Environmental Sensitivity Index Guidelines

Version 4.0

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Environmental Sensitivity Index Guidelines
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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, the Office of Response and Restoration:

- 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, the Office of Response and Restoration provides comprehensive solutions to environmental hazards caused by oil, chemicals, and marine debris.

Chapter 1 – Introduction to Environmental Sensitivity Index Mapping

Chapter 2 - Fundamentals of the ESI Shoreline Classification System

Chapter 3 – ESI Shoreline Classification Methodology

Chapter 4 – The ESI Biology Component

CHAPTER 1

Introduction to Environmental Sensitivity Index Mapping

1.1 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 nearby (**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 submersed aquatic vegetation and coral reefs.
3. Human-Use Resources – specific areas that have added sensitivity and value because of their use (such as beaches, parks and 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.

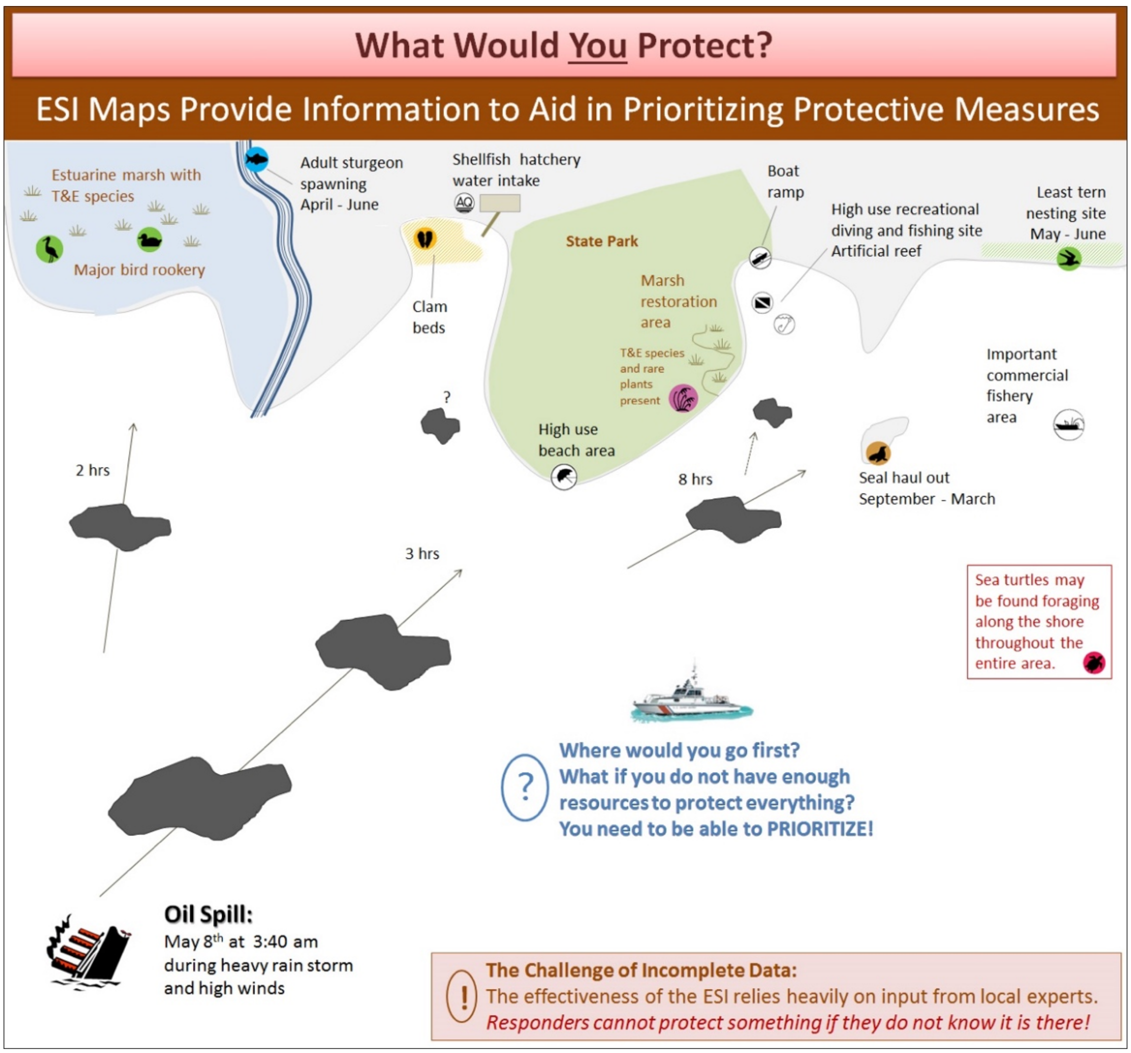

Figure 1.1: ESI maps and data help responders and planners determine protection priorities

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.

1.2 Background

Environmental Sensitivity Index (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 most of the U.S. coast, including Alaska, 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. Because of reproduction costs, these had a limited distribution and were also challenging to update. Since 1989, the ESI data have been compiled using a Geographic Information System (GIS). The digital ESI data serve 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 the printed and PDF 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 socio-economic data
- potential sources for biological and socio-economic data
- the data structure for a digital ESI product
- guidance on QA/QC of the ESI data
- standard output formats and symbology to be shown on soft and hard copy maps
- metadata requirements and standards

1.3 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. 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 spill cooperatives. Data sharing and updates are greatly facilitated by a uniform data structure.

1.4 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 Environmental Sensitivity Index mapping
- Chapter 2 – Fundamentals of the 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 – The ESI Socioeconomic (Human-Use) Component: Steps to Collecting, Creating, and Compiling Socioeconomic Data and the ESI Socioeconomic Data Table Structure and Content
- Chapter 6 – Database Compilation & Quality Control Procedures for ESI Data Deliverables to NOAA
- Chapter 7 – Creating ESI Metadata
- Appendices:

- A: ESI Biological Elements and Subelements
- B: The ESI Data Dictionary: ESI Data Tables, Field Names, Descriptions, and Attribute Values
- C: Diagram of 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 Date(s) and Atlas Numbers
- G: Hard Copy Map Production: Data Filtering, Presentation, and Symbology
- H: Step by Step Metadata Guide

CHAPTER 2

Fundamentals of the ESI Shoreline Classification 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 was originated in 1976 for Lower Cook Inlet (Michel et al. 1978). Since that time, the ranking system has been refined and expanded to cover shoreline types throughout the world. The classification scheme has also been modified to include lacustrine and riverine shoreline types (NOAA 1995). The complete list of standard ESI shoreline rankings is composed of categories for four environmental settings: estuarine, lacustrine, riverine, and palustrine. To facilitate data use and exchange, these shoreline types and associated ranks should be used on all sensitivity mapping projects (See Figure 2.1). The environmental settings are applied as follows:

- Estuarine: Shorelines adjacent to marine and coastal waters affected by tides
- Lacustrine: Shorelines along large lakes
- Riverine: Shorelines along large freshwater rivers
- Palustrine: Shorelines along small freshwater lakes (only applied to wetlands, ESI = 10)

The classification scheme is based on an understanding of the physical and biological character 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 of 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 closely 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. Early geomorphology 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 impacted habitat (Hayes and Gundlach 1975; Gundlach and Hayes 1978; Gundlach et al. 1978; Michel et al. 1978).

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	3A: Fine to Medium Grained Sand Beaches
3B	E	3B: Scarps and Steep Slopes (Sand)
3B	L	3B: Eroding Scarps (Unconsolidated Sediment)
3B	R	3B: Exposed, Eroding Banks (Unconsolidated Sediment)
3C	E	3C: Tundra Cliffs
4	E	4: Coarse Grained Sand Beaches
4	L	4: Sand Beaches
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	E	6A: Gravel Beaches (Granules/Pebbles) – used in Alaska
6A	R	6A: Gravel Bars and Gently Sloping Banks
6B	E/L/R	6B: Riprap
6B	E	6B: Gravel Beaches (Cobbles/Boulders) – used in Alaska
6D	E	6D: Boulder Rubble
7	E/L	7: Exposed Tidal Flats
8A	E/L	8A: Sheltered Scarps (Bedrock/Mud/Clay)
8A	E	8A: Sheltered, Impermeable, Rocky Shores
8B	E/L/R	8B: Sheltered, Solid Man-Made Structures
8B	E	8B: Sheltered, Permeable, Rocky Shores
8C	E/L/R	8C: Sheltered Riprap
8D	E	8D: Sheltered, Rocky Rubble Shores
8E	E	8E: Peat Shorelines
8F	R	8F: Vegetated, Steeply Sloping Bluffs
9A	E	9A: Sheltered Tidal Flats
9A	L	9A: Sheltered Sand and Mud Flats
9B	E/L/R	9B: Vegetated Low Banks
9C	E	9C: Hyper-Saline Tidal Flats
10A	E	10A: Salt and Brackish Water Marshes
10B	E/L/P/R	10B: Freshwater Marshes
10C	E/L/P/R	10C: Swamps
10D	E/L/P/R	10D: Scrub and Shrub Wetlands
10E	E	10E: Inundated Low Lying Tundra
10F	E	10F: Mangroves

Figure 2.1: ESI Shoreline Classification

Environment code: E = estuarine, L = lacustrine, R = riverine, P = palustrine

Two physical factors, wave-energy flux and tidal-energy flux, primarily determine the degree of exposure, also referred to as the *hydrodynamic energy level*, at the coastline. Wave-energy flux is basically a function of the average wave height, measured over at least one year. Where waves are typically large (e.g., heights more than one 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 flux is also important in determining the potential of oil-spill impacts on coastal habitats, although not as pervasive as wave-energy flux. 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. The effect of the currents on biological communities can also be pronounced. For example, highly mobile substrates set in motion by strong tidal currents typically harbor considerably fewer infauna than stable substrates. Tidal currents generally increase as tidal range increases.

Wave and tidal energy combine to produce a continuum of energy along a coastline. For the sake of portrayal on a map, this continuum must be broken into classes, clear-cut divisions of high, mixed, or low energy. Within a mapping region, the degree of energy present on one shoreline segment is assessed relative to the overall energy levels in the region. High-energy shorelines (1A-2B) are regularly exposed to large waves or strong tidal currents during all seasons. They most commonly occur along the outermost coastline of a region or where dominant winds cause waves to strike the shoreline directly or by wave refraction. Mixed-energy shorelines (3A-7) often have seasonal patterns in storm frequency and wave size. Low-energy shorelines (8A-10F) are sheltered from wave and tidal energy, except during unusual or infrequent events. 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.

Inherent in these energy classes are inferences to the persistence of stranded oil. *High energy* means rapid natural removal, usually within days to weeks. *Low energy* means slow, natural removal, usually within years. *Mixed energy* means that stranded oil will be removed when the next high-energy event occurs, which could be days or months after the spill. The removal of oil on a mixed-energy coast is an event-driven process. Shorelines that do not have predictable, seasonal storms that generate waves of a significant size or from a particular direction are even more difficult to characterize. Along these shorelines, high-energy events usually happen more than once each year but their timing is generally unknown. A shoreline of this type has the potential for longer-than-usual oil persistence. This type of shoreline has storm berms with one to three years of vegetation growth and greater macroalgae coverage on the larger boulders in the intertidal zone than would be seen on a beach exposed to more frequent storms. Efforts should be made to differentiate beaches with irregular patterns in sediment mobility, particularly for gravel beaches.

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 subsurface 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 2.2**)
1A	=	Exposed, Rocky Banks; (riverine)
1B	=	Exposed, Solid Man-Made Structures; (estuarine, lacustrine, and riverine**: Figure 2.3**)
1C	=	Exposed, Rocky Cliffs with Boulder Talus Base; (estuarine, lacustrine, and riverine: **Figure 2.4**)

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 within a few weeks. 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 2.2: Exposed, Rocky Shores with ESI rank of 1A.

Figure 2.3: Exposed, Solid Man-Made Structures with ESI rank of 1B.

Figure 2.4: Exposed, Rocky Cliffs with Boulder Talus Base with ESI rank of 1C.

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 five 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 impacts and pressures.

Shoreline types that meet these elements include:

2A = Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay); (estuarine: **Figure 2.5**)

2A = Shelving Bedrock Shores; (lacustrine: **Figure 2.6**)

2A = Rocky Shoals and Bedrock Ledges; (riverine)

2B = Exposed Scarps and Steep Slopes (Clay); (estuarine)

As with ESI = 1, 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 that has multiple wave-built berms, the ESI classification designates the beach as an additional shoreline type, for example 6A/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 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 or concentration areas.

Figure 2.5: Exposed, Wave-Cut Platforms (Bedrock/Mud/Clay) with ESI rank of 2A.

Figure 2.6: Shelving Bedrock Shores associated with lake environments with ESI rank of 2A.

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 (fine- to medium-grained sand) with oil penetration usually less than ten cm.
- Sediments are well-sorted and compacted (hard).
- On beaches, the slope is very low, less than five degrees.
- The rate of sediment mobility is low, so the potential for rapid burial is lower.
- 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	=	Fine- to Medium-Grained Sand Beaches; (estuarine: **Figure 2.7**)
3B	=	Scarps and Steep Slopes (Sand); (estuarine: **Figure 2.8**)
3B	=	Eroding Scarps (Unconsolidated Sediment); (lacustrine: **Figure 2.9**)
3B	=	Exposed, Eroding Banks (Unconsolidated Sediment); (riverine: **Figure 2.10**)
3C	=	Tundra Cliffs; (estuarine: **Figure 2.11**)

This shoreline rank includes exposed sand beaches on outer shores, sheltered sand beaches along bays and lagoons, and sandy scarps and banks along lake and river shores. Compact, fine-grained sand substrates minimize oil penetration, reducing the amount of oiled sediments to be removed. Furthermore, 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. Cleanup on fine-grained sand beaches is simplified by the hard substrate that can support vehicular and foot traffic. Infaunal densities vary significantly both spatially and temporally.

Figure 2.7: Fine- to Medium-Grained Sand Beach with ESI rank of 3A.

Figure 2.8: Scarps and Steep Slopes (Sand) with ESI rank of 3B.

Figure 2.9: Eroding Scarps (Unconsolidated Sediment) associated with lacustrine environments with ESI rank of 3B.

Figure 2.10: Exposed, Eroding Banks (Unconsolidated Sediment) in riverine environments with ESI rank of 3B.

Figure 2.11: Tundra Cliffs with ESI rank of 3C.

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 25 cm possible.
- The slope is intermediate, between 5 and 15 degrees.
- Rate of sediment mobility is relatively high, with accumulation of up to 20 cm of sediments within a single tidal cycle possible; there is a potential for rapid burial and erosion of oil.
- Sediments are soft, with low trafficability.
- There are relatively low densities of infauna.

Shoreline types that meet these elements include:

4 = Coarse-Grained Sand Beaches; (estuarine**: Figure 2.12**)

4 = Sand Beaches; (lacustrine)

4 = Sand Bars and Gently Sloping Banks; (riverine**: Figure 2.13**)

Coarse-grained sand beaches are ranked separately and higher than fine- to medium- grained sand beaches because of the potential for higher oil penetration and burial, which can be as great as 1 m. These beaches can undergo very rapid erosional and depositional cycles, with the potential for rapid burial of oil, even after only one tidal cycle. Cleanup is more difficult, as equipment tends to grind oil into the substrate because of the loosely packed sediment. Also, cleanup techniques often have to deal with multiple layers of oiled and clean sediments, increasing the amount of sediments to be handled and disposed of. These more mobile sediments usually have low infaunal populations, which also vary greatly over time and space. In some areas, there is no clear distinction between sand beach types because they cannot be readily differentiated by grain size. Under these conditions, such as along the Great Lakes, all sand beaches are ranked as ESI = 4.

Figure 2.12: Coarse-Grained Sand Beaches with ESI rank of 4.

Figure 2.13: Sand Bars and Gently Sloping Banks in riverine environment with ESI rank of 4.

