sites, water intakes, archaeological sites, etc.) and spill response features (boat ramps, beach access sites, etc.) are often obtained through a combination of web searches, resource expert meetings, and review of the most recent regional Area Contingency Plan (ACP), compiled by the USCG The ACP will provide a list of content deemed important to oil spill response efforts. When applicable, ensure that the resource expert or data provider is identified for inclusion in the tabular information that accompanies the features.

As a generality, most of the content for the human-use data layers will be downloaded from online sources. A review of source metadata and a meeting with the data providers should be prioritized to ensure the downloaded data are current. Finally, a review and inquiry regarding additional resources and/or relevant sources may be conducted with the regional NOAA Scientific Support Coordinator (SSC) and/or EPA Regional Response Coordinator.

The number of human-use features included in the ESI have been reduced/streamlined to only include features that support response and response activities. Large, complex datasets that are modeled and readily available from other sources, such as storm surge data, are no longer included. See Appendix D for a list of priority features that may be included in an ESI.

5.2.2 Steps to Data Collection

When collecting the socio-economic data for an ESI product, federal and state GIS clearinghouses are a good place to start. Contact applicable data providers if data are not readily available for download online. Once data are obtained, review for content, relevance to the ESI, and currency. If discrepancies or obvious errors exist in a data source, a review with the data provider and/or expert should be conducted to ensure issues are resolved. This happens frequently with U.S. Fish & Wildlife Service (USFWS) National Wildlife Refuge (NWR) boundaries. The dataset of USFWS lands is available online, but the boundaries for each NWR should be reviewed with the Reserve Manager or biologist to ensure accuracy. These data can be further reviewed by resources experts during biological data collection and review meetings.

Certain sensitive datasets will not be available through public clearinghouses. Obtaining information on highly sensitive resources, such as archaeological sites, water intakes, pipelines, and some aquaculture facilities and leases, will most likely require the data compiler to contact the data steward directly. Because the ESI data products are made available to the public, the data provider may require masking of sensitive resources. Although it is helpful to compile contact information alongside all resources included in the ESI SOCECON dataset, it is especially important for any feature that is obscured either through buffering or attribution masking. In addition to including contact information in the tabular data, a brief write-up in the introductory materials is often warranted, and this information should be addressed in the ESI metadata.

5.2.3 Data Compilation

Creating Features

Mapping of human-use features cannot begin until the ESI base data layers have been finalized. The regional ESI AOI and HYDROP features should be used as the base features to which all appropriate human-use features are clipped. Creating topologically correct representations of the data is a pervasive theme when creating any ESI features.

During creation of the ESI human-use features, it is important to employ logical methodologies to ensure proper integration of multiple datasets. One task is to ensure borders match when that appears to be the intent of the data. Border mismatches may arise when sources from two entities are brought together for the ESI. Significant overlap between two datasets that you expect to be congruent might necessitate a review with the resource experts before adjustments are made for purposes of the ESI. In these cases, the authoritative data set will likely be chosen as the source with which to match all overlapping boundaries.

When possible, you should ensure that jurisdictional datasets are nested correctly and clipped to land or water as appropriate. Further, state waters should also be nested with the state boundary, and the federal water demarcation should share a boundary with the state water demarcation. Careful thought and attention to the hierarchy of jurisdictional boundaries will ensure that slivers and gaps are not introduced during the dataset compilation.

In addition to congruency between adjacent human-use features, it is essential that features abutting the shoreline share the same boundary line as the Hydro polygons. Because source data sets typically rely on different base shorelines, adjustments are necessary to match the ESI shoreline -- e.g., marine sanctuaries should not overlap land, and land features should not extend into offshore waters. Similarly, jurisdictional boundaries may or may not include offshore waters, so clipping human-use features appropriately to land or water as needed, rather than attempting to resolve underlaps with the ESI shoreline is a cost-effective approach. An evaluation of metadata or written legal definitions as well as information from the data provider (s) may be necessary to ensure that features are accurately portrayed for the purposes of the ESI and to ensure the original intent of the data has not been violated by edge matching to the ESI features. (Refer to Appendix H for more information). Although all attempts should be made to retain the intent of the original data source, the ESI data products are not intended to be used as an authoritative source for legally defined jurisdictional boundaries. These boundaries are included as a reference for planning and response.

Another potential pitfall when using multiple datasets to create a robust human-use data layer is duplicating mapped features. This may happen when two or more source data sets are used to map a particular human-use type. In the event of an overlap in the same geographical extent, mapping should defer to the appropriate authoritative source. Multiple data sources are often needed to fully cover a geographic area—for example, when combining state and local datasets to map features like marinas, boat ramps, and reef locations (among other features). Careful review of locational and attribute duplication should be prioritized. If feature overlap/duplication occurs and sources are equally credible, cite and use the source responsible for > 50% of the data and delete the identical feature(s).

Data Tables

Attribution fields for the SOC_DAT and SOURCES tables were presented in Section 5.1. It is critical to record contact information (names, phone numbers) for the resource experts during the data collection process to properly document in the SOC_DAT table as well as in the SOURCES table. This information is especially important for sensitive, protected resources, as these resources are more likely to have their spatial or attribution information masked, and additional detail may be needed to respond appropriately. These types of resources are also often associated with legal protection status that may require special consideration and communication with the resource manager in the event of a spill.

Masking Sensitive Resources

Several human-use features, especially archaeological sites, pipelines, and water intakes, may be at risk of sabotage or other acts of vandalism. They are, however, equally at risk of damage from spill and/or clean-up activities and cannot be protected if responders are unaware of their presence. Various techniques may be used to mask the spatial information of these data. One example is random locational shifts with an appropriately sized buffer to ensure the resource is still captured. Other resources benefit from generalizing the name of the resource in the attribute table. Resource experts may have additional ideas on how best to mask their resources while still including enough information to alert planners and responders to their presence. Any technique chosen should be approved by the appropriate data expert. In all cases, it is important to include contact information for the data source and resource guardian, so they can be contacted for more detailed information during a spill event.

Expert Review Meetings

After the data collection phase, reviews with resource experts should be conducted to address any data inconsistencies (such as mismatched borders or conflicting information from multiple sources), to ensure that the most current data are being used, and to fill in any missing feature or attribute information. These meetings can be conducted via phone, webinar or in person. As always, be courteous and respectful of the resource expert's time and data. If the experts are difficult to contact or fail to respond, the regional NOAA SSC may be able to help. A proper citation of the review meetings should be made in the SOURCES table and included in the introductory materials when appropriate.

Invasives

Mapping invasive species can provide valuable information to the ESI product. The reasoning is two-fold. 1) To avoid any confusion that these are valuable, high-risk species that need protection; and 2) to accurately portray the presence of these species to ensure that cleanup efforts do not cause further negative impacts in sensitive coastal regions.

Information on invasive species is no longer incorporated into the ESI atlas using traditional methodologies, but rather (at client request) included in the ESI introductory pages with a  symbol depicting this information so that responders are doubly aware of the potential for invasive species introduction via vessels and equipment brought from outside the response region.

An excerpt from the New York/New Jersey ESI introductory materials is included here as an example:

INVASIVE SPECIES

The spread of invasive or non-native species can degrade habitat, increase the potential for crop damage and diseases in humans, livestock and natural resources, reduce biodiversity through competition and limit recreational opportunities. Invasive species often opportunistically spread after disturbance events alter the natural landscape. Oil spill response and clean up often alters the landscape in a manner conducive to the spread of invasive species as crews often mobilize from all over the U.S. in response to large scale spill events.

Boats, trailers, waders and other fishing equipment can spread invasive species from waterbody to waterbody unless properly cleaned after use. Regulations prohibit boats from launching from or leaving DEC launch sites without first draining the boat and cleaning the boat, trailer and equipment of visible plant and animal material. Many New York counties, towns and villages also have laws in place that prohibit the transport of aquatic invasive species on boats, trailers and equipment.

Asiatic sand sedge and water chestnut are invasive species of particular concern to land managers in this AOI. Asiatic sand sedge is an exotic plant that threatens beaches and the rare species that rely on them such as seabeach amaranth and piping plover. It was recently discovered in New York on Staten Island and Long Island following Hurricane Sandy and a large effort is underway to eradicate it. Invasive plants can also form dense monocultures that could impede oil spill response. Water chestnut, an invasive floating aquatic plant found on the Hudson River, forms thick, impenetrable mats in June and July. Invasive species were not included in the maps as they are not priority resources for protection, but planners and responders should be aware of their presence and coordinate response activities with the appropriate invasive species coordinator and/or land manager to prevent the spread of these species.

Invasive Species Contacts:

- New Jersey Invasive Species Strike Team: http://www.njisst.org/
- New York Invasive Species Information: http://www.nyis.info/index.php

5.2.4 Generalized Processing Steps

The following steps address how to create and process human-use data for an atlas.

1. Using a study area polygonal boundary spatial dataset and Appendix D for a complete list of pertinent human-use resource types and visit state and federal GIS data repositories to first ascertain available data.
2. Contact state and federal resource experts to present collected data and also obtain data not readily available via online resources.
3. Process/compile collected data. Check for geometry errors, duplicate points, and other inherent issues within the data and assign attribution. Match polygonal boundaries to the ESI feature dataset and to other datasets within that feature dataset. Input the associated tabular information into the SOC_DAT data table.
4. Meet with resource experts to review compiled and processed data. Correct identified errors, add/remove data, or other steps to ensure accuracy and currentness of the information.
5. Repeat the above steps to ensure data are congruent.
6. Perform a check to confirm that all records in the spatial data are represented in the SOC_DAT data table and vice versa.
7. In preparation for atlas delivery, perform quality assurance/quality control measures (see Chapter 6).

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CHAPTER 6

Database Compilation & Quality Control Procedures for ESI Data Deliverables to NOAA

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6 ESI Data Deliverables to NOAA - Database Compilation and Quality Control Procedures

6.1 Introduction

Once the raw data are collected and evaluated for inclusion in the final database, compilation and Quality Assurance/Quality Control (QA/QC) measures are performed to ensure the final product conforms to the ESI data standard. This section is intended to give an overview of the compilation and QA/QC process with the understanding that there are many ways to compile data that will meet the standards outlined in the ESI data dictionary. Best practices, as well as common errors, are covered here to ensure that contractor deliveries meet the ESI data quality standards, and that the final databases are free of topology and attribution errors. This will ensure the data are compatible with ESI tools used to generate secondary ESI products, as well as with NOAA's Environmental Response Management Application (ERMA), used to serve spatial data to the response community.

6.1.1 ESI Database Structure

The ESI database contains three feature datasets, each with multiple feature classes of varying feature types (points, lines, and polygons, inclusion of any or all of these feature types will vary by atlas), and the relational tables that provide attribution (see **Figure 6.1**). During data collection and evaluation, data may have been stored and assessed in varying formats. The next step is to compile all the data into the final ESI database schema for delivery. The ESI Data Dictionary (*Appendix B*) and the ESI Data Table Entity Relationship diagram (*Appendix C*) outlines naming conventions, appropriate feature types, and field types and properties. The schema should be reviewed to ensure the final ESI database conforms to these standards. It is suggested that shell data schemas be utilized and the finalized data are appended into these shells ensuring the appropriate fields, ordering, and field types are retained in the final delivery.

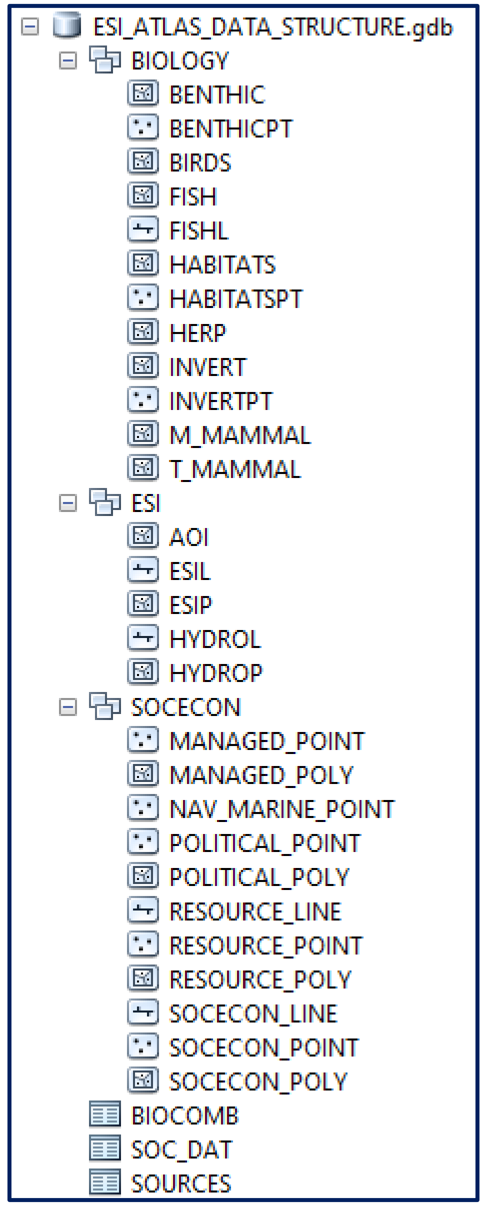

Figure 6.1: ESI feature classes and attribute tables.

In addition to delivering the final ESI dataset following the schema shown, the ESI master species list will accompany the final deliverable in Microsoft Excel format. The ESI contractor should request a copy of the master species list from the ESI Program Manager. A brief description of the master species list spreadsheet is shown in **Table 6.1**.

Table 6.1: ESI master species list spreadsheet format and attributes.

Field Name	Storage	Sample Values
SPECIES_ID	Long	76
NAME	Text (35)	Bald eagle
GEN_SPEC	Text (45)	Haliaeetus leucocephalus
ELEMENT	Text (10)	BIRD
SUBELEMENT	Text (10)	raptor
GRANK	Text (8)	G5
GRANKDATE	Long	201703
EL_SPE	Text (6)	B00076

6.2 Feature Dataset Compilation

6.2.1 Base Layers – Shoreline Compilation

The following process assumes that, up to this point, all of the shoreline data (features and attribution) are stored in four feature classes – **ESIL**, **ESIP**, **HYDROL**, and **HYDROP**.

The final ESI data delivery schema dictates that the attribution for the shoreline features is held in the attribute tables of each feature class. The required fields and acceptable values for the attribute tables of each feature class can be found in Appendix B in the ESI Data Dictionary.

The **ESIL**, **ESIP**, and **HYDROL** feature classes contain the field SOURCE_ID, which is linked to the **SOURCES** table. SOURCE_ID in these feature classes identifies the vector, raster, or other source used to create the line or polygon for the corresponding feature. **ESIL** and **ESIP** also contain the key field, ESI_SOURCE. The ESI_SOURCE links to the **SOURCES** table where information, regarding the source used to classify each ESI line segment or polygon, resides.

Each feature class is evaluated for topological soundness (and corrected as needed), then dissolved on the appropriate fields to aggregate adjacent lines or polygons with identical attributes. Finally, a check is performed to ensure that all ESI lines are oriented in the same direction, with land on the right side and water on the left.

6.2.2 SOCECON – Human-use Data Compilation

The following outlines one approach to human-use data compilation. Although another compilation method may be chosen, this guidance should be useful for identifying requirements and pitfalls. This approach assumes that, to this point, all the socio-economic data (features and attribution) are being stored in three feature classes, one each for points, lines, and polygons organized by type.

The final ESI data schema dictates that the attribution for human-use features is held primarily within the **SOC_DAT** table. Related source information resides in the **SOURCES** table, which is linked via

SOURCE_ID to the **SOC_DAT** table. Each human-use feature has a unique numerical attribute, HUNUM (Human Use NUMber), which links the feature to the **SOC_DAT** table. Assuming interim human-use data were stored by feature type alone during data collection, an integer field called HUNUM should be added to the attribute table. To populate HUNUM, a *find identical* operation can be performed to evaluate which attribution is identical for more than one feature. The *find identical* value is then added to the assigned atlas id (see Appendix F) * 100,000 to generate the final HUNUM. More information on HUNUM can be found in Section 5.1.2.

Once the HUNUM value is created, the contractor can port all the attributes, including the HUNUM, to the SOC_DAT table. Note that the TYPE field in the human-use feature classes is an abbreviated form of the TYPE field in the SOC_DAT table. Appropriate values for these fields are listed in the ESI Data Dictionary, Appendix B. When information held within the SOC_DAT table describes more than one feature in the human-use feature classes, the result is a one-to-many relationship between SOC_DAT and the feature classes.

Features within the SOCECON feature dataset are allowed to overlap so, assuming the requisite edge-matching and topological checks were completed on the raw data (see Section 5.2.3), this step requires minimal work to format into the final delivery schema. The main task is comprised of organizing the features into the appropriate feature classes and linking the features to the SOC_DAT table. Features are grouped by the type of resource they represent (navigation or marine features = NAV_MARINE, political/jurisdictional features = POLITICAL, etc.), and by the feature type used to represent the feature (points, lines, or polygons).

6.2.3 Biology Data Compilation

There are multiple approaches to the biology compilation that can result in an ESI compliant data deliverable. The following method assumes that, up to this point, all the biological data (features and attribution) were stored by ELEMENT and feature class type - one each for points, lines, and polygons.

The final ESI data delivery schema dictates that the attribution for BIOLOGY features is mainly held within the table named **BIOCOMB**. A unique numerical attribute, the RARNUM (Resource At Risk NUMber), is used to link features to the **BIOCOMB** table. The ESI Data Dictionary (Appendix B), and the flow diagram of the table structures and relationships (Appendix C) illustrate the final data construct. The source information is held within the **SOURCES** table and is linked via a SOURCE_ID (G_SOURCE for geographic source) from the **BIOCOMB** table.

As with the SOCECON feature datasets, biology polygons features allow overlapping polygon data. This assumes that edge-matching and topological checks were completed. Furthermore, the biological resources should share coincident lines with the ESI base layers where appropriate.

When information within the **BIOCOMB** table is used to describe one or more features in a biological feature class, the result is a many-to-many relationship, since a single RARNUM typically represents more than one species and/or set of attributes.

6.3 Minimum Mapping Unit – Application to Biological and Human-use Features

Although the ESI is provided to the end user in a digital geodatabase, the presentation of the data on the final PDF maps and printed atlases must also be considered when compiling at risk resource data. ESI databases and maps include point, line, and polygon features that are compiled from a variety of sources. When depicted on the PDF and printed atlas products, the symbology of the points and lines are dynamically adjusted to ensure visibility and proper display at the scale of the map. This is not the case for polygon features. A minimum mapping unit (MMU) threshold, no longer a requirement, can help ensure that polygons are shown at a target map scale and provides a standard for the smallest feature that should be included in the geodatabase. There are cases when the MMU is too large for a specific resource. In this case the MMU may be set by the resource data provider. Additionally, if the data are to be displayed digitally and maps will not be printed the MMU may not apply. These decisions will be determined by the contractor in close collaboration with NOAA.

In general, the diameter, in meters, of the smallest discernible feature on a map is equal to half of the thousands unit of the map scale (see https://www.esri.com/arcgis-blog/products/product/imagery/on-map-scale-and-raster-resolution/). If the MMU is established according to these guidelines, it would equal 12.5 meters at 1:25,000 scale, 25 meters at 1:50,000 scale and 50 meters at 1:100,000 scale (see **Table 6.2**).

Table 6.2: Sample MMU, buffer, and area (circular buffer of a point feature) for varying map scales.

Scale	MMU (meters)	Buffer (meters)	Area (meters)
1:25,000	12.5	6.25	~125
1:50,000	25	12.5	~500
1:100,000	50	25	~2000

Features can be mapped below the MMU threshold and should be evaluated for accuracy. If appropriate, features can be buffered or merged with adjacent polygons to meet the MMU threshold. This will ensure that all sensitive resources are displayed in the atlas products. If a point feature is to be converted to an ESI polygon, it should be buffered by at least half of the MMU in order to ensure it will be displayed.

Understanding how small features are introduced into the dataset is important. There are three primary ways this can happen: 1) direct inclusion of small source features; 2) masking or converting a point or line feature (feature type conversion) by using a buffer smaller than the desired MMU; and 3) when biological and/or human-use features are clipped to features in the ESI feature dataset (e.g., clipping features to a land or ESI habitat polygon, smaller than the MMU).

Small Source Features - Depending on the resource depicted and the accuracy of the locational data, direct inclusion of small source features, without manipulation to increase size, might result in the introduction of features smaller than the minimum mapping unit. For example, sensitive plant locations, including submerged aquatic vegetation, are often surveyed or captured using remote sensing techniques. These features are highly accurate in their locational representation and, when patchy or small in nature, such as conversion from a raster to a polygonal representation, the source features used to represent these at-risk resources may be as small as 10 square meters. Similarly, nesting locations of birds and reptiles are often surveyed, and locations can be highly accurate. If these source features are delivered as polygons, they often will be small in nature and will need to be converted to points or buffered to ensure they are represented on the map products.

Feature Type Conversion – At times it may be appropriate to convert data delivered as points or lines to polygons. This may be to ensure that an entire life event is captured in one layer (fish runs represented as lines in the original data) or because there is a request to obscure the exact location of a sensitive resource. Buffering a line or point feature is the most common conversion method to create a polygon feature. Consideration of the final map scale in which the data will be displayed is essential to ensure that a feature below the MMU is not introduced into the ESI geodatabase.

Clipping to ESI Features – When biological or human-use features represent resources restricted to land, it is common practice to clip these features to the HYDROP feature class. Likewise, features may be mapped to habitats found in the ESIP feature class. This can result in land/habitat features being mapped to polygons below the MMU, for example on small marsh islands in back bays. These features, although accurate based on the shoreline products, are too small to be visible on the map products. This is usually not an issue as features clipped to land and habitat are, often, wide ranging and the at-risk resource will be represented on the map on the land features that exceed the MMU.

Eliminating polygon features smaller than the MMU is left to the discretion of the data compiler and/or with input from the resource data provider. Some smaller features that represent legitimate habitat or species' occurrences may be preserved in the geodatabase, with the knowledge that these features may not be visible in map products but can be utilized as a digital product for analysis. All polygons falling below the MMU should be reviewed by the contractor, with confirmation that the small polygons were intentional, and that they should not be deleted in the preparation of the final database.

6.4 Quality Assurance and Quality Control Procedures

Quality assurance/quality control (QA/QC) procedures should be performed by the contractor prior to delivery to NOAA. These steps check for completeness and consistency of the data and should be performed after the data have been fully compiled and attributed in compliance with ESI data structure. Once delivered to NOAA, additional QA procedures will be performed.

The time required to complete the pre-delivery QA/QC checks on an ESI database typically ranges from a few days to more than a week depending on the complexity and overall volume of data. The contractor QA/QC protocols can be divided into three main tasks: 1) Assessing accurate feature geometry and topology; 2) Evaluating tabular data attribution; and 3) Generating the final geodatabase for delivery. Common data quality checks, and validation errors associated with each, are outlined below.

6.4.1 Assessing Feature Geometry

Geometry

Features should be evaluated for errors such as null or non-simple geometries. This includes topological errors such as illegal vector intersections or overlaps and spatial rule inconsistencies or violations. If detected, invalid geometries must be corrected. This may be done manually or programmatically with the aid of various GIS tools.

Checks should be performed for duplicate geometries. When found, the appropriate action will depend on the feature class and the associated attributes. Duplicate features in the *biological feature classes* may, 1) share identical attributes, or 2) have varying attributes. In the first case, all but one of the features should be removed. In the second case, varying attributes of the overlapping features should be evaluated and further compiled as necessary, given that overlapping polygons are accepted in the biology feature classes. Duplicate, overlapping geometries are allowed in *biological feature classes*, but there should not be duplicates with the same attribution. Duplicate, overlapping geometries are allowed in *socioeconomic feature classes*, but there should not be duplicates with the same attribution.

Inherent and Operational Feature Error

During data compilation and processing, uncertainty inherent to the source data (e.g., modeled vs. direct observation data) should be taken into consideration and documented in the metadata. Operational errors introduced in the processing and compilations phases, (see **Figure 6.2**) must be corrected prior to finalizing the data. For example, it is essential that nonlinear segments in polyline or polygon features (such as arcs or curves) be corrected by densifying, or adding vertices, to ensure they have sufficient vertices to match the detail of other features in the dataset. Non-linear segments often result from processing “true curve” features (using ArcGIS Pro Buffer, Clip, Union. etc. tools to create new circles/ellipses) and cause features to perform erratically, resulting in geoprocessing failure or erroneous outputs. Best practices for handling “true-curves” can be found in Esri Technical Support (https://support.esri.com/en-us/knowledge-base/faq-what-are-the-best-practices-to-remove-true-curves-f-000021740). On the other hand, features should also be checked for excessive complexity by ensuring that redundant or extraneous vertices are removed. For example, linear data are often delivered with segmented lines. Unless individual segments are attributed differently, these segments should be dissolved to generate a single, continuous line.

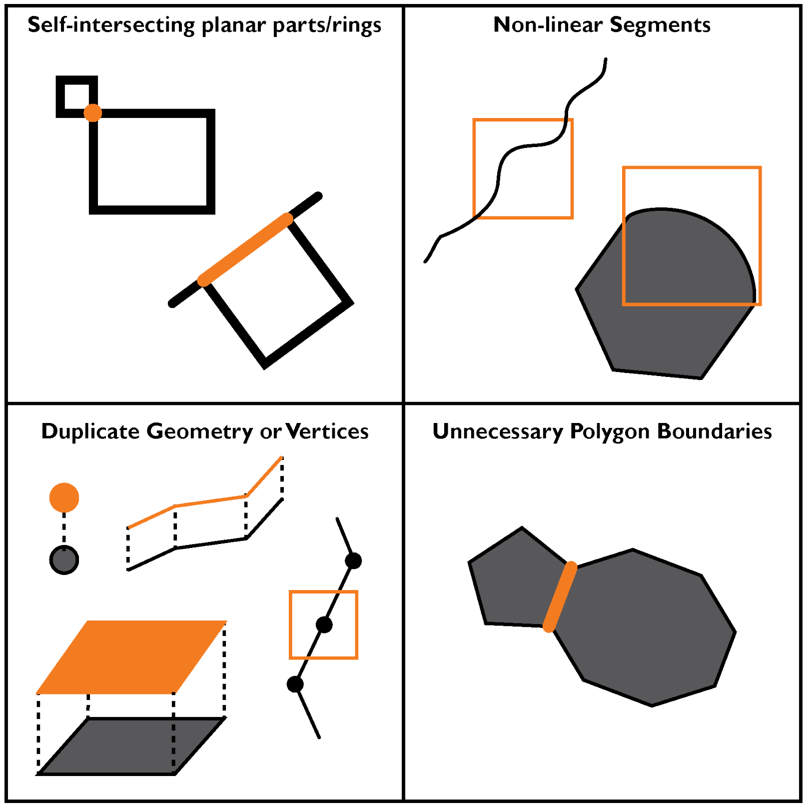

Figure 6.2: Examples of invalid non-simple geometries.

ESI Line (*ESIL*) features are checked for operational errors by ensuring coincident arcs and computing a geometric intersection with the *HYDROP* feature class land and water polygons. Spatial relationships can then be assessed to check for consistency in the "from-to" line direction. Lines should be digitized to follow the convention "water on the left; land on the right" to prevent errors in landward/seaward representation in the symbology (**Figure 6.3**).

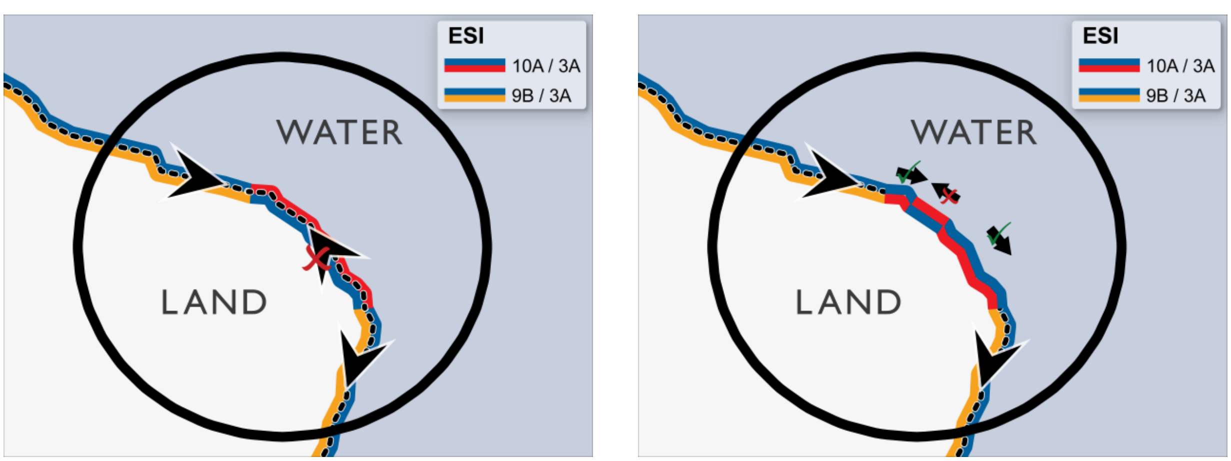

Figure 6.3: The effect of line direction on shoreline symbolization.

Any ESI lines, or parts of lines, with water on the right and land on the left will require the "from-to" direction to be "flipped", or reversed, so that the last vertex becomes the first. Figure 6.3 shows an example of an incorrect line (on left), or line segment (on right), direction. All ESI lines attributed with LINE = 'S' should be checked to ensure line digitization follows convention. Visual spot checks can be performed by symbolizing the shorelines using arrowheads to view the orientation of the lines.

A different error type will result if any ESI line segments have not been properly clipped to the HYDRO layer. Any ESI segment, attributed with LINE = 'S', that has either land or water on both sides has either not been properly clipped to the HYDRO layer or is incorrectly attributed. All ESI shoreline segments must be congruent with the lines in the HYDRO layers.

Edge-Matching, Slivers – Underlaps and Overlaps

All features should be clipped to the regional area of interest (AOI) polygon. Biological and human-use land- or water-only features should be clipped to the appropriate HYDROP features. In general, adjacent features should share boundaries; overlapping, "near adjacent" polygons may result in nonsensical slivers. Feature alignment must be evaluated to ensure that any overlaps (hatched, **Figure 6.4**) or underlaps (black, Figure 6.4) along adjacent polygon boundaries were not introduced in error. Polygon gaps, where space exists between adjacent features, may indicate a topology problem. This error is common when features are integrated into the ESI database without first checking for congruency with the shoreline. Potential artifacts can be assessed by computing a geometric union within the feature class, without allowing underlaps. The resultant features should be evaluated to determine if the underlap should be assimilated into an adjacent polygon, or if they reflect the original intent.

Decoupling the ESIL (ESI Line) and ESIP (ESI Polygon) layers reduces the need to mitigate underlaps when creating these feature classes. The ESIP layer should be clipped with the water polygon in the HYDROP layer to eliminate overlaps. Underlaps resulting from this process do not need to be mitigated.

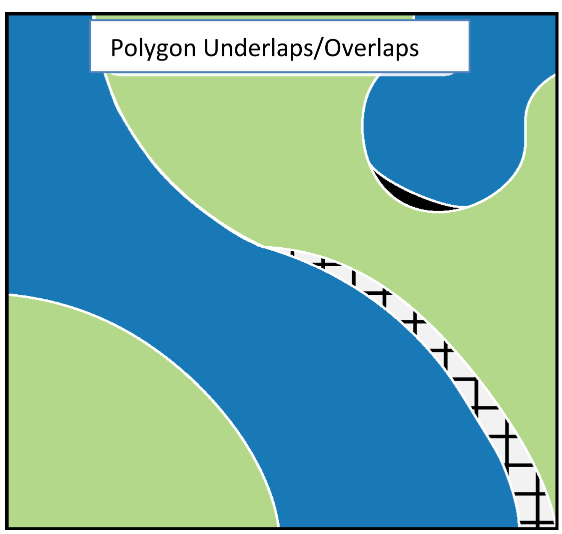

Figure 6.4: Slivers, underlaps, and overlaps.

Sliver polygons, resulting from overlaps or underlaps between adjacent features, can also be introduced when creating or editing features. Although they may be a legitimate result of the overlay, they present topology problems in features intended to edgematch. Slivers are assessed in terms of the thinness, or regularity, of an object, using an area-perimeter calculation expressed as the ratio (*T*) comparing the feature area (*A*) and perimeter (*P*):

$$T = 4\pi * (\frac{A}{P^2})$$

Small polygons with a low thinness ratio value should be manually reviewed to ensure the polygon is not an unintended sliver. These polygons should be merged with the appropriate adjacent feature.

Dangles (**Figure 6.5**) occur when an orphaned node on either end of a line does not connect to an adjacent feature. These errors are often introduced when lines are digitized without setting the appropriate snapping environments. Offending features should be assessed using appropriate tolerance criteria to ensure dangles are only present where allowed (e.g., streams, breakwaters, groins, etc.).

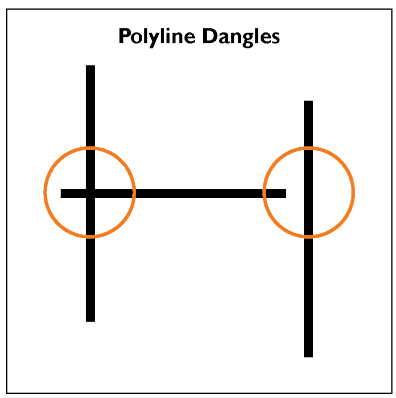

Figure 6.5: Example of polyline dangles.

6.4.2 Evaluation of Tabular Data Attribution

Data Structure
Check that field naming, formatting, and ordering conventions are followed consistently and that the associated properties for each field, such as type or length (if applicable), match the ESI data schema exactly. Scripts, tools, and schemas can be used to ensure compliance.

Content of Fields
Values assigned to the attribute fields must conform to the ESI data standards, including the data type and range of acceptable values. Complete guidance is presented in the ESI Data Dictionary Appendix B, as well as in the diagram of the ESI data schema in Appendix C.

Any "Null" values should be converted to empty/blank values in text fields or set to zero in numerical fields. In addition, ensure that regional (RARNUM, HUNUM) identifiers assigned during data finalization are formatted according to convention. All **BIOCOMB** table records should link through the RARNUM to the related BIOLOGY feature classes and secondary to the **SOURCES** tables on the appropriate "Source_ID" attribute. Similarly, all **SOC_DAT** table records should link through HUNUM to the related SOCECON feature classes and secondary links to the **SOURCES** table must be established on the appropriate "Source_ID" attribute. Any orphaned features or records should be assessed and corrected. Jurisdictional features and attribution in the **SOC_DAT** table should be evaluated to ensure all relevant U.S. Coast Guard District and Sector information is included. Any discrepancies or omissions should be resolved prior to data delivery. See **Table 6.3** for standard checks to perform on the data table fields and values.

Table 6.3: Checks for proper field values.

Field	Description
CONC	Reduce complexity where appropriate. Both qualitative and quantitative values should be reviewed for consistency (med vs medium, 10s vs 10's). Remove leading, trailing, or errant spaces and ensure records intended to be left blank are populated with a hyphen ("-")
BREED	Review for completeness and accuracy. Ensure that all months when breed categories are occurring are reflected in the *JAN* to *DEC* monthly seasonality fields. Review breed category fields (refer to Table 4.3 in Chapter 4) to ensure values are logical and conform to the required format.
S (State) or F (Federal) Status	Ensure that status and GRANK are up-to-date and accurate. If compiling data for an ESI region that spans state boundaries, ensure that each state status is accurately captured and attributed appropriately.
Sources	Ensure that all records in the BIOCOMB and SOC_DAT tables link to a record in the SOURCES table. Likewise, all feature classes in the ESI feature dataset (with the exception of HYDROP) should have *SOUCRCE_ID*s linking to the SOURCES table. Ensure the fields in the SOURCES table are populated accurately and consistently, for example vector digital data vs. digital vector data, "US FISH AND WILDLIFE SERVICE" vs. "USFWS".

6.4.3 Generating the ESI Geodatabase and Finalizing Data for Delivery

During database finalization, the structure and schema of all components within the geodatabase should be reviewed. The organization and content should follow the ESI data schema exactly. Check each of the following:

1) All feature classes and layer names match the standardized naming convention outlined in the ESI Data Dictionary (Appendix B).

2) All feature attribute tables have the appropriate fields, that the fields are in the order listed in the ESI data dictionary, the fields are properly named and typed, and all fields are appropriately populated with legal values.
3) All feature classes reside within the appropriate feature dataset.
4) The source data are unprojected, using GCS North American 1983, Unit: Degrees, WKID (well-known ID)/Factory Code: 4269, Authority: EPSG.
5) The Atlas ID number has been properly incorporated into the RARNUMs and HUNUMs.

The final ESI geodatabase should be reviewed for strict adherence to the physical database structure and logical schema established in the ESI data dictionary and outlined in this document. The ESI database name must be pre-approved by the ESI Program Manager, and the ESI Atlas number must be obtained from NOAA. A "shell" geodatabase comprising all possible feature datasets, feature classes, and tables can be created according to the accepted schema to prevent simple schema mistakes. For final delivery, data that have passed the QA/QC checks can be appended into the appropriate template feature class or table by mapping the intermediate input fields to template output fields to ensure adherence to structural and schematic conventions. In this way, the finalized data are assured to be organized, validated, and delivered in full compliance with ESI data schema.

The ESI data are now ready for delivery to NOAA where additional checks and rechecks will be performed. An ArcGIS Pro Project will contain the symbolized ESI data, and the relational links for all tables will be defined. The final data are posted to NOAA's Office of Response and Restoration website for public download. (https://response.restoration.noaa.gov/esi_download).

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CHAPTER 7

ESI Metadata

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7 Creating ESI Metadata

7.1 Background

Thorough metadata records are essential to maximize the user's ability to navigate and interpret the ESI GIS data. Metadata helps the user by providing detailed and structured information on the "what, where, when, how, who, and why" of each component of an ESI geodatabase. The descriptive content of a metadata record helps users identify, assess, and access ESI data. All ESI atlases published to date have included metadata in some form. The standards for publishing metadata documents have evolved over time as various metadata content standards have been created, reviewed, and nationally and internationally accepted.

Metadata have been required for all publicly available geospatial data from Federal sources since 1994, when the National Spatial Data Infrastructure (NSDI) was established by Executive Order 12906 (The White House 1994). The Federal Geographic Data Committee (FGDC) published metadata guidelines in 1998, known as the Content Standard for Digital Geospatial Metadata or CSDGM (FGDC 1998). ESI metadata have been developed and published following these guidelines from 1998 to 2016. For example, the Long Island-2009 ESI products include PDF map files, a Geodatabase and ArcGIS Map Document, and metadata records in several common formats (e.g., xml, html) for each of the ESI elements (HYDRO, ESI, SOCECON, all Biology elements) (NOAA/ORR 2017). These metadata records were all crafted using the FGDC-STD-001-1998 standard, and they are part of the ESI data package.

The following discussions make reference to both the FGDC/CSDGM and ISO metadata standards. It should be noted that the FGDC standard has been used historically for the ESI products. As for the publication of these guidelines, **all new ESI metadata must comply with the ISO standard**. References to FGDC content is solely for background and comparison purposes.

7.2 Metadata Standards

NOAA and other Federal agencies adopted an internationally recognized metadata standard developed by the International Organization for Standardization (ISO) (NOAA/NCDDC 2012). Development of the ISO Standard 19115 began in 1999 to reconcile different metadata standards used by different organizations and nations. The ISO 19115: Geographic Information - Metadata standard includes many of the same elements of the FGDC-CSDGM standard, but allows for greater flexibility, such as tiered (parent/child) relationships between metadata records, standardized descriptors through codesets, and accommodates new technologies (e.g., map services) and international scope (NOAA/NCDDC 2012). The original ISO 19115 standard was finalized in 2003, endorsed by the FGDC in 2010 (OMB 2010; FGDC 2011), and adopted by NOAA as a Procedural Directive in 2011 (NOAA/EDMC 2011). Since then, NOAA has developed tools and guidance to support the new ISO standard, while also maintaining compatibility with the older FGDC/CSDGM standard and offering crosswalks between the two formats.

Building upon ISO 19115, NOAA also uses ISO 19115-2, an extension of the core standard that includes specialized elements for documenting gridded and imagery datasets, sensor and platform metadata, and data acquisition details—areas not fully addressed by the original standard. In 2019, ISO released an updated version of the standard, ISO 19115-1:2014 and ISO 19115-2:2019, which together provide a more comprehensive and modern framework for geospatial metadata. NOAA's metadata practices incorporate both parts to support a wide range of environmental and geospatial data holdings, particularly where sensor-based, satellite, or remotely sensed data are involved.

Most elements captured in the FGDC/CSDGM format are also represented in the ISO standard, but information is recorded in different places in the metadata record, and the overall organization of the metadata records differ between the two formats. The FGDC has developed an ISO-FGDC Metadata Crosswalk document (FGDC 2009) and other helpful resources (FGDC 2014; 2015) to support this transition. FGDC, together with Federal agencies and stakeholders, are continuing to work together to develop guidance for adopting the ISO standard and enhancing user creation of quality metadata records for their geospatial data (FGDC 2017).

In the earlier FGDC-CSDGM standard, many of the details of a GIS layer and associated tables were recorded in a section titled "Entity and Attribute Information." The CSDGM standard allowed only one geometry type (e.g., points OR lines OR polygons) per metadata record. Under the ISO-19115 standard, each feature class (or layer) and associated tables are considered as Entities or "Child Items" within the hierarchical "Parent" metadata record. This structure enables documentation of multiple feature types (e.g., points AND/OR lines AND/OR polygons) and the inclusion of entity-specific attribute details within a nested metadata framework.

7.3 Metadata Tools

Metadata records can be produced in a variety of formats, including text, html, and xml. Although there are a variety of software packages to assist with metadata development, when developing metadata to either the CSDGM or ISO standards, it is much easier and more efficient to use tools that have been developed specifically for these formats. The NOAA ESI team adopted an official metadata catalog known as InPort[1], which supports the new ISO standard and provides retro-compatibility with the FGDC/CSDGM standard. In 2016, all existing ESI metadata in the FGDC/CSDGM format were exported from their previous host application to InPort. This system offers a user-friendly means of creating and editing metadata records, and NOAA's ESI program expects that InPort will remain its preferred platform for metadata development for the foreseeable future. InPort's input interface simplifies the complex ISO metadata section sequence, allowing the author to focus on content rather than require expertise in ISO xml schema. You can then readily export a metadata record to text, html, and/or xml which adheres to the ISO-19115 format.

7.4 ESI Metadata Process and NOAA Requirements

The NOAA ESI metadata products should reflect the data as they are delivered to the public. The geographic themes (Feature Datasets and Feature Classes) and associated related tables (BIOCOMB, SOC_DAT, and SOURCES) should be described in the metadata. See Appendix C for a graphic of the NOAA ESI Data structure.

[1] InPort (Information Portal) was developed by the Fisheries Information System (FIS) to give NOAA Fisheries, the National Ocean Service (NOS), and its partners the capability to catalog and search data holdings.

The final object counts for the NOAA deliverable also need to be represented in the metadata. For this reason, delivery of the *final* metadata to NOAA may require editing and completion following the NOAA QA/QC and compilation of the ESI GIS data for public distribution. The processing time required by NOAA is generally 2-4 weeks, assuming the ESI data themselves are complete and compliant with the ESI requirements and structure.

NOAA acceptance of the metadata deliverable necessitates a completed record for each ESI feature class be published in InPort, and exported and delivered to NOAA in text, html and xml formats. Metadata development should be done in parallel with data acquisition and compilation. The final “revisit” of the metadata, after NOAA QA/QC and approval, should require minimal effort to update (or verify) object counts and numeric ranges that may change slightly during the QA/QC process. This revisit also provides an opportunity for the contractor to review and comment on the final ESI GIS product, prior to posting.

7.5 ESI Metadata Templates

Contractors developing ESI content for NOAA will be able to access InPort after requesting log-in and password information from the ESI Program Manager, and approval from InPort administrative staff. There will also be individuals available to help with questions regarding InPort navigation and the general ESI metadata process. Unfortunately, it is not possible to grant access to InPort for those developing ESI data outside of the NOAA program. However, the sample templates and associated metadata instructions (Appendix J) should help all users in developing ISO compliant metadata.

The NOAA ESI team has developed a set of templates in InPort to help with creation of ISO-compliant metadata records for all layers within the ESI Geodatabase. These can be copied and edited to develop new metadata records in InPort, or they can be exported as xml documents to be edited in other applications or platforms. Entities or “Child Items” should be added for each geometry type covered in the metadata record, as well as for each associated data table.

HYDRO Metadata Template: This template can be modified to create a single metadata record for the HYDRO line and polygon feature classes in the ESI geodatabase. Combining multiple geometry types (e.g., lines and polygons) in a single metadata record is accomplished in InPort by including each geography feature class as a distinct “Child Item” or Entity within the metadata record. In this case, the HYDRO metadata record would include “Child Items” or Entities for HYDROL and HYDROP, as well as for the data table SOURCES. Other elements of the metadata record such as Abstract, Spatial Information, and Lineage must be crafted to reflect the multiple geometry types.

ESI Metadata Template: This template can be modified to create a metadata record for the ESI line (classified shoreline) and polygon feature classes in the ESI Feature Dataset. In this case, the ESI metadata record would include “Child Items” or Entities for ESIL, ESIP, and SOURCES. As with the HYDRO metadata record, descriptions in the primary metadata record must be written to reflect the multiple geometry types.

BIOLOGY Metadata Template: This template can be modified to create a metadata record for each of the ESI Biological Elements, including BIRDS, FISH, INVERTS, HERPS, HABITATS, BENTHIC, M_MAMMALS, T_MAMMALS. A single metadata record can include layers containing points, lines, and/or polygons, by including a “Child Item” or Entity for each geography layer. For example, a metadata record for the ESI BIOLOGY element BIRDS represented by both polygon and point features would include Child Items or Entities for BIRDS and BIRDPT, as well as for the tables BIOCOMB and SOURCES.

Human-Use Metadata Templates: These templates can be modified to create a metadata record for each of the Human-Use ESI Feature classes, including NAVIGATION/MARINE, PARKS/MANAGED AREAS, POLITICAL/JURISDICTIONAL, RESOURCE MANAGEMENT, and SOCECON. A single metadata record can include feature classes containing points, lines, and/or polygons, by including a Child Item or Entity for each feature layer. For example, a metadata record for the ESI Human-Use element NAVIGATION/MARINE, represented by polygons, lines, and points, would include Child Items or Entities for NAV_MARINE_POLYS, NAV_MARINE_LINES, NAV_MARINE_POINTS, SOC_DAT, and SOURCES.

7.6 Step-by-step Guidance for Development of ESI Metadata

Appendix J contains a table outlining the development of ESI metadata using the InPort platform. Those developing ESIs outside of NOAA may still benefit from these guidelines, which capture content suggestions applicable to most any metadata application, particularly those that target the ISO 19115/-2 metadata standard.

CHAPTER 8

ESI References

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8 ESI References

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APPENDIX A

ESI Biological Elements and Subelements

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APPENDIX A: ESI BIOLOGICAL ELEMENTS AND SUBELEMENTS

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
BENTHIC			
Benthic	algae	Algal beds, important species	Areas of intertidal, subtidal, or pelagic algae may be mapped if identified as an important benthic habitat. Pelagic *Sargassum* is assigned the subelement 'algae'.
Benthic	coral	Living, reef-building coral areas, rare species	Corals are important habitats and may be mapped as groups, reef types, or species. Some corals have special conservation status (e.g., ESA listed species).
Benthic	hardbottom	Known distributions of colonized or uncolonized hard substrate	Areas that are not living coral reef but provide hard bottom substrate that may or may not be colonized by sponges, algae, and/or corals.
Benthic	kelp	Beds or forests of kelp	Areas of kelp that are well-established.
Benthic	reef	Hardened substrate of unspecified relief formed by reef building corals and other organisms	Includes areas that are not living coral reef, but provide substrate that may be colonized by sponges, algae, corals, or oysters.
Benthic	sav	Submerged aquatic vegetation	Seagrass and other submerged aquatic vegetation are important subtidal habitats and are often mapped as polygons representing the dominant species in an area (e.g., eelgrass). SAV may be mapped as a group of species, e.g., "seagrass".
Benthic	softbottom	Areas where the seabed consists of fine-grained sediments (mud and sand)	Unconsolidated sediments may be mapped if critical to species using certain benthic habitat types in certain atlases. Use of this subelement is rare.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
BIRD			
Bird	alcid	Rookeries, wintering/rafting areas, other concentration areas	Occur in offshore waters and on islands or cliffs where they nest.
Bird	bird	Threatened, endangered, or rare occurrences; nesting sites	Endangered, threatened or rare birds that rely on coastal habitats are included, especially if nesting occurs in the area; 'bird' may be assigned as a subelement if common name is masked due to sensitivity.
Bird	diving	Rookeries, feeding/ wintering areas, other concentration areas	Typically shown in nearshore areas along shorelines and on tidal flats, islands, and in sheltered bays, estuaries, lagoons, etc.
Bird	gulls and terns	Nesting sites, other concentration areas	Usually shown as buffers along shorelines and on tidal flats, islands, and in sheltered bays, estuaries, lagoons, etc.
Bird	landfowl	Threatened, endangered, or rare occurrences; nesting sites; other concentration areas	Occur in terrestrial areas, sometimes in and around wetlands; typically, only map ESA or State listed species of landfowl.
Bird	passerine	Threatened, endangered, or rare occurrences; nesting sites; other concentration areas	Endangered, threatened or rare passerines that rely on coastal or wetland habitats are included when appropriate, especially if nesting occurs in the area.
Bird	pelagic	Rookeries; feeding, roosting, rafting, or other concentration areas	Occur in offshore waters and on islands or cliffs where they nest.
Bird	raptor	Nesting sites, migratory/feeding concentration areas	Occur along rivers, coastal shorelines, in wetlands, and in sheltered waters.
Bird	shorebird	Nesting sites, migratory stopover concentrations, other concentration areas	Typically mapped using a 100 m buffer (onshore and offshore) along sand and gravel beaches. They are also mapped on tidal flats and in wetland habitats.
Bird	wading	Rookeries, feeding, roosting, other concentration areas	Usually restricted to wetlands, tidal flats, tidal creeks, and the margins of sheltered waters (bays, estuaries, lagoons, sloughs).
Bird	waterfowl	Migratory and wintering areas, nesting sites, other concentration areas	Waterfowl (ducks and geese) are usually mapped in nearshore areas such as bays, estuaries, and lagoons, and are also commonly shown extending through salt, brackish, and fresh marshes, and into rivers. Some species groups such as sea ducks may be mapped further offshore.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
FISH*			
Fish	fish	Spawning and nursery areas; concentration areas; threatened, endangered or rare occurrences	All fish species, focusing on ecologically and/or economically important species, and species of special conservation concern. Many fish have life stages that use different habitats.

*All FISH subelements that were present in ESI Atlases published through 2025 have been collapsed into a single "fish" subelement. Previously used FISH subelements were "anadromous", "diadromous", "e_nursery", "e_resident", "freshwater", "m_benthic", "m_pelagic", and "m_resident". All fish subelements were collapsed into a single "fish" subelement to reduce unnecessary complexity in the ESI database and to resolve the issue of redundancy among subelements where multiple subelements may apply to a single species.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
HABITAT			
Habitat	fav	Floating aquatic vegetation	Species of high conservation concern or species that provide key habitat for aquatic fauna.
Habitat	plant	Special/rare plants, habitats, or communities	Listed species or species of high conservation concern. Includes all mapped terrestrial plant species.