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 of the substrate (mixed sand and gravel) allows oil penetration up to 50 cm.
- Spatial variations in the distribution of grain sizes are 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 burial and erosion of oil during 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 2.14**)

5 = Mixed Sand and Gravel Bars and Gently Sloping Banks; (riverine**: Figure 2.15**)

The gravel-sized component can be composed of bedrock, 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, 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, in particular, can have microenvironments that are more protected from wave energy (called wave shadows) where natural removal may be much slower than the adjacent beach.

Figure 2.14: Mixed Sand and Gravel Beaches with ESI rank of 5.

Figure 2.15: Mixed Sand and Gravel Bars and Gently Sloping Banks in riverine environment with ESI rank of 5.

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 possible 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 exposure, and thus in the frequency of mobilization by waves.
- Penetration can extend to depths below those of annual reworking.
- Sediments have 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 2.16**)

6A = Gravel Bars and Gently Sloping Banks; (riverine**: Figure 2.17**)

6A = Gravel Beaches (Granules/Pebbles); (estuarine; Southeast Alaska only)

6B = Riprap; (estuarine, lacustrine, and riverine**: Figure 2.18**)

6B = Gravel Beaches (Cobbles/Boulders); (estuarine; Southeast Alaska only)

6D = 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 fragments can be the equivalent of gravel along Gulf of Mexico and South Atlantic 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 beach face. 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.

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. Sometimes, the only way to clean riprap completely is to remove and replace it.

Figure 2.16: Gravel Beaches with ESI rank of 6A.

Figure 2.17: Gravel Bars and Gently Sloping Banks in riverine environment with ESI rank of 6A.

Figure 2.18: Riprap with ESI rank of 6B.

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

The essential elements are:

- They are flat (less than three 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.
- 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.

Shoreline types that meet these elements include:

7 = Exposed tidal flats; (estuarine and lacustrine**: Figure 2.19**)

Exposed tidal 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.

Oil does not readily adhere to or penetrate the compact, water-saturated sediments of exposed sand flats. Instead, the oil is pushed across the surface and accumulates at the high-tide line. Even when large slicks spread over the tidal 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.

Figure 2.19: Exposed Tidal Flats with ESI rank of 7.

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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 organisms on hard substrates.

Shoreline types that meet these elements include:

8A	=	Sheltered Scarps (Bedrock/Mud/Clay); (estuarine and lacustrine**: Figures 2.20, 2.21**)
8A	=	Sheltered, Impermeable, Rocky Shores; (estuarine; Southeast Alaska only)
8B	=	Sheltered, Solid Man-Made Structures; (estuarine, lacustrine, and riverine**: Figure 2.22**)
8B	=	Sheltered, Permeable, Rocky Shores; (estuarine; Southeast Alaska only)
8C	=	Sheltered Riprap; (estuarine, lacustrine, and riverine**: Figure 2.23**)
8D	=	Sheltered, Rocky Rubble Shores; (estuarine**: Figure 2.24**)
8E	=	Peat Shorelines; (estuarine**: Figure 2.25**)
8F	=	Vegetated, Steeply Sloping Bluffs; (riverine**: Figure 2.26**)

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 rocky rubble slopes, which tend to trap oil beneath a veneer of coarse material. Both 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 and riprap are the man-made equivalents, with similar oil behavior and persistence patterns. Usually, more intrusive cleanup is necessary for aesthetic reasons. In riverine 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 2.20: Sheltered Scarps (Bedrock/Mud/Clay) with ESI rank of 8A.

Figure 2.21: Sheltered Scarps (Bedrock/Mud/Clay) in lacustrine environment with ESI rank of 8A.

Figure 2.22: Sheltered, Solid Man-Made Structures with ESI rank of 8B.

Figure 2.23: Sheltered Riprap with ESI rank of 8C.

Figure 2.24: Sheltered, Rocky Rubble Shores with ESI rank of 8D.

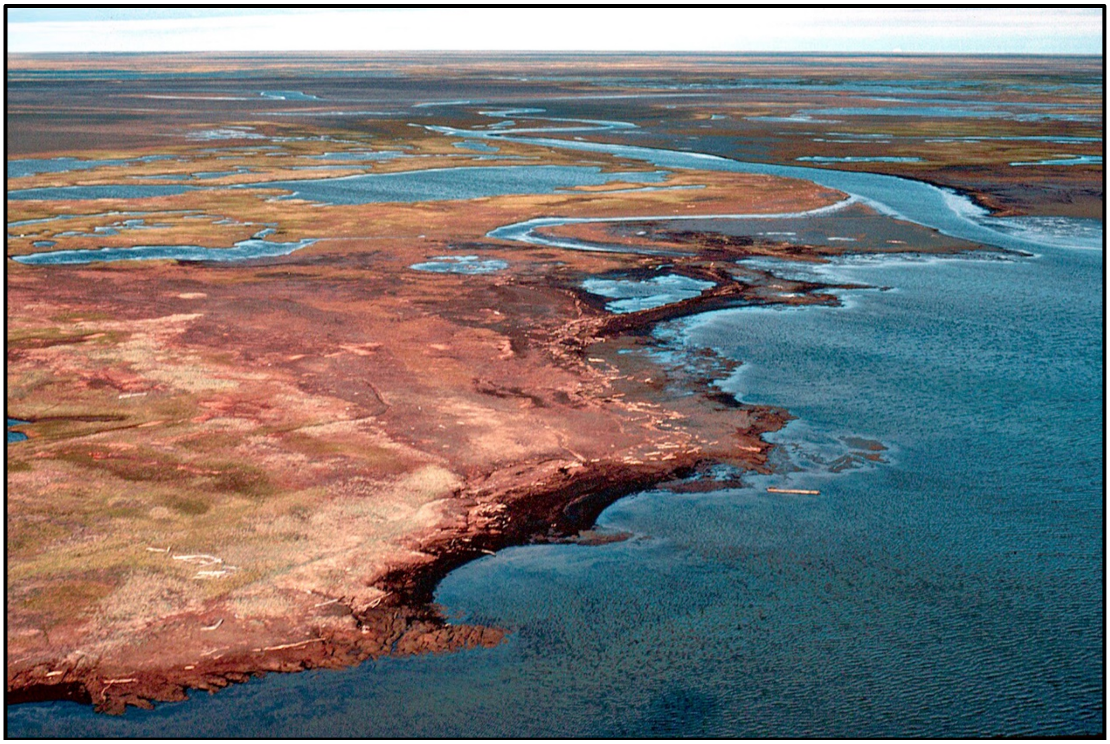


Figure 2.25: Peat Shorelines with ESI rank of 8E.

Figure 2.26: Vegetated, Steeply Sloping Bluffs in riverine environment with ESI rank of 8F.

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 three degrees) and dominated by 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 soft, with low trafficability.
- Infaunal densities are usually very high.

Shoreline types that meet these elements include:

9A = Sheltered Tidal Flats; (estuarine**: Figure 2.27**)

9A = Sheltered Sand and Mud Flats; (lacustrine**: Figure 2.28**)

9B = Vegetated Low Banks; (estuarine, lacustrine, and riverine**: Figure 2.29**)

9C = Hyper-Saline Tidal Flats; (estuarine**: Figure 2.30**)

The soft substrate and limited access makes sheltered tidal flats almost impossible to clean. Usually, any cleanup efforts mix oil deeper into the sediments, prolonging 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.

Figure 2.27: Sheltered Tidal Flats with ESI rank of 9A.

Figure 2.28: Sheltered Sand and Mud Flats in lacustrine environment with ESI rank of 9A.

Figure 2.29: Vegetated Low Banks with ESI rank of 9B.

Figure 2.30: Hyper-Saline Tidal Flats with ESI rank of 9C.

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, respectively.
- 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 yearly 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 2.31**)

10B = Freshwater Marshes; (estuarine, lacustrine, riverine, and palustrine**: Figure 2.32**)

10C = Swamps; (estuarine, lacustrine, riverine, and palustrine**: Figure 2.33**)

10D = Scrub and Shrub Wetlands; (estuarine, lacustrine, riverine, and palustrine**: Figure 2.34**)

10E = Inundated Low Lying Tundra; (estuarine**: Figure 2.35**)

10F = Mangroves; (estuarine**: Figure 2.36**)

Marshes, mangroves, and other 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 also 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 soils, but can pool on the surface or in animal burrows and root cavities, and soak into accumulated organic matter, such as wrack. 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 and Rutherford 2013).

Figure 2.31: Salt and Brackish Water Marshes with ESI rank of 10A.

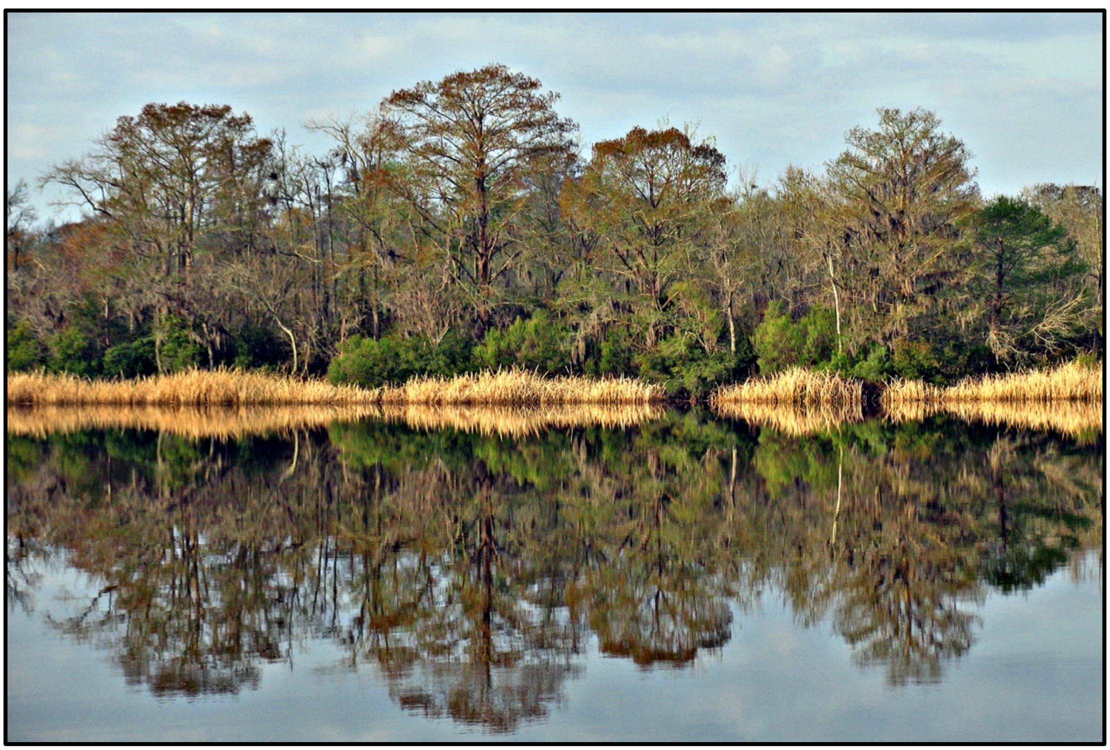


Figure 2.32: Freshwater Marshes with ESI rank of 10BA.

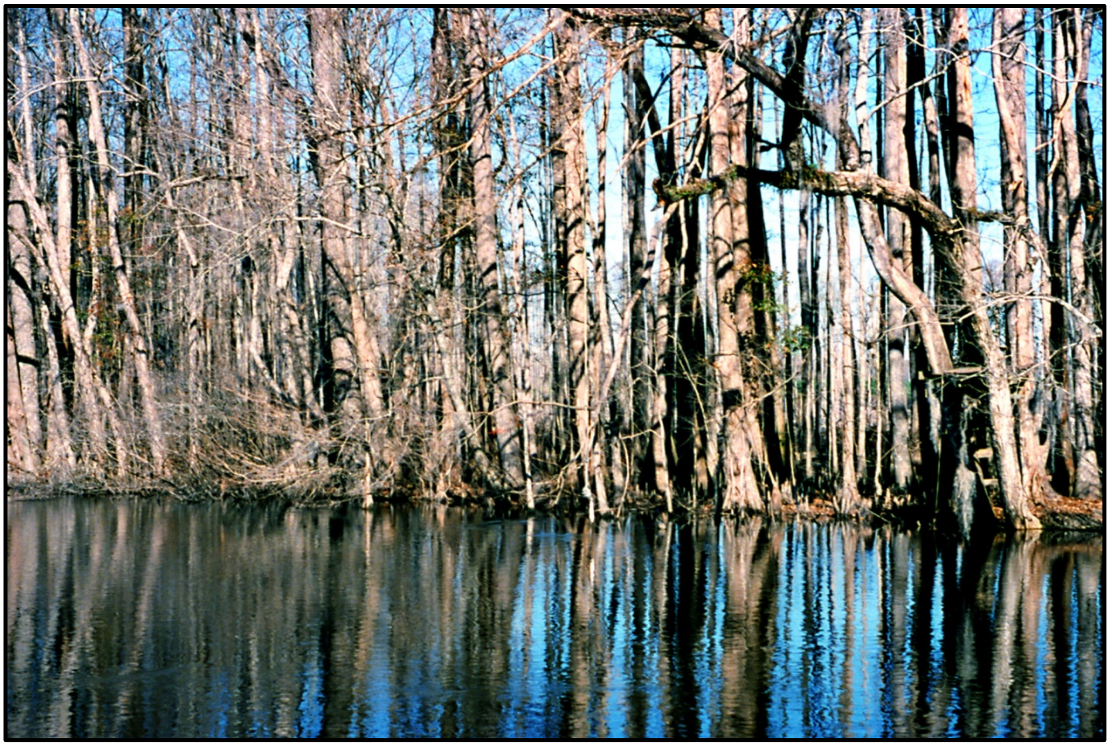


Figure 2.33: Swamps with ESI rank of 10C.

Figure 2.34: Scrub and Shrub Wetlands with ESI rank of 10D.

Figure 2.35: Inundated Low Lying Tundra with ESI rank of 10E.

Figure 2.36: Mangroves with ESI rank of 10F.

CHAPTER 3

ESI Shoreline Classification Methodology

3.1 ESI Shoreline Classification

3.1.1 What to Map

The Environmental Sensitivity Index (ESI) scale, as described in Chapter 2, categorizes coastal shorelines and habitats in terms of their sensitivity to spilled oil, taking into consideration a number of natural physical and biological factors. The most sensitive habitats - vegetated wetlands and sand and mud flats - are especially important to capture when mapping the shoreline. For this reason, the ESI shoreline dataset is composed of both the linear shoreline and polygonal datasets representing important habitats, as follows:

- Vegetated wetlands
- Sand and mud flats
- Classified estuarine, riverine, lacustrine, and/or palustrine shorelines within the boundary of the area being mapped
- Shoreline structures such as piers, groins, jetties, etc.

In order to accurately apply the ESI scale during classification of shoreline wetland habitats, the best available, highest resolution data sources for the area of interest (AOI) must be identified. Each feature mapped as a polygon will, in most cases, share a coincident line typically referred to as the land/water interface. Most shoreline sources will have the land/water interface mapped at mean high tide, which is the target tidal datum for the ESI HYDRO layer. However, there may be times when the best available shoreline data was acquired without tidal control. When tidal elevation of the land/water interface varies based on the source data, the sources table should link to the original metadata that includes acquisition considerations. Likewise, the ESI metadata for the HYDRO layer should clarify the tidal datum of each data source used. Regardless of the tidal elevation used for creating these datasets, the shoreline classification is always classified out to mean low water.

3.1.2 ESI Shoreline Data Components

The ESI shoreline feature dataset includes five feature classes – **ESIL**, **ESIP**, **HYDROL**, **HYDROP**, and **AOI** (area of interest). The required attributes for each feature class are listed in the Base Layers section of the Data Dictionary (Appendix B). More detailed descriptions of each feature class and its attributes are provided here.

Classified Shoreline Polylines (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. The ESIL classified shoreline will also be used to delineate the shoreward side of the **HYDROP** data layer.

Some man-made structures, for example major piers, breakwaters, groins, and jetties, may be mapped as noncontiguous lines in the ESIL dataset. 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.

Feature Class Attributes

Data attributes and valid values for this feature class are as enumerated in Appendix B under **ESIL** (ESI LINES). The following fields are generated from the ESI attribute: MOST_SENSITIVE, LANDWARD_SHORETYPE, SEAWARD_SHORETYPE1, SEAWARD_SHORETYPE2, GENERAL_SYMBOL, and GENERALIZED_ESI_TYPE. Reference Appendix B to see how these fields are populated. A brief descriptions of all other attributes follows.

ESI

The ESI field is populated during the classification process and contains a numeric or alpha-numeric coded description of the shoreline characteristics for each shoreline segment. (See **Figure 2.1** in the previous chapter for a list of acceptable ESI code components.) Shoreline segments can have up to three ESI codes in their classification. Multiple codes are separated by a forward slash and ordered to represent the shoreline organization of that particular segment. The first code in the sequence is always the most landward shoreline type. For example, a saltwater marsh fringed by a sheltered mud flat would be coded as 10A/9A (10A: Salt and Brackish Water Marshes/9A: Sheltered Sand and Mud Flats /Water). If the shoreline segment is adjacent to an ESI coded polygon in the **ESIP** layer, the code for that polygon must be incorporated into the ESI line classification. As an example, a sheltered seawall fronted by a fine-grained sand beach with an exposed tidal flat beyond the beach is coded as 8B/3A/7.

LINE

The LINE field describes the type of water/land interface. All line segments that serve as a shoreline boundary between open water and land are attributed a value of S. All shoreline hydrography not associated with seawater (lakes, ponds, reservoirs, some rivers and streams, etc.) 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: 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, L-lacustrine, and P-palustrine. The entire area mapped for an ESI AOI will typically contain a single type of environment, but it is possible to have a combination of environments (for example, when the AOI includes both the estuarine and riverine 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.

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 alpha-numeric ESI code for each line are recorded. It is useful to assign unique values to each source before classification begins. Ultimately the source values for the ESI base layers will range from 1 – 100, and will be concatenated with the atlas ID to assure source IDs are unique across atlases.

SOURCE_ID

The SOURCE_ID is a numerical value that links to the SOURCES table where specifics about the shoreline source 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. Ultimately the source values for the ESI base layers will range from 1 – 100, and will be concatenated with the atlas ID to assure source IDs are unique across atlases.

Classified Shoreline 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 tidal flats (both sheltered and exposed). Vegetated wetlands are mapped because they are the most sensitive habitats and are very important for their biological value. Tidal flats are also biologically important and are included in the **ESIP**. 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.

Feature Class Attributes

The attributes associated with ESIP (ESI POLYGONS) are summarized in Appendix B. A brief description of each attribute is also provided below.

ESI

The ESI field contains a numeric or alpha-numeric coded description of the wetland, tidal flat, or other classified polygon type. There are a variety of national and regional wetland datasets that may be used as a starting point. For example, the National Wetlands Inventory (NWI) data (classification listed in the NWI_ATTRIBUTE field), and NOAA's Coastal Change Analysis Program (C-CAP) data (classification found in the CLASS_NAME field). Source wetland datasets may present a variety of different classification schemes that will need to be converted to the ESI scale. Wetland locations and classifications should be verified with imagery and/or observation during the shoreline classification process. At the same time, additional wetland, and particularly tidal flat, data may be derived by the mapper from the imagery. Shoreline exposure (exposed vs. sheltered) needs to be considered when developing a cross-walk and assigning ESI codes. Refer to Section 3.3.2, Mapping and Classification Concepts, Exposed vs. Sheltered for additional guidance.

WATER_CODE

The WATER_CODE field indicates whether an ESIP polygon is land-based (L) or water-based (W). Vegetated wetland polygons are coded with L = land, tidal flat polygons are coded with W = water.

ENVIR

The ENVIR field describes the physiographic type of environment where the polygon is located. Acceptable values are estuarine (E), riverine (R), lacustrine (L), or palustrine (P).

ESI_DESCRIPTION

The ESI_DESCRIPTION is populated with the numeric 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 geographic source for the polygon is recorded. It is useful to assign unique values to each source before classification begins. Ultimately the source values for the ESI base layers will range from 1 – 100, and will be concatenated with the atlas ID to assure source IDs are unique across atlases.

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 alpha-numeric ESI code for each polygon are recorded. It is useful to assign unique values to each source before classification begins. Ultimately the source values for the ESI base layers will range from 1 – 100, and will be concatenated with the atlas ID to assure source IDs are unique across atlases.

Hydrography Polylines (HYDROL)

The hydro polylines (HYDROL) are created by aggregating all the ESIL lines attributed with a LINE value other than 'S', and/or are lines that do not represent the perimeter of a polygon. Inland lines reflect rivers or streams, and are attributed with LINE = 'H', however lines attributed with 'H' that form the boundary of an inland lake, should not be included. Offshore lines may represent docks, jetties, piers, etc. A full list of feature attributes and acceptable values is provided in Appendix B under HYDROL (HYDRO LINES).

Hydrography Polygons (HYDROP)

The hydro polygons (HYDROP) represent the land and water features that 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, like 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', to the regional AOI, creating closed land and water features. Each feature is classified as either land (L) or

Water (W) in the attribute WATER_CODE.

Area of Interest (AOI)

The ESI mapping boundary, or area of interest (AOI), is a polygon created manually at the onset of each ESI mapping effort. 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 delineated by the 12-nautical mile marine boundary. There are no attributes associated with this layer.

3.1.3 Mapping Projection

The ESI data components, shorelines and wetlands, are developed using data layers from various federal and state sources. It is recommended that the source data layers be created and edited in a projected coordinate system (e.g., State Plane) that is appropriate for the area being mapped. Upon completion of the ESI dataset, the final ESI data are delivered to the NOAA ESI Program Manager in geographic coordinates, using NAD 83 for the horizontal datum.

3.2 Creating ESI Shoreline Feature Classes

3.2.1 Determining the Regional ESI Area Boundary (AOI)

The ESI area boundary, or area of interest (AOI), is created manually at the onset of each ESI mapping effort. The extent is determined under close consultation with the ESI Program Manager and must be coincident with adjacent ESI regions. 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. 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 off shore.

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
- NOAA managed resource areas

3.2.2 Creating the ESIL Dataset

Most often, the ESIL shoreline utilizes existing data, often from a combination of different sources. Selection of a shoreline source should take the following into consideration:

- When the shoreline was mapped, particularly in regions prone to coastal change. Regardless of the currency, any deviation observed directly or from imagery should be incorporated during the shoreline classification phase.
- Scale must be 1:24,000 or larger
- Preference should be given to tidally controlled (mean high water) shoreline data when of equal quality
- Shoreline selected by state agencies for other regional mapping efforts

All polygonal datasets should be converted to lines and put into the selected local projection before integrating datasets. Unique numerical SOURCE_ID values should be assigned to each source before the datasets are patched together. When integrating datasets, the most current dataset is most often the primary shoreline to which all other datasets are appended.

The resulting shoreline must be continuous, except at the extents of the AOI. Special attention must be given to matching edges between datasets to ensure continuity. After piecing together all available datasets, there may still be gaps in the shoreline. The shoreline for missing areas will need to be digitized from the most current imagery available.

Sources for the shoreline datasets may also contain data for structural features such as piers, breakwater, and jetties. These structures are often not large enough to be mapped as a part of what will become the shoreline polygon, but they are still considered part of the shoreline and should be included in the HYDROL and ESIL data layers. If no datasets are available for these features, they can be digitized from current imagery. In this case, and in the case of using disparate sources for the linear features, assure that lines representing structures that should intersect with the shoreline (i.e. piers) are snapped to the contiguous shoreline. In general, only features 24 meters or longer need to be collected. Putting these features in a separate feature class while creating and processing the shoreline is recommended, especially for maintaining the correct topology (see Section 3.2.4). These features can be reinserted before classification begins or can be classified separately and added before final QA/QC.

Linear representation of narrow rivers and streams should also be included in the ESIL and HYDROL data layers. This is particularly important in regions where anadromous/diadromous fish are mapped. All fish lines should match the corresponding line mapped in these two base feature layers. Likewise, when mapping fish streams, if there is no corresponding line from the source used for inland hydrography, one should be added. Inland linear water features are assigned a LINE value of ‘H’.

The continuous shoreline(s) in ESIL, representing the water/land interface, will have LINE values of “S”. All other lines in the ESIL will have one of the other values listed under ESIL (ESI LINES) in Appendix B.

Data sources for ESIL:

- Previously completed ESI shoreline for the area – adjacent regions should be consulted at the onset of any new ESI update process to ensure region to region continuity
- 1:1,000 - 1:24,000 NOAA Continually Updated Shoreline Product (CUSP) and NOAA National Shoreline
- 1:24,000 USGS High-Resolution National Hydrography Dataset (NHDPlus)
- Datasets provided by state agencies and other end-users
- Current satellite and aerial imagery
- Imagery collected as part of the ESI update effort

3.2.3 Creating the ESIP Dataset

Wetland boundaries are usually obtained from one or more of the sources listed below and are verified, modified, and/or amended during the shoreline classification process. Each dataset is assigned a unique numerical SOURCE_ID value before integration. The wetland attributes of the source datasets will need to be converted to the ESI scale. Additionally, if any source data are in raster format, these must be converted to polygons and integrated into the ESIP feature class. In either case, the ESI value applied to the ESIP polygons should be verified with imagery.

Tidal flats are also included in the ESIP data. Some wetland's data sources may contain tidal flat locations, though it may be necessary to hand digitize tidal flats from current imagery. Tidal flats are classified as ESI type 7 (exposed tidal flats), or ESI type 9A (sheltered tidal flats) See Section 3.3.2, Mapping and Classification Concepts, Exposed vs. sheltered for additional guidance on exposure.

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 is the region best known for shoreline of this type.

To ensure that the shoreline is consistent, the ESIL features with LINE = "S" are considered the definitive water/land boundary and all ESIP polygons must be clipped to this boundary (i.e., no wetland polygons should overlap with the water side of the ESIL shoreline).

The polygons in the ESIP have a minimum mapping unit (MMU) of 500 square meters (see Section 3.3.2), thus any polygons smaller than this should be eliminated before finalization of this feature class.

Data sources frequently used during the compilation of the ESIP feature class:

- Previous ESI datasets
- U.S. Fish and Wildlife Service National Wetlands Inventory (NWI)
- NOAA Coastal Change Analysis Program (C-CAP)
- U.S. Geological Survey Gap Analysis Program national land cover
- Datasets provided by state agencies and other end-users

3.2.4 Topology rules for ESIL/ESIP

Recall that the ESIL shoreline is considered the definitive water/land boundary and must be maintained as such throughout the classification process. The best way to ensure this is to create a topological relationship between the ESIP and ESIL such that, for every polygon boundary in the ESIP, there is a coincident line in the ESIL. In order to validate topology rules across these feature classes, it may be necessary to create temporary lines in the ESIL with a unique value for the LINE attribute (a value different than the valid LINE values listed in Appendix B). In this way, all ESIP polygon/polygon interfaces are recorded. The topology rules must be maintained throughout the classification process so that ESIP polygon boundaries and ESIL lines remain coincident. The topology rules to create this relationship are as follows:

- ESIL Must Not Overlap
- ESIL Must Not Intersect
- ESIL Must Be Single Part
- ESIL Must Not Have Dangles
- ESIL Must Be Covered by Boundary of ESIP
- ESIP Must Not Overlap
- ESIP Must Not Have Gaps
- ESIP Boundary Must Be Covered by ESIL

Once the rules are created, the topology must be validated. The only valid exception to the rules is a gap error around the AOI extent beyond which there are no lines or polygons. All other errors must be addressed and fixed. After classification is complete and before the final QA/QC when the topological relationship is no longer needed, the temporary lines that were added to the ESIL can be removed.

3.3 Shoreline Classification

The ESI scale, described in Chapter 2, categorizes coastal habitats in terms of their sensitivity to spilled oil based on a number of natural physical and biological factors. 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 Scientific Support Coordinator is also recommended during this process.

3.3.1 Identifying Datasets for Use in Classification

There may be a variety of datasets available for classifying the shoreline. Some of the most common sources are described below.

- 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 shoreline. Google Earth, Bing, ShoreZone (where available), and other recent Federal and State imagery sources are readily available.
- Acquisition of new low-altitude oblique aerial imagery conducted by the project staff during overflights may be needed in areas with low-quality or out-of-date imagery, particularly where the shoreline is covered by overhanging vegetation or where the vertical shorelines cannot be mapped correctly without an oblique view. Such overflights are expensive, requiring aircraft charter and time for processing of georeferenced imagery. For NOAA projects, the U.S. Coast

Guard aircraft (either from Air Stations or the Auxiliary) may provide aircraft and crew for the overflights at minimal costs. The NOAA Scientific Support Coordinator or the NOAA ESI Program Manager can assist with the coordination of U.S. Coast Guard assets.

- Physical data such as grain size, salinity, and prevailing wind speed and direction (useful for differentiating between sheltered and exposed environments) may be available from sources such as the NOAA National Centers for Environmental Information (NCEI), NOAA National Data Buoy Center, and ShoreZone.
- Coastal habitat maps and literature may be important sources of information on beach grain size, in particular.
- Ground observations may be needed to confirm the shoreline class, particularly to determine the grain size of beach sediment, but also to become familiar with the shoreline types in the study area. This method requires travel to the study site and is very slow, thus, it should concentrate on specific, pre-determined areas.

3.3.2 Mapping and Classification Concepts

Minimum mapping unit: Line segments will be split at locations where the ESI classification changes. The minimum line segment size is based on the concept of the minimum mapping unit (MMU). The MMU provides a standard for the smallest feature to be mapped and can be used to ensure features are visible at a target scale. In general, the diameter in meters of the minimum discernible feature in a map is equal to half of the thousands unit of the map scale. ESI maps are typically printed at a scale of 1:50,000, thus the minimum segment length, which is the same as the MMU, equals 25 m. This concept is extended to polygon area by calculating the area of a circle with the diameter of the minimum discernible feature, which in this case is the same as the minimum segment length, 25 m. Thus, the MMU for polygons equals 491 square meters, which is rounded up to 500 square meters. It is generally recommended that a scale no larger than 1:4,000 be used for classification, though there may be cases where zooming in further may be necessary to ensure accuracy.

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 fetch distances compared to wind roses that show direction and speed. 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 tidal flats, a grain size of sand and the presence of bed forms indicate an exposed setting, whereas a grain size of mud indicates a sheltered setting. Visible wave activity over large areas in imagery is often an indication of exposed shorelines.

Tidal datum: While the target tidal datum for the ESI HYDRO layers is mean high water, the ESI lines and polygons are classified to the mean lower low water tidal datum. In the case where the shoreline type at the mean high water level varies from the shoreline composition in the intertidal zone, the ESI classification will consist of more than one value. Be aware aerial and satellite imagery are captured at various phases of the tide; this variation should be taken into consideration while classifying the shoreline.

Beach grain size: Distinguishing between the different types of beaches can be very difficult, especially when trying to decide if a beach is composed of fine- to medium-grained sand (3A) or coarse-grained sand (4). Fine-grained sand beaches tend to be wider and flatter (**Figure 2.7**). Coarse-grained sand beaches are usually narrower in width and often steeper than finer-grained beaches (**Figure 2.12**). It should be noted that this characteristic is often difficult to observe in aerial imagery. As such, 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 allows, field verification by the mapping team, and/or regional SSC, is also encouraged.

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 2.14** for an example of a mixed sand and gravel beach. Beaches composed mostly or entirely of shell are also classified as gravel beaches.

Wetland shorelines: ESIL line segments that are coincident with wetland polygon boundaries must contain the ESI code for the wetland (10A-10F) as the first (or only) value in the ESI attribute. For example, a shoreline segment that borders a salt marsh must have the ESI code "10A". If that salt marsh has a mud flat beyond it, the line segment would have a value of "10A/9A". If the entire segment does not border the wetland polygon, it may need to be split.