*The HABITAT subelements "upland" and "wetland" were present in ESI Atlases published through 2025. These subelements have been removed as of the end of 2025 to reduce unnecessary complexity in the ESI database and to resolve the issue of redundancy among subelements where multiple subelements may apply to a single species.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
HERP			
Herp	alligator	Concentration areas, nesting areas, general distributions	Includes American alligator and American crocodile (which is ESA listed).
Herp	amphibian	Threatened, endangered, or rare occurrences	Aquatic/wetland concentrations of species of high conservation concern (e.g., mudpuppy).
Herp	frog	Threatened, endangered, or rare occurrences	Aquatic/wetland concentrations of species of conservation concern (e.g., California red-legged frog).
Herp	lizard	Threatened, endangered, or rare occurrences	Includes species of conservation concern (e.g., St. Croix ground lizard).
Herp	reptile	Threatened, endangered, or rare occurrences	Includes species of special conservation concern; 'reptile' may be assigned as a subelement if common name is masked due to sensitivity.
Herp	snake	Threatened, endangered, or rare occurrences	Include species of high conservation concern (e.g., eastern massasauga).
Herp	turtle	Nesting and concentration areas; threatened, endangered, or rare occurrence	Concentration areas (especially nesting) for marine, estuarine, aquatic, or wetland species; occurrences for upland species of conservation concern.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
INVERT*			
Invert	barnacle	Harvest areas, high concentrations	Includes ecologically and/or economically important species in estuarine or marine waters.
Invert	bivalve	Harvest areas; concentration areas; threatened, endangered, or rare occurrences	Includes ecologically important, fishery species, and listed species of clam, mussel, oyster, or scallop.
Invert	cephalopod	Harvest areas, high concentrations	Includes ecologically and/or economically important species of squid or octopus.
Invert	chordate	Harvest areas, high concentrations	Includes ecologically and/or economically important species in estuarine or marine waters.
Invert	crab	Harvest and nursery areas, high concentrations	Includes ecologically and/or economically important species of crab in estuarine or marine waters.
Invert	crayfish	Concentration areas; harvest areas; threatened, endangered, or rare occurrences	Includes ecologically and/or economically important crayfish species, and species with special conservation status.
Invert	echinoderm	Harvest areas, high concentrations	Includes ecologically and economically important species of sea stars, sea urchins, crinoids, sea cucumbers, and brittle/basket stars and species of conservation concern.
Invert	gastropod	Harvest areas; high concentrations; threatened, endangered, or rare occurrences	Includes ecologically and economically important species of snails, whelks, and abalone, some of which have special conservation status.
Invert	insect	Threatened, endangered, or rare occurrences	Threatened, endangered, or rare occurrences of select species (e.g., tiger beetles).
Invert	invert	Harvest areas; high concentrations; threatened, endangered, or rare occurrences	Includes ecologically and economically important and vulnerable species of inverts; also used when true subelement must be masked due to sensitivity of data.
Invert	lobster	Nursery, spawning, and harvest areas; general distributions	Includes ecologically and/or economically important species in estuarine or marine waters.
Invert	shrimp	Harvest and nursery areas, high concentrations, general distributions	Includes ecologically and/or economically important species in estuarine or marine waters.
Invert	worm	Harvest areas, concentration areas	Includes species that are harvested for subsistence, culturally valued, or of ecological or conservation concern.

*The INVERT subelement “shellfish” was present in ESI Atlases published through 2025. This subelement has been removed as of the end of 2025 to reduce unnecessary complexity in the ESI database and to resolve the issue of redundancy among subelements where multiple subelements may apply to a single species.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
M_MAMMAL			
Marine Mammal	dolphin	Concentration areas, migratory routes, residence areas	Known areas of concentration, calving, or migration for dolphins and porpoises in marine and estuarine waters. Includes listed species and/or species of high conservation concern. All marine mammals are protected under the Marine Mammal Protection Act (MMPA).
Marine Mammal	manatee	Concentration areas, cold weather refugia	Known areas of concentration and winter refugia; may be mapped in freshwater, estuarine and marine areas. West Indian manatee is an ESA listed species.
Marine Mammal	pinniped	Haul outs, pupping sites, concentration areas	Known concentration areas, haul outs, and pupping sites; may be mapped both in water and on land. Includes listed species and/or species of high conservation concern. All marine mammals are protected under the MMPA.
Marine Mammal	polar_bear	Concentration areas, denning concentrations	Known concentration and denning areas. May be mapped both in water and on land. Polar bear is an ESA listed species.
Marine Mammal	sea_otter	Concentration areas, breeding areas	Known concentration areas. May be mapped both in water and on land. Sea otters are ESA listed (population dependent) and protected under the MMPA.
Marine Mammal	whale	Migratory or other concentration areas	Known areas of concentration, calving, or migration may be mapped in marine waters. All marine mammals are protected under the MMPA.

Element	Subelement	Areas/Sites to be Mapped	Unique Characteristics
T_MAMMAL			
Terrestrial Mammal	bat	Colonies for threatened and endangered species	Known areas of colonies or concentrations for species of special conservation concern.
Terrestrial Mammal	bear	Foraging and denning areas	Intertidal feeding or aquatic/wetland concentrations; den locations.
Terrestrial Mammal	canine	Known occurrences or likely habitat associations	Threatened/endangered or rare species occurrences (e.g., red wolf).
Terrestrial Mammal	feline	Known occurrences or likely habitat associations	Threatened/endangered or rare species occurrences (e.g., Florida panther).
Terrestrial Mammal	sm_mammal	Known occurrences or likely habitat associations	Concentration areas for aquatic furbearers (e.g., river otters) or occurrences for species of special conservation concern occurrences (e.g., beach mice).
Terrestrial Mammal	ungulate	Migratory or other concentration areas; known occurrences	Known areas of concentration, migration or occurrence for species with special conservation status.

APPENDIX B

ESI Data Dictionary

Feature Layers, ESI Data Tables, Field Names, Descriptions, and Attribute Values

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APPENDIX B: ESI DATA DICTIONARY

Base Layers			
Geographic Themes	**Attribute Names**	**Description**	**Attribute Values**
ESIL (ESI LINES)	ESI (Text, 12 Characters)	Shoreline classification	Ranges from 1 through 10 with various combinations and qualifiers See pages B-19 and B-20 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute).
	LINE (Text, 2 Characters)	Geographic Feature	B = Breakwater D = Dock FN = Fender G = Glacier GR = Groin H = Hydrography J = Jetty P = Pier S = Shoreline
	ENVIR (Text, 1 Character)	Physiographic region	E = Estuarine L = Lacustrine R = Riverine
	MOST_SENSITIVE (Text, 4 Characters)	If multiple shoreline types appear in ESI classification, this field represents the highest value (most sensitive type); otherwise, it is the same value as the ESI field. This value is commonly used for symbolization	Ranges from 1 through 10 with various qualifiers.
	LANDWARD_SHORETYPE (Text, 60 Characters)	The alphanumeric representation and physical description of the first (or only) ESI type found in the ESI field	1A: Exposed, Rocky Shores 1B: Exposed, Solid Man-Made Structures Etc. See pages B-19 and B-20 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute).
	SEAWARD_SHORETYPE1 (Text, 60 Characters)	The alphanumeric representation and physical description of the second ESI type in the ESI field (if applicable)	Same as LANDWARD_SHORETYPE, above.

Base Layers ***cont'd***

Geographic Themes	Attribute Names	Description	Attribute Values
ESIL (ESI LINES) cont'd	**SEAWARD_SHORETYPE2 (Text, 60 Characters)**	**The alphanumeric representation and physical description of the third ESI type in the ESI field (if applicable)**	**Same as LANDWARD_SHORETYPE, above.**
	GENERAL_SYMBOL (Short Integer)	**This field is used for symbolizing the ESI shoreline based on a generalized classification scheme; if multiple generalized types occur, this will reflect the highest value**	**Ranges from 1-5** **See pages B-19 and B-20 for the ESI to GENERALIZED_ESI_TYPE crosswalk.**
	GENERALIZED_ESI_TYPE (Text, 180 Characters)	**The alphanumeric representation and physical description of the generalized ESI shoreline type**	**Singular or combination of Values below:** **1: Armored** **2: Rocky and Steep Shorelines (Bedrock/Sand/Clay)** **3: Beaches (Sand/Gravel)** **4: Flats (Mud/Sand)** **5: Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)** **See pages B-19 and B-20 for the ESI to GENERALIZED_ESI_TYPE crosswalk.** **Use a forward slash "/" without spaces to separate combinations of Values.**
	SOURCE_ID (Long Integer)	**Atlas ID + Source code for shoreline origination**	**Source codes for ESIL (prior to their concatenation to the Atlas ID) should be in the range of 1-100. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
	ESI_SOURCE (Long Integer)	**Atlas ID + Source code for shoreline classification**	**Source codes for ESIL (prior to their concatenation to the Atlas ID) should be in the range of 1-100. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
ESIP (ESI POLYS)	**ESI (Text, 12 Characters)**	**Habitat classification**	**2A, 5, 7, 9A, 9C (Flats)** **10A, 10B, 10C, 10D, and 10F (Marshes, Scrub-Shrub, and Mangroves)** **U = Unclassified holes** **See pages B-19 and B-20 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute).**

Base Layers ***cont'd***

Geographic Themes	Attribute Names	Description	Attribute Values
ESIP (ESI POLYS) cont'd	WATER_CODE (Text, 1 Character)	Land and water designations	L = Land W = Water
	ENVIR (Text, 1 Character)	Physiographic region	E = Estuarine L = Lacustrine P = Palustrine
	ESI_DESCRIPTION (Text, 60 Characters)	The alphanumeric representation and the physical description of the polygon's ESI type	7: Exposed Flats 9A: Sheltered Flats 10A: Salt and Brackish Water Marshes Etc. See pages B-19 and B-20 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute).
	SOURCE_ID (Long Integer)	Atlas ID + Source code for shoreline origination	Source codes for ESIP (prior to their concatenation to the Atlas ID) should be in the range of 1-100. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.
	ESI_SOURCE (Long Integer)	Atlas ID + Source code for habitat poly classification	Source codes for ESIP (prior to their concatenation to the Atlas ID) should be in the range of 1-100. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.
HYDROL (HYDRO LINES)	LINE (Text, 2 Characters)	Geographic feature	B = Breakwater D = Dock FN = Fender G = Glacier GR = Groin H = Hydrography J = Jetty P = Pier
	SOURCE_ID (Long Integer)	Atlas ID + Source code for shoreline origination	Source codes for HYDROL (prior to their concatenation to the Atlas ID) should be in the range of 1-100. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.
HYDROP (HYDRO POLYS)	WATER_CODE (Text, 1 Character)	Land and water designations	L = Land W = Water

Base Layers *cont'd*

Geographic Themes	Attribute Names	Description	Attribute Values
INDEX (POLYS) – maps	**TILE_NAME** **(Text, 32 Characters)**	**Map number**	**1-N: N = # maps in atlas**
	NAME **(Text, 255 Characters)**	**USGS Quad name OR descriptive name of region covered**	**Examples:** **USGS Quad Name: Cape Flattery/Makah Bay** **Descriptive name of region: Santa Rosa Beach, Florida**
	SCALE (Long Integer)	**Map production scale**	**For 11"x17" paper, various scales are used. Only scale denominators are entered.**
OR	**PAGE SIZE** **(Text, 11 Characters)**	**Hardcopy map size**	**Usually 11"x17"; inset maps vary. See metadata for a complete list of page sizes.**
	VIEW_PDF **(Text, 255 Characters)**	**VIEW_PDF (Text)**	**Pathname +atlas/region name + _ESI _ + TILE-NUMBER.PDF; if the number is less than 100, should pad with zeros as needed.** **example:** http://response.restoration.noa.gov/sites/default/files/esimaps/NorthernCalifornia_ESI_039.pdf
AOI (POLYS)– no maps	**NAME** **(Text, 255 Characters)**	**USGS Quad name OR descriptive name of region covered**	**Example:** **Descriptive name of region: South Carolina ESI**

Biology			
Geographic Themes	**Attribute Names**	**Description**	**Attribute Values**
BENTHIC (POLYS)	**RARNUM (Long Integer)**	**Direct link to BIOCOMB table**	**A 9-digit integer represents a unique combination of species, their seasonalities, concentrations, and their geographic source. This region's unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
BENTHICL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
BENTHICPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
BIRDS (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
BIRDSL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
BIRDSPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
FISH (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
FISHL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
FISHPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HABITATS (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HABITATSL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HABITATSPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HERP (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HERPL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
HERPPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
INVERT (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
INVERTL (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
INVERTPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
M_MAMMAL (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
M_MAML (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
M_MAMPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
T_MAMMAL (POLYS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
T_MAML (LINES)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	
T_MAMPT (POINTS)	**RARNUM (Long Integer)**	**Same as RARNUM in BENTHIC**	

Human-Use

Geographic Themes	Attribute Names	Description	Attribute Values
POLITICAL_POLY (POLYS)	**TYPE (Text, 4 Characters)**	**Code identifying a political or jurisdictional management feature that is mapped as a polygon** ***See pages B-23 to B-24 for additional information on the human-use feature grouping by type.** ***See pages B-25 to B-29 for the human-use type explanations.**	**CG = Coast Guard** **IB = International Boundary** **ST = State/State Border** **TL = Tribal Lands**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
POLITICAL_LINE (LINES)	**TYPE (Text, 4 Characters)**	**Same as TYPE in POLITICAL_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in POLITICAL_POLY**	
POLITICAL_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in POLITICAL_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in POLITICAL_POLY**	

Human-Use *cont'd*

Geographic Themes	Attribute Names	Description	Attribute Values
MANAGED_POLY (POLYS)	**TYPE (Text, 4 Characters)**	**Code identifying a park or managed area feature that is mapped as a polygon *See pages B-23 to B-24 for additional information on the human-use feature grouping by type. *See pages B-25 to B-29 for the human-use type explanations.**	**FO = National Forest MA = Management Area MS = Marine Sanctuary NC = Nature Conservancy NERR = National Estuarine Research Reserve NL = National Landmark NP = National Park P = Park (State) SPA = State Protected Area WR = Wildlife Refuge**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
MANAGED_LINE (LINES)	**TYPE (Text, 4 Characters)**	**Same as TYPE in MANAGED_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in MANAGED _POLY**	
MANAGED_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in MANAGED _POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in MANAGED _POLY**	

Human-Use *cont'd*

Geographic Themes	Attribute Names	Description	Attribute Values
RESOURCE_POLY (POLYS)	**TYPE (Text, 4 Characters)**	**Code identifying a resource management feature that is mapped as a polygon** ***See pages B-23 to B-24 for additional information on the human-use feature grouping by type.** ***See pages B-25 to B-29 for the human-use type explanations.**	**AQ = Aquaculture** **AR = Artificial Reef** **CF = Commercial Fishing** **CH = Critical Habitat** **EH = Essential Habitat** **FA = Fishery Area** **RF = Recreational Fishing** **S = Subsistence** **WI = Water Intake**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
RESOURCE_LINE (LINES)	**TYPE (Text, 4 Characters)**	**Same as TYPE in RESOURCE_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in RESOURCE_POLYS**	
RESOURCE_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in RESOURCE_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in RESOURCE_POLY**	

Human-Use *cont'd*			
Geographic Themes	**Attribute Names**	**Description**	**Attribute Values**
NAV_MARINE_POLY (POLYS)	**TYPE** **(Text, 4 Characters)**	**Code identifying a navigational/marine – recreational/maritime feature that is mapped as a polygon.** ***See pages B-23 to B-24 for additional information on the human-use feature grouping by type.** ***See pages B-25 to B-29 for the human-use type explanations.**	**AN = Anchorage** **A2 = Access** **BR = Boat Ramp** **DV = Diving** **F = Ferry** **FR = Ferry Route** **LD = Lock And Dam** **M = Marina** **PT = Port** **RM = River Mile** **SL = Shipping Lane**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table.**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
NAV_MARINE_LINE (LINES)	**TYPE** **(Text, 4 Characters)**	**Same as TYPE in NAV_MARINE_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in NAV_MARINE_POLY**	
NAV_MARINE_POINT (POINTS)	**TYPE** **(Text, 4 Characters)**	**Same as TYPE in NAV_MARINE_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in NAV_MARINE_POLY**	

Human-Use *cont'd*			
Geographic Themes	**Attribute Names**	**Description**	**Attribute Values**
SOCECON_POLY (POLYS)	**TYPE (Text, 4 Characters)**	**Code identifying a human-use (socecon) feature that is mapped as a polygon.** ***See pages B-23 to B-24 for additional information on the human-use feature grouping by type.** ***See pages B-25 to B-29 for the human-use type explanations.**	**A = Airport** **AS = Archaeological Site** **AV = Abandoned Vessel** **B = Beach** **C = Campground** **HP = Heliport** **HS = Historical Site** **HWR = Historic Wreck** **NOAA = NOAA Facility** **PL = Pipeline** **R = Road (or Bridge)** **RR = Rail Route** **S2 = Surfing** **WO = Wash Over**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table.**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
SOCECON_LINE (LINES)	**TYPE (Text, 4 Characters)**	**Same as TYPE in SOCECON_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in SOCECON_POLY**	
SOCECON_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in SOCECON_POLY**	
	HUNUM (Long Integer)	**Same as HUNUM in SOCECON_POLY**	

Data Tables	Attribute Names	Description	Attribute Values
BIOCOMB	**ELEMENT** **(Text, 10 Characters)**	**Category of species**	**BENTHIC** **BIRD** **FISH** **HABITAT** **HERP** **INVERT** **M_MAMMAL** **T_MAMMAL**
	SUBELEMENT **(Text, 10 Characters)**	**Element subgroup**	**Subelement of species. Must be lowercase.**
	RARNUM (Long Integer)	**Resource at risk number which links directly to the RARNUM listed in the feature attribute table. *Multiple records can share the same RARNUM.**	**A 9-digit integer represents a unique combination of species, their seasonalities, concentrations, and their geographic source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
	MAPRAR (Long Integer)	**An identifier that is used in map production for legibility. This number is the same as RARNUM without the atlas specific prefix.**	**A 9-digit integer represents a unique combination of species, seasonalities, concentrations, and their sources.**
	SPECIES_ID (Long Integer)	**Species identification number**	**An integer ranging from 1 – 99,999. Numbers are unique within elements and are universal across atlases.**
	NAME **(Text, 35 Characters)**	**Common name**	**Common name of the species. Only the first letter of the Common Name is upper case unless the Common Name is a proper name.**
	GEN_SPEC **(Text, 45 Characters)**	**Scientific name**	**Genus and species name of the species. Only the first letter of the Genus is upper case and the remainder is lowercase.**
	S (Text, 1 Character)	**State species status code at time of ESI publication**	**One-letter code representing sensitive status at the state level E = Endangered, T = Threatened, C = Species of Concern. X = Experimental essential population S = Threatened or endangered due to similarity of appearance.**

Data Tables	Attribute Names	Description	Attribute Values
BIOCOMB *cont'd*	**F (Text, 1 Character)**	**Federal species status code at time of ESI publication**	**Standard, two-letter code**
	STATE (Text, 2 Characters)	**State abbreviation**	**Values may be numeric, such as 1:24000, or text, such as UNKNOWN (non-digital data only), or VARIES.**
	S_DATE (Long Integer)	**Date the associated S status ranking was assessed**	**Date fields must be YYYY, or YYYYMM, or YYYYMMDD. If date is not known or if the day is not of consequence, then it should be YYYYMM. The same is true if month is not known or is not of consequence, you would use YYYY**
	F_DATE (Long Integer)	**Date the associated F status ranking was assessed**	**Same as S_DATE, above**
	CONC (Text, 20 Characters)	**Concentration of the species**	**May be qualitative or a number of individuals. A hyphen "-" is used to denote no data. Must be documented in metadata. See page B-21 for a list of the most used qualitative concentration attribute values.**
	G_SOURCE (Long Integer)	**Unique key that links to the geographic source in the SOURCES table**	**Source codes for biology (prior to their concatenation to the Atlas ID) should be in the range of 301-99,999. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
	JAN (Text, 1 Character)	**Present in January**	**X = present; Blank = not present**
	FEB (Text, 1 Character)	**Present in February**	**Same as JAN, above**
	MAR (Text, 1 Character)	**Present in March**	**Same as JAN, above**
	APR (Text, 1 Character)	**Present in April**	**Same as JAN, above**
	MAY (Text, 1 Character)	**Present in May**	**Same as JAN, above**
	JUN (Text, 1 Character)	**Present in June**	**Same as JAN, above**
	JUL (Text, 1 Character)	**Present in July**	**Same as JAN, above**
	AUG (Text, 1 Character)	**Present in August**	**Same as JAN, above**
	SEP (Text, 1 Character)	**Present in September**	**Same as JAN, above**
	OCT (Text, 1 Character)	**Present in October**	**Same as JAN, above**
	NOV (Text, 1 Character)	**Present in November**	**Same as JAN, above**
	DEC (Text, 1 Character)	**Present in December**	**Same as JAN, above**

Data Tables	Attribute Names	Description	Attribute Values
BIOCOMB *cont'd*	**NESTING** **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, FISH, INVERT, HABITAT, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	MIGRATING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, FISH, INVERT, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	MOLTING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, FISH, INVERT, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	HATCHING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, FISH, INVERT, HABITAT, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	SPAWNING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	EGGS **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	LARVAE **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, HABITAT, HERP, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**

Data Tables	Attribute Names	Description	Attribute Values
BIOCOMB *cont'd*	**JUVENILES** **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, HABITAT, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	ADULTS **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, HABITAT, M_MAMMAL, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	MATING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, FISH, HABITAT, HERP, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	CALVING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, FISH, INVERT, HABITAT, HERP, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**
	PUPPING **(Text, 15 Characters)**	**Month range where this life history stage is occurring. Not used for BENTHIC, BIRD, FISH, INVERT, HABITAT, HERP, or T_MAMMAL elements.**	**X = occurring** **"- "= life stage not present** **N/A = life stage not applicable**

Data Tables	Attribute Names	Description	Attribute Values
SOURCES	**SOURCE_ID (Long Integer)**	**Unique key that links to the BIOCOMB and SOC_DAT tables, in addition to the ESIL, ESIP, and HYDROL feature attribute tables.**	**Integer ranging from 1 – 99,999 added to the atlas number *100,000 to generate a number that is unique across atlases.** **Source numbers ranging from 1-100 are reserved for the ESIL, ESIP, and HYDROL data sources.** **Source numbers ranging from 101-300 are reserved for Human-use data sources.** **Source numbers ranging from 301 – 99,999 are reserved for the biological data sources.** **If a source provides information for more than one layer "type", additional source records should be included.**
	ORIGINATOR (Text, 255 Characters)	**The providing agency or company, followed by the name of the individual provider(s) if appropriate**	**Free text – Format in upper case**
	DATE_PUB (Long Integer)	**Publication or data collection date**	**Date fields must be YYYY, or YYYYMM, or YYYYMMDD. If date is not known or if the day is not of consequence, then it should be YYYYMM. The same is true if month is not known or is not of consequence, use YYYY.**
	TITLE (Text, 255 Characters)	**Name of the data set, publication, or contents from interview**	**Free Text – Format in upper case**
	DATA_FORMAT (Text, 80 Characters)	**Media Type**	**Free Text Format in upper case. Common values include EXPERT KNOWLEDGE, DOCUMENT, VECTOR DIGITAL DATA, SPREADSHEET, HARDCOPY TEXT.**
	PUB_PLACE (Text, 255 Characters)	**Publication Location**	**City, State Abbrev – may be left blank. Format in upper case.**
	PUBLISHER (Text, 255 Characters)	**Data Publisher**	**Free Text– may be left blank. Format in upper case.**
	PUBLICATION (Text, 255 Characters)	**Citation of source (if applicable)**	**Free Text– may be left blank. Format in upper case.**

Data Tables	Attribute Names	Description	Attribute Values
SOURCES *cont'd*	**LINK (Text, 255 Characters)**	**URL to the data if internet-available or to the website of the data provider**	**URL. Must be copied as is from the address bar & must be fully qualified (begin with http://) & contain no "<" or ">" characters.**
	SCALE (Text, 20 Characters)	**Source scale denominator of data**	**Values may be numeric, such as 1:24000, or text, such as UNKNOWN (non-digital data only), or VARIES.**
	TIME_PERIOD (Text, 34 Characters)	**Beginning and ending dates of the source data**	**Free text description**

Data Tables	Attribute Names	Description	Attribute Values
SOC_DAT	**HUNUM (Long Integer)**	**Human-use resource at risk number which links directly to the HUNUM listed in the feature attribute table. *Multiple records can share the same HUNUM.**	**A 9-digit integer represents a unique or unique combination of human-use features, based on their type, name, and their source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
	ELEMENT (Text, 10 Characters)	**Category of human-use features**	**POLITICAL MANAGED RESOURCE NAV_MARINE SOCECON**
	TYPE (Text, 35 Characters)	**Value of the abbreviated TYPE attribute found in the POLITICAL, MANAGED, RESOURCE, NAV_MARINE and SOCECON feature layers**	**A = AIRPORT AN = ANCHORAGE AQ = AQUACULTURE AR = ARTIFICIAL REEF AS = ARCHAEOLOGICAL SITE AV = ABANDONED VESSEL A2 = ACCESS B = BEACH BR = BOAT RAMP C = CAMPGROUND CF = COMMERCIAL FISHING CG = COAST GUARD CH = CRITICAL HABITAT DV = DIVING EH = ESSENTIAL HABITAT F = FERRY FA = FISHERY AREA FO = NATIONAL FOREST FR = FERRY ROUTE HP = HELIPORT HS = HISTORICAL SITE HWR = HISTORIC WRECK IB = INTERNATIONAL BOUNDARY LD = LOCK AND DAM M = MARINA MA = MANAGEMENT AREA MS = MARINE SANCTUARY NC = NATURE CONSERVANCY NERR = NATIONAL ESTUARINE RESEARCH RESERVE NL = NATIONAL LANDMARK NOAA = NOAA FACILITY NP = NATIONAL PARK P = PARK PL = PIPELINE**