Wetland data converted from outside sources should be reviewed against the most recent imagery and verified or corrected as appropriate.

Tidal flats: As previously mentioned, tidal flats are sometimes included in the wetland habitat or land cover datasets used to create the ESIP data layer. Additional tidal flats may need to be digitized using aerial and satellite imagery. A tidal flat is defined as a flat, intertidal surface, without vegetation. Many tidal channels in wetlands have muddy banks that are relatively steep and thus are not to be mapped as tidal flats; segments classified as 10A/9A should not occur in most marsh tidal channels. In most cases, the tidal flat is the most seaward shoreline class; an exception would be on very wide wave-cut platforms where the tidal flat occurs landward of the outmost edge of the rock platform.

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. If such tidal flats are visible in the imagery and are larger than the MMU of 500 square meters, they should be digitized and added to the ESIP data layer. Tidal flats mapped as polygons are considered to be water features (WATER_CODE = "W") and have an ESI classification of "7" or "9A".

In cases where the tidal flat is not classified as a single class shoreline type, and is smaller than the MMU, the feature is not included as a polygon, but the ESIL must still incorporate the ESI code for the tidal flat as the seaward component. 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.

Multiple shoreline types: As previously mentioned, ESI shoreline segments may be composed of more than one type of shoreline. It is important to capture these sensitive shorelines in the ESI attribute in the correct order. Segments can have up to three ESI codes in a sequence with the most landward shoreline type listed first. Codes must be separated by a forward slash. See Section 3.3.3 below regarding illogical shoreline sequences.

3.3.3 Common Issues and QA/QC

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

- 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. The maximum scale used for editing is 1:5,000. Zooming in beyond this scale provides detail that is generally not visible at printed map scales. The topological relationship between the ESIP and ESIL features should always be maintained and local topology validation should be performed after a shoreline shape is edited.
- As mentioned previously, satellite and aerial imagery are captured during varying phases of the tide. Other input datasets, such as CUSP and NHDPlus, 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.
- 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.
- There may be shorelines in the upper reaches of rivers that may not fit the environment code used for the majority of the project area. For example, an ESI in a primarily estuarine environment may include some shoreline that is more appropriately typed riverine, or lacustrine. See Appendix B, ESI Data Dictionary, for more information.
- Wetland datasets usually specify whether a habitat is salt water 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.
- GIS geoprocessing tools such as eliminate and dissolve sometimes introduce imperceptible errors at the edges of the resulting datasets. For example, eliminate may cause a slight, non-uniform spatial shift at the edges of the dataset. Steps should be taken to identify and eliminate these errors.
- 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. It will be necessary to dissolve the temporary polygons back into the original HYDROP polygon prior to final delivery.

A rigorous QA/QC process must follow the completion of the shoreline classification. It is very important to make sure the shoreline is still continuous and coincident in the ESIL and ESIP data layers. This can be done by validating the topology rules and fixing any errors. Other common items to check for are listed below.

- Illogical shoreline sequences are a common error found during the QA/QC process. Invalid classification sequences might include mixing sheltered and exposed types, for example 6B/9A or 8B/7, although mixing these is sometimes valid. For example, a sheltered seawall fronted by a fine-grained sand beach with a sand flat beyond the beach would be classified as 8B/3A/7, a valid sequence. Other common invalid sequences combine vegetated low banks with marshes (9B/10A or 9B/10B) or a sand beach beyond a salt marsh (10A/3A). The geologist will need to look at a list of questionable ESI values and determine which are valid for the geographic area being classified.
- As mentioned in Section 3.3.2, shoreline segments that share a boundary with a wetland polygon must contain the ESI code for that polygon (10A-10F) in their classification sequence.
- All attributes in ESIP, ESIL, HYDROP, and HYDROL must have valid values and cannot be null. See Appendix B for a list of valid values for all attributes.
- All ESIL shoreline segments (LINE = ‘S’) must be directionally mapped to have land on the right, water on the left. This will assure the line is properly symbolized in the map products and final geodatabase.

CHAPTER 4

The ESI Biology Component

Steps to Collecting, Creating, and Compiling Biological Data and the ESI Biological Data Table Structure and Content

4.1 Introduction to ESI Biological Resources

4.1.1 Purpose of Biological Resource Mapping in the ESI

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 very 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-stages, and the habitats where these life-stages 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 marine or aquatic species concentrate during significant life stages or activities - such as nesting, pupping, foraging, or molting
- Sheltered, nearshore environments where early life stages or important reproductive activities occur and where oil tends to accumulate
- Habitats suitable for specific life stages or along critical migratory routes
- Specific areas that are vital sources for seed or propagation
- Areas where a significant percentage of the population is likely to be exposed to oil
- Species/habitats that may be impacted by cleanup activities or treatment of oil
- Species of commercial, recreational, and/or ecological importance

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

4.1.2 Biology Data Components

The ESI biology are divided into eight master *ELEMENTS*:

BENTHIC	BIRDS	FISH
HABITATS	HERPETOFAUNA	INVERTEBRATES
MARINE MAMMALS	TERRESTRIAL MAMMALS	

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 how the classification works.

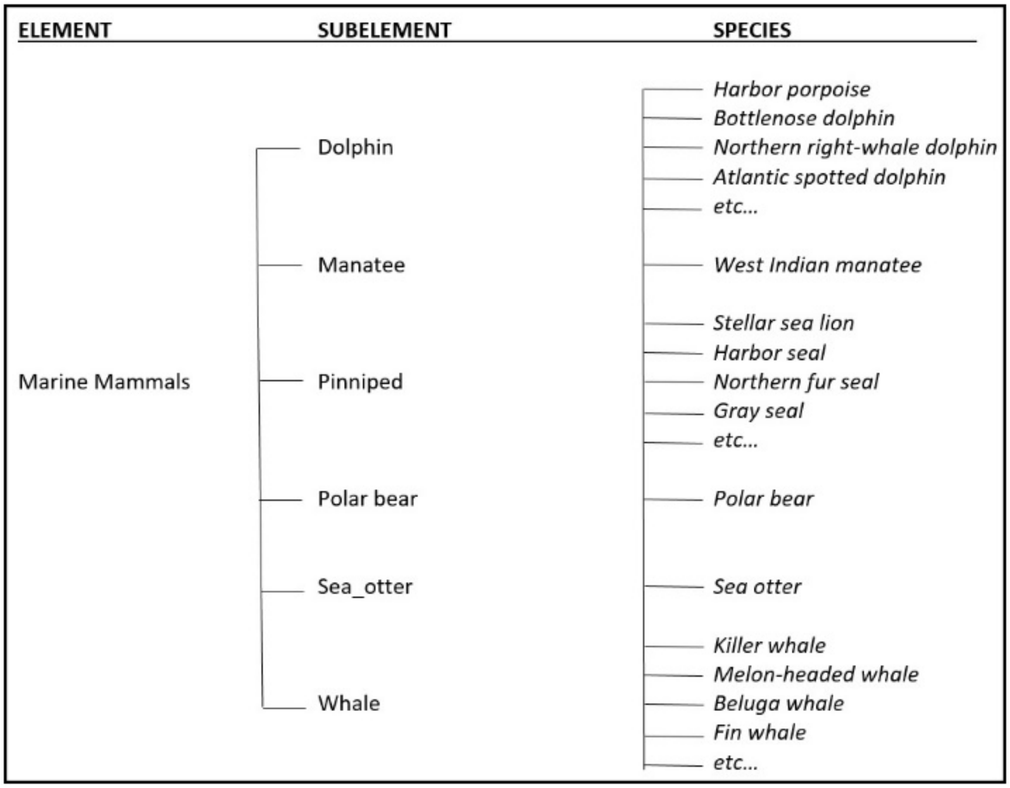


Figure 4.1: *Sample ELEMENT, SUBELEMENT, SPECIES breakdown*

Biological features are generally mapped at the species level, though some exceptions apply. NOAA maintains a master species list for the ESI available at: *https://response.restoration.noaa.gov/esi_specieslist*. This list currently includes over 5,000 species and species groupings. For each entry, the attributes ELEMENT, SUBELEMENT, GEN_SPEC (genus and species), and NAME (common name or local variation) are provided. There is also a SPECIES_ID number which is unique within each element.

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. Theoretically, this means there can be up to three feature classes for a single element, though this will rarely happen. For most distributions, polygonal representation is most appropriate and desirable. Polygons have the advantage of showing the extent of a resource occurrence and lend themselves well to GIS analysis. Section 4.2 – Creating ESI Biological Content, provides more specific guidance on biological mapping considerations and about masking sensitive resources.

4.1.3 Biological Attributes and the ESI Data Tables

There are two data schemas for the biological data tables. One utilizes several related tables to store information in discrete, easily managed tables. This is the format used during data collection and is the format required for deliverables to NOAA. It is also the format that these guidelines address. The other schema is used for public distribution of the ESI data. It simplifies the related tables into a flat file, to ease data viewing and querying by the end user. This format is generated by NOAA during the final QA of the data. The composition of the tables and fields for both schemas is provided in Appendix C. A comprehensive overview of the relational structure required for the NOAA delivery, including table fields and acceptable values, is outlined in the ESI Data Dictionary – Appendix B. This section will provide some general considerations for populating the relational tables.

Feature Class Attributes

Each biological feature class has just two attributes (**Figure 4.2**), both of which provide a link to additional information in the standalone data tables.

Feature Class Attributes:

Field name	Storage	Sample Values
ID	Double	2830100001, 2830500001
RARNUM	Long	28300001

Figure 4.2: *Biological feature class attributes*

ID

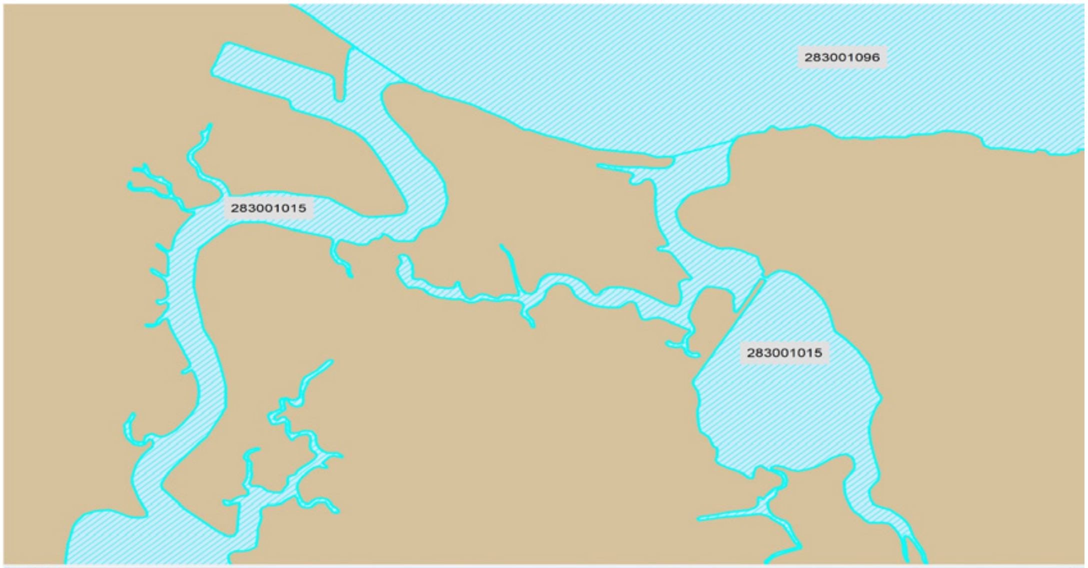
The ID is a unique feature identifier. This attribute consists of a 10-digit number incorporating the atlas number, a layer identification number, and the feature number. The ID provides a one-to-one relationship between the features and the **BIO_LUT** lookup table that then links, through the RARNUM, to the relational data tables. The one-to-one relationship and the lookup tables are used during quality checks of the ESI data deliverable. Some sample IDs are shown below. Layer# 01 represents polygonal bird features; layer# 07 represents polygonal invertebrate features. A full explanation and list of layer# values can be found in Appendix C.

2830100001 ➔ atlas# 283 ➔ element/layer# 01 ➔ feature# 000001

2830700001 ➔ atlas# 283 ➔ element/layer# 07 ➔ feature# 000001

RARNUM

The RARNUM is the direct link from the feature class to the attribute tables. Many species frequently co-occur, and habitats are often shared by a large assortment of species. The ESI approach does not allow overlapping polygon features within an element and, as such, necessitates multiple species be allowed to share a common feature representation. This is accomplished using a Resource at Risk number, or RARNUM. Each RARNUM represents a unique combination of species (of the same element), with species attribute values identical for concentration, seasonality, life-history information (i.e. breeding), mapping qualifier, and sources. **Figure 4.3** illustrates the RARNUM link from the map to the data table **BIORES**, and the many-to-many relationship between the map objects and the biology attribute tables. Because the same assemblage of species may occur in several locations across the mapped area, the RARNUM provides a many-to-many correspondence between the feature class and the associated attribute tables and reduces the unnecessary duplication of attributes in the data tables.



BIORES

RARNUM	SPECIES_ID	CONC	MAPPING_QUALIFIER	SEASON_ID	G_SOURCE	S_SOURCE	ELEMENT	EL_SPE	EL_SPE_SEA
283001015	85	COMM	NURSERY AREA	2	28300402	28300401	FISH	F00085	F0008502
283001015	86	COMM	NURSERY AREA	1	28300402	28300401	FISH	F00086	F0008601
283001015	98	COMM	NURSERY AREA	1	28300402	28300401	FISH	F00098	F0009801
283001015	145	COMM	NURSERY AREA	1	28300402	28300401	FISH	F00145	F0014501
283001015	168	COMM	GENERAL DISTRIBUTION	1	28300402	28300401	FISH	F00168	F0016801

Figure 4.3: *Illustration of the RARNUM's many-to- many relationship: multiple polygons with same RARNUM, linking to multiple records in the BIORES table.*

The 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 of current ESIs) and the last six digits are indicative of the unique species or resource group within the atlas. Some examples include:

234000001 ➔ atlas# 234 | resource grouping 1

219000001 ➔ atlas# 219 | resource grouping 1

In this example, we see both South Carolina (atlas# 234) and Northwest Peninsular Florida (atlas# 219) with the same resource group number (1), but the *RARNUM* remains unique since the atlas number is embedded. This assures that there is no duplicity when viewing multiple atlases at the same time.

BIO_LUT table

The BIO_LUT table is a conduit from the biological features to the relational data tables. The fields RARNUM and ID are the same as described for the feature attribute table (**Figure 4.4**).

BIO_LUT table:

Field name	Storage	Sample Values
RARNUM	Long	28300001
ID	Double	2830100001, 2830500001

Figure 4.4: *Fields in BIO_LUT table*

BIORES table

The **BIORES** table contains the attributes SPECIES_ID, CONC and MAPPING_QUALIFIER, as well as several links to attributes stored in ancillary tables (**Figure 4.5**). The feature class and **BIO_LUT** tables link to the **BIORES** table through the RARNUM.

BIORES table:

Field name	Storage	Sample Values
RARNUM	Long	28300001
SPECIES_ID	Long	22
CONC	Text (20)	High, Potential, 100's
MAPPING_QUALIFIER	Text (25)	Nesting, Spawning
SEASON_ID	Long	1, 22
G_SOURCE	Long	28300201
S_SOURCE	Long	28300399
ELEMENT	Text	BIRD, FISH
EL_SPE	Text (6)	B00001, F00122
EL_SPE_SEA	Text (8)	B0000101, F0012202

Figure 4.5: *Fields in BIORES table*

RARNUM

Previously described, this ultimately provides the link from the biological features to the related attribute tables.

SPECIES_ID

The SPECIES_ID is a NOAA-assigned species number unique within each element. The current master species list has over 5,000 species and/or species groupings/generalizations, and is available at *https://response.restoration.noaa.gov/esi_specieslist*. This list contains the SPECIES_ID values and the element, sub-element, scientific (when applicable) and common names of the species they represent. If the species list requires additions, a list of preferred sources is provided in *Appendix E*. Submit this information to NOAA for verification and a unique SPECIES_ID will be added to the master species list, along with all relevant species information.