SOC_DAT *cont'd*	**TYPE** *cont'd* **(Text, 35 Characters)**	**Value of the abbreviated TYPE attribute found in the POLITICAL, MANAGED, RESOURCE, NAV_MARINE and SOCECON feature layers**	**PT = PORT** **RR = RAIL ROUTE** **RF = RECREATIONAL FISHING** **RM = RIVER MILE** **RR = RAIL ROUTE** **S = SUBSISTENCE** **SL = SHIPPING LANE** **SPA = STATE PROTECTED AREA** **ST = STATE** **S2 = SURFING** **TL = TRIBAL LAND** **WI = WATER INTAKE** **WO = WASH OVER** **WR = WILDLIFE REFUGE**
	NAME **(Text, 50 Characters)**	**The name of the mapped resource, such as park name, marina name, etc.**	**If applicable and available; Free Text – Format in upper case**
	CONTACT **(Text, 80 Characters)**	**Person or agency responsible for the resource**	**If applicable and available; Free Text – Format in upper case**
	PHONE **(Text, 12 Characters)**	**Phone number**	**XXX-XXX-XXXX, If applicable and available**
	LINK **(Text, 255 Characters)**	**Link to the resource webpage**	**URL. Must be copied as is from the address bar & must be fully qualified (begin with https://) & contain no “<” or “>” characters.**
	G_SOURCE (Long Integer)	**Unique key that links to the geographic source in the sources table**	**Source values (prior to their concatenation to the Atlas ID) should be in the range of 101-300. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**

ESI Values, Classification Descriptions, and Crosswalk to Generalized ESI Codes and Descriptions

ESI Code	Environment Code	Shoreline Classification Description		Generalized ESI Code	Generalized ESI Description
Variable: ESI	**Variable: ENVIR**	**Variable: LANDWARD_SHORETYPE, SEAWARD_SHORETYPE1, SEAWARD_SHORETYPE1, ESI_DESCRIPTION**		**Variable: General_Symbol**	**Variable: General_ESI_TYPE**
1A	E/L	1A: Exposed, Rocky Shores		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
1A	R	1A: Exposed, Rocky Banks		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
1B	E/L/R	1B: Exposed, Solid Man-Made Structures		1	Armored
1C	E/L/R	1C: Exposed, Rocky Cliffs w/Boulder Talus Base		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
2A	E	2A: Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
2A	L	2A: Shelving Bedrock Shores		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
2A	R	2A: Rocky Shoals and Bedrock Ledges		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
2B	E	2B: Exposed Scarps and Steep Slopes (Clay)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
3A	E/L	3A: Sand Beaches		3	Beaches (Sand/Gravel)
3B	E/L/R	3B: Scarps and Steep Slopes (Unconsolidated Sediment)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
3C	E	3C: Tundra Cliffs		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
4	R	4: Sand Bars and Gently Sloping Banks		3	Beaches (Sand/Gravel)
5	E/L	5: Mixed Sand and Gravel Beaches		3	Beaches (Sand/Gravel)
5	R	5: Mixed Sand and Gravel Bars and Gently Sloping Banks		3	Beaches (Sand/Gravel)
6A	E/L	6A: Gravel Beaches		3	Beaches (Sand/Gravel)
6A	R	6A: Gravel Bars and Gently Sloping Banks		3	Beaches (Sand/Gravel)
6B	E/L/R	6B: Riprap		1	Armored
6B	E	6B: Cobbles/Boulder Beaches		3	Beaches (Sand/Gravel)
6C	E	6C: Boulder Rubble		1	Armored

ESI Values, Classification Descriptions, and Crosswalk to Generalized ESI Codes and Descriptions

ESI Code	Environment Code	Shoreline Classification Description		Generalized ESI Code	Generalized ESI Description
Variable: ESI	**Variable: ENVIR**	**Variable: LANDWARD_SHORETYPE, SEAWARD_SHORETYPE1, SEAWARD_SHORETYPE1, ESI_DESCRIPTION**		**Variable: General_Symbol**	**Variable: General_ESI_TYPE**
7	E/L	7: Exposed Flats		4	Flats (Mud/Sand)
8A	E/L/R	8A: Sheltered Rocky Shores and Sheltered Scarps in Mud/Clay		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
8B	E/L/R	8B: Sheltered, Solid Man-Made Structures		1	Armored
8D	E	8D: Sheltered, Rocky Rubble Shores		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
8E	E	8E: Peat Shorelines		3	Beaches (Sand/Gravel)
8F	R	8F: Vegetated, Steeply Sloping Bluffs		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
9A	E/L	9A: Sheltered Flats		4	Flats (Mud/Sand)
9B	E/L/R	9B: Vegetated Low Banks		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
9C	E	9C: Hyper-Saline Flats		4	Flats (Mud/Sand)
10A	E	10A: Salt- and Brackish Water Marshes		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10B	E/L/R	10B: Freshwater Marshes		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10C	E/L/R	10C: Swamps		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10D	E/L/R	10D: Scrub and Shrub Wetlands		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10E	E	10E: Inundated Low Lying Tundra		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10F	E	10F: Mangroves		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)

QUALITATIVE CONCENTRATION ATTRIBUTE VALUES

NOTE: A hyphen ("-") is used to denote no data.

Examples of the most commonly used qualitative concentration values.

Concentration Attribute Values (*examples*)	
High	Occasional
Medium	Very high
Low	Present
Highly abundant	Possible/potential
Abundant	Very rare
Common	Very low
Rare	Uncommon
	- Denotes no data

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HUMAN-USE FEATURES – GROUPING OF TYPES

Following is a breakdown of the human-use data grouping like "types" together. Each grouping is assigned an ELEMENT, which loosely corresponds to the field ELEMENT in the biology data layers. The impact on the ESI deliverable will be:

1. What was previously the MANAGEMENT layer will now be divided into up to 5 distinct feature classes with types distributed as shown below.
2. Likewise, the SOCECON (point and line layers) will be divided into up to 5 distinct feature classes each as shown below.
3. The field ELEMENT (Text, 10 characters) is added to the SOC_DAT table (between HUNUM and TYPE) and populated with the values shown below.
4. Metadata will need to be provided for each of these individual feature classes/layers.

ELEMENT = POLITICAL

Layer Description: POLITICAL/JURISDICTIONAL MANAGEMENT

Feature Class Name: POLITICAL_POLY/LINE/POINT

SOCECON TYPES: CG - Coast Guard, IB – International Boundary, ST – State (or State Border), TL – Tribal Land

ELEMENT = MANAGED

Layer Description: PARKS/MANAGED AREAS

Feature Class Name: MANAGED_POLY/LINE/POINT

SOCECON TYPES: FO – National Forest, MA – Management Area, MS – Marine Sanctuary, NC – Nature Conservancy, NERR – National Estuarine Research Reserve, NL – National Landmark, NP – National Park, P – Park (State), SPA – State Protected Area, WR – Wildlife Refuge

ELEMENT = RESOURCE

Layer Description: RESOURCE MANAGEMENT

Feature Class Name: RESOURCE_POLY/LINE/POINT

SOCECON TYPES: AQ – Aquaculture, AR – Artificial Reef, CF – Commercial Fishing, CH – Critical Habitat, EH – Essential Habitat, FA – Fishery Area, RF – Recreational Fishing, S – Subsistence, WI – Water Intake

ELEMENT = NAV_MARINE

Layer Description: NAVIGATION/MARINE - RECREATIONAL/MARITIME

Feature Class Name: NAV_MARINE_POLY/LINE/POINT

SOCECON TYPES: AN – Anchorage, A2 – Access, BR – Boat Ramp, DV – Diving, F – Ferry, FR – Ferry Route, LD – Lock and Dam, M – Marina, PT – Port, RM – River Mile, SL – Shipping Lane

ELEMENT = SOCECON

Layer Description: OTHER HUMAN-USE (SOCECON) FEATURES

Feature Class Name: SOCECON_POLY/LINE/POINT

SOCECON TYPES: A – Airport, AS – Archaeological Site, AV – Abandoned Vessel, B – Beach, HP – Heliport, HS – Historic Site, HWR – Historic Wreck, NOAA – National Oceanic Atmospheric Administration Facility, PL – Pipeline, RR – Rail Route, S2 – Surfing, WO – Washover

HUMAN-USE TYPE EXPLANATIONS

A – **Airport:** Mapped as points, this refers to locations of airports, airfields, landing strips, etc., whether they are manned or unmanned. The data may come from federal, state, regional, or local programs. Also refers to Heliport (HP).

AN – **Anchorage:** Mapped as points or polygons, this refers to locations (or areas) where commercial vessels can be anchored offshore outside shipping lanes. The data may come from federal, state, regional, or local programs.

AQ – **Aquaculture:** Typically mapped as points but may be mapped as polygons, this refers to farmed and/or managed aquaculture/mariculture sites that may be impacted by oiling, natural disaster, or cleanup activity. The data may come from federal, state, regional, or local programs.

AR – **Artificial Reef:** Typically mapped as points but may also be mapped as polygons, this refers to locations of reefs made of man-made materials or natural materials purposely placed at a site for fishing or sport diving purposes. The data may come from federal, state, regional, or local programs.

AS – **Archaeological Site:** This refers to the location of water, coastal, or wetland-associated archaeological sites. Mapped as point features that may be offset or generalized to purposely obscure the exact location to protect the resource from illegal activity. The data may come from federal or state historic preservation offices. Also refer to Historic Site (HS), Historic Wreck (HWR).

AV – **Abandoned Vessel:** Mapped as points, this refers to abandoned or derelict vessels. These data come from NOAA's Office of Response and Restoration. Also refers to Historic Wreck (HWR).

A2 – **Access:** Mapped as points, this refers to vehicular or foot access locations to beach, wetland or river shoreline. The data may come from state, regional, or local programs, road atlases (such as Delorme), and map services (such as ESRI Worldmap) and may be supplemented with expert knowledge. Differs from Boat Ramps (BR).

B – **Beach:** Typically mapped as points but may also be mapped as polygons, this refers to high use recreational beach sites. A typical high use site would be indicated by a nearby parking lot of substantial size, and likely (but not necessarily) other recreational beach amenities such as bath houses, lifeguard stations, and food and drink concessions. The data may come from state, regional, or local programs, road atlases (such as Delorme), and map services (such as ESRI Worldmap) and may be supplemented with expert knowledge.

BR – **Boat Ramp:** Mapped as points, this refers to publicly available boat ramps or launch sites. The data may come from state, regional, or local programs and may be supplemented with expert knowledge. Also refer to Access (A2).

C – **Campground:** Mapped as points, this refers to public campgrounds. The data may come from federal, state, or regional programs.

CF – **Commercial Fishing:** Typically mapped as points but may also be mapped as polygons. Important, high use sites, fished by commercial fishers on a regular basis. The data may come from federal, state, regional, or local programs.

CG – **Coast Guard:** This refers to USCG station locations mapped as points. The data may come from federal, state, or regional programs.

CH – **Critical Habitat:** Typically mapped as polygons but may also be mapped as points, this refers to designated critical habitat defined under the Endangered Species Act that contains areas needed for the conservation and/or recovery of a threatened or endangered species; for example, leatherback sea turtle, killer whale, Steller sea lion, salmonids (i.e., salmon, trout, and Pacific eulachon), etc. The data may come from federal, state, regional, or programs.

DV – **Diving:** Mapped as points, this refers to popular recreational diving and snorkeling sites. The data may come from state, regional, or local programs and are typically supplemented with expert knowledge. Also refer to Artificial Reef (AR).

EH – Essential Habitat: Typically mapped as polygons but may also be mapped as points, this refers to significant habitats, including vernal pools, needed to support key life stages of ecological communities or species. Areas designated as 'Essential Fish Habitat' by a federal fishery management plan may also be mapped as EH. The data may come from state, regional, or local programs and are typically supplemented with expert knowledge.

F – **Ferry:** Mapped as points, this refers location of state and local ferry terminals. The data may come from state or local programs. Also refer to the line feature Ferry Route (FR).

FA – **Fishery Area:** Mapped as points or polygons, this refers to defined areas or locations where fish or shellfish species are managed by a federal or state agency. The data may come from federal, state, or regional programs.

FO – **National Forest:** Mapped as polygons, this refers to boundaries of National Forest managed areas. The data come from the USDA Forest Service.

FR – **Ferry Route:** Mapped as lines, this refers to locations of state and local ferry traffic routes. The data may come from state or local programs. Also refer to Ferry (F).

HP – **Heliport:** Mapped as points, this refers to standalone heliports. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

HS – **Historic Site:** Typically mapped as polygons but may also be mapped as points, this refers to known historical sites that are found on the Registry of National Historic Places and state registries and are sites that may be disturbed by oiling or cleanup activity. In many cases these data are unavailable, or sites must be offset to obscure exact locations. The data may come from the National Park Service, state, or local agencies. Also refer to Historic Wreck (HWR), Archaeological Site (AS).

HWR – **Historic Wreck**: Mapped as points, this refers to abandoned or derelict vessels of historic significance. In many cases these data are unavailable, or sites must be offset or generalized. The primary source should be NOAA's Office of Coast Survey Wrecks and Obstructions Database, but the data may come from the National Park Service, NOAA's Office of National Marine Sanctuaries, state, or local agencies. Also refer to Abandoned Vessel (AV), Historic Site (HS).

IB – **International Boundary:** Mapped as lines, this refers to the Canadian and Mexican boundaries in the appropriate US ESI atlas areas. The data may come from federal, state, or regional programs.

LD – **Lock and Dam:** Mapped as points, this refers to marine lock systems and/or dams. The data may come from state, local, or regional programs.

M – **Marina:** Mapped as points, this refers to publicly available marina locations. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. Also refer to Boat Ramp (BR).

MA – **Management Area:** Mapped as polygons, this refers to lands that are managed at a local or agency level and may include managed lands that do not fall into another, more specific, human-use type. This category will include items that do not fall under: Regional/State Park, National Park, Nature Conservancy, Marine Sanctuary, or anything else already listed in Human-Use categories. The data may come from federal, state, regional, or local programs. Also refer to Park (Regional or State), National Park, etc.

MS – **Marine Sanctuary:** Mapped as polygons, this refers to areas that are managed by NOAA as National Marine Sanctuaries. These data come from NOAA's Office of National Marine Sanctuaries.

NC – **Nature Conservancy:** Mapped as polygons, this refers to areas that are managed by the Nature Conservancy. These data come from The Nature Conservancy.

NERR – **National Estuarine Research Reserve:** Mapped as polygons, this refers to areas that are managed by the National Estuarine Research Reserve System. These data come from the NOAA National Estuarine Research Reserve System.

NL – **National Landmark:** Mapped as points or polygons, this refers to locations of National Landmarks that are managed by the National Park Service that may be disturbed by oiling or disaster cleanup activities. These data come from the National Park Service, National Historic Landmarks Program. Also refer to Historical Site (HS).

NOAA – **National Oceanic Atmospheric Administration Facility:** Mapped as points, this refers to the locations of NOAA facilities. The data may come from federal, state, regional, or local programs.

NP – **National Park:** Mapped as polygons, this refers to locations of National Parks that are managed by the National Park Service. This data comes from the National Park Service.

P – **Park (State):** Mapped as polygons, this refers to jurisdictional boundaries of parks, natural preserves, recreation areas, etc. that are managed at the state level. The data may come from state, regional, or local programs. Also refer to Beaches, Historical Sites/Areas, Management Areas, and National Parks.

PL – **Pipeline:** Mapped as lines, this refers to oil and gas pipeline infrastructure. The data may come from federal, state, regional, or local programs. It is often not available for public distribution, and/or only a subset of the pipelines may be available.

PT – **Port:** Mapped as points, this refers to the locations of commercial docks and ports such as container ports. The data may come from state, regional, or local programs and may be supplemented with expert knowledge.

RF – **Recreational Fishing:** Typically mapped as points, these areas depict locations that are fished for sport, either for pleasure or competition. The data may come from state, regional, or local programs and may be supplemented with expert knowledge.

RM – **River Mile:** Mapped as points, this refers to the distance in miles along a river from its mouth. The data may come from state, regional, or local programs.

RR – **Rail Route:** Mapped as lines, these refer to train lines as part of a transit system. The data may come from state, regional, or local programs.

S – **Subsistence:** Typically mapped as points but may also be mapped as polygons, this refers to subsistence harvest of invertebrates, fish, birds, and other species and typically related to native or tribal populations. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. Also refer to Tribal Lands (TL).

SL – **Shipping Lane:** Typically mapped as lines but may also be mapped as polygons, these depict the general flow of merchant shipping between two departure/terminal areas. These are normally found in oceans or large lakes as a regularly used route for vessels. The data may come from federal, state, regional, or local programs.

SPA – **State Protected Area:** Mapped as polygons, these are areas that receive varied levels of state protection. Examples of areas with this designation are wilderness areas and exploited areas. The data may come from state programs and supplemented with expert knowledge. Also refer to: Regional or State Parks and Management Areas.

ST – **State (or State Border):** Mapped as lines or polygons, this refers to the official border between states. The data may come from state, regional, or local programs and supplemented with expert knowledge.

S2 – **Surfing:** Mapped as points, these depict popular surfing locations. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

TL – **Tribal Land:** Mapped as polygons or lines, these depict areas managed by a Native American tribe under the U.S. Bureau of Indian Affairs. Ideally the data will be provided by the tribe, but may also come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

WI – **Water Intake:** Mapped as points, these locations represent sites that withdraw water from streams, lakes, rivers, and reservoirs such as drinking water intakes, industrial intakes, and aquaculture intakes. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

WO – **Washover:** Mapped as points, this refers to a washover site, or washover fan. This feature is a relatively flat surface on the top of a barrier island complex that slopes gently landward. It is usually created when water, forced landward by breaking waves, flows across the top of the barrier island during high spring tides or storms. This process creates a flattened-off surface along which sand is transported across the top of the spit into the standing water (lagoon) or marsh landward of the spit. These geomorphic features are mapped during the shoreline classification.

WR – **Wildlife Refuge:** Mapped as polygons, these areas represent typically government-owned, natural wildlife refuges that provide species protection by regulating hunting practices, wildlife and forestry management, and restrictions on human activity. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. Also refer to: Regional or State Park, Management Areas, State Protected Areas.

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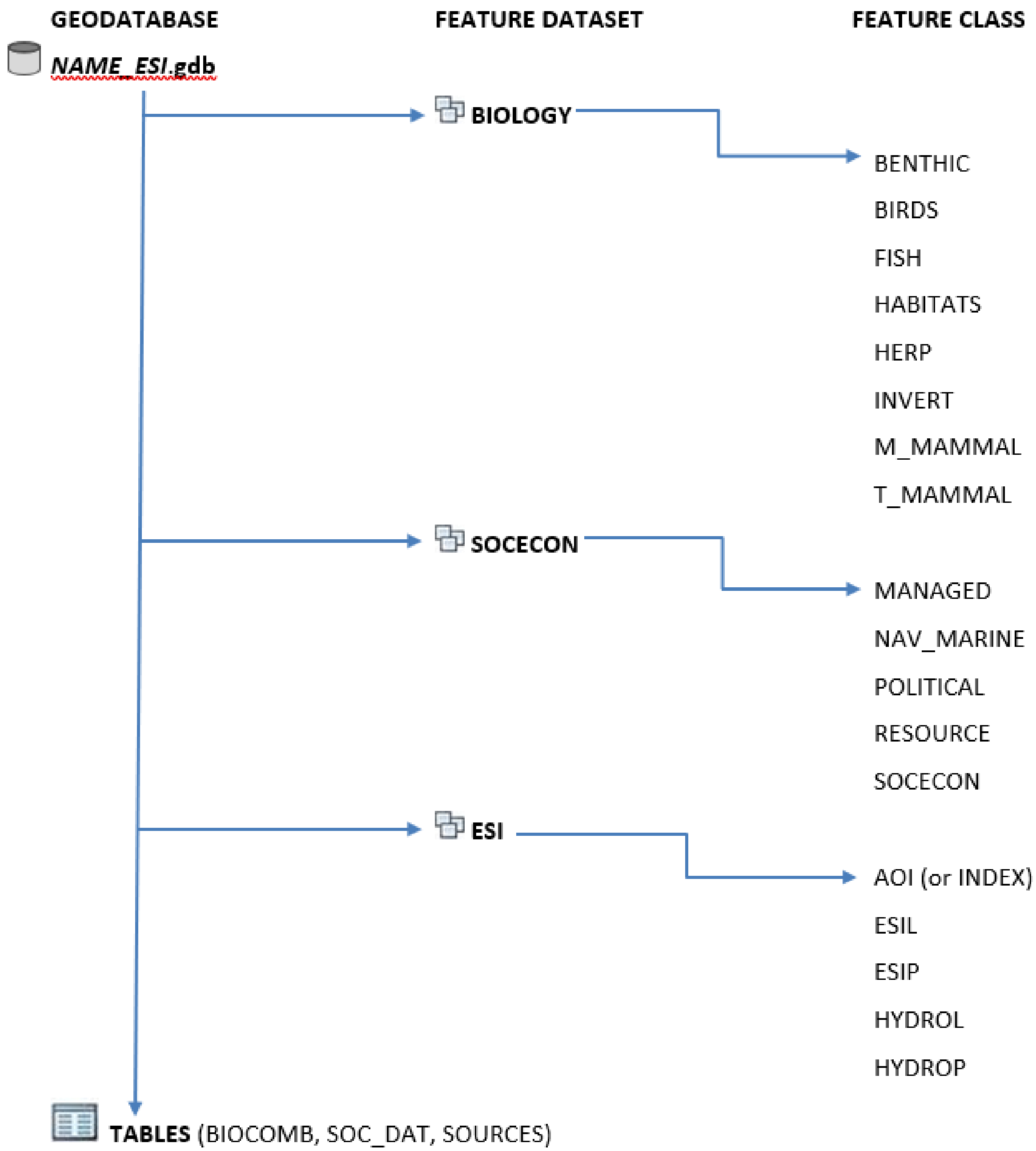
GEODATABASE DELIVERY FORMAT

Geospatial data sets and associated data tables meeting the NOAA ESI data delivery standards will be provided to NOAA in a File Geodatabase. The geodatabase will be organized by Feature Datasets containing Feature Classes. A Feature Dataset is collection of feature classes, and a Feature Class is a collection features with each feature class having the same type of geometry (point, line, or polygon). The associated non-spatial data tables are stored in the geodatabase. The schematic below describes the NOAA ESI geodatabase delivery format.



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APPENDIX C

ESI Data Table Structure and Associated Relationships

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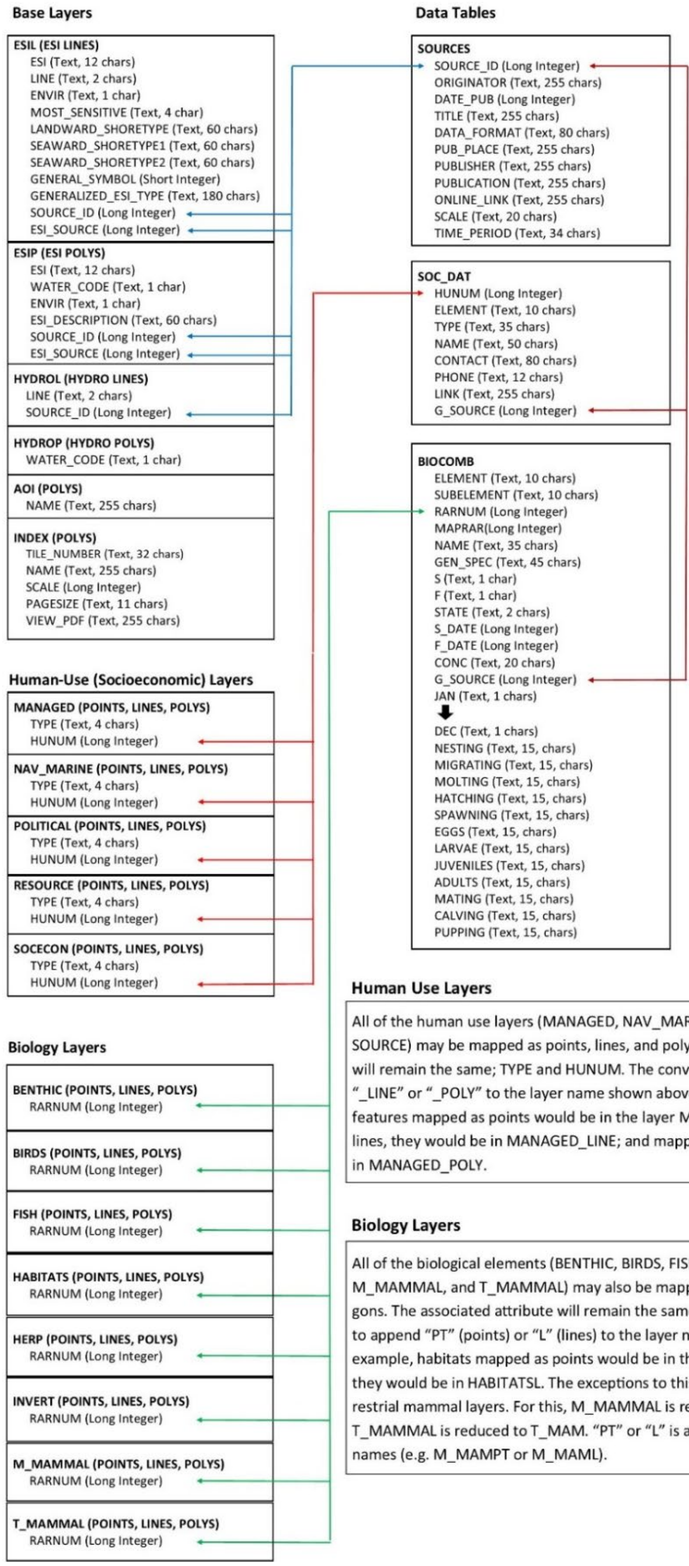
APPENDIX C: ESI DATE TABLE STRUCTURE AND ASSOCIATED RELATIONSHIPS



Human Use Layers

All of the human use layers (MANAGED, NAV_MARINE, POLITICAL, and RESOURCE) may be mapped as points, lines, and polygons. The associated attributes will remain the same; TYPE and HUNUM. The convention is to append "_POINT", "_LINE" or "_POLY" to the layer name shown above. As an example, MANAGED features mapped as points would be in the layer MANAGED_POINT; mapped as lines, they would be in MANAGED_LINE; and mapped as polygons, they would be in MANAGED_POLY.