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 4.2.7 provides some guidance on assignment of concentration values.

MAPPING_QUALIFIER

The MAPPING_QUALIFIER attribute (**Figure 4.6**) was introduced in 2015 and serves three primary purposes.

1) Provides guidance to the data collector. When choosing which species occurrences are appropriate to include in an ESI, the mapping qualifier can help keep focus on populations and life stages that are particularly vulnerable to oiling. Mapping qualifiers highlight discrete life stages or vulnerabilities (i.e., nesting, molting, haul out site, etc.). In addition to specific mapping qualifiers, there is one qualifier that is used to denote more general representations of species distributions, referred to as "General Distribution". There may be times when the only information for an important species is best categorized as "General Distribution". Consider avoiding general distribution polygons for species where more explicit data are available, as it may obscure more critical species occurrences.
2) Provides the map and data users with critical information for prioritizing resource protection. For example, if a large seasonal migration is occurring during a spill, the mapping qualifier alerts the responder to consider the areas utilized.
3) The mapping qualifier is used to highlight discrete habitats and locations, where a critical life stage or vulnerable species occurs. On the ESI PDF and hard-copy maps, occurrences qualified as "General Distribution" are included in the report/tabular data, but not shown on the map itself. (See Appendix G – Mapping and Data Filtering Guidelines).

BIRDS	FISH & INVERTEBRATES	MARINE MAMMALS
Concentration Area	Concentration Area	Concentration Area
Migration	Nursery Area	Calving
Nesting	Spawning Area	Denning
Rafting	Harvest Area	Haul Out
Roosting	Vulnerable Occurrence	Migration
Vulnerable Occurrence	Migration	Pupping
Wintering	General Distribution	Thermal Refuge
General Distribution		Vulnerable Occurrence
		General Distribution
HERPETOFAUNA	**BENTHIC & HABITAT**	**TERRESTRIAL MAMMALS**
Concentration Area	Concentration Area	Colony
Migration	High Ecological Value	Concentration Area
Nesting	Vulnerable Occurrence	Hazard
Vulnerable Occurrence	General Distribution	Migration
General Distribution		Vulnerable Occurrence
		General Distribution

Figure 4.6: *Acceptable values for MAPPING_QUALIFIER*
(Additional information located in Data Dictionary, Appendix C)

SEASON_ID

The SEASON_ID is a number ranging from 1-99, and is unique at the species level. It is used to distinguish between different seasonal representations of the same species within an atlas region. Each SEASON_ID that is assigned for a species links to a combination of monthly presence and breed category information. For example, if American oystercatchers are overwintering along the coast in high densities from November to March, and are nesting in a different location within the atlas region from April to August, these two seasonalities could be captured using the SEASON_IDs of 1 and 2 respectively. This number, combined with ELEMENT and SPECIES (EL_SPE_SEA), provides a link to both the **SEASONAL** and **BREED** tables.

G_SOURCE & **S_SOURCE**

G_SOURCE (geographic source) and S_SOURCE (seasonality source) provide a link from the **BIORES** 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 Long Island Sound atlas (atlas number 287) will have biological source IDs beginning with 28700301.

ELEMENT

As previously mentioned, there are eight unique biological groupings within the ESI, corresponding to ELEMENT; these are *BENTHIC* (X), *BIRD* (B), *FISH* (F), *HABITAT* (H), *HERP* (R), *INVERT* (I), *M_MAMMAL* (M), and *T_MAMMAL* (T). The letters in parenthesis are used to designate each element in the EL_SPE and EL_SPE_SEA fields (defined below).

EL_SPE

EL_SPE provides a link from the **BIORES** table to the **SPECIES** and **STATUS** tables. It is a concatenation of the ELEMENT letter designation and the 5-digit SPECIES_ID number (preceded by 0's if needed). For example the benthic species eelgrass, with a SPECIES_ID = 1, would have an EL_SPE value of X00001, where X designates the benthic element.

EL_SPE_SEA

EL_SPE_SEA provides a link from the **BIORES** table to the **SEASONAL** and **BREED** tables. It is a concatenation of the ELEMENT letter designation, the 5-digit SPECIES_ID number (padded with 0's if needed), and the 2-digit SEASON_ID number (also padded with a 0 if necessary). For example the bird species green honeycreeper, with a SPECIES_ID of 656, and a SEASONAL_ID of 2, would have an EL_SPE_SEA value of B0065602.

SPECIES table

The SPECIES table contains a single record for each species mapped within the ESI region (**Figure 4.7**). It is a subset of NOAA's master species list, specific to the mapped region. In the event that 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 table. The field EL_SPE provides the connection between the **BIORES** table and the **SPECIES** table.

SPECIES table:

Field name	Storage	Sample Values
SPECIES_ID*	Long	1, 25, 10502
NAME	Text (35)	White hawk, Intertidal fish
GEN_SPEC	Text (45)	Leucopternis albicollis, NULL
ELEMENT*	Text (10)	BIRD, FISH
SUBELEMENT*	Text (10)	raptor, fish
GRANK	Text (8)	G3, G5
GRANKDATE	Long	2012, 201102, 20050322
EL_SPE*	Text (6)	B00663, F01143

Figure 4.7: *Fields in Species table (*Complete descriptions of these fields appear above)*

SPECIES_ID

Described in the **BIORES** table section above.

NAME

Most often the NAME field denotes the common name for a specific species mapped. At times, however, a generalized or descriptive name may be appropriate. 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.

GEN_SPEC

This field provides the genus and species of the 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 genus name capitalized, and all other letters in lower case.

ELEMENT & SUBELEMENT

Described in the **BIORES** table section.

GRANK

GRANK reflects the conservation status ranking as defined by NatureServe (http://explorer.natureserve.org/granks.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 species list, though it is a good idea to verify that status remains current. (http://explorer.natureserve.org/servlet/NatureServe?init=Species)

GRANKDATE

GRANKDATE should reflect 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, 201401 would represent January 2014.

EL_SPE

This is the link to and from the **BIORES** table. Complete description provided in the **BIORES** table section.

STATUS table

The **STATUS** table contains a record for each federally and/or state listed species found in the ESI region (**Figure 4.8**). For ESI regions spanning two or more states, the **STATUS** table will have a species record for each state where it has a protection status. If a species is federally but not state listed, a single record can be used, with the STATE field populated with the 2-letter abbreviation of any of the states in the ESI region. If it is federally listed and there are multiple records for state listing, the federal status should be included in each. The field EL_SPE provides the link to and from the **BIORES** table.

STATUS table:

Field name	Storage	Sample Values
ELEMENT*	Text (10)	BIRD, FISH
SPECIES_ID*	Long	1, 25, 10502
STATE	Text (2)	VA, TX, WA
S	Text (1)	E, T, C, X, S
F	Text (1)	E, T, C, X, S
S_DATE	Long	2012, 201102, 20050322
F_DATE	Long	2012, 201102, 20050322
EL_SPE*	Text (6)	B00663, F01143

Figure 4.8: *Fields in Status table (*Complete descriptions of these fields appear above)*

ELEMENT
Described in the **BIORES** table section.

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 **STATUS** record.

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 holds the abbreviation for the state status. Acceptable values are E – Endangered, T – Threatened, C – Species of Concern, X – Experimental essential population, S – Threatened or endangered due to similarity of appearance.

F (Federal Listing Status)

The U.S. Fish & Wildlife Service maintains a list of all federally listed species, as determined by that agency or by the National Marine Fisheries Service. There are two separate lists, one for wildlife and one for plants. (https://www.fws.gov/endangered/what-we-do/listing-overview.html). The F field holds 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, S – Threatened or endangered due to similarity of appearance.

S_DATE

This field is used to indicate when the 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, 201401 would represent January 2014.

F_DATE

As with S_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, 201401 would represent January 2014.

EL_SPE

EL_SPE provides the link to and from the **BIORES** table. It is described in more detail under the **BIORES** table section.

SEASONAL table

The **SEASONAL** table (referred to as 'seasonality table') provides monthly presence information about individual species occurrences (**Figure 4.9**). For example, a shorebird that is migrating from February to April, and from July to September, will have the fields FEB, MAR, APR, JUL, AUG and SEP marked with an 'X', which corresponds to the **BIORES** record with the mapping qualifier of 'migration', and equivalent months filled out in the **BREED** table. The field EL_SPE_SEA provides the link to and from the **BIORES** table.

SEASONAL table:

Field name	Storage	Sample Values
ELEMENT*	Text (10)	BIRD, FISH
SPECIES_ID*	Long	1, 25, 10502
SEASON_ID*	Long	2, 29
JAN	Text (1)	X, ' ' (blank)
FEB	Text (1)	X, ' ' (blank)
MAR	Text (1)	X, ' ' (blank)
APR	Text (1)	X, ' ' (blank)
MAY	Text (1)	X, ' ' (blank)
JUN	Text (1)	X, ' ' (blank)
JUL	Text (1)	X, ' ' (blank)
AUG	Text (1)	X, ' ' (blank)
SEP	Text (1)	X, ' ' (blank)
OCT	Text (1)	X, ' ' (blank)
NOV	Text (1)	X, ' ' (blank)
DEC	Text (1)	X, ' ' (blank)
EL_SPE_SEA*	Text (8)	B0066302, F0114329

Figure 4.9: *Fields in Seasonal table (*Complete descriptions of these fields appear above)*

ELEMENT, SPECIES_ID, & SEASON_ID

These fields are described in the **BIORES** table section.

JAN, FEB, MAR…, DEC

These fields represent monthly presence/absence. If the species is present, and the MAPPNG_QUALIFIER applies, the field is populated with an 'X'; if it is not present, the field is left blank. For example, if the double-crested cormorant is present within a particular habitat year-round, but has two species entries within the same RARNUM because it is migrating from March to May, and August to November, one SEASON_ID will reflect the MAPPING_QUALIFIER "migration", and have the fields MAR, APR, MAY, AUG, SEP, OCT, NOV populated with an 'X'; a different SEASON_ID will reflect the months that apply to the other mapping qualifier, in this case "general distribution", and will have all applicable month fields populated with an 'X'.

EL_SPE_SEA

This field provides the link to and from the **BIORES** table. It is described in detail under the **BIORES** table section.

BREED table

The **BREED** table provides monthly information about breeding and life stage activities (**Figure 4.10**). As a searchable table, it enables end users to query when and where specific life stage activities are occurring. (There is a very similar table (**BREED_DT**) used in the simplified data schema provided for public distribution.)

BREED table:

Field name	Storage	Sample Values
EL_SPE_SEA*	Text (8)	B0066302, F0114329
MONTH	Long	1, 2, ...12
BREED1	Text (1)	Y, N, -
BREED2	Text (1)	Y, N, -
BREED3	Text (1)	Y, N, -
BREED4	Text (1)	Y, N, -
BREED5	Text (1)	Y, N, -

Figure 4.10: *Fields in Breed table (*Complete descriptions of these fields appear above)*

EL_SPE_SEA

This field provides the link to and from the **BIORES** table. It is fully described under the **BIORES** table section.

MONTH

This field contains the numeric representation of the month. An individual EL_SPE_SEA value can have up to twelve corresponding **BREED** records, as a record is entered for each month that has some breed activity occurring. If a particular species occurrence is associated with no breed/life stage activities, there will be no related EL_SPE_SEA records in the **BREED** table.

BREED1 – BREED5

The reproductive or life-stage activities vary by element. There are no life-stage activities associated with the elements benthic, habitats, or t_mammal, hence there will be no records in the **BREED** table corresponding to these elements. **Figure 4.11** presents the BREED1-BREED5 activities by element:

ELEMENT	BIRD	FISH	INVERT	HERP	M_MAMMAL
BREED1	Nesting	Spawning	Spawning	Nesting	Mating
BREED2	Migrating	Eggs	Eggs	Hatching	Calving
BREED3	Molting	Larvae	Larvae	Internesting	Pupping
BREED4	n/a	Juveniles	Juveniles	Juveniles	Molting
BREED5	n/a	Adults	Adults	Adults	n/a

Figure 4.11: *Breed/Life-stage activities corresponding to BREED1-BREED5*

The BREED1 – BREED5 fields are populated with a 'Y' if the life stage is occurring, an 'N' if it is not occurring, or '-' if the life stage does not apply to the specified element.

SOURCES table

All ESI feature classes – the biology, socioeconomic, and the base ESI and HYDRO layers, share the SOURCES table (**Figure 4.12**). This is where feature and attribute specific metadata resides. In addition to providing citations for the ESI data, the SOURCES table can help users identify regional experts.

SOURCES table:

Field name	Storage	Sample Values
SOURCE_ID	Long	23400322, 23700003
ORIGINATOR	Text (255)	NOAA FISHERIES SERVICE
DATE_PUB	Long	2015, 201307
TITLE	Text (255)	CRITICAL HABITAT LOGGERHEAD SEA TURTLE
DATA_FORMAT	Text (80)	VECTOR DIGITAL DATA, EXPERT KNOWLEDGE
PUB_PLACE	Text (255)	FEDERAL REGISTER, SILVER SPRING, MD
PUBLISHER	Text (255)	DEPARTMENT OF INTERIOR, NOAA
PUBLICATION	Text (255)	FEDERAL REGISTER VOL 65, UNPUBLISHED
ONLINE_LINK	Text (255)	http://www.fws.gov/wetlands
SCALE	Text (20)	1:25,000, VARIES, UNKNOWN
TIME_PERIOD	Text (34)	2006-2008, 199004, 1997

Figure 4.12: *Fields in Sources table*

SOURCE_ID

The numbers populating this field provide a link to/from the **BIORES** and **SOC_DAT** tables, as well as the **HYDROL, ESIL,** and **ESIP** feature classes. The number is constructed as follows:

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

The base source number is added to the atlas number * 100,000, making the SOURCE_ID unique across atlases. The corresponding fields in the **BIORES** table are G_SOURCE and S_SOURCE; in the SOC_DAT table the fields are G_SOURCE and A_SOURCE; and in the HYDRO and ESI feature classes the link is to SOURCE_ID and ESI_SOURCE.

ORIGINATOR

This field contains the name of the providing agency or company, followed by the name(s) of the individual provider(s) if appropriate. All text is formatted in upper case.

DATE_PUB

For published sources, this will be the actual publication date. In the case of expert opinion, this date should reflect the data collection date, or the date of the interview if the study is ongoing. As with all dates it should follow the format YYYY, YYYYMM, or YYYYMMDD, where Y is the numeric year, M the numeric month and D the numeric date.

TITLE

This is the name of the publication or data set, or an identifying summary of the contents received from expert input. All text is formatted in upper case.

DATA_FORMAT

This reflects how the data was delivered. Common values include EXPERT KNOWLEDGE, DOCUMENT, VECTOR DIGITAL DATA, SPREADSHEET, HARDCOPY TEXT. All text is formatted in upper case.

PUB_PLACE

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

PUBLISHER

When applicable, this field should contain the data publisher, otherwise it is left blank. All text is upper case.

PUBLICATION

When applicable, this field should contain a citation of the source, otherwise it is left blank. All text is upper case.

ONLINE_LINK

This field contains a URL to the original data, if it is publically available for download. If not, it should provide a link to the providing agency's website, preferably a page that provides additional detail about the data used in the ESI. The URL should be copied as it appears in the address bar. It needs to be fully qualified (include the http:// portion), and should not include any "<" or ">" characters.

SCALE

SCALE is a text field that describes the scale of the original data. Values may be numeric or descriptive. Examples are 1:24000, 24000 (denominator of scale only), UNKNOWN, and VARIES. Textual content should be formatted in upper case. If the source does not have a scale associated with the content (e.g., it was used for seasonality information), a value of 'N/A' is assigned.

TIME_PERIOD

This reflects 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, 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.