Biology Layers

All of the biological elements (BENTHIC, BIRDS, FISH, HABITATS, HERP, INVERT, M_MAMMAL, and T_MAMMAL) may also be mapped as points, lines, and polygons. The associated attribute will remain the same, RARNUM. The convention is to append "PT" (points) or "L" (lines) to the layer name as shown above. As an example, habitats mapped as points would be in the layer HABITATSPT; as a line they would be in HABITATSL. The exceptions to this rule are the marine and terrestrial mammal layers. For this, M_MAMMAL is reduced to M_MAM and T_MAMMAL is reduced to T_MAM. "PT" or "L" is appended to the reduced layer names (e.g. M_MAMPT or M_MAML).

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APPENDIX D

Commonly Referenced Sources for ESI Data

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APPENDIX D: COMMONLY REFERENCED SOURCES FOR ESI DATA

This appendix provides a list of some commonly referenced ESI data sources, most reflecting regional or national datasets. This list is provided as a reference and is not intended to be exhaustive or to replace communication with data from regional and local resource experts. Often, states have geographic data portals that may be good sources of data; however, it is not recommended that any of these be used without additional consultation with local and/or regional experts. The regional Scientific Support Coordinator (SSC) may help identify some of these experts; additionally, ESIs mapped previously for the region and/or adjacent regions include information about regional experts and contributing agencies.

The following list has three main sections: Common Biological Sources, Common Human-Use Sources, and Common Shoreline and Wetland Sources. The Common Biological Sources section is further divided into sources which provide information for multiple elements and those that apply to a specific element or elements. For each source, the list includes the Author or Originator, Title, Online Linkage, and the region or regions covered in parentheses.

Common Biological Sources

Multiple Elements

Integrated Ocean Observing System (IOOS), Marine Biodiversity Observation Network (MBON) Data Portal, https://mbon.ioos.us/ (Coastal U.S.)

Integrated Ocean Observing System (IOOS), Regional Data Portals, https://ioos.noaa.gov/data/regional-data-portals/ (Coastal U.S.)

Mid-Atlantic Regional Council on the Ocean (MARCO), Mid-Atlantic Ocean Data Portal, https://portal.midatlanticocean.org/ (Mid-Atlantic U.S.)

NatureServe, NatureServe Explorer, https://explorer.natureserve.org/ (U.S. and Canada)

NOAA National Centers for Environmental Information, Gulf of America Data Atlas, https://gulfatlas.noaa.gov/ (Gulf of America)

NOAA Fisheries, Species Directory, https://www.fisheries.noaa.gov/species-directory/threatened-endangered (U.S.)

NOAA Fisheries, Section 7 Mappers:

- Southeast Region: https://www.fisheries.noaa.gov/resource/map/southeast-region-esa-section-7-mapper (Southeast U.S.)
- Greater Atlantic Region: https://www.fisheries.noaa.gov/resource/map/greater-atlantic-region-esa-section-7-mapper (Mid-Atlantic and Northeast)

Northeast Ocean Data, Data Download, https://www.northeastoceandata.org/data-download/ (Northeast U.S.)

Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP), The World Data Center for Marine Mammal, Seabird, Sea Turtle, Shark, and Ray Distributions, http://seamap.env.duke.edu/ (Worldwide)

California Cooperative Oceanic Fisheries Investigations (CALCOFI), Marine Ecosystem Data, http://calcofi.org/ (California)

U.S. Fish and Wildlife Service, Environmental Conservation Online System (ECOS), https://ecos.fws.gov/ecp/ (U.S.)

Birds

eBird, Explore eBird, https://ebird.org/explore (Worldwide)

National Audubon Society, https://www.audubon.org/important-bird-areas (U.S.)

Sea Duck Joint Venture. 2022. Atlas of Sea Duck Key Habitat Sites in North America, https://seaduckjv.org/science-resources/sea-duck-key-habitat-sites-atlas/ (North America)

U.S. Geological Survey, North Pacific Pelagic Seabird Database, https://www.usgs.gov/centers/alaska-science-center/science/north-pacific-pelagic-seabird-database (North Pacific and Arctic)

Fishes and Invertebrates

NOAA Fisheries, Essential Fish Habitat Mapper, https://www.habitat.noaa.gov/apps/efhmapper/ (Continental U.S.)

NOAA Fisheries, Alaska Essential Fish Habitat Mapper, https://www.fisheries.noaa.gov/resource/map/alaska-essential-fish-habitat-mapper (Alaska waters)

Essential Fish Habitat documentation (examples below):

- NOAA Fisheries. 2017. Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat and Environmental Assessment. https://www.fisheries.noaa.gov/atlantic-highly-migratory-species/atlantic-hms-fishery-management-plans-and-amendments (Atlantic and Gulf of America)
- Gulf of Mexico Fishery Management Council. 2016. Final Report: 5-Year Review of Essential Fish Habitat Requirements. https://gulfcouncil.org/ (Gulf of America)

NOAA Fisheries – multiple resources available. Review documents by region: Alaska, New England/Mid-Atlantic, Pacific Islands, Southeast, and West Coast, https://www.fisheries.noaa.gov/regions

State agency websites (see examples below):

- California Department of Fish and Wildlife, Marine Species Portal, https://marinespecies.wildlife.ca.gov/ (California)
- Florida Fish and Wildlife Research Institute, Species Accounts and Stock Assessments, https://myfwc.com/research/saltwater/ (Florida)

Benthic

NOAA Deep-Sea Coral Research and Technology Program, Data, https://deepseacoraldata.noaa.gov/data (Worldwide)

NOAA Office for Coastal Management, Seagrasses, https://www.fisheries.noaa.gov/inport/item/56960 (U.S.)

Marine Mammals

NOAA, U.S. Navy, Biologically Important Areas II, https://oceannoise.noaa.gov/biologically-important-areas (Aleutian Islands and Bering Sea (U.S. and Russia); Arctic (U.S., Canada, and Russia); Gulf of Alaska; Hawaii; West Coast (U.S. and northern America)) as described in:

Harrison J, Ferguson MC, New L, Cleary J, Curtice C, DeLand S, Fujioka E, Halpin PN, Tyson Moore RB and Van Parijs SM (2023) Biologically Important Areas II for cetaceans within U.S. and adjacent waters - Updates and the application of a new scoring system. Front. Mar. Sci. 10:1081893. doi: 10.3389/fmars.2023.1081893

Common Human-Use Sources

Esri, World Imagery Basemap, http://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer (Nationwide)

Federal Aviation Administration, Airports, https://aisfaa.opendata.arcgis.com/datasets/e747ab91a11045e8b3f8a3efd093d3b5_0/explore?location=9.618464%2C-1.633886%2C2.71 (Nationwide)

Integrated Ocean Observing System (IOOS), Home Page, https://ioos.noaa.gov/ (Coastal U.S.)

Integrated Ocean Observing System (IOOS), Regional Data Portals, https://ioos.noaa.gov/data/regional-data-portals/ (Coastal U.S.)

Mid-Atlantic Regional Council on the Ocean, Mid-Atlantic Ocean Data Portal, 2016, https://portal.midatlanticocean.org/visualize/ (Mid-Atlantic U.S.)

National Park Service, Administrative Boundaries of National Park System Units – National Geospatial Data Asset National Parks Dataset, https://irma.nps.gov/DataStore/Reference/Profile/2224545?lnv=True (Nationwide)

National Park Service, National Register of Historic Places Map Server, https://irma.nps.gov/DataStore/Reference/Profile/2305746 (Nationwide)

The Nature Conservancy, Conservation GIS Data, https://geospatial.tnc.org/datasets/TNC::tnc-lands-public-layer-2025/about (Nationwide)

NOAA Center for Operational Oceanographic Products and Services, Physical Oceanographic and Real-Time Measurement System, http://tidesandcurrents.noaa.gov (Coastal U.S.)

NOAA National Centers for Coastal Ocean Science, National Mussel Watch Locations, https://coastalscience.noaa.gov/science-areas/pollution/mussel-watch/ (Coastal U.S.)

NOAA Office of National Marine Sanctuaries, National Marine Sanctuaries GIS Data, https://sanctuaries.noaa.gov/library/imast_gis.html (Coastal U.S.)

NOAA Fisheries, EFH Mapper, https://www.habitat.noaa.gov/apps/efhmapper/ (Coastal U.S.)

NOAA Office for Coastal Management, Digital Coast, https://coast.noaa.gov/digitalcoast/ (Coastal U.S.)

NOAA Office for Coastal Management, Marine Cadastre Hub, https://hub.marinecadastre.gov/ (Coastal U.S.)

NOAA Office of Coast Survey, Shipping Lanes, Maritime Limits/Boundaries, Maintained Channels, https://nauticalcharts.noaa.gov/data/gis-data-and-services.html (Coastal U.S.)

NOAA Office of Coast Survey, Wrecks and Obstructions ENC Direct to GIS, https://nauticalcharts.noaa.gov/learn/encdirect/#using-the-map (Coastal U.S.)

Northeast Regional Planning Board, Northeast Ocean Data Portal, https://www.northeastoceandata.org/ (Northeast U.S.)

Pacific Fishery Management Council, Groundfish Fishery Management Plan, Appendix B, Pacific Coast Groundfish Essential Fish Habitat, 2023, https://www.pcouncil.org/documents/2022/08/pacific-coast-groundfish-fishery-management-plan.pdf (West Coast)

U.S. Army Corps of Engineers, National Inventory of Dams, https://nid.sec.usace.army.mil/#/downloads (Nationwide)

U.S. Census Bureau, Military Installation National Shapefile, 2019, https://catalog.data.gov/dataset/tiger-line-shapefile-2019-nation-u-s-military-installation-national-shapefile (Coastal U.S.)

U.S. Census Bureau, TIGER/Line Shapefiles, https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html (Nationwide)

U.S. Department of Agriculture Forest Service, Geospatial Clearinghouse, https://data.fs.usda.gov/geodata/edw/datasets.php?dsetCategory=boundaries (Nationwide)

U.S. Department of the Interior Indian Affairs, Division of Resource Integration Service, https://biamaps.geoplatform.gov/BIA-Opendata/Data/ (Nationwide)

U.S. Department of Transportation, Bureau of Transportation Statistics, National Census of Ferry Operators (Terminals, Segments) https://www.bts.gov/NCFO (Nationwide)

U.S. Department of Transportation, Bureau of Transportation Statistics, Port Areas, https://geodata.bts.gov/datasets/usdot::port-areas/about (Coastal U.S.)

U.S. Energy Information Administration, U.S. Energy Atlas Geoportal, https://atlas.eia.gov/search (Nationwide)

U.S. Fish and Wildlife Service, USFWS Threatened & Endangered Species Active Critical Habitat, https://ecos.fws.gov/ecp/report/table/critical-habitat.html (Nationwide)

U.S. Fish and Wildlife Service, National Realty Tracts Simplified, https://gis-fws.opendata.arcgis.com/datasets/fws::fws-national-realty-tracts-simplified/explore?location=3.561459%2C0.000000%2C2.64 (Nationwide)

U.S. Geological Survey, National Map: Transportation (including Railways, Airports, Ferries, etc.), Governmental Boundaries, https://nationalmap.gov/small_scale/atlasftp.html (Nationwide)

West Coast Governors Alliance on Ocean Health, West Coast Ocean Data Portal, https://portal.westcoastoceans.org/ (Pacific Coast U.S.)

Common Shoreline and Wetland Sources

Florida Department of Environmental Protection (FDEP), Water Management Districts Land Use Land Cover, https://geodata.dep.state.fl.us/datasets/FDEP::statewide-land-use-land-cover/about (Coastal Florida)

NOAA/NMFS Alaska Regional Office, Alaska ShoreZone Coastal Mapping and Imagery, https://www.fisheries.noaa.gov/alaska/habitat-conservation/alaska-shorezone (Alaska)

NOAA/NOS National Geodetic Survey, Continually Updated Shoreline Product (CUSP), https://coast.noaa.gov/digitalcoast/data/cusp.html (Coastal U.S.)

NOAA Office for Coastal Management, Coastal Change Analysis Program (C-CAP) Land Cover Classifications, https://coast.noaa.gov/digitalcoast/training/ccap-land-cover-classifications.html (Coastal U.S.)

NOAA Office for Coastal Management, U.S. Great Lakes Hardened Shorelines Classification 2019, https://coast.noaa.gov/digitalcoast/data/hardened-shorelines.html (Great Lakes)

NOAA Office of Response and Restoration, Environmental Sensitivity Index (ESI) Maps and Data, https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/environmental-sensitivity-index-esi-maps-and-data (US)

Texas Parks and Wildlife Department (TPWD), Ecological Mapping Systems (EMS), Western Gulf Coastal Plain, https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/ (Coastal Texas)

U.S. Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI), Classification of Surface Waters and Wetlands of the United States, https://www.fws.gov/program/national-wetlands-inventory (Coastal U.S.)

U.S. Geological Survey (USGS), National Hydrography Dataset (NHD), https://www.usgs.gov/national-hydrography/national-hydrography-dataset (U.S.)

U.S. Geological Survey (USGS), 3D Hydrography Program (3DHP), https://www.usgs.gov/3d-hydrography-program/access-3dhp-data-products (replaces USGS NHD retired products for the entire U.S.)

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APPENDIX E

Taxonomic Sources for Common and Scientific Species Names

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APPENDIX E: TAXONOMIC SOURCES FOR COMMON AND SCIENTIFIC SPECIES NAMES

The following sources can be referenced when an addition to the master species list is required. Identifying the proper scientific and common names for a species can streamline the addition of the species. Requests for additions should be sent to the ESI Program Manager. The final entry may be modified to assure the best fit in the master list.

Benthic

Cairns, S.D., et al. 2003. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Cnidaria and Ctenophora, 2nd Edition. Special Publication 28. American Fisheries Society, Bethesda, MD. 126 pp. Book for sale from AFS at: https://fisheries.org/bookstore/all-titles/special-publications/x51028xm/.

Birds

Chesser, R.T., S.M. Billerman, K.J. Burns, C. Cicero, J.L. Dunn, B.E. Hernández-Baños, R.A. Jiménez, Oscar Johnson, A.W. Kratter, N.A. Mason, P.C. Rasmussen, and J.V. Remsen, Jr. 2024. Check-list of North American Birds (online). American Ornithological Society. Available at: https://checklist.americanornithology.org/taxa/.

Fish

Page, L.M., K.E. Bemis, T.E. Dowling, H.S. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, K.E. Hartel, R.N. Lea, N.E. Mandrak, M.A. Neighbors, J.J. Schmitter-Soto, and H.J. Walker Jr. 2023. Common and Scientific Names of Fishes from the United States, Canada, and Mexico, 8th edition. Special Publication 37. American Fisheries Society, Bethesda, MD. September 2023. 435 pp. Book for sale from AFS at: https://fisheries.org/bookstore/all-titles/special-publications/namesoffishes8/.

Froese, R. and D. Pauly (editors). 2024. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2024). Available at: https://www.fishbase.org.

Invertebrates

McLaughlin, P.A., et al. 2005. Common and Scientific Names of Aquatic Invertebrates from the U.S. and Canada: Crustaceans. Special Publication 31. American Fisheries Society, Bethesda, MD. August 2005. 545 pp. Book for sale from AFS at: https://fisheries.org/bookstore/all-titles/special-publications/x51031xm/.

Turgeon, D.D., et al. 1998. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks, 2nd Edition. Special Publication 26. American Fisheries Society, Bethesda, MD. 536 pp. Book for sale from AFS at: https://fisheries.org/bookstore/all-titles/special-publications/x51026xm/.

WoRMS Editorial Board. 2024. World Register of Marine Species. Available from https://www.marinespecies.org at VLIZ. doi:10.14284/170.

Marine Mammals

Committee on Taxonomy. 2024. List of Marine Mammal Species and Subspecies. Society for Marine Mammalogy, Anacortes, WA. Species list available at: https://www.marinemammalscience.org/species-information/list-marine-mammal-species-subspecies/.

Plants

Natural Resources Conservation Service. 2024. PLANTS Database. U.S. Department of Agriculture. Available at: http://plants.usda.gov.

Reptiles and Amphibians

Society for the Study of Amphibians and Reptiles. 2017. Checklist of the Standard English and Scientific Names of Amphibians and Reptiles, 8th Edition. Available at: https://ssarherps.org/publications/north-american-checklist/.

Terrestrial Mammals

American Society of Mammalogists. 2017. Mammal Species List. Searchable list available at: http://www.mammalogy.org/mammals-list.

Wilson, D.E. and D.M. Reeder (editors). 2005. Mammal Species of the World. A Taxonomic and Geographic Reference, 3rd Edition. Johns Hopkins University Press. 2,142 pp. Available at: https://www.departments.bucknell.edu/biology/resources/msw3/.

APPENDIX F
Previously Published ESI Data with Publication Dates and Atlas Numbers

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APPENDIX F: PREVIOUSLY PUBLISHED ESI DATA WITH PUBLICATION DATES AND ATLAS NUMBERS

The following is a list of ESI atlases, their publication date(s) and atlas number(s). Some regions have been published in GIS format more than once. These are indicated with earlier versions noted in parenthesis.

Atlas Name/Region	Publication Date(s)	Atlas Number(s)
Atlantic Coast:		
Connecticut		
Long Island Sound	2016	283
Rhode Island, Connecticut, NY/NJ Metropolitan Area	2001	71
Delaware		
Delaware Bay (Delaware, New Jersey, Pennsylvania)	2014 (1996)	212 (12)
Florida – East	2020 (1995)	222, (22)
Florida – St. Johns River	1997	37
Georgia	2015 (1997)	236 (36)
Maine		
Maine & New Hampshire	2016	281
Maryland		
Chesapeake Bay & Outer Coasts of Maryland and Virginia	2016	285
Maryland	2007	47
Massachusetts		
Massachusetts & Rhode Island	2016	282
Massachusetts	1999	45
New Hampshire		
Maine & New Hampshire	2016	281
New Hampshire	2004	77
New Jersey		
New York and New Jersey (Metro, Hudson, S. Long Island)	2016	284
Delaware, New Jersey, Pennsylvania	2014 (1996)	212 (12)
Rhode Island, Connecticut, NY/NJ Metro Area	2001	71
New York		
Long Island Sound	2016	283
New York and New Jersey (Metro, Hudson, S. Long Island)	2016	284

Atlas Name/Region	Publication Date(s)	Atlas Number(s)
Hudson River	2006	52
Long Island	2009	53
Rhode Island, Connecticut, NY/NJ Metropolitan Area	2001	71
North Carolina	2016 (2011, 1996)	335 (235, 35)
Pennsylvania		
Delaware, New Jersey, Pennsylvania	2014 (1996)	212 (12)
Rhode Island		
Massachusetts & Rhode Island	2016	282
Rhode Island, Connecticut, NY/NJ Metropolitan Area	2001	71
South Carolina	2015 (1996)	234 (34)
Virginia		
Chesapeake Bay & Outer Coasts of Maryland and Virginia	2016	285
Virginia	2005	55
Gulf of America (formally Gulf of Mexico):		
Alabama	2007 (1996)	231 (31)
Florida – Northwest Peninsular (W. Pen 1)	2016 (1996)	219 (19)
Florida – Panhandle (West)	2023 (2012) (1995)	318 (218) (18)
Florida – South	2025 (2013) (1996)	321 (221) (21)
Florida – Southwest Peninsular (W. Pen 2)	2016 (1996)	220 (20)
Louisiana	2014 (2003)	233 (33)
Mississippi	2010 (1995)	232 (32)
Texas – Upper Coast	2013 (1995)	213 (13)
Texas – Lower Coast	*	*
Texas Outer Coast	2024	90
BSEE Gulf of Mexico (Offshore)	2023	86

Atlas Name/Region	Publication Date(s)	Atlas Number(s)
Pacific:		
Alaska – Aleutians	2001	72
Alaska – Bristol Bay	2004	56
Alaska – Cook Inlet/Kenai Peninsula	2002 (1985)	11 (60)
Alaska – Kodiak Island/Shelikof Strait	1997	57
Alaska – North Slope	2005	70
Alaska – Northwest Arctic	2002	73
Alaska – Norton Sound/Pribilof Islands	1983	*
Alaska – Prince William Sound	2000	59
Alaska – Southeast	1992/2001	10
Alaska – Western	2003	74
Alaska – BSEE Cook Inlet (Offshore)	2023	87
Alaska – BSEE North Slope (Offshore)	2023	88
Alaska – OSRI Birds – Cook Inlet	2024	260
California – Central	2006	8
California – Northern	2008	207
California – San Francisco Bay	1998	30
California – Southern	2010 (1995)	209 (9)
BSEE Southern California (Offshore)	2024	89
Hawaii	2001	65
Oregon		
Outer Coast of Washington & Oregon	2014	80
Columbia River	2004	41
Washington		
Outer Coast of Washington & Oregon	2014	80
Puget Sound & Strait of Juan de Fuca	2006	79
Columbia River	2004	41

Atlas Name/Region	Publication Date(s)	Atlas Number(s)
Great Lakes:		
Lake Erie System	2022 (1985)	217 (*)
Lake Huron	1994	3
Lake Michigan (Eastern)	1985	*
Lake Michigan (Northern)	1994	4
Lake Michigan (Southern)	1994	5
Lake Michigan (Western)	1993	2
Lake Michigan	2025	202
Lake Ontario	2023 (1993)	211 (1)
Lake Superior	1994	6
Straits of Mackinac & St. Clair -Detroit River System	2019	201
St. Marys River	2021	186
St. Lawrence River	2021	187
U.S. Territories:		
Guam & the Northern Mariana Islands	2005	78
American Samoa	2001	76
Puerto Rico	2000	66
Virgin Islands (U.S. & British)	2000	67

An asterisk (*) in the Atlas Number column denotes that the ESI atlas is not digital available, published as a hardcopy product only. The asterisk in the Publication Date column for the Texas -Lower Coast ESI means that atlas was not published by NOAA therefore did not follow the ESI Guidelines.

ATLAS NUMBER ASSIGNMENT

The atlas number assigned to each atlas is generally dependent upon the atlas number of the initial publication, if applicable. If the current atlas is a second edition, a ‘200’ would typically be added to the number of the initial publication. For example, using the table above, the Southern California atlas was initially published in 1995 with an atlas number of 9. The second edition of this atlas (covering the same geographic area) published in 2010 was assigned the atlas number of 209. This pattern is not followed if adding 200 would create a conflict with existing atlas numbers or if a specific number is requested by NOAA. In general, atlas numbers are selected to preserve space for future editions within the existing numbering structure.

APPENDIX G
ESI MAP PRODUCTION
Presentation and Symbology

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APPENDIX G: ESI MAP PRODUCTION PROCESS AND CARTOGRAPHIC CONSIDERATIONS

ESI data have been published as hardcopy products since the early 1980s and later became available in both hardcopy and PDF formats. In 1989, NOAA began distributing ESI data in various GIS formats, though maps remained the most requested ESI product. Today, the digital ESI Geodatabase format is widely used for both digital and hardcopy map production The most important aspect of ESI map production is representing the vast amount of complex data in a user friendly, readable map.

In early ESI maps, the ESI shoreline was hand drawn with color markers onto the USGS quad maps. The focus was on the outer coast, with limited detail on smaller bays and inland waters. The complexity of the ESI shoreline and classification, as well as the extent of area mapped, have expanded over the years. Current ESI maps are compiled based on high-resolution shoreline and wetlands data of various scales typically ranging from 1:4,000 – 1:24,000, extending up to five miles inland of the shoreline and offshore to the state-waters boundary, 12 nautical miles, or the international boundary. Coordinate with NOAA ESI Data Managers to determine the appropriate offshore extent.

The ESI biological resources data have also increased in quantity and complexity. The first ESI maps indicated the occurrence of a species with an icon depicting the subelement and dots representing the seasonal presence. Each icon was specific to a single, or very few, species. The number(s) on the icon corresponded to a species list in the Introductory pages. Today, occurrences mapped with points, lines, or polygons (polygons mapped as overlapping polygons) are often associated with several species, and a single species may have multiple seasonalities. The species, seasonality, life history, and status (threatened/endangered) are reported on the “back of the map” data table. The growing complexity is obvious when comparing data collected in the 1980s vs. contemporary ESI data. For example, see a St. Marys River ESI map grid prepared in 1986 compared to the same map grid published in 2021 (**Figure G.1**).

As the ESI maps evolved, the “Resources At Risk” NUMber (RARNUM) was introduced to simplify spatial and tabular detail. Geographic features were associated with biological resources with an icon and an RARNUM (calculated by ELEMENT) which linked the features to tabular information (species, concentration, status (threatened/endangered), monthly presence, seasonality, and life history) on the back of the maps. NOTE: the Map ID process described in Version 4.0 of the guidelines relating the mapped data to the spatial data was difficult to execute, therefore it has been removed from Version 5.0 of the guidelines. The numbering is consistent throughout the atlas, meaning RARNUM 25 on map 1, will reference the same assemblage as RARNUM 25 on map 66. This system simplifies the utility of the map for the end-user.

Like the biological resources data, the human-use resources data have also increased in complexity. It is important to display human-use data useful for the emergency response and planning community on the ESI map. Human-use resources mapped per Version 4.0 of the guidelines expanded well beyond the critical resources needed for the response community. Additionally, the expansion of the human-use data in Version 4.0 made maps extremely cluttered and less readable for the end-user. Please refer to Chapter 5 and Appendix H for significant changes to the human-use data included in the ESI.

To display the abundant amount of ESI data on a user friendly, readable map product, the objective is to feature the most sensitive resources while retaining other critical information contained within the ESI.

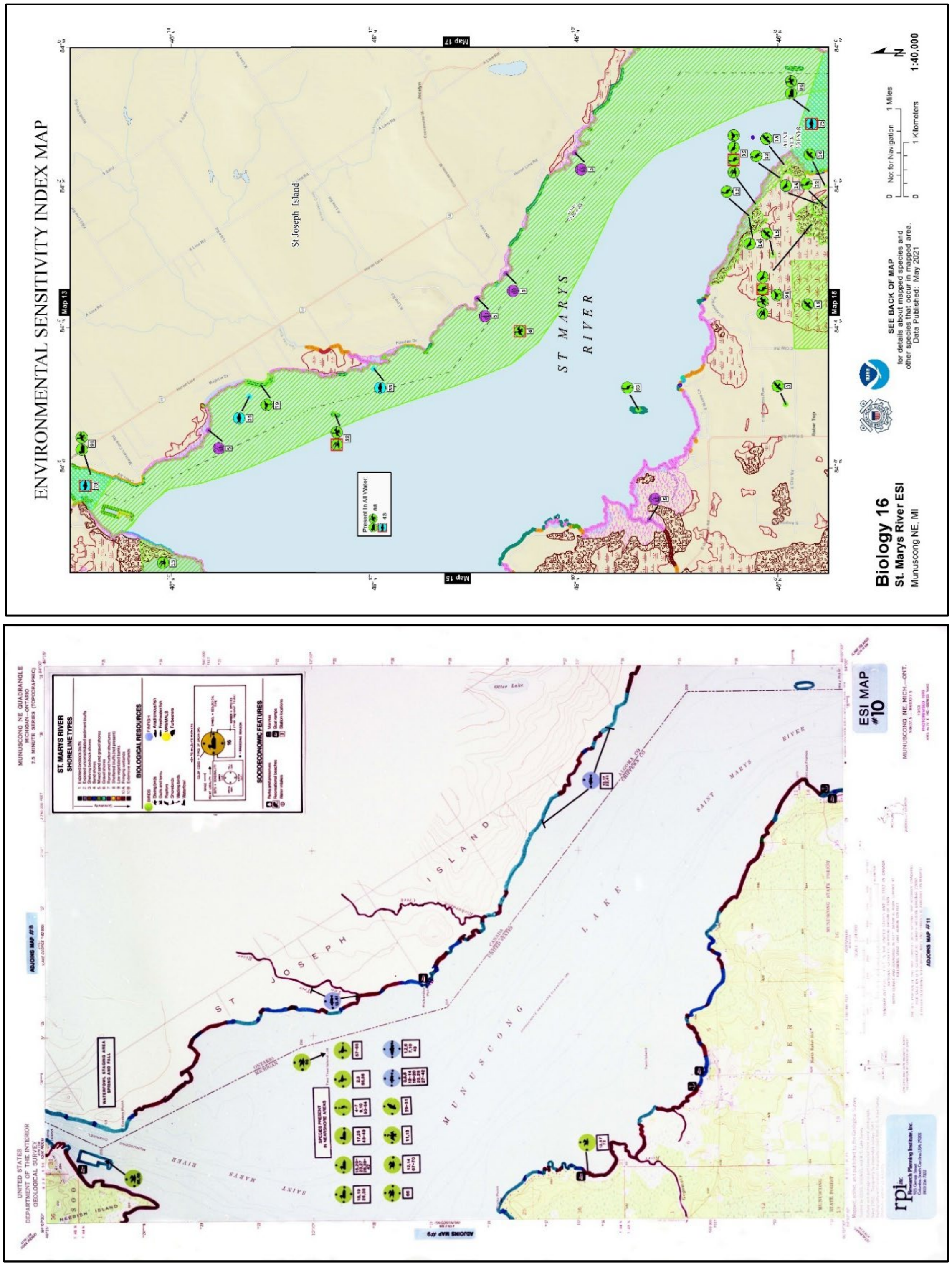

Figure G.1: Comparison of biological complexity - St Marys River ESI 1986 vs. 2021.

While the abundance of coastal information increases the utility of the digital ESI, it makes production of a mapped rendition of the data extremely challenging. Several changes were made to the ESI map product starting in 2014.

1) Each ESI atlas map is based on the USGS topographic map grid at a scale to maximize an 11”x17” page. The ESI data is subdivided into two maps based on the same USGS topographic map grid at the same map scale. The layout for the first map displays the biological features along with the shoreline and coastal habitats. The second map displays human-use features, shorelines, and coastal habitats.
2) The map tiles are based on the land/water interface. All ESI classified shorelines should be represented on a map. The use of an irregular, floating map grid as described in Version 4.0 of the guidelines is not acceptable.
3) Biological data are either displayed on the map or assigned a Present Throughout (PTO) designation for a specific geography on the map. The most vulnerable species or life stages (threatened/endangered, critical life stages, discrete occurrences) are typically displayed on the map. Features assigned to a PTO are displayed in a PTO box on the front of the map. The PTO box contains geographic reference, subelement icon, and corresponding RAR numbers (**Figure G.2**). Features removed from the map cannot be assigned a PTO of “Present in Mapped Area” as all features must reference a geographic feature. Examples of acceptable PTO references are below:

- Present in All Water
- Present in Nearshore Water
- Present in Inshore Water
- Present on Sand Beach
- Present in Salt Marsh
- Present in Mangroves
- Present in Lake Michigan
- Present in Delaware Bay
- Present on Land
- Present Along Shoreline

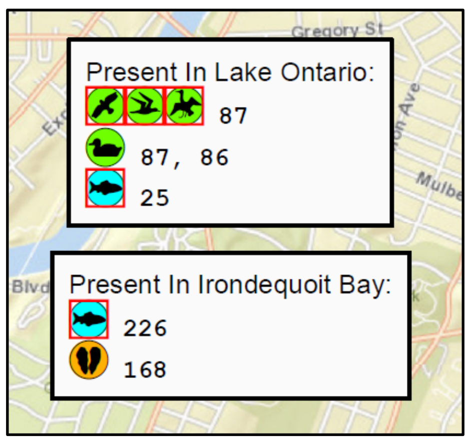

Figure G.2: Examples of PTO geographic references and PTO boxes.

4) The human-use features are mapped in a similar manner to the ESI biology maps. Human-use features are typically displayed on maps, but some features can be assigned a PTO to reduce clutter.
5) All biological features must have an RAR number and be displayed on the "back of the map" data table for each biology map grid. Human-use features displayed on the map with a human-use number must be displayed on the "back of the map" data table for each human-use (SOCECON) map (**Figure G.3**).

BIOLOGICAL RESOURCES:

BENTHIC:

RAR#	Species	S	F	Concentration	Mapping Qualifier	J	F	M	A	M	J	J	A	S	O	N	D
81	Deep sea coral			Potential	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D
221	Hardbottom reef			-	Vulnerable Occurrence	J	F	M	A	M	J	J	A	S	O	N	D
222	Coral and rock			Scattered	Vulnerable Occurrence	J	F	M	A	M	J	J	A	S	O	N	D
235	Seagrass			Continuous	High Ecological Value	J	F	M	A	M	J	J	A	S	O	N	D
236	Seagrass			Patchy	High Ecological Value	J	F	M	A	M	J	J	A	S	O	N	D
238	Johnson's seagrass	T	T	Present	Vulnerable Occurrence	J	F	M	A	M	J	J	A	S	O	N	D
240	Johnson's seagrass	T	T	Potential	Vulnerable Occurrence	J	F	M	A	M	J	J	A	S	O	N	D
	Seagrass			Continuous	High Ecological Value	J	F	M	A	M	J	J	A	S	O	N	D

BIRD:

RAR#	Species	S	F	Concentration	Mapping Qualifier	J	F	M	A	M	J	J	A	S	O	N	D	Nesting		Migrating	Molting
121	Florida scrub-jay	T	T	-	Vulnerable Occurrence	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
130	Black-bellied plover			109	Concentration Area	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Dunlin			109	Concentration Area	J	F	M	A	M			A	S	O	N	D	-	-	-	-
	Pectoral sandpiper			109	Concentration Area			M	A	M		J	A	S	O	N		-	-	-	-
	Ruddy turnstone			109	Concentration Area	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Sanderling			109	Concentration Area	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Semipalmated plover			109	Concentration Area	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Semipalmated sandpiper			109	Concentration Area	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Western sandpiper			109	Concentration Area	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Willet			109	Concentration Area	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
134	Double-crested cormorant			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Gulls			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Pelicans			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Terns			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Waterfowl			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
153	Black skimmer	T		Up To 8 Birds	Concentration Area	J	F	M	A	M	J	J	A	S	O	N	D	May-Sep	-	-	-
	Least tern	T		Up To 117 Birds	Concentration Area			M	A	M	J	J	A	S				Apr-Aug	-	-	-
184	Black skimmer	T		-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Brown pelican			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Gulls			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Terns			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
185	Audubon's shearwater			-	General Distribution				A	M	J	J	A	S	O	N		-	-	-	-
	Black-capped petrel			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Black tern			-	General Distribution			M	A	M				S	O	N		-	-	-	-
	Bridled tern			-	General Distribution				A	M	J	J	A	S	O			-	-	-	-
	Brown noddy			-	General Distribution				A	M	J	J	A	S	O			-	-	-	-
	Cory's shearwater			-	General Distribution					M	J	J	A	S	O	N		-	-	-	-
	Great shearwater			-	General Distribution					M	J	J	A	S	O			-	-	-	-
	Herring gull			-	General Distribution	J	F	M	A	M				S	O	N	D	-	-	-	-
	Laughing gull			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Northern gannet			-	General Distribution	J	F	M	A							N	D	-	-	-	-
	Parasitic jaeger			-	General Distribution				A	M			A	S	O			-	-	-	-
	Pomarine jaeger			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Red-necked phalarope			-	General Distribution			M	A	M								-	-	-	-
	Red phalarope			-	General Distribution	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-
	Royal tern			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-
	Sooty tern			-	General Distribution				A	M	J	J	A	S	O			-	-	-	-
	White-tailed tropicbird			-	General Distribution				A	M	J	J	A	S	O			-	-	-	-
	Wilson's storm-petrel			-	General Distribution				A	M	J	J	A	S				-	-	-	-

FISH:

RAR#	Species	S	F	Concentration	Mapping Qualifier	J	F	M	A	M	J	J	A	S	O	N	D	Spawning		Eggs	Larvae	Juveniles	Adults
133	Atlantic croaker			-	General Distribution	J	F	M	A	M	J	J	A	S	O	N	D	-	-	-	-	-	-
	Black drum			-	General Distribution	J	F	M	A	M		J	A	S	O	N	D	-	-	-	-	-	-
	Blue runner			-	General Distribution					M	J		A	S	O			-	-	-	-	-	-

HUMAN USE RESOURCES:

MANAGED: PARKS/MANAGED AREAS:

HUN#	Name	Contact	Phone
5186	JOHN C AND MARIANA JONES HUNGRYLAND WEA	PAM BOODY, AREA BIOLOGIST; DAVE SWEETAY, DISTRICT BIOLOGIST	561-625-5122
5196	JONATHAN DICKINSON STATE PARK	MARK NELSON, THOMAS BROWN	561-744-9814

NAV_MARINE: NAVIGATION/MARINE - RECREATIONAL/MARITIME:

HUN#	Name	Contact	Phone
1035	CYPRESS CREEK NATURAL AREA KAYAK LAUNCH DOCK	PALM BEACH COUNTY	
1099	JONATHAN DICKINSON STATE PARK	FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION	
1122	LIMESTONE CREEK NATURAL AREA CANOE/KAYAK LAUNCH	PALM BEACH COUNTY	
1197	RIVERBEND PARK CANOE AND KAYAK LAUNCH	PALM BEACH COUNTY	
1481	G92 CONTROL STRUCTURE	SFWMD	
1500	STRUCTURE NO. 46	SFWMD (PAST C&SF FCD)	

POLITICAL: POLITICAL/JURISDICTIONAL MANAGEMENT:

HUN#	Name	Contact	Phone
320	SOUTH PERMITS BRANCH - PALM BEACH GARDENS	PERMIT OFFICE	561-472-3504
1261	DISTRICT 7 - SECTOR MIAMI	HEADQUARTERS	305-535-4300
1276	MARTIN		
1280	PALM BEACH		
1358	EPA REGION 4	MAIN OFFICE	404-562-9900
1372	FEMA REGION IV	MAIN NUMBER	770-220-5200

RESOURCE: RESOURCE MANAGEMENT:

HUN#	Name	Contact	Phone
1299	TRICHECHUS MANATUS CRITICAL HABITAT	SE REGIONAL OFFICE	404-679-7319
1367	COASTAL INLETS	PACE WILBER	561-440-1333

SOCECON: OTHER SOCECON FEATURES:

HUN#	Name	Contact	Phone
228	BR RANCH	LOGAN FLEMING	407-747-5390
269	TAILWINDS	MITCHELL RACKER	917-881-0101
1334	JUPITER, TOWN OF - WATER TREATMENT PLANT		
1335	LOXAHATCHEE ENVIRONMENTAL CONTROL DISTRICT - WWTP		
1390	FLYING H	CHRISTOPHER T. HENDERSON	407-747-3500

Figure G.3: Example of “back of the map” data tables. Biological resources (top). Human-use resources (bottom).

6) Electronic versions of biology and human-use PDF maps are now distributed as layered geographic PDFs. Individual biological and human-use feature classes can be turned off/on allowing the user to create thematic maps. Layered geographic PDFs increase the visibility/readability of the color-coded shoreline features and contain inherent spatial reference information, allowing the map to be used in many GIS packages.

Advances in GIS technology have driven the development of an ArcGIS Pro Add-In for creating "on-the-fly" ESI Maps. Nearly every aspect of ESI map production described Version 4.0 guidelines (2019) has changed. ESI map production described in Version 5.0 of the guidelines aligns the product more closely with its original purpose as a spill planning and response tool.

The ArcGIS Pro "map-on-the-fly" Add-in is licensed to NOAA through July 2028 or until the Software is deprecated, whichever comes first. Contact the NOAA ESI Program Manager for access to the RPI ESI Toolbar and Map Creation User Guide.

Biological Resources: Filtering and Map Presentation

Biological data are compiled and organized by RAR number to reduce the complexity of the features displayed on the map. Filtering the biological data and assigning PTOs should be completed by working closely with the project biologists. The goal is to display the most critical species locations on the map and assign geographically referenced PTOs to large comprehensive geometries. The "back of the map" data tables will display all the species information and relate to a specific geography on the map.

Biology Data: Map Presentation

Biological features are symbolized by a hatched area, line, or point symbol, color-coded to match the ESI standardized symbol set (**Figure G.5**). The corresponding attribute information is summarized on the "back of map" data table of the map (Figure G.3).

Biological features are accompanied by marker symbols (icons) representing the unique biological subelements found in the mapped feature. Icons are determined by the subelement listed in the BIOCOMB table for the species by RAR number. If any state or federally listed species appears within a feature, the corresponding subelement icon will include the red square box denoting species status (See **Figure G.4)**. If an RAR has more than one subelement present in a feature, icon symbols are grouped to include each unique subelement assemblage (Figure G.4). The RAR number corresponding to the attributes on the back of the map is shown below the icon or icon assemblage. RAR numbers in the PTO box will be displayed to the right of the subelement icon (Figure G.2).

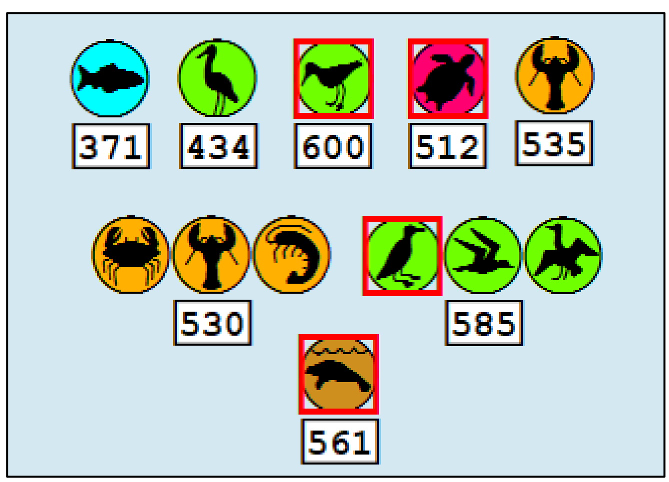

Figure G.4: Example of ESI Biological Resource Symbology (Icons). Red box around the icon denotes threatened/endangered status.

Figure G.5: Biological features symbol set, colors, icons, and hatch patterns.

Human-use Data: Map Presentation

Human-use (socioeconomic) elements are also represented with icon symbols depicting the type of resource mapped (**Table G.1**). To reduce the amount of data presented on the human-use map and to maximize readability, PTO boxes can be assigned to human-use features similarly to the biology resources. Not every human-use feature is given a Human-Use NUMber (HUNUM). Features without a HUNUM are shown on the map but not reported on the "back of the maps" data tables. The remaining human-use features displayed on the map with a HUNUM are reported on the "back of the maps" data tables (Figure G.3).

Table G.1: Human-use features symbol set (icons), HUNUM, and map/table display.

CODE	ICON	TYPE	HUNUM on MAP	MAP and TABLE STATUS
A		AIRPORT	YES	Map and Table
A2		ACCESS	NO	Map
AN		ANCHORAGE	NO	Map
AQ		AQUACULTURE	YES	Map and Table
AR		ARTIFICIAL REEF	YES	Map and Table
AS		ARCHAEOLOGICAL SITE	NO	Map
AV		ABANDONED VESSEL	NO	Map
B		BEACH	NO	Map
BR		BOAT RAMP	YES	Map and Table
C		CAMPGROUND	YES	Map and Table
CF		COMMERCIAL FISHING	NO	Map
CG		COAST GUARD	YES	Map and Table
CH		CRITICAL HABITAT	YES	Map and Table
DV		DIVING	NO	Map
EH		ESSENTIAL HABITAT	YES	Map and Table

F		FERRY	NO	Map
FA		FISHERY AREA	YES	Map and Table
FO		NATIONAL FOREST	YES	Map and Table
FR		FERRY ROUTE	NO	Map
FR		FERRY ROUTE (LINE)	NO	Map
HP		HELIPORT	YES	Map and Table
HS		HISTORICAL SITE	NO	Map
HWR		HISTORIC WRECK	NO	Map
IB		INTERNATIONAL BORDER	NO	Map
IB		INTERNATIONAL BORDER (LINE)	NO	Map
IR		TRIBAL LAND	YES	Map and Table
LD		LOCK AND DAM	YES	Map and Table
M		MARINA	YES	Map and Table
MA		MANAGEMENT AREA	YES	Map and Table
MS		MARINE SANCTUARY	YES	Map and Table
NC		NATURE CONSERVANCY	YES	Map and Table
NERR		NATIONAL ESTUARINE RESEARCH RESERVE	YES	Map and Table
NOAA		NOAA FACILITY	YES	Map and Table
NL		NATIONAL LANDMARK	YES	Map and Table
NP		NATIONAL PARK	YES	Map and Table
P		PARK	YES	Map and Table
PF		PLATFORM	YES	Map and Table

PL		PIPELINE	NO	Map
PL		PIPELINE (LINE)	NO	Map
PT		PORT	YES	Map and Table
R		BRIDGE (ROAD) LINE	NO	Map
RF		RECREATIONAL FISHING	NO	Map
RR		RAIL ROUTE (LINE)	NO	Map
S		SUBSISTENCE	YES	Map and Table
S2		SURFING	NO	Map
SL		SHIPPING LANE (LINE)	NO	Map
SPA		STATE PROTECTED AREA	YES	Map and Table
ST		STATE	NO	Map
ST		STATE BORDER (LINE)	NO	Map
TL		TRIBAL LAND	YES	Map and Table
WI		WATER INTAKE	YES	Map and Table
WO		WASH OVER	NO	Map
WR		WILDLIFE REFUGE	YES	Map and Table
		OUTLINE - ALL MANAGEMENT AREA POLYGONS	NO	Map

ESI Shoreline and Habitat Polygon Mapping

The ESI shoreline and habitat polygons are shown on both the human-use and biology maps. The standardized color scheme (**Figure G.6**) is designed to emphasize the most sensitive shoreline types by featuring warm/hot colors, while less sensitive shoreline types are represented with cool colors. This symbology has remained virtually the same since the first ESI maps, except for minor modifications made in 2015 to better accommodate color blindness and to assure shoreline types that have been added over the years fit appropriately into the cool-to-warm color spectrum.

ESI Shoreline and Habitat Ranking

Symbols	Shoreline Classification Description*	CMYK
	1A) Exposed, Rocky Shores (E/L) 1A) Exposed, Rocky Banks (R) 1B) Exposed, Solid Man-Made Structures (E/L/R) 1C) Exposed, Rocky Cliffs w/Boulder Talus Base (E/L/R)	56/94/0/13
	2A) Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay) (E) 2A) Shelving Bedrock Shores (L) 2A) Rocky Shoals and Bedrock Ledges (R) 2B) Exposed Scarps and Steep Slopes (Clay) (E)	38/44/0/0
	3A) Sand Beaches (E/L) 3B) Scarps and Steep Slopes (Unconsolidated Sediment) (E/L/R) 3C) Tundra Cliffs (E)	100/65/15/0
	4) Sand Bars and Gently Sloping Banks (R)	82/27/0/0
	5) Mixed Sand and Gravel Beaches (E/L) 5) Mixed Sand and Gravel Bars and Gently Sloping Banks (R)	100/10/34/0
	6A) Gravel Beaches (E/L) 6A) Gravel Bars and Gently Sloping Banks (R)	100/45/53/0
	6B) Riprap (E/L/R) 6B) Cobble/Boulder Beaches (E)	78/34/100/0
	7) Exposed Flats (E/L)	0/0/100/25
	8A) Sheltered Rocky Shores and Sheltered Scarps in Mud/Clay (E/L/R)	0/0/100/0
	8B) Sheltered, Solid Man-Made Structures (E/L/R)	0/34/28/0
	8D) Sheltered, Rocky, Rubble Shores (E) 8E) Peat Shorelines (E) 8F) Vegetated, Steeply Sloping Bluffs (R)	2/4/100/0
	9A) Sheltered Flats (E/L) 9B) Vegetated Low Banks (E/L/R) 9C) Hyper-Saline Tidal Flats (E)	0/42/99/0
	10A) Salt and Brackish Water Marshes (E)	0/100/100/0
	10B) Freshwater Marshes (E/L/R)	0/50/0/0
	10C) Swamps (E/L/R)	20/90/80/0
	10D) Scrub and Shrub Wetlands (E/L/R)	55/100/100/0
	10E) Inundated Low Lying Tundra (E)	0/50/0/0
	10F) Mangroves (E)	55/100/100/0

* Physiographic region description in parentheses: (E) Estuarine, (L) Lacustrine, (R) Riverine

Figure G.6: Example of shoreline symbolization for single and multiple shoreline types.

The shoreline is symbolized with lines wide enough to be seen at the mapped scale and to also accommodate multiple types, since ESI shorelines may be classified with up to three distinct shoreline types. **Figure G.7** shows a labeled sample to point out a homogenous shoreline (type 10A - Salt- and Brackish-Water Marshes), and a shoreline segment with two types (Sheltered Flat – 9A, backed by Salt- and Brackish-Water Marshes - 10A). There are also two segments shown that represent three shoreline types: ESI 7 – Exposed Tidal Flats, on the seaward side, backed by ESI 6A – Gravel Beaches, and ESI 10A – Salt- and Brackish-Water Marshes on the landward side. Each of these segments share a boundary with an ESI polygon of type 10A and serve as a reminder that any shoreline bordering an ESI polygon may also share the ESI type of the polygon it abuts.

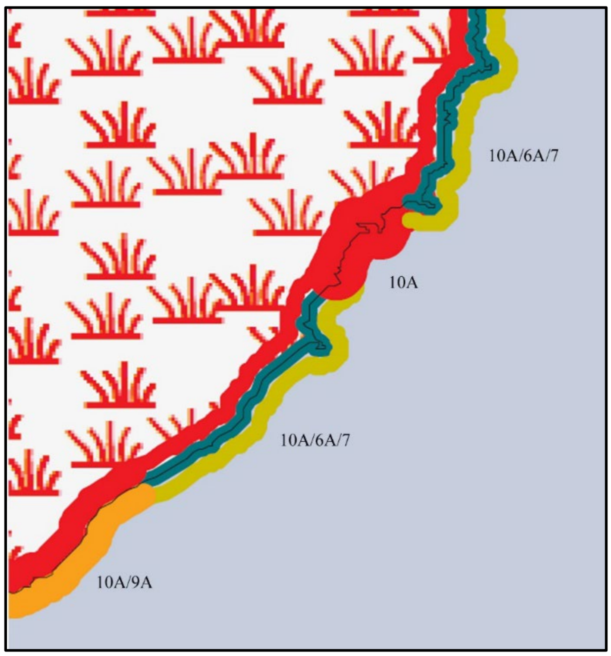

Figure G.7: Example of shoreline symbolization for single and multiple shoreline types.

Because the symbolized ESI shoreline requires width to enhance readability, the shoreline is shown twice on the maps: first the color-coded, classified shoreline is displayed, then the shoreline is drawn again, symbolized with a narrow, black line to show the detailed shape of the shoreline.

To accurately display a shoreline segment with multiple types, proper ordering of the shoreline classification is essential. The most landward type is listed first, with any additional types appended based on proximity to land. The map symbolization must also reflect this order. Prior to symbolizing, the QA process confirms that all shoreline segments are directionally mapped to have the land on the right. If any shoreline segments (*Line* = 'S') have land to the left, they are flipped so the symbolization properly reflects the intended landward to shoreward beach composition.

When the hatched, color-coded biological polygons are displayed with the shoreline, it can be difficult to discern the shoreline colors underneath. For this reason, ESI PDF maps are now layered, to allow the user to turn off the biology layers and view only the ESI shoreline and polygons.

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APPENDIX H

Revisions to the ESI Guidelines from Version 4.0 to Version 5.0

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APPENDIX H: REVISIONS TO THE ESI GUIDELINES FROM VERSION 4.0 TO VERSION 5.0

Advances in technology, data collection methodologies, end-user needs, and ESI applications have driven the evolution of the ESI atlas creation process. Nearly every aspect has changed in some way since the 2019 Version 4.0 guidelines, aligning the product more closely with its original purpose as a spill response tool. While ESIs are now also used for applications like hurricane response and other purposes, feedback from NOAA, focus groups, and end-user surveys support these updates to better prioritize core goals and enable more timely, cost-effective revisions of the ESI product. Changes from the 2019 Version 4.0 guidelines to Version 5.0 are outlined below within their respective categories.