4.2 Creating ESI Biological 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. With this in mind, it is the task of ESI Biologists 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 the 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 will drive successful data collection and compilation efforts, and ultimately lead to a relevant and usable ESI product.

4.2.1 Create a Working Species List

At risk resources will vary from region to region, but will always include coastally dependent species that are federally and/or state listed as threatened or endangered. All ESI species lists start with this consideration in mind. The US Fish and Wildlife Service, Ecological Services Division as well as state fish and wildlife divisions are the best resources to tap when identifying at risk species within your ESI region. In addition to these primary target species, focus should be placed on species that have an increased vulnerability due to life stage or activities occurring in environments likely to be oiled. Consideration should also be given to any species that may be harvested for consumption or may have other economic impacts if affected by a spill. Appendix A provides some guidance to the types of species to consider and some general mapping approaches (see **Figure 4.13**).

For ESI regions that have been mapped previously, starting with the same species list and cross checking with species mapped in adjacent regions (particularly if these regions have been updated more recently), is a reasonable starting point. 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. Engagement with these experts will most certainly result in further refinement of the list.

Element	Sub-Element	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
BENTHIC				
	algae	Algal beds, important species	Concentration area, High ecological value	Areas of intertidal or subtidal algae may be mapped if identified as an important benthic habitat
	coral	Living, reef-building coral areas, rare species	Concentration area High ecological value, Vulnerable occurrence	Corals are widely considered as important habitats, and may be mapped as groups or to the species-specific level. Some corals have special status, e.g. ESA listed *Acropora* species
	hardbottom	Other hard substrates that provide structural habitats or cover	High ecological value	Generally includes areas that are not living coral reef, but provide hard bottom substrate
	kelp	Beds or forests of kelp	Concentration area, High Ecological Value	Areas of kelp that are well-established, and not likely to vary year to year
	sav	Submerged aquatic vegetation	Concentration area, High ecological value, Vulnerable occurrence	Seagrass and other submerged aquatic vegetation are widely considered as important subtidal habitats, and are often mapped as polygons representing the dominant species in an area (e.g. eelgrass).

Figure 4.13: *Excerpt from* Appendix A - *mapping considerations at the subelement level*

While speaking with experts, discuss how ESI databases are not an inventory but rather a concise list of at risk resources. Explain how the existing species list was compiled and that it is meant only as a starting point; their input and expertise is essential to determining the species that are ultimately mapped. Provide guidance to keep the discussions focused. For instance, for the fish species list, which often contains the most species and may be the largest feature class, focus efforts on identifying species that are state and/or federally listed, diadromous in nature, commercially or recreationally important, or species that aggregate in large numbers to reproduce in the region. Additionally, consider focusing on early life history activities, as these early life stages are when fish are most vulnerable to spilled oil.

4.2.2 Identifying Partners, Resource Experts, and Relevant Data Sets

NOAA Scientific Support Coordinator (SSC) Role

The NOAA regional Scientific Support Coordinator (SSC) is an invaluable resource to tap 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 that 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 may choose to attend data collection meetings, perhaps presenting an overview of the types of data that will be requested and some general background on the ESI. Their attendance at these meetings can strengthen their ties and familiarity with the regional experts which may ease cooperation and coordination if an oil spill does occur. 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 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; contact the ESI Program Manager for a recent copy. This letter, and 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

State, Federal, 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. 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 data sets and individuals willing to share their expertise, as well as help with review of draft data products.

As species 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 source 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 are the most current and that their 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.

4.2.3 Contacting, Engaging, and Meeting with Resource Experts

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 amongst their other job obligations. Simplifying the data collection and review process, being appreciative, and maintaining cooperative partnerships are all 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 is a complete and accurate reflection of the data provided. Initial contact may be through a call or email to the potential data provider, to explain the ESI product and usages, as well as the data needs. During this call, ESI Biologists should 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). For particular elements, a checklist might be appropriate when reviewing what species and data should be included in the ESI. Some key considerations are: is the species listed as threatened or endangered? Is the species coastally dependent? Does the species reproduce in the AOI? Does the species congregate in large numbers during discrete time periods or life events?

Pre-Workshop Planning

During, or shortly after initial calls with resource experts, scheduling an in-person meeting should be a priority. These meetings should focus on identifying and refining the species list and collecting data. It may be useful to compile a selection of possible dates, in an attempt to accommodate as many resource experts as possible within a similar time frame. It is typically most efficient to plan all in-person meetings within a 5-day business week (or multiple business weeks, depending on the size of the AOI) in order to capture as much information as possible while minimizing travel.

It is useful to plan to meet with experts with similar expertise together so that data sources and mapping strategies for the target species can be addressed in fewer discussions. Topics may be as general as “fish”, as specific as one particular species, or grouped by ESI subelement, like “shorebirds” or “sea turtles”. Workshops typically last 2-4 hours with each group of experts, and involve brainstorming available data and identifying other resource experts to contact. In some cases, particularly when dealing with digital data sets, resource experts may provide data sets in advance, allowing for the ESI Biologists to display the data in an ArcGIS project for discussion at the workshops. For data that is not currently in a digital format, it is useful to have base maps prepared where experts can hand draw areas of species occurrence and/or concentration, or use GIS software to capture locational and attribute information during the workshops.

Data Collection Workshop Tips and Protocols

During the in-person workshops, keep in mind that the experts are the authoritative source on the species they study and manage; however, the ESI Biologists and the SSC need to provide guidance on 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. Information in the form of handouts, previous ESI maps, example digital data sets, and bulleted lists (often in a PowerPoint format) that clearly articulate the intent of the ESI can be very helpful.

With regard to threatened and endangered species, it is critical that listing status for all species be reviewed by the data providers. 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, Evolutionarily Significant Units). It is important to discuss data that are captured in the ESI attribute tables at the initial in-person meeting as well, including life-history and seasonality (for the SEASONALITY and BREED tables) information, and how to assign concentration values and mapping qualifiers.

Some experts may be resistant to sharing data because of the sensitive nature of a particular resource. Be prepared to find approaches that will work for the data providers while still serving the objective of the ESI. Remind them that if a responder is unaware of the location of a sensitive resource, protection may be delayed. ESIs are a tool often used in the early hours of a response, before resource experts may be contacted, particularly when a spill occurs after hours or on weekends or holidays. There are multiple ways a species or location can be obscured (see Data Creation Considerations section), and the metadata and sources table ensure the response team has the appropriate contact when more detailed information is required.

Post Data Collection and Compilation Review Workshops

A second set of in-person, or 'review' workshops should take place after data have been incorporated into a format that is compatible with the ESI data schema and a draft product is available for review. A review with the data provider should ensure that the intent of the data was accurately captured and that no security or sensitivity concerns were violated. It is imperative to provide interim products for feedback to make sure the data are being represented as intended. Conducting these workshops with multiple species experts at the same time to review a draft of the ESI product is preferred.

During the review meetings, draft map products should be shared with the data experts so they can see how their data are represented and integrated with data from other sources. During these meetings, experts should identify gaps in the data and/or source information and additional data can be added to the feature class at this time. The review meetings add great value to the ESI as well as solidifying the ESI product as a reputable, vetted source of the most up-to-date data applicable to oil spill planning and response. The number and format of interactions with data providers may vary based on the available data and the individual preferences of the contributing data providers.

If interim data products are developed during compilation of a specific data set, check to see if the data provider would be interested in receiving them. As mentioned, there will be some resources for which no digital data exists, or digital data are supplemented through conversations with the expert. Returning these data to the provider in a digital format (aside from through the ESI data as a whole) can provide them with something tangible for their time and effort. It can be a motivator, as well as a sincere gesture of goodwill.

4.2.4 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 a 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, excel 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 are presented. A willingness to integrate data from a variety of sources into a compiled product sets the ESI apart from many common 'layered' GIS products, where attributes differ between data sets, multiple data sets are obscuring each other, etc. Expert knowledge and ancillary information, even when it is not supported by verified field data, can be a valuable source 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 species/sources matrix (**Figure 4.14**). This table helps visualize data coverage and identify where additional outreach and data are needed.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1																							
2		SourceID (Links to Sources_List):	240	241	242	243	244	245	246	247	248	249	250	251	252	253	255	256	257	258	259	260	261
3		Count of Contributions	1	1	1	2	2	1	1	1	2	2	1	1	2	68	49	38	42	10	11	1	1
4	# Sources																						
23	13	Common snook														1	1	1	1				
24	5	Cownose ray														1			1				
25	12	Crevalle jack														1	1	1	1				
26	10	Dolphin														1	1	1	1				
27	11	Florida pompano														1		1					
28	10	Gag grouper														1	1	1	1				
29	10	Goliath grouper														1	1		1				
30	10	Gray snapper														1	1	1	1				
31	7	Gray triggerfish														1	1	1	1				
32	6	Great hammerhead														1	1		1		1		
33	10	Gulf flounder														1	1	1					

Figure 4.14: Sample *Species/Source matrix, including tally of sources/species and contributions/source*

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. Depending when in the process a data set was acquired, it may be necessary to revisit the plan for compiling the data from a source once species in similar habitats, etc. are presented by other data providers. It is not uncommon to acquire data from more than one source for the same species or species groups. For instance, often there are State, Federal, University, NGO and other partners with the same resource concerns and priorities who all maintain data sets over time. When practical, this is the primary reason why getting resource experts from multiple agencies in the same room or digital meeting is critical. When this is not possible, it is important to consider all data received, but be able to make decisions on what data serves the purpose of the ESI most adequately, and/or if it is practical to use data sets from different agencies for different geographies. For instance, when meeting with NPS 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 perhaps a State partner that is providing a state-wide data set.

Incorporation of Edits into Final Deliverables

Upon completion of the review with the data providers, the ESI Biologists must work with their GIS Department to 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 it should be top priority for ESI Biologists to revisit the initial mapping strategy across all elements, to ensure that all edits and data additions and deletions that occurred throughout the process still result in a seamless and concise final deliverable.

4.2.5 Creating ESI Feature Classes

Key Considerations for Inclusion of Polygonal Biological Features

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

Buffering and Matching Species to Habitats

When manipulating biological features for inclusion in the ESI database, polygons may be clipped to appropriate geographic features, such as tidal flats and marshes; they may be bounded by appropriate bathymetric or topographic contours; or they may be created by buffering the shoreline. Determining common biologically relevant boundaries and buffer sizes beforehand will help focus the compilation effort, keep the data manageable, and minimize topographic issues such as slivers and small polygons that provide little useful information.

When appropriate, uniform buffers should be used both within and between feature datasets (elements). For example, critical 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 will best represent both the nesting habitat for sea turtles and migratory or staging areas for shorebirds. These resulting features will offer the user of the ESI a very clear picture that the shoreline represented with these buffers 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 rely on their eggs for food might be 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 all of the sand beaches within the AOI (or expert designated subsection thereof) and including tidal flats as polygonal features.

As discussed above, ESI data will come from multiple sources, some in a digital format and others as a narrative. When digital source polygons were derived, it is highly likely the base shoreline differed in currency and/or resolution from the ESI shoreline. For this reason, all data delivered as digital polygons should be reviewed and modified based on original intent, to match the ESI shoreline and other polygon 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. This is essential to ensure a cohesive dataset.

Benthic features, such as reefs and submerged aquatic vegetation, might also be noted as important for a wide variety of species. Therefore, benthic habitat data, most often provided in a digital vector format, can be used as a basis to create features for the species that are dependent upon them. As a note, 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 or taxa may better serve the ESI end user than the more detailed original data set as provided by the resource expert.

Finally, 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. If there is not a HYDRO feature currently represented in the ESI feature dataset, existence of the stream should be verified, and the HYDROL feature class should be modified to include the stream feature.

Key Considerations for Inclusion of Point and Line Biological Features

Point features are most often used to represent bird nests, pinniped haul-out sites, the mouth of streams used by anadromous or native stream species, and for polygon features that will be too small to display on a hard copy or PDF ESI. Chapter 6 presents guidance on the minimum mapping unit considerations as they relate to the ESI data. Lines are typically reserved for features that represent streams, such as anadromous fish runs, native stream species, or federally listed mussels. 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 experts may be resistant to sharing precise locational data because of the sensitive nature of a particular resource, which may influence how a feature is mapped. For example, a provider may have highly accurate point data showing nesting sites for bald eagles, but are reluctant to share the data for fear 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 a polygon that includes the nest site, but does not pinpoint the exact location. This should be documented in both the Introductory Pages and in the metadata. For more information, see the Obscuring Sensitive Resources section below.

4.2.6 Data Tables – Capturing the When and Why

To this point, we have been primarily focusing on capturing the 'who', 'what' and 'where' of at-risk resources - i.e., the features. The 'why' and the 'when' are just as important to oil spill responders and planning teams. The attributes provided in the related data tables capture when at risk resources are expected to be present and life stage activities that may be occurring.

Seasonal Considerations: Populating Key Attribute Fields

Many of the biological resources mapped are migratory, wintering, or using the region for a critical life history stage or season (e.g., nesting, spawning, or pupping). This information is extremely important to capture and highlight. If an oil spill occurs in February, the responders may encounter a different suite of species than if a spill happens in July. Queries of resources at risk are both spatial and seasonal in nature. A summary of an area generated for two opposing seasons may capture different resources, depending on the region, climate, species present, and other environmental factors specific to that atlas.

As mentioned previously, mapping qualifiers are required attributes for all biological features. This attribute highlights life-history, seasonality, vulnerability, whether a species is commercially, recreationally, or subsistence harvested, etc. For example, if an island is identified as supporting a nesting colony of seabirds, the mapping qualifier associated with that feature would be listed as “Nesting”. Similarly, the seasonal presence attribution that is linked to this feature should include the months in which the seabird species is using the island as a nesting site. Further, the BREED attribution should reflect the months during which the specific BREED categories are occurring on the island. (**Figure 4.11** provides a summary of the life history categories for each ELEMENT.)

If this island is also used as a roosting site for the same seabird species, a separate feature attributed with “Roosting” should be created. The "roosting" feature will be attributed with seasonality and BREED associated with the roosting behavior. When mapping to this detail, a species may be included within a final feature more than once (after RARNUM’s have been assigned). This is acceptable if additional information reflected in the second, or third, mapping qualifier indicates a discrete life history trait that further puts the species or species group at risk during a spill event.

4.2.7 Data Creation Considerations

Number of Species per RARNUM

While there are no hard and fast 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 50 species, or several hovering around that count or greater, it is time to 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 40-60% 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 de-emphasize the species occurrences of greatest concern?

3) It may be appropriate to have two (rarely more) records for a single species in the same RARNUM, where more than one *specific* (other than GENERAL DISTRIBUTION) mapping qualifier applies. In cases where a single RARNUM has both GENERAL DISTRIBUTION and an additional mapping qualifier, re-evaluate whether inclusion of the GENERAL DISTRIBUTION mapping is appropriate for the ESI.
4) Mismatched, overlapping polygons may create slivers or other unintended polygons, potentially resulting in RARNUMs with an artificially high number of species records. This is because the slivers will contain the species and attributes present in each of the original polygons.
5) Similarly, using polygons to map transition zones, such as fresh- to salt-water fish habitats, may result in a large number of species records if the overlap contains all species records from each contributing polygon. **Figure 4.15** shows two examples where the species record count for the highlighted polygons rose to over 70 species. Consider if the added complexity adds value, or if these can appropriately be shown as two vs. three polygons. Utilize common borders whenever possible.
6) Monthly seasonality and breed activities can be reflected in the BREED and SEASONALITY tables of the same species record, even if there are two distinct seasons.
7) Consider combining records that have similar spatial extents into a single polygon and RARNUM where possible to avoid multiple overlapping polygons with similar boundaries.
8) 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
9) 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 plant species by their status as threatened or endangered. Conversely, it is likely necessary to maintain the common name and Federal T/E status intact for federally listed plant species.
10) In all cases, **conveying that state and/or federally protected species are present, requiring consultation with species experts before response or clean-up activities are started, should be a high priority.**
11) Whenever data has been modified or simplified into broader groupings, record this information in both the introductory pages and the metadata lineage section.