ESI SHORELINE (CHAPTERS 2 & 3)

The following ESI Shoreline changes have been made between Versions 4.0 and 5.0 due to a variety of reasons. Shoreline classification is almost exclusively done from high-resolution aerial and satellite imagery, making changes to shoreline rankings necessary due to the inability to differentiate certain shoreline types. ESI data are often made available via online map platforms such as NOAA's ERMA, thus printed maps are often not requested or required. Datasets that are used to create the shoreline contain attributes that can be converted to the ESI scale and often have features that are smaller than what were previously recommended.

Changes to ESI shoreline rankings:

- ESI 3A (previously fine-grained sand beaches) and 4 (previously coarse-grained sand) have been aggregated into 3A to include all sand beaches with no grain size distinction because it is extremely difficult to differentiate between fine- and coarse-grained sand in the imagery commonly used for classification. Teams on the ground during a response will be able to make this call when they are recommending cleanup actions.
- ESI 4 is now being used for sand bars in riverine environments because they are prevalent in some areas.
- ESI 8C (sheltered riprap) was dropped because it was determined that there was no need to differentiate the different degrees of exposure for riprap shorelines.
- The descriptions for 7 and 9A flats no longer include the substrate type (sand, mud) due to the potential for exposed mud flats. The description for exposed flats in estuarine and lacustrine environments and for sheltered flats in estuarine environments no longer includes the word 'tidal' to allow for exposed flats in non-tidally influenced environments. Also, ESI Code 7 has been removed from the riverine environment because sand flats in rivers are sand bars (ESI 4).
- ESI codes specific to Southeast Alaska (SE AK Only) were dropped; this area will use the same classification descriptions as any other area in the U.S.

Decoupling ESIP and ESIL: Version 4.0 required that the ESI code for a wetland or intertidal habitat polygon in ESIP must be incorporated into the ESI line classification for any shoreline segments adjacent to that polygon. Having this requirement resulted in hundreds to thousands of small shoreline "slivers" (tiny line segments usually less than a centimeter in length) that bottlenecked the QA/QC process.

Additionally, Version 4.0 required that small, alongshore sliver polygons had to be mitigated between the ESIP and ESIL layers. Eliminating the alongshore sliver polygons increased the project level of effort and project cost. Thus, this is no longer a requirement and ESIL and ESIP are considered decoupled. Also, there are many cases where a wetland is adjacent to the shoreline but there is a narrow band of riprap (or some other significant shoreline type) between the wetland and shoreline.

<u>Changes to the HYDROL feature class</u>: In Version 4.0, the HYDROL feature class was composed of inland rivers and/or streams and offshore features such as docks, jetties, piers, etc. from ESIL but did not include the shoreline or boundaries around inland lakes and ponds. In Version 5.0, HYDROL represents the boundary between water and land and is composed of all ESIL features with LINE='S' and LINE='H'. Other linear features that are not part of the water/land boundary, such as jetties and groins, are also retained in the HYDROL feature class.

<u>Removal of the Minimum Mapping Unit (MMU) requirement</u>: The concept of the MMU was created to provide a standard for ensuring visibility of features on printed maps at a target scale. However, the MMU for an ESI dataset is no longer tied to the printed scale of the ESI map as specified in Version 4.0 of the ESI Guidelines and is no longer a requirement. If anything, the MMU should be defined by the client.

<u>ESI Shoreline Classification Scale</u>: The ESI shoreline classification scale has evolved since the 1980s. **Figure H.1** shows the general evolution of the classification scale. Refer to Chapters 2 and 3 as well as Appendix G for additional information for classifying and mapping the ESI.

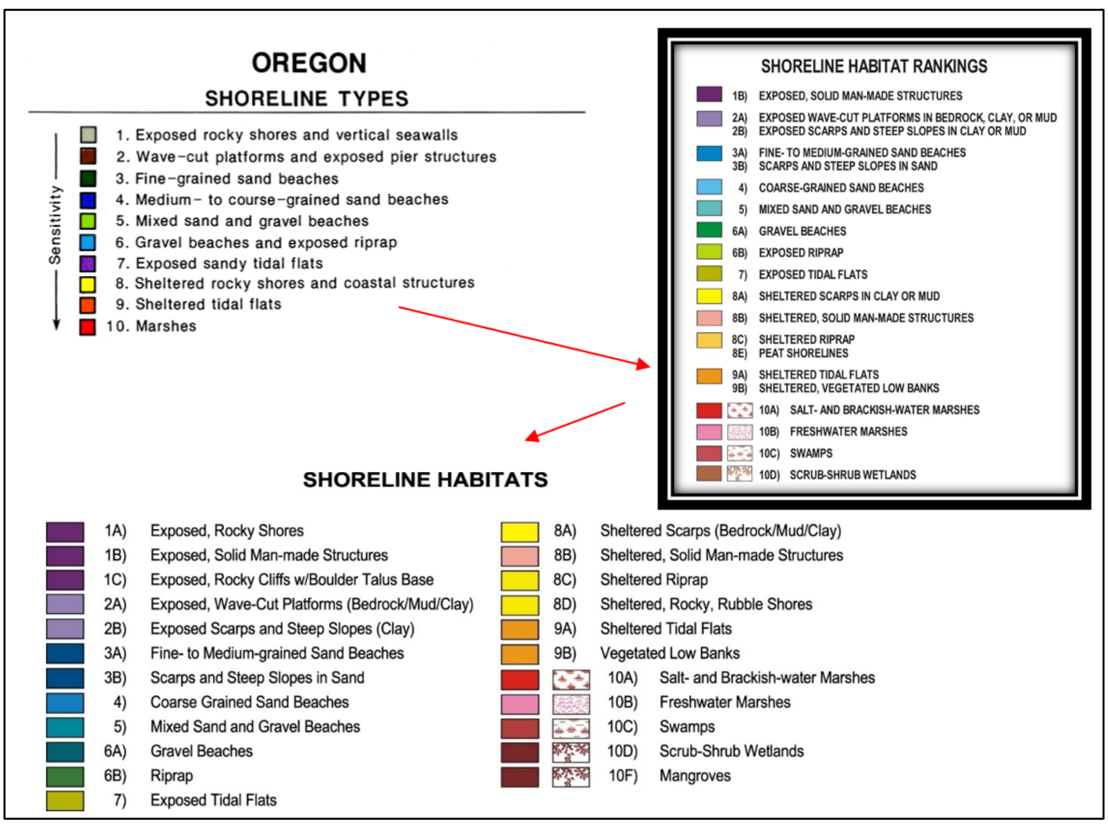

Figure H.1 General ESI shoreline classification evolution.

ESI BIOLOGY COMPONENT

The following ESI Biology changes have been made between Versions 4.0 and 5.0 as there is a renewed focus on mapping species and attributes that are drivers for spill response decisions, thus prioritizing, a) federal and state listed threatened and endangered species, b) commercial and recreational species, c) sensitive species and life history stages, and d) concentration areas. See Appendix G for additional information for mapping biological resources.

- Mapping of biological features is no longer associated with a MMU based on a printed map scale. The MMU is typically determined in close coordination with the resource expert and data providers.

<u>Attributes that have been discontinued:</u>

- Dropped mapping qualifier so there are less attributes to populate/confirm legality for. Mapping qualifiers were redundant with breed categories.
- Dropped S-Source so there are less attributes to populate/confirm legality for. S-Source bibliographic information is covered in the Introductory pages.
- Dropped INTERNESTING breed category as it is not relevant to decision making for in-water or beach nesting sea turtle protection in responses.

<u>Streamlining of subelements:</u>

- Collapsed all FISH subelements into a single “fish” subelement as the subelement designations for fish did not add value in terms of decision making for response and added unnecessary complexity.
- Dropped “upland” and “wetland” subelements from HABITAT element as they were not relevant to decision making for shoreline response options.
- Dropped “shellfish” subelement from INVERT element as it was redundant with other remaining subelement designations based on taxonomy.

<u>Spatial Data and Attributes:</u>

- Non-overlapping polygon requirement has been removed. The requirement for BIOLOGY feature dataset polygons to be collapsed or ‘cut’ at intersections, forming new polygons in areas of overlap has been removed in Version 5.0. Removing this requirement allows for overlapping polygons within the individual BIOLOGY Feature Dataset. This requirement was costly to implement and introduced unnecessary errors, as it created new features after the data had received a thorough quality check. It also created the need for additional checks as well as extra steps to remove records to normalize all associated tables. The small polygons created in some cases introduced unnecessary slivers and distorted the geometry, among other issues.
- The ID attribute in the feature classes is no longer with the migration to overlapping polygons in Version 5.0. RARNUM is used to relate the biology feature classes to the BIOCOM table. For this reason, the BIO_LUT is deprecated.

<u>Data collection and depiction changes:</u>

- HABITATS (terrestrial plants) – These features no longer need to be mapped to the full inland extent of the ESI, typically 5-miles inland from the shoreline. HABITATS are mapped within ½-mile of the shoreline but must include the full extent inland extent of shoreline adjacent marsh habitats.

HUMAN-USE (SOCIOECONOMIC) COMPONENT

<u>Human-Use Types Omitted</u>

The adoption of an abbreviated list of human-use types is warranted for many reasons, mainly due to the departure from the original use of ESI data as a spill response tool. Featuring an extensive list of human-use types that are typically depicted as point locations such as campgrounds, landfills, factories, renewable energy sites, and others obscures data that are more relevant to the original intent of the ESI atlas and delays response activities as the user has to determine and prioritize pertinent information in a short amount of time. It is important to note that although we are moving away from mapping certain types in Version 5.0, those types may be included if they are region-based or at the request of the client.

Jurisdictional boundaries (e.g., EPA and FEMA regions) are authoritative, generally cover much of the geographic extent of an atlas, and are readily available elsewhere. Featuring these datasets within the ESI framework and matching those to a newly created ESI shoreline is extremely time-consuming and costly. Online mapping interfaces (e.g., ERMA) have become mainstream and are readily available to the user by incorporating ESI data as well as jurisdictional boundaries from various authoritative sources.

The natural hazard element containing various categories of storm surge inundation areas as well as tsunami inundation zones was removed due to their widespread coverage within the ESI atlas and, like jurisdictional boundaries, matching those to a newly created ESI shoreline is extremely time-consuming and costly. These datasets were often complex and nested within themselves and, like jurisdictional boundaries, often cover the entire geographic extent of the ESI atlas and require extensive processing to effectively incorporate into the ESI product.

Invasive species mapping has been removed regarding traditional mapping methodology. These data may still be featured in the atlas upon request, with information included within the introductory pages and/or associated documents as necessary.

Figure H.2 compares the human-use features mapping guidance from Version 4.0 and new guidance found in Version 5.0. The redlined features have been removed from Version 4.0. It is important to note that historical human-use features may be mapped at the request of the ESI Program Managers.

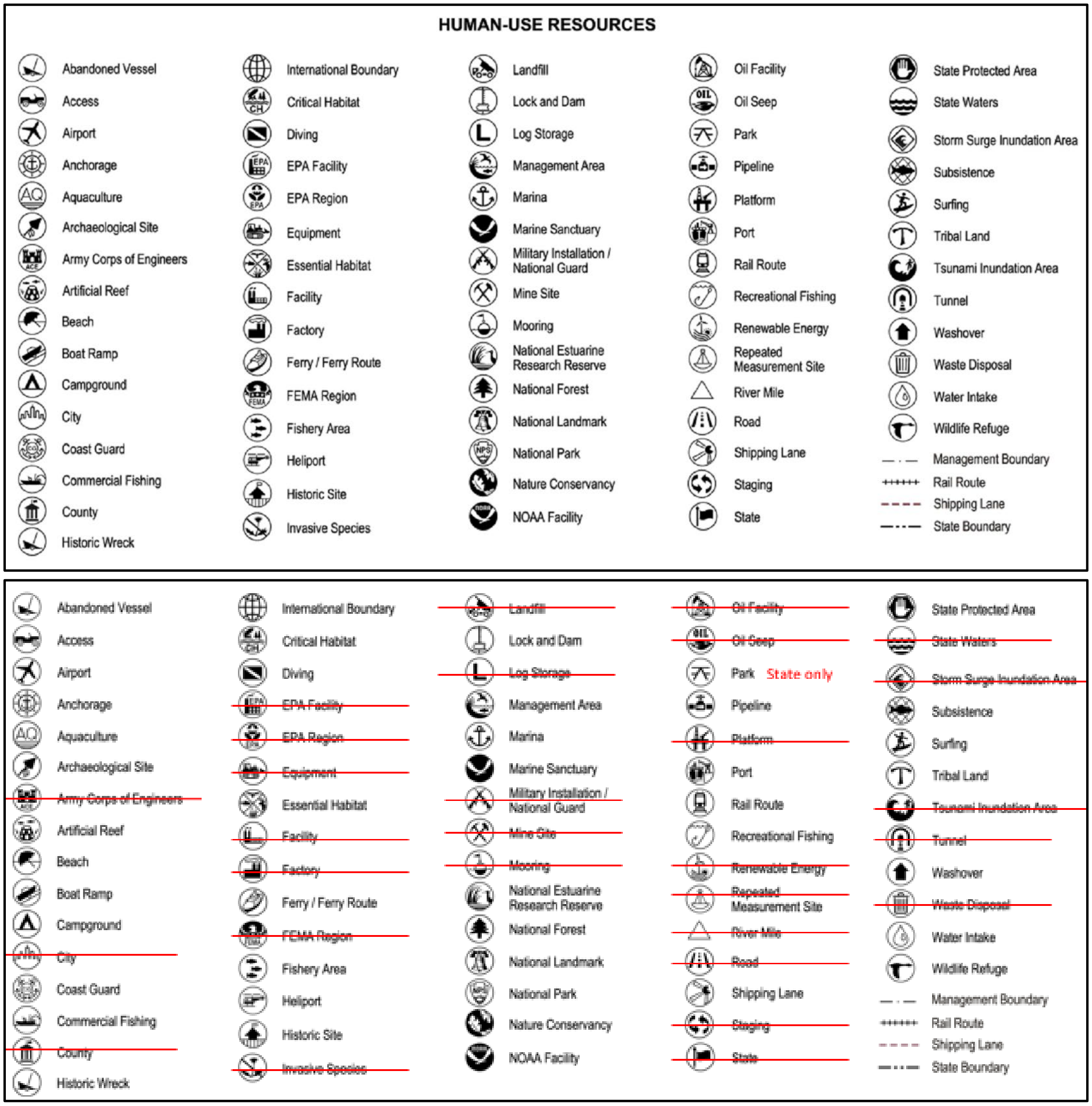

Figure H.2. Mapped human-use types (77 features) Version 4.0 (top) vs huma-use types mapped per Version 5.0 (bottom), redlined features have been omitted. Approximately 50 Human-use features to be mapped in Version 5.0**.**

Coincident Boundary Requirement Removed

Because source data sets typically rely on different base shorelines, adjustments have been necessary to match each dataset to the ESI shoreline in the past. Cost-effective reductions have moved the process away from matching each individual source dataset to the ESI shoreline. Following a review of any associated metadata, written legal definitions, and/or information from the data provider(s), clipping human-use features appropriately to land or water as needed, rather than attempting to resolve underlaps with the ESI shoreline is the approach adopted in Version 5.0.

Non-overlapping Polygon Requirement Removed

The requirement for BIOLOGY and SOCECON feature dataset polygons to be collapsed or 'cut' at intersections, forming new polygons in areas of overlap has been removed in Version 5.0. This requirement was costly to implement and introduced unnecessary errors, as it created new features after the data had received a thorough quality check. It also created the need for additional checks as well as extra steps to remove records to normalize all associated tables. The small polygons created by this step had to be checked for MMU violations and, in some cases, introduced unnecessary slivers and distorted the geometry, among other issues.

Feature Class Attributes

With the migration from non-overlapping polygons to allow for overlap in the SOCECON feature datasets in Version 5.0, the extra polygons that were once formed as overlapping features were 'cut' at intersections are no longer created. The ID attribute was used to identify which polygons were associated with HUNUMS by way of a join between the spatial data and lookup table (deprecated). See SOC_LUT for more information.

Associated Data Tables

The SOC_LUT was a path between the human-use features and the associated SOC_DAT data table housing information for each HUNUM. With the removal of the requirement for non-overlapping polygons, additional polygons are no longer created and tracked via ID. Each polygon now contains just the associated HUNUM that can be joined directly to the SOC_DAT table using the HUNUM attribute (one-to-one relationship).

The SOC_DAT table, as mentioned above, contains information for each HUNUM of the SOCECON feature dataset. Formerly, both the geographic source (G_SOURCE) as well as the attribute source (A_SOURCE) were required in this table. Version 5.0 has removed the A_SOURCE requirement, as both source types are typically the same for most datasets. Removing this requirement omits population of another field and further streamlines processes.

APPENDIX I

Layout for Introductory Pages

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APPENDIX I: LAYOUT FOR INTRODUCTORY PAGES

The ESI introductory pages (intro pages) are a critical component of the ESI Atlas, as they provide detailed process descriptions, expert contacts, and bibliographic information, as well as data use limitations to be considered. The following guide lays out the components of the ESI intro pages.

Headers, footers, and naming conventions

ESI intro pages are typically titled: Environmental Sensitivity Index: Atlas Title (e.g., Lake Michigan, South Florida). Footers are the atlas title – lower case Roman numeral page numbers (e.g., Lake Michigan – iii). The following sections are included in all ESI intro pages.

Introduction

The introduction section includes a detailed description of the geographic Area of Interest (AOI), including major water bodies, islands, bays, rivers, etc. that fall within the AOI boundaries. It also includes a brief description of the three main ESI categories and use restraints.

Shoreline Habitat Mapping

The shoreline habitat mapping section describes:

- Sources and methods used to update and classify the shoreline and shoreline habitats.
- ESI shoreline classification and ranking scale description.
- Behavior and persistence of oil in shoreline habitats, including a list of shoreline types with reference to descriptions at the end of the document.

Sensitive Biological Resources

The sensitive biological resources section describes:

- A list of source agencies who provided data, including seasonality and life-history information, and reviewed the draft product.
- Key features on ESI maps:
    - A legend or key identifying elements, subelements, and associated icons displayed on pdf/hardcopy maps.
    - Brief description of spatial species representation (polygons, lines, or points).
    - Explanation of subelement grouping scheme.
    - Resources at Risk number (RAR#) definition.
    - Explanation of federal and state listing status and other tabular attributes.
    - Description of feature-level source information.

Detailed processing steps and background information for each mapped element are described in separate subsections for each element (Marine Mammals, Birds, Herpetofauna, Terrestrial Mammals, Fish, Invertebrates, Benthic Habitats, Habitats).

- Description of species depicted (species-level information for federal -and state-listed species and subelement-level information for others).
- Individual species, subelement, or data source-based processing notes.
- Processing notes, including determination of concentration values and data sources.
- Expert contact table, including name, agency, city, phone number, and species/program of expertise.
- Major data sources used bibliography.

Human-Use Resources

This section includes descriptions of each mapped human-use resource, including:

- Polygons, points, and linear features.
- HUNUM and data table attributes.
- Table of human-use resource types and icons included in the ESI Atlas.
- Source information and processing notes for each mapped human-use type.
- Any non-traditional additional mapped human-use resources (e.g., Great Lakes Restoration Initiative – restoration project sites for Lake Michigan).

Geographic Information System

- Explanation of data layers, databases, and metadata.
  - Shoreline Classifications – ESI shoreline habitat classification storage.
  - Sensitive Biological Resources – storage as points, polygons, and lines.
  - Human-Use Features – storage as points, polygons, and lines.

Acknowledgments

Appropriate Use of Atlas and Data

Example text: This atlas and the associated database were developed to provide summary information on sensitive natural and human-use resources for the purposes of oil and chemical spill planning and response. Although the atlas and database should be very useful for other environmental and natural resource planning purposes, they should not be used in place of data held by any contributing agencies. Likewise, information contained in the atlas and database cannot be used in place of consultations with natural and cultural resource agencies, or in place of field surveys. Also, this atlas should not be used for navigation.

Species List

Table of common and scientific names of all mapped species and species groups organized by element and subelement, with federally or state listed species underlined. See example below.

Common Name	Scientific Name
BIRDS	
DIVING	
American white pelican	*Pelecanus erythrorhynchos*
Common loon	*Gavia immer*

Shoreline Descriptions

Section includes all ESI shoreline types mapped by name and shoreline ranking with a photograph from overflights, ground surveys, or oblique aerials used for classification, plus a description, predicted oil behavior, and response considerations for each ESI shoreline type mapped.

Example Shoreline Description:

EXPOSED, ROCKY SHORES (L) ESI = 1A

DESCRIPTION

- Exposed bedrock, often forming cliffs with an extended platform offshore.
- The rock surface can be highly irregular, with numerous cracks and crevices.
- Sediment accumulations are uncommon and usually ephemeral because waves remove the sediments.
- They occur along less than 1% of the shoreline.

PREDICTED OIL BEHAVIOR

- Any oil that is deposited is rapidly removed from exposed faces, although oil persistence is related to the incoming wave energy.
- The most resistant oil would remain as a patchy band at or above the high-water line.

RESPONSE CONSIDERATIONS

- Cleanup is usually not required.
- Access can be difficult and dangerous.
- Washing techniques with ambient water are most effective while oil is still fresh.

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APPENDIX J

Step by Step Metadata Guide

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APPENDIX J: STEP BY STEP METADATA GUIDE

This appendix provides a table with step-by-step guidance on creating ESI metadata using the NOAA *InPort* platform. These instructions can be used together with the ESI Metadata Templates to create thorough high-quality metadata for an ESI data set. Some metadata elements in *InPort* are entered as text or numbers, and some are selected from drop-down menus.

Several items in the following tables reference the metadata templates for examples of appropriate content. Those without access to *InPort* can still use the following guidelines and view exported versions from the links below, as well as published ESI records at https://inport.nmfs.noaa.gov.

All metadata records for a single ESI atlas are grouped into a single *InPort* directory, called a Project (PRJ). Within the Project, there will be individual Data Set (DS) records for each resource mapped. The Data Set record is the most comprehensive record, describing what's mapped, geometry types (points, lines, and/or polys), spatial extent, sources, and more. Each metadata Data Set will have one or more child items (entities) describing the feature data table(s) – one for each geometry mapped, and any related data tables.

Links to exported metadata tables:

ESI Metadata Templates (PRJ)

- ESI Feature Dataset
  - ESI metadata template (DS) - will describe both ESI LINE and ESI POLY feature sets
    - Sample ESIL child record metadata template (entity) –for lines
    - Sample ESIP child record metadata template (entity) – for polys
  - HYDRO metadata template (DS) - will describe both HYDRO LINE and HYDRO POLY feature sets
    - Sample HYDROL child record metadata template (entity) – for lines
    - Sample HYDROP child record metadata template (entity) – for polys
- BIOLOGY Feature Dataset
  - BIOLOGY metadata template (DS) – one for each biological element, may include points, lines, and/or polys
    - Sample BIOLOGY child record metadata template (entity) – one for each geometry type
    - BIOFILE metadata template (entity) – Include as a child item for all biological DS records. A BIOCOMB template has been created.
- SOCECON Feature Dataset
  - SOCECON metadata template (DS)
    - Sample HUMAN-USE child record metadata template (entity) – ALL of the above DS records should include a child record for each geometry type included in the DS
  - SOC_DAT metadata template – Include as a child item for all SOCECON DS records

Include with ALL metadata DS records (except HYDROP):
- SOURCES metadata template (entity) – applies to every metadata DS records, except HYDROP

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Port Section/Item	Guidance	Example(s)
1. Item Identification	This section provides information to identify a metadata record, i.e., title, abstract, purpose, etc.	
Title	Include the ESI atlas name and the year of publication; the biology and human-use records should include the name of the element; the ESI records should include base name of the dataset (HYDRO, ESI).	Long Island Sound ESI 2016 – BIRDS South Carolina ESI 2015 - HYDRO
Short Name	Not required. If this field is left blank, InPort will simply use the Title, which is preferred.	
Status	ESI data sets are generally considered "Complete". Other InPort options include "In Work" and "Planned".	Complete
Abstract	A brief narrative summary. Should reference the specific ESI data element and geographic types (Polygons, Points), the location and theme keywords, and other descriptive terms to assist in identifying relevant datasets.	*See Metadata templates for examples.*
Purpose	Describes the intent of the ESI data under OPA 1990, and caveats for their use. This section uses boiler plate text, as found in the metadata templates.	*See Metadata templates for examples.*
Notes	This field is for internal notes as needed. It will not be viewable in the public metadata record.	
Other Citation Details	Citation for contractor preparing the data for this ESI data set.	*See Metadata templates.*
Supplemental Information	Other information for this item or data set.	

2. Keywords	Keywords are words or phrases which summarize an aspect of the catalog item. Types of commonly used Keywords for ESI data sets would include "Theme" and "Spatial". Theme = word or phrase to describe the subject of the catalog item. Spatial = geographic name(s) of a location(s) covered by the catalog item. Temporal and Stratum Keywords are also allowed, but not used for ESI data sets.	Two applicable Thesaurus include NASA's Global Change Master Directory (GCMD) for Theme (Science) and Spatial (Location) keywords, and ISO 19115 Topic Categories for Theme keywords.

Theme Keywords

Thesaurus		**Keyword examples**
Global Change Master Directory (GCMD) Science Keywords	Where applicable, use Theme Keywords (as character strings) from NASA's Global Change Master Directory (GCMD) Science Keywords. A list of applicable science and spatial GCMD keywords is provided at the end of this appendix.	Earth Science > Human Dimensions > Environmental Impacts > Oil Spills
Global Change Master Directory (GCMD) Science Keywords	GCMD Science Keywords are hierarchical character strings. Use entire character string.	Earth Science > Biological Classification > Animals/Vertebrates > Birds
ISO 19115 Topic Category	Where applicable, use ISO 19115 Topic Category keywords such as "biota" and/or "Environment".	Biota
ISO 19115 Topic Category		Environment
None		Coastal Resources
None		Coastal Zone Management
None		Environmental Monitoring
None		Environmental Sensitivity Index
None		ESI
None		Oil Spill Planning
None		Sensitivity Maps
None		Wildlife

InPort Section/Item	Guidance	Example(s)

Spatial Keywords Spatial keywords for states and major waterbodies in study area.

Thesaurus		**Keyword examples**
Global Change Master Directory (GCMD) Location Keywords	Where applicable, use Spatial Keywords (as character strings) from NASA's Global Change Master Directory (GCMD) Location Keywords. A list of applicable science and spatial GCMD keywords is provided at the end of this appendix.	Continent > North America > United States of America > Maryland
None		Chesapeake Bay
None		Potomac River

3. Physical Location	Location of the information being cataloged. For ESIs, in most cases this will be NOAA OR&R, Seattle WA, USA.	
Organization		Office of Response and Restoration
City		Seattle
State/Province		WA
Country		USA
Location Description		

4. Data Set Information	A set of related data objects, such as the ESI Geodatabase. A Data Set contains one or more Data Entities (e.g., Layers, Tables) and their attributes (fields or columns).	
Data Set Type	Drop-down menu (e.g., GIS Files).	GIS Files
Maintenance Frequency	Frequency with which changes and additions are made to the data - not the metadata.	As needed
Maintenance Note	Specifics regarding maintenance of the GIS data. ESI data are considered static once published. However, if issues such as broken links or erroneous table contents are identified, the Geodatabase and/or Map Document may be updated.	*See Metadata templates for examples.*
Data Set Publication Status	The publication status of the Data Set - Published, Unpublished, or Unknown.	Published
Data Set Publication Date	The publication date of the data set, as a year, month, or day.	October 2016
Data Presentation Form	Drop-down menu in InPort, use "Map (digital)" for ESI data.	Map (digital)
Source Media Type	Drop-down menu in InPort, use "Online" for ESI data.	Online
Entity Attribute Overview	Detailed summary of the information contained in a data set. Should include the ESI Element (e.g., BIRDS) or theme, and the geometry type or types (e.g., points and/or lines and/or polygons) used to represent the ESI element.	*See Metadata templates for examples.*
Entity Attribute Detail Citation	Reference to the complete description of the entities, including column names and formats attributes, and attribute values for the data set.	NOAA ESI Guidelines
Entity Attribute Detail URL	URL to entity attribute detail citation	https://response.restoration.noaa.gov/esi
Distribution Liability	Statement of the liability assumed by the distributor.	*See Metadata templates.*

InPort Section/Item	Guidance	Example(s)

4. Data Set Information (continued)

Data Set Credit	Recognition of those who funded the ESI data. This will generally include NOAA/ORR, as well as any other state/federal agencies who contributed financial support.	*See Metadata templates for examples.*
Instrument	Not applicable to ESI data.	
Platform	Not applicable to ESI data.	
Physical Collection/Fishing Gear	Not applicable to ESI data.	

5. Support Roles	At least one Distributor Org, one Metadata Contact, one Point of Contact, and one Data Steward should be listed.	
Support Role Type	Include entries for Data Steward, Distributor, Metadata Contact, and Point of Contact.	Data Steward
From Date	The date of the ESI publication.	2016
To Date	Leave blank for ESI data, defaults to "Present".	Present
Contact	Select ESI Program Manager from drop-down menu for all roles except Distributor where Office of Response and Restoration should be selected.	ESI Program Manager -or- Office of Response and Restoration
Address (Mailing)	This and remaining fields self-populate when ESI Program Manager or Office of Response and Restoration are selected from the drop-down menu.	7600 Sand Point Way NE Seattle, WA 98115
Email Address		orr.esi@noaa.gov
Phone Number		
Fax		
Business Hours		
Organization		Office of Response and Restoration
Organization Address		1305 East-West Highway Silver Spring, MD 20910
Organization Phone		
Organization URL		https://response.restoration.noaa.gov
Business Hours		
Contact Instructions		

6. Extents	Information about geographical extents (horizontal and temporal) for this record.	
Currentness Reference	Select Publication Date from drop-down menu.	Publication Date
Extent Group 1		
Extent Description	Comment reflecting that the given extent is for the entire ESI area of interest, i.e. the extent of all land and water features included in the overall ESI study region, not the extent of objects mapped for the individual theme.	This extent reflects the geographic bounding box for the entire ESI area of interest, and is not limited to the exact extent of the objects mapped for [BIRDS]
Extent Group 1/Geographic Area 1		
W° Bound	Enter bounding box in decimal degrees.	-73.92726
E° Bound		-71.79632
N° Bound		41.98704
S° Bound		40.68816
Description		Bounding box for [Long Island Sound] area of interest

InPort Section/Item	Guidance	Example(s)

6. Extents (continued)

Extent Group 1/Time Frame 1		
Time Frame Type	For ESI data sets, Time Frame = "Range".	Range
Start	Date (or year) when ESI data collection was started.	February, 2017
End	Date (or year) when ESI data collection was completed.	May, 2018
Description	Include explanation of date range.	Data collection for the ESI [Long Island Sound] atlas began in 2/2017, and was concluded and published in 5/2018
Alternate Start Info	Not used.	
Alternate End Info	Not used.	

7. Spatial Information

Spatial Resolution		
Angular Distance	The angular sample measure value.	
Angular Distance Units	e.g., Degree.	Degree
Horizontal Distance	The horizontal ground sampling distance value.	
Horizontal Distance Units	e.g., Meter.	Meter
Vertical Distance	The vertical sampling distance value.	
Vertical Distance Units	e.g., Meter.	Meter
Equivalent Scale Denominator	The level of detail expressed as the scale of a comparable hard copy map or chart.	
Level of Detail Description	A brief textual description of the spatial resolution of the resource.	
Spatial Representation		
Grid Representation Used?		No
Vector Representation Used?	Vector data are used to spatially represent the geographic information.	Yes
Text/Table Representation Used?	Text files and tables are used to convey attribute information associated with the vector objects.	Yes
TIN Representation Used?		No
Stereo Model Representation Used?		No
Video Representation Used?		No
Vector Representation	For "Vector Representation" of the ESI Data Sets, Topology Level is considered "Geometry Only"; Polygons are considered as "Complex Objects"; Lines are considered as "Curve Objects"; Points are considered as "Point Objects". The counts should reflect the final object counts in the publicly distributed Geodatabase for ALL feature classes included in this metadata record. (For example, BIRDS may have both a point and polygon feature class representation).	
Topology Level	Select "Geometry Only" from drop-down menu	Geometry Only

InPort Section/Item	Guidance	Example(s)

7. Spatial Representation (Vector Representation) (continued)

Complex Object Present?	Indicates the presence of polygon features related to this metadata record.	Yes/No
Complex Object Count	Total number of polygons related to this record.	1 to N
Composite Object Present?	Not used in ESI data.	No or blank
Curve Object Present?	Indicates the presence of line features related to this metadata record.	Yes/No
Curve Object Count	Total number of lines related to this record.	1 to N
Point Object Present?	Indicates the presence of point features related to this metadata record.	Yes/No
Point Object Count	Total number of points related to this record.	1 to N
Solid Object Present?	Not used in ESI data.	No or blank
Surface Object Present?	Not used in ESI data.	No or blank

Reference Systems		
Coordinate Ref System	Select EPSG Code = 4269 from Browse Menu	EPSG:4269. Geographic 2D, NAD83

8. Access Information

Security Class	Select "Unclassified" from drop-down menu.	Unclassified
Security Classification System	N/A	
Security Handling Description	N/A	
Data Access Policy	N/A	
Data Access Procedure	Reference to the zipped Arc geodatabase.	*See Metadata templates*
Data Access Constraints	All ESI data are public, with no access constraints.	None
Data Use Constraints	Caveats "Not for Navigation" and "Management boundaries are not considered legal boundaries", etc.	*See Metadata Templates for standard wording*
Metadata Access Constraints		None
Metadata Use Constraints		None

9. Distribution Information

Start Date	The date the ESI geodatabase was made public.	November, 2016
End Date	Leave blank for ESI data, defaults to "Present".	Present
Download URL	The complete web address where the data resides.	https://response.restoration.noaa.gov/esi_download
Distributor	Individual or organization responsible for access.	Office of Response and Restoration
File Name	Full path to ESI Geodatabase download.	LongIslandSound_2016_GDB.zip
Description	A brief description of the content of the file being downloaded.	This feature class is a part of the downloadable Esri Arc Geodatabase
File Date/Time	Date the downloadable ESI Geodatabase was published.	November 13, 2016
File Type	The type of file offered for download.	Arc Geodatabase
File Size	File size and units of the downloadable file.	176 MB
Application Version	For ESI data, will be the version of Esri software used.	ArcGIS 10.4
Compression	If used, the technology used to compress data in the file.	Zip
Review Status	Pertains to the file being downloaded. From drop-down menu use "Chked Viruses Inapp Contnent".	Checked for viruses and Inappropriate Content

InPort Section/Item	Guidance	Example(s)
10. URLs	Relevant URLs linking to, for example, the ESI home page, the relevant ESI browse graphic, and the ESI Guidelines. The URL for data download is **not** included here. See template for all links to include.	
URL	Complete web address to the ESI home page.	https://response.restoration.noaa.gov/esi
URL Type	Description of what the URL links to – drop-down menu.	Online Resource
File Resource Format	The format of the linked file/resource: JPG, PDF, HTML	HTML
Description	Description of the content the URL contains.	Overview of ESI data content and uses

11. Technical Environment		
Description	Modify the example text as need to reflect systems and software used.	The software package used to develop the atlas is Environmental Systems Research Institute's ArcGIS for Desktop 10.2(R). The hardware configuration is PCs with Windows Operating System 7.

12. Data Quality		
Representativeness	Generally not applicable for ESI data sets.	
Accuracy	Accuracy of ESI data are variable as particularly the human-use and biology data come from multiple sources. There is some general text included in the template to address this issue; however, for the ESI and HYDRO layers, some specific language should be included.	*See Metadata Templates for examples*
Analytical Accuracy	Not generally included for ESI data sets.	
Quantitation Limits	Not generally included for ESI data sets.	
Bias	Not generally included for ESI data sets.	
Comparability	Not generally included for ESI data sets.	
Completeness Measure	Not generally included for ESI data sets.	
Precision	Not generally included for ESI data sets.	
Analytical Precision	Not generally included for ESI data sets.	
Field Precision	Not generally included for ESI data sets.	
Sensitivity	Not generally included for ESI data sets.	
Detection Limit	Not generally included for ESI data sets.	
Completeness Report	Information about omissions, selection criteria, generalization, definitions used, and other rules used to derive the data set. For ESI BIOLOGY data sets, this section includes a complete list of species for the referenced element, including Species_ID, Common Name, and Scientific Name (if applicable).	*See Metadata Templates for examples*
Conceptual Consistency	Description of the quality control procedures performed on the data.	*See Metadata Templates for examples*

InPort Section/Item	Guidance	Example(s)
13. Lineage		
Lineage Statement	Provide a description of data processing steps used to generate the dataset, including a general explanation of the dataset lineage (sources and processing steps). The sources cited in this section include all records in the SOURCES table that link to the specific data set(s) referenced in this metadata record.	*See Metadata Templates for examples*
Sources	Specific information for each data source. Multiple sources can be cited.	
Citation Title	Generally appropriate to use the contents of the SOURCES table "Title" field.	NEW YORK NATURAL HERITAGE PROGRAM BIODIVERSITY DATABASE
Originator/Publisher	From the "Originator" field in the SOURCES table.	NEW YORK NATURAL HERITAGE PROGRAM
Publish Date	If applicable, can reformat the "Date_Pub" field of the SOURCES table.	10/2014
Extent Type	Temporal extent of the data – Discrete, Range, Continuing. The "Time_Period" field may provide guidance whether Range or Discrete is most appropriate.	Range
Extent Start Date/Time	The start date of the source data.	1980
Extent End Date/Time	If extent type is range, the end date of the source data.	2014
Scale Denominator	From the "Scale" field of the SOURCES table.	24000
Citation URL	From the "Online_Link" field in the SOURCES table.	https://ebird.org/home
Citation URL Name	If applicable.	
Citation URL Description	If applicable.	
Source Contribution	Brief description of how source was used.	
Process Steps	Information on the steps used to process and integrate the source data into the respective ESI feature dataset. Multiple Process Steps may be included and may enhance readability. Steps should address integration of specific data sources as well as overall processing concepts.	
Process Step Number	The sequence number of this step.	1
Description	Description of the process step. Describe each step individually, by adding Process Step sections. Each process Description section is limited to 4,000 characters.	*See Metadata Templates for examples*
Process Date/Time	When the process was completed. May be appropriate to cite the delivery date to NOAA.	October, 2015
Process Contact	For ESI data, this will be the ESI Program Manager.	ESI Program Manager: NOAA, Office of Response and Restoration
Phone (Voice)	Not included for ESI data.	
Email Address	Email of Process Contact.	orr.esi@noaa.gov
Source Citation	The lineage source (cited above) associated with this process step.	NEW YORK NATURAL HERITAGE PROGRAM BIODIVERSITY DATABASE

InPort Section/Item	Guidance	Example(s)
14. Child Items (Entities and Attributes)	Each geographic feature class (layer) and associated data table pertaining to this metadata record will be considered an "Entity" or Child Item. Each field within an entity is considered an attribute. The "Score" field is internal to InPort. All feature class records will have at least one child item that reflects the table associated with the geographic layer; it may have more, if more than one geometry type is described. (Example: BIRD POINT, BIRD POLY). In addition, depending on the Feature Data Set (FDS) the layer resides in, you will have additional child items. For the Biology FDS, you will include child items BIOCOMB and SOURCES. For Socecon FDS, include SOC_DAT and SOURCES. For the base layers in the Hydro FDS, you should include SOURCES, if there is a link to that table from the feature class's data table. The Child Items in the primary metadata record will self-populate (looking similar to what is shown below) once you have added these Child Items to the metadata data set record.	

Score	Type	Title
	Entity (ENT)	BIOCOMB
	Entity (ENT)	SOURCES
	Entity (ENT)	BIRD POLYS
	Entity (ENT)	BIRD POINTS

Edit Data Attribute Details	For each attribute of each Child Item, the following must be completed. Sample below for the BIRD POLY feature table.	
Sequence Order	The numeric order of the column in the table.	3
Name	Name of the attribute.	RARNUM
Data Storage Type	Data Type of the referenced field.	Long
Required?	Is this attribute required?	Yes
Primary Key?	Is this a primary key?	Yes
Max Length	Length in field definition.	8
Minimum Length	Not applicable to ESI data	7
Precision	N/A, since all numeric ESI fields are integer based	
Status	Drop-down menu options.	Active
Description	See samples in templates and descriptions in the ESI guidelines for potential wording.	A 7-8-digit identifier that links records in the BIOCOMB data table to related records in the biological data layers
General Data Type	Character, Integer, Real Number, Date.	Integer
Units	If applicable, the unit of measurement for this column.	
Case Restriction	Text - upper, lower or mixed case allowed. In the ESI SOC_DAT table, many fields must be in Upper Case.	
Display Example	Not applicable to ESI data.	
Format Mask	Not applicable to ESI data.	
Null Value	Symbol used to represent a null value. For ESIs, this may be '0' (numeric) or '-' for character fields.	
Null Value Meaning	Explanation of null value, if one is used. Relevant for concentration field in BIOCOMB table, for example.	
Allowed Values	Range of values for this column. Must be completed after creation of final Geodatabase. Updated after NOAA review, if necessary.	28300001-28300515
Default Value	Value to be placed in a column when no data are entered.	
Foreign Key Relations	Tables with which this column has key relationships.	BIOCOMB
Derivation	If derived (such as EL_SPE_SEA) algorithm as to how the value is established.	
Validation Rules	Not applicable to ESI data.	

InPort Section/Item	Guidance	Example(s)
15. Related Items (optional)	Optional, but this can be used to identify and cite other related metadata records stored in InPort.	
Related Item Cat ID	InPort catalog number.	
Title	Title of related item.	
Notes	Any applicable notes describing the relationship of this item to the current item.	

16. Catalog Details	Details regarding the share level, modification dates and review dates for the catalog item. Initially generated by InPort, but some fields may be edited.	
Catalog Item ID		47292
Metadata Record Created by		[Defaults to signed-in user]
Metadata Record Created		2017-09-08 10:59+0000
Metadata Record Last Modified by		[Defaults to signed-in user]
Metadata Record Last Modified		2017-10-05 16:45+0000
Metadata Record Published		
Owner Org		NOAA/ORR
Metadata Publication Status		Never Published
Metadata Workflow State		Draft
Metadata Next Review Date		
Linking Share Level		Across InPort Catalog

17. FAQs (optional)	optional	
Date		The date of the FAQ question and answer. Defaults to system date.
Author		Author of FAQ question.
Question		
Answer		

18. Data Management	This is an optional section provided by InPort, and is not required in the ISO-19115 metadata standard. It is designed for internal use, and has not been used for ESI metadata.	

19. Issues (optional)	If there are significant issues in the ESI data set or metadata record, they can be recorded here. Optional section provided by InPort, but not required in ISO-19115 metadata standard.	
Issue Date	Date when issue occurred or became known.	
Author	Name of person reporting issue.	
Issue		Description of issue.

InPort Section/Item	Guidance	Example(s)
20. Activity Log (optional)	A log of activities and events that affect the metadata record. Not required in ISO-19115 metadata standard.	
Activity Time	Activity date/time, or data/time.	
Activity Type	Type of activity or event.	
Responsible Party	Party responsible for activity or event.	
Description	Description of activity or event.	

Global Change Master Directory (GCMD) Science Keywords potentially relevant for ESI data
Thesaurus = “Global Change Master Directory (GCMD) Science Keywords"
Copy and paste entire character string into metadata “Theme Keyword” field.

ESI Element	GCMD Keyword String
ALL ELEMENTS	Earth Science > Human Dimensions > Environmental Impacts > Oil Spills
ESIL, HYDROL	Earth Science > Oceans > Coastal Processes > Shorelines
ESIL, HYDROL	Earth Science > Land Surface > Geomorphic Landforms/Processes > Coastal Landforms > Shorelines
ESIP	Earth Science > Biosphere > Aquatic Ecosystems > Wetlands
ESIP	Earth Science > Biosphere > Aquatic Ecosystems > Wetlands > Estuarine Wetlands
BENTHIC	Earth Science > Biological Classification > Plants > Macroalgae (Seaweeds)
BENTHIC	Earth Science > Biosphere > Aquatic Ecosystems > Benthic Habitat
BIRDS	Earth Science > Biological Classification > Animals/Vertebrates > Birds
FISH	Earth Science > Biological Classification > Animals/Vertebrates > Fish
HABITAT	Earth Science > Biological Classification > Plants
HABITAT	Earth Science > Biosphere > Vegetation
HERP	Earth Science > Biological Classification > Animals/Vertebrates > Amphibians
HERP	Earth Science > Biological Classification > Animals/Vertebrates > Reptiles
INVERT	Earth Science > Biological Classification > Animals/Invertebrates
M_MAMMAL	Earth Science > Biological Classification > Animals/Vertebrates > Mammals > Carnivores > Seals/Sea Lions/Walruses
M_MAMMAL	Earth Science > Biological Classification > Animals/Vertebrates > Mammals > Cetaceans
M_MAMMAL	Earth Science > Biological Classification > Animals/Vertebrates > Mammals > Dugongs/Manatees
T_MAMMAL	Earth Science > Biological Classification > Animals/Vertebrates > Mammals
T_MAMMAL	Earth Science > Biological Classification > Animals/Vertebrates > Mammals > Rodents
NAV_MARINE	Earth Science > Human Dimensions > Infrastructure
NAV_MARINE	Earth Science > Human Dimensions > Infrastructure > Transportation
PARKS/MANAGED AREAS	Earth Science > Human Dimensions > Social Behavior > Recreational Activities/Areas
POLITICAL/JURISDICTIONAL	Earth Science > Human Dimensions > Boundaries > Administrative Divisions
POLITICAL/JURISDICTIONAL	Earth Science > Human Dimensions > Boundaries > Political Divisions > Country Boundaries
POLITICAL/JURISDICTIONAL	Earth Science > Human Dimensions > Boundaries > Political Divisions > State Boundaries
RESOURCE MANAGEMENT	Earth Science > Human Dimensions > Economic Resources > Aquaculture Production
RESOURCE MANAGEMENT	Earth Science > Human Dimensions > Economic Resources > Mariculture Production

ESI Element	GCMD Keyword String
SOCECON	Earth Science > Human Dimensions > Economic Resources > Energy Production/Use
SOCECON	Earth Science > Human Dimensions > Infrastructure > Cultural Features
SOCECON	Earth Science > Human Dimensions > Infrastructure > Pipelines
NAT_HAZARD	Earth Science > Oceans > Coastal Processes > Storm Surge

Global Change Master Directory (GCMD) Location Keywords potentially relevant for ESI data
Thesaurus = "Global Change Master Directory (GCMD) Location Keywords"
Copy and paste entire character string into metadata "Spatial Keyword" field.

GCMD Keyword Type	GCMD Keyword String
LOCATION	Continent > North America > United States f America > ***insert state name***
LOCATION	Ocean > Arctic Ocean > Beaufort Sea
LOCATION	Ocean > Arctic Ocean > Chukchi Sea
LOCATION	Ocean > Atlantic Ocean > North Atlantic Ocean
LOCATION	Ocean > Atlantic Ocean > North Atlantic Ocean > Caribbean Sea > Puerto Rico
LOCATION	Ocean > Atlantic Ocean > North Atlantic Ocean > Caribbean Sea > Virgin Islands
LOCATION	Ocean > Atlantic Ocean > North Atlantic Ocean > Gulf of Maine
LOCATION	Ocean > Atlantic Ocean > North Atlantic Ocean > Gulf of Mexico
LOCATION	Ocean > Pacific Ocean > Central Pacific Ocean > Hawaiian Islands
LOCATION	Ocean > Pacific Ocean > North Pacific Ocean
LOCATION	Ocean > Pacific Ocean > North Pacific Ocean > Bering Sea
LOCATION	Ocean > Pacific Ocean > North Pacific Ocean > Gulf of Alaska

APPENDIX K

Example Letter for ESI Collaboration

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APPENDIX K: EXAMPLE LETTER FOR ESI COLLABORATION

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
7600 Sand Point Way N.E. - Bin C15700
Seattle, Washington 98115

Month Day, Year

Information about Environmental Sensitivity Index Maps
For Collaborators and Data Providers

Since the late 1970's, the National Oceanic and Atmospheric Administration (NOAA) has provided oil spill planners and responders maps of coastal resources at risk from oil spills; since the mid-1990's these data have also been distributed in various GIS formats. The Environmental Sensitivity Index (ESI) maps and data are unique in that they use standardized methods to combine biological and human-use data with a high-resolution shoreline classified by oil sensitivity[i]. The ESI data, together with NOAA's oil spill and response guidelines, are used to assess shoreline oiling and evaluate cleanup options. Localizing these diverse resource types within a single product helps state, local, tribal, and federal responders make informed decisions when a spill happens. ESI maps and data are integrated into area contingency plans and are used in a variety of planning and preparation exercises.

The biology published in the ESI products consolidates data collected from the authoritative sources within the mapped region. The focus is on species that are particularly valued or at risk, such as Threatened and Endangered species, areas of dense populations, nesting or breeding sites, etc. Species and habitat locations are represented as polygons, lines, and points, and are attributed with monthly presence/absence, life stage seasonality and concentration. Additionally, each mapped object is linked to the name of the data source and any contact information the source chooses to include. This is of particular value, as it connects the ESI users to the local experts who can provide current, detailed information during a spill event. Close contact with the regional experts helps responders to refine protection strategies as a spill evolves.

The quality of the ESI product is highly dependent on the contributions and cooperation of the data experts. NOAA and our contractor, [*name*], will work closely with the data providers to assure their data are displayed and attributed accurately. If there is concern regarding publication about a particularly sensitive resource, we can work to modify locational and/or attribute information to protect the exact location or details of the resource. In such cases, NOAA and [*contractor name*] will work with the responsible agency/data provider to determine the best way to meet their requirements, while retaining sufficient information for responders to know that an important resource is present in the area. Our goal is to assure that the ESI provides spill planners and responders with the information they need to make informed protection and clean-up decisions; without knowledge regarding the presence of a sensitive resource, they will not be able to consider it in their protection and clean-up plans.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
7600 Sand Point Way N.E. - Bin C15700
Seattle, Washington 98115

Any data provided as part of this work will be used solely for the purpose of developing the ESI. The data will not be used to create other products, nor will the information be redistributed in its entirety. The final compiled ESI products are publicly available.

For more information about the ESI products, supporting tools and available data, please visit http://response.restoration.noaa.gov/esi. You may also contact me at any time if you have additional questions.

Thank you for your assistance in continuing to make the ESI a quality product!

Sincerely,

ESI Program Manager
Emergency Response Division

[i] The Environmental Sensitivity Index Guidelines is a NOAA technical memorandum that documents the data content, structure, and collection methods for this national map product. The document can be viewed and downloaded at http://response.restoration.noaa.gov/esi_guidelines. Other job aids and field guides (such as the *Shoreline Assessment Job Aid* and the guide, *Characteristic Coastal Habitats)* are examples of the integration of the ESI maps and data with nationally-accepted oil spill protection and response guidelines. The job aids and guides are available as PDF files at http://response.restoration.noaa.gov/responsejobaids

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The U.S. DEPARTMENT OF COMMERCE

Howard Lutnick, Secretary

National Oceanic and Atmospheric Administration

Dr. Neil Jacobs,
Under Secretary of Commerce for
Oceans and Atmosphere

National Ocean Service

Nicole LeBoeuf,
Assistant Administrator for
Ocean Services and Coastal Zone Management