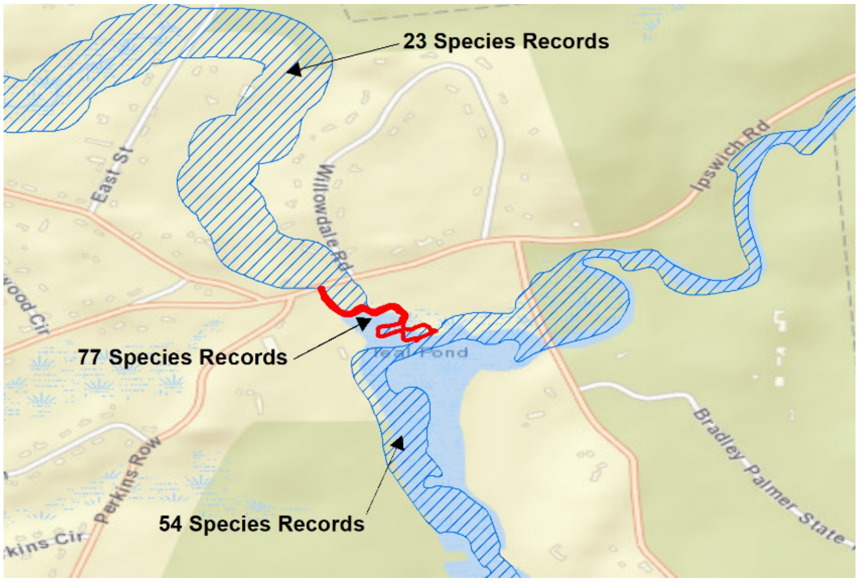


Figure 4.15: *Overlapping fish polygons at transition zones*

Obscuring Sensitive Resources

For a variety of reasons, a data provider may request that species locations presented in the ESI be altered so that either the exact location and/or identity is obscured from the public. This is most often the case with threatened or endangered populations or with 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. If this is the case, ensure that the "true" location of the resource is still within the buffered feature. When appropriate, if approved by the data provider, clip the final feature 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 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 that is endemic to that region. In this case, further obscuring the resource by either using "Endangered Reptile" or even "Endangered Herpetofauna" may be appropriate. There are species names available to distinguish that there are more than one endangered reptile in the region (Endangered Reptile 1, Endangered Reptile 2, etc.), if needed (i.e., in the event that 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.

Assigning Concentration Values

Though numeric counts seem to provide the highest level of detail, it is important to be aware of how these data will ultimately be represented in the ESI database. Once all data from all sources are compiled, and the final RARNUMs are generated, it is unlikely that a count, initially intended for a single or group of polygons, will be represented the same as it was originally mapped. Because the ESI biology structure does not support overlapping polygons, polygons may split or be "absorbed" by other polygons within the same element. Data are often provided with numeric counts as the only concentration value available, and it is difficult to assign a qualitative value. In these cases, careful data compilation at the element level will ensure that the concentrations are depicted as intended.

In the example below (**Figure 4.16**), you can see an original bird polygon spanning a small island and some tidal flats. Within this polygon, there is a record for Sandwich terns with a concentration of 1,125 nests. On the right, you see how this information is ultimately represented in the ESI data, after compilation with the other bird data. The original polygon is now divided into five distinct polygons, each with a record for Sandwich tern with a concentration of 1,125 nests. This can be very misleading to the end user if they select individual polygons and see those counts. We know the data doesn't now reflect 5,625 nests, but the end-user will not have access to the original intent.

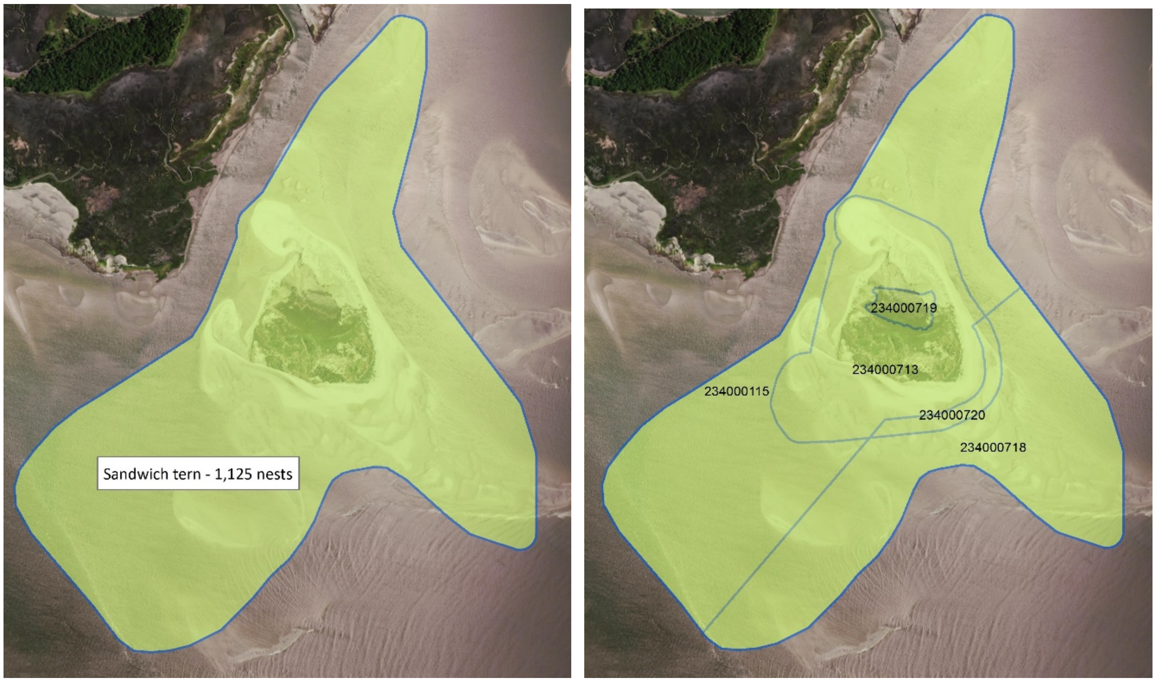


Figure 4.16: *Left - Sandwich Tern data as collected; Right - after compilation with other bird data*

When creating the ESI PDF maps, this issue resolves for adjacent polygons of a single species with like attributes; however, other issues may arise. In the American coot example, shown below – **Figure 4.17**, there are 3,332 polygons mapped to fresh water bodies and freshwater marshes. (The green, hatched polygons represent the American coot.) These polygons represent 239 unique RARNUMs. Each polygon record has the same concentration value of 1000s. It is impossible to know whether this concentration reflects the sum total of all these polygons, or if it represents polygon groups found in more discrete areas. It is highly unlikely that it accurately reflects the concentration of each individual polygon.

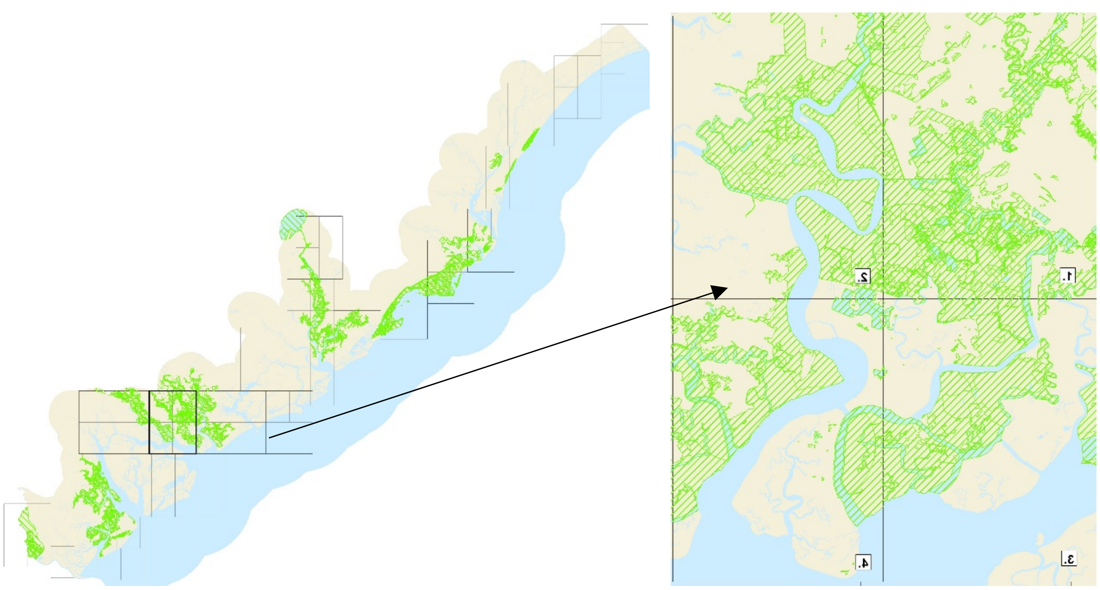


Figure 4.17: *Wintering sites for the American coot, all with CONC values of "1000s"*

This is further complicated when maps are made, or queries are made on a subset of the data. In the above example, the map on the left shows the extent of the atlas. On the right you see the boundaries for four biology maps. Polygons are further subdivided in this process, even if they are adjacent and have been dissolved earlier in the mapping process.

The ESI Data Dictionary (Appendix B) contains a list of some common CONC qualitative values. A detailed explanation of what a particular CONC value reflects for a specific species/region can be recorded in the metadata and the atlas introductory pages.

CHAPTER 5

The ESI Socio-Economic (Human-Use) Component

Steps to Collecting, Creating, and Compiling Socioeconomic Data

and the ESI Socioeconomic Data Table Structure and Content

5.1 Introduction to ESI Socioeconomic Resources

5.1.1 What to map

Non-living resources may also be impacted by spilled oil and other natural and/or man-made disasters. In this purview, the ESI focus is on resources that warrant protection from oiling and/or clean-up operations, resources that inherently may themselves pose a threat, and those resources that may be utilized for an effective response. Knowledge of jurisdictional and management boundaries is also important to ensure responders are in contact with the proper regional authorities during an event. Oil spills can also result in serious economic consequences, notably by impacting recreational and commercial fisheries. As a whole, these are the type of resources mapped in the Socioeconomic/Human-Use portion of the ESI.

There are nearly 100 socioeconomic ESI "types" used in prior ESI products; not all are appropriate for every region. There are required features for *all* ESI atlases, for example certain jurisdictional boundaries and essential habitats. Other features included in most ESIs that should be mapped if present in the region and are boat ramps, airports, management areas, parks, etc. Still other socioeconomic types are mapped when relevant to a particular area, such as tsunami inundation areas and hurricane storm surge areas. More detail on required human-use features, and mapping considerations for other socioeconomic features is presented in section 5.2.

5.1.2 Human-Use Data Components

The ESI human-use data are divided into six master *elements* that equate to feature classes. These are:

ELEMENT	Feature types	ELEMENT	Feature types
POLITICAL	Political/Jurisdictional	MANAGED	Parks/Managed areas
RESOURCE	Resource management	NAV_MARINE	Navigation/Marine
SOCECON	Socioeconomic	NAT_HAZARD	Natural Hazards

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 (and map layer); collectively these feature classes are housed within the feature dataset SOC_DAT.

Under the feature attribute table definitions, the ESI Data Dictionary (Appendix B) specifies to which ELEMENT and feature type each human-use type corresponds. There are also two ancillary sections in the 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.

5.1.3 Human-Use Attributes and the ESI Data Tables

Unlike the biological data, the data schema for the human-use deliverable to NOAA, and the final public distribution format, are virtually the same. This is because there is only one primary related attribute table, the **SOC_DAT** table. A brief description of the human-use data tables appear next.

Feature Class Attributes:

With one exception, each human-use feature class table has three attributes. Two provide a link to additional information in the standalone data tables; the third attribute is an abbreviation of the human-use type the feature represents. The exception is the NAT_HAZARD_POLY feature class. When used to represent flood inundation from storm surge, this feature class has a fourth attribute, DEPTH, which specifies the extent of flooding associated with that particular feature and storm category.

Feature Class Attributes:

Field name	Storage	Sample Values
TYPE	Text (4)	A, WO, BR, WI
ID	Double	2836000001, 2836200001
HUNUM	Long	28300001

Figure 5.1: *Human-use feature class attributes*

TYPE

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

ID

The ID is a unique feature identifier. It is stored as a double and is a 10-digit number incorporating the atlas number, a layer identification number, and the feature number. The ID provides a one-to-one relationship between the features and the **SOC_LUT** lookup table that then links to the relational data tables. The one to one relationship and the lookup tables are used during final quality checks performed by NOAA, but they are removed before posting for download from NOAA. Sample IDs are shown below. Layer# 60 represents natural resource polygons; layer# 62 represents natural resource points. A full explanation and list of layer# values are provided in the Data Dictionary (Appendix C).

2836000001 ➔ atlas# 283 ➔ element/layer# 60 ➔ feature# 000001
2836200001 ➔ atlas# 283 ➔ element/layer# 62 ➔ feature# 000001

HUNUM

The HUNUM is the direct link from the human-use feature classes, and from the **SOC_LUT**, to the **SOC_DAT** table. Unlike the RARNUM, it is uncommon for a HUNUM to be associated with multiple records in the **SOC_DAT** table. This is in part due to the inclusion of the TYPE field. 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.

Additionally, unlike the ESI biology data, 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.

SOC_LUT table

The SOC_LUT table is a path from the human-use features to the **SOC_DAT** table. The fields, HUNUM and ID are the same as described for the feature attribute table. This table is not included in the final ESI geodatabase, but is used during the final QA/QC of the data delivered to NOAA.

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 object-level source information (**Figure 4.12**). The human-use feature classes and the **SOC_LUT** table link directly to the **SOC_DAT** table through the HUNUM.

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
A_SOURCE	Long	283000102, 283000299

Figure 5.2: *Fields in SOC_DAT table*

HUNUM

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

ELEMENT

The ELEMENT field is populated with one of six values describing the primary category of the feature. These are POLITICAL, MANAGED, RESOURCE, NAT_HAZARD, NAV_MARINE, and SOCECON. These elements, together with the feature type (polygon, line, point), correspond to the feature class name. This field was introduced to the ESI data in 2015 when the content of the human-use data was expanded, and narrows down feature classes/layers to specific categories of data.

TYPE

TYPE spells out the abbreviated socecon TYPE found in the feature classes. Acceptable attribute values and the corresponding abbreviations are listed in the Data Dictionary under the **SOC_DAT** table description.

NAME

If applicable, this field holds the actual name of the resource, 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 will contain 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 publically available for download from the agency, this field should contain a link to the agency website, 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 & A_SOURCE

G_SOURCE (geographic source) and A_SOURCE (attribute source) provide a link from the **SOC_DAT** table to the **SOURCES** table, where feature level source information is provided. The region unique portion of the human-use source numbers range from 101-300. This value is then added to the atlas number * 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 – the biology, socioeconomic, and the base ESI and HYDRO layers, share the SOURCES table. This is where feature-specific metadata resides. 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 4.1.3, **Figure 4.12**, and attribute values and descriptions are provided in the Data Dictionary.

5.2 Creating ESI Socioeconomic 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 oil spill planning and response. Not all human-use types are necessary or provide useful information for every region. Consultation with the regional Scientific Support Coordinator and other local oil spill responders and stakeholders is necessary to ensure that each ESI product best serves the local community. For example, storm surge inundation is mapped only in areas that frequently have tropical storms; whereas, jurisdictional information, boat ramps and beach access locations are always included in the ESI, as this information is essential for oil spill response activities regardless of the region.

5.2.1 Identifying Relevant Datasets and Resource Experts

As introduced in the previous section, the Human-Use feature dataset contains information on jurisdictional resources (POLITICAL, MANAGED), economic, cultural, and response resources (RESOURCE, SOCECON), marine and navigational resources (NAV_MARINE) as well as information on regional natural hazards, such as storm surge potential and tsunami inundation zones (NATURAL_HAZARD).

The ESI jurisdictional features include state and county boundaries, Coast Guard regions and districts, and National Park boundaries, among others. Appendix D provides a list of authoritative sources for most jurisdictional boundaries; in order to maintain consistency across atlases, these are the sources that should be used for these features. Standardized 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.

Economically and culturally important resources (commercial and recreational fishing areas, aquaculture sites, water intakes, archaeological sites, etc.) and spill response features (staging areas, 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 United States Coast Guard. 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. Mapping of any natural hazard features will vary by region, and will need to be coordinated with the ESI Program Manager.

As a generality, most of the content for the ESI SOCECON 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(s) and/or EPA Regional Response Coordinator(s).

5.2.2 Steps to Data Collection

When collecting the socioeconomic data for an ESI product, federal and state GIS clearinghouses are a good place to start. Reach out to 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 all 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. You will be in contact with these experts for biological data collection and review, and these boundaries can be affirmed or amended at the same time.

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. Since 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 always be addressed in the ESI metadata.

5.2.3 Data Compilation

Creating Features

Mapping of SOCECON 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 SOCECON 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.

When possible, you should ensure that jurisdictional datasets are nested correctly and clipped to land or water as appropriate. For example, county boundaries should be nested within the state boundaries. 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 SOECON features, it is essential that features abutting the shoreline share the same boundary line as the Hydro polygons. Source data sets were likely created using a different base shoreline from the one used for the ESI. Logical matching to the ESI shoreline may therefore require modifications to the SOCECON features (e.g. marine sanctuaries should not overlap land, land features should not extend into offshore waters, etc.). On a related note, jurisdictional boundaries may or may not include offshore waters. An evaluation of metadata or written legal definitions may be necessary to ensure these features are accurately portrayed for the purposes of the ESI. 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 a definitive source for legally defined jurisdictional boundaries. These boundaries are included as a reference for planning and response. Review any edits to the source data sets with the data provider(s) to make sure that the original intent of the data has not been violated by edge matching to the ESI features.

Another potential pitfall when using multiple datasets to create a robust ESI SOCECON data layer is double mapping of a feature. This may happen when two or more source data sets are used to map a particular Human-Use type. It is most likely to occur when using a combination of 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 in order 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 to damage from spilled oil 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. Proper citation of the review meetings should be made in the SOURCES table and included in the introductory materials when appropriate.

5.5.4 A Note on Invasive Species

Although by most definitions invasive species are considered a biological component of the environment, for the purposes of the ESI these are included with the Human-Use content. The reasoning is two-fold. 1) To avoid any confusion that these are valuable, high-risk species that are in need of 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 should also be included in the ESI introduction 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***

CHAPTER 6

Database Compilation & Quality Control Procedures

for ESI Data Deliverables to NOAA

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

6.1.1 Introduction

Previous sections outlined how to identify sources, interview species experts, and compile raw spatial and attribute data. Once all the raw data are collected and evaluated for inclusion in the final database, compilation and Quality Assurance/Quality Control (QA/QC) measures are enacted to ensure the final product conforms to all ESI data standards. This section is intended to give a broad 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.

6.1.2 ESI Database Structure

The ESI database contains three feature datasets, each with multiple feature classes of varying feature types (points, polygons, and lines – 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. It is now time to compile all of the data into the final database schema for delivery. The ESI Data Dictionary (*Appendix B*) 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 are generated and the finalized data are appended into these shells ensuring the appropriate fields, ordering, and field types are retained in the final delivery.

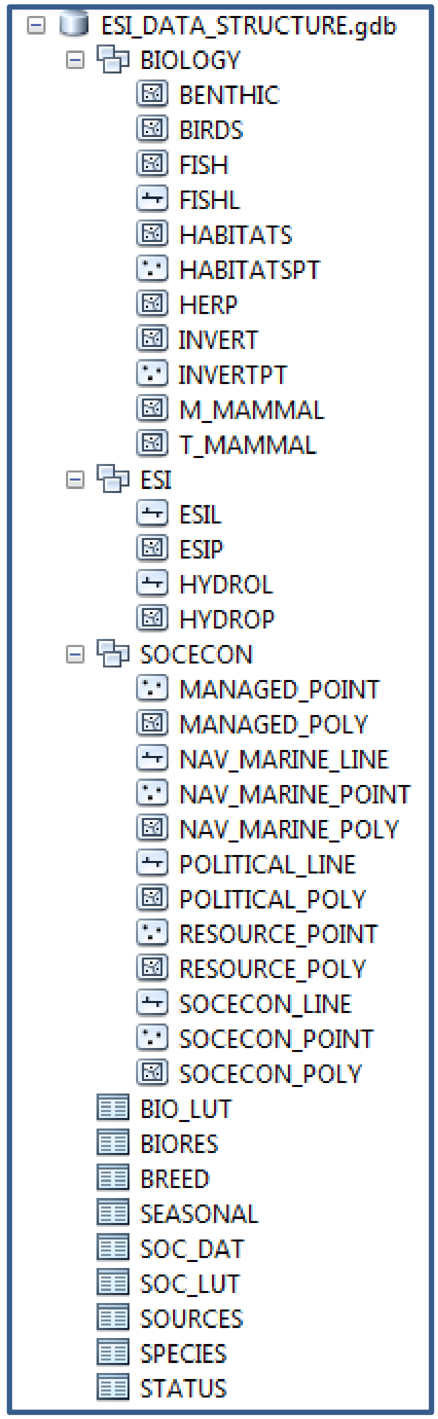


Figure 6.1: *ESI feature classes and attribute tables*

6.2 Feature Dataset Compilation

6.2.1 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 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 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 assure 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 Compilation

The following outlines one approach to the SOCEON compilation. Although you may choose another compilation method, the sample should be useful for identifying requirements and pitfalls. This approach assumes that, to this point, all of the socioeconomic data (features and attribution) are being stored in three feature classes, one each for points, polygons and lines.

The final delivery schema dictates that the attribution for SOCECON 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 socioeconomic feature has a unique numerical attribute, HUNUM (Human Use NUMber), which links the feature to the **SOC_DAT** table. Assuming interim SOCECON 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 * 100,000 to generate the final HUNUM. More information on HUNUM can be found in section 5.1.3.

Once the HUNUM value is created, you can port all of the attributes, including the HUNUM, to the SOC_DAT table. Note that the TYPE field in the SOCECON feature classes is an abbreviated form of the TYPE field in the SOC_DAT table. Appropriate values for these fields are listed in the Data Dictionary, Appendix B. When information held within the SOC_DAT table describes more than one feature in the SOCECON 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, polygons, or lines). An ID field is added to the feature class which represents the feature type, the layer type and unique feature (see *Appendix B*). Finally, a lookup table is generated that holds the ID and HUNUM values.

6.2.3 Biology Compilation

As was the case for the SOCECON 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 of the biological data (features and attribution) were stored by ELEMENT and feature class type - one each for points, polygons and lines.

The final delivery schema dictates that the attribution for BIOLOGY features is mainly held within the table named **BIORES**. A unique numerical attribute, the RARNUM (Resource At Risk NUMber), is used to link features to the **BIORES** table. Additional relational tables hold seasonal and life stage information and link to and from the **BIORES** table through various key fields. The 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, and S_SOURCE for seasonal source) from the **BIORES** table.

The biological polygon features require an overlay analysis process, as overlapping features are not permitted in this feature dataset. During the data creation phase, overlapping, multi-part polygon features are typically created. These must be converted to non-overlapping single-part features prior to data finalization and delivery. The first step is to ensure each feature class contains single part features.

Next, compute a geometric union within each feature class whereby new vertices are inserted along shared boundaries where features overlap. The resulting features are evaluated to determine which features are duplicative, meaning they have the same footprint, and which features are unique. Each feature is then assigned a unique identifier ("RARNUM"), with features that share the same geometry, assigned the same RARNUM value. At this point, attributes can be appended into the BIORES table carrying along the RARNUM value, and all attributes, other than the RARNUM, can be deleted from the feature class. Duplicate features are removed. In this process, multiple overlapping features are aggregated into a single feature while maintaining their associated attribution as the RARNUM value is now linked to the collective information for the feature, held in the **BIORES** table. The species groups, aka RARNUM groupings, will need to be evaluated for duplication of species/attribute combinations, and reduced to a singular RARNUM for each unique combination. When identical RARNUM groupings are renumbered to remove redundant sets of attributes, the RARNUM value associate with the linked features will also need to be updated.

When information within the **BIORES** table (and associated attribute tables) 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

Fragmented polygons are a common by-product of the process to resolve overlapping polygons, and they must be removed from the dataset. To address this issue, the ESI specified minimum mapping unit (MMU) can be used to identify features that fall below the ESI map scale/data resolution. See also section 6.4.1.3 for additional checks to identify fragmented and sliver polygons.

6.3 Minimum Mapping Unit – application to Biological and Human-Use features

Although the ESI is provided to the end user in a digital dynamic 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 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.

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 http://maps.unomaha.edu/Peterson/gis/notes/dataquality.html). If the MMU is established according to these guidelines, it would equal 12.5 meters at the 1:25,000 scale, 25 meters at the 1:50,000 scale and 50 meters at the 1:100,000 scale (see **Figure 6.2**).

Scale	MMU (meters)	Buffer (meters)	Area (meters^2)
1:25,000	12.5	6.25	~125
1:50,000	25	12.5	~500
1:100,000	50	25	~2,000

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

Features below the MMU threshold should be evaluated for accuracy and, if appropriate, 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. Likewise, any biological polygon feature should have an area of roughly 500 m^2 or greater, and a human use feature should be equal to or exceed roughly 2,000 m^2 to ensure that it will be included in the atlas products.

Understanding how small features are introduced into the database is important. There are four primary ways this can happen: 1) direct inclusion of small source features; 2) masking or converting a point or line feature by using a buffer smaller than the desired MMU; 3) aggregation of overlapping polygons during generation of the biological RARNUM values; and 4) 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, 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, more often than not, will be small in nature and will need to be converted to points or buffered to ensure they are represented on the atlas products.

Feature Type Conversion – At times it may be appropriate to convert data delivered as lines or points 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 (1:50,000 for Biology data and 1:100,000 for Human Use data) is essential to ensure that a feature below the MMU is not introduced into the ESI geodatabase.

RARNUM Creation/Overlap Removal – When two or more overlapping polygons are resolved during the final data preparation stage, small sliver polygons can be introduced. These are most often the result of two adjacent features overlapping slightly. After overlapping polygons are resolved, the data should be reviewed to ensure that small features were not accidentally introduced, and are resolved as appropriate.

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, more often than not, 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. Some smaller features that represent legitimate habitat or species' occurrences may be preserved in the geodatabase, with the knowledge that these features will not be included in atlas products. When delivering the data to the NOAA program manager*, the data compiler should report the number of occurrences of biological and human use features that fall below the MMU, as well as the reason they were retained*. During the final QA, this information will insure that the polygons were reviewed by the contractor, 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

Several 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, and the data tables are converted into the flat file format for distribution to the end users**.**

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: (a) Assessing accurate feature geometry and topology, (b) Evaluating tabular data attribution, and (c) 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. 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. The second case is indicative of inappropriate or incomplete merging of data sets. Attributes for these polygons will need to be merged, and a new RARNUM generated. All but one of the features should be removed, with the remaining feature now associated with the regenerated RARNUM.

Duplicate geometries found in the *ESI feature classes* may also 1) share identical attribution, or 2) have varying attribution. Those with the same attribution should be cleaned so only one polygon remains. If two or more identical ESI features exist with different attribution, they should be manually reviewed, and only the most appropriately attributed polygon retained.

Duplicate geometries are allowed in *socioeconomic feature classes*, but there should not be duplicates with the same attribution.

Inherent and Operational Feature Error

During the data capture and manipulation process, uncertainty inherent to the source data (e.g., modeled vs. direct observation data) should be taken into consideration and documented in the metadata and in the atlas introductory pages. Operational errors introduced in the processing and compilations phases, (see **Figure 6.3**) 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 ArcMap tools to create new circles/ellipses, generate buffers, etc.) and cause features to perform erratically resulting in geoprocessing failure or erroneous outputs. 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.

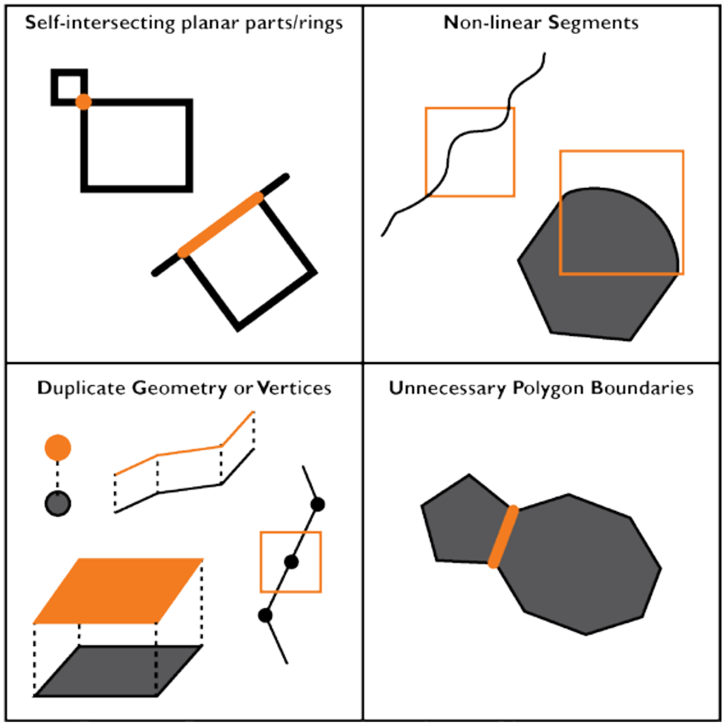


Figure 6.3: *Examples of invalid non-simple geometries*

ESI Line (*ESIL*) features are checked for operational errors by first 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 6.4**).

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 6.4** 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.

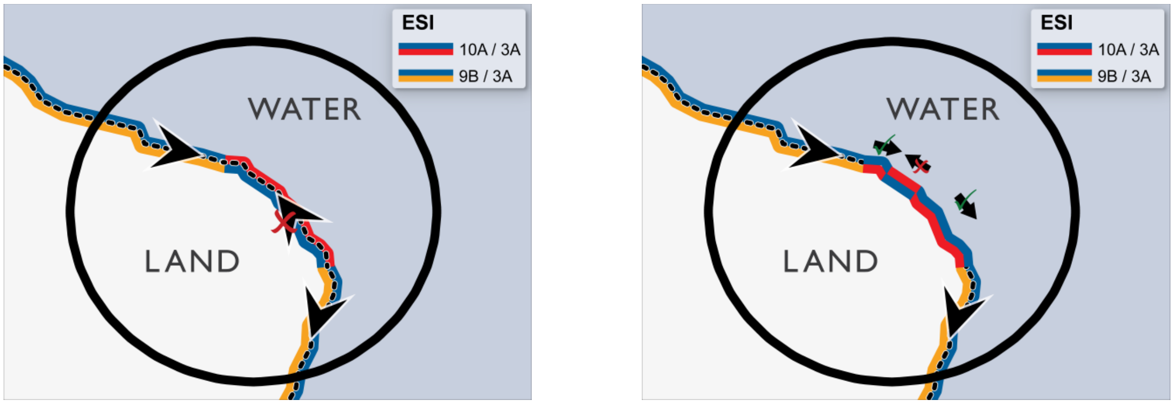


Figure 6.4 – *The effect of line direction on shoreline symbolization*

Edge-Matching, Sliver and Gaps

All features should be clipped to the regional area of interest (AOI) polygon, and biological or socioeconomic 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 sharing attributes from both features, or no attributes at all. Feature alignment must be evaluated to ensure that any overlaps (hatched, **Figure 6.5**) or gaps (black, **Figure 6.5**) 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 gaps, to create new features in the existing gaps. The resultant features should be evaluated to determine if the gaps should be assimilated into an adjacent polygon, or if they reflect the original intent.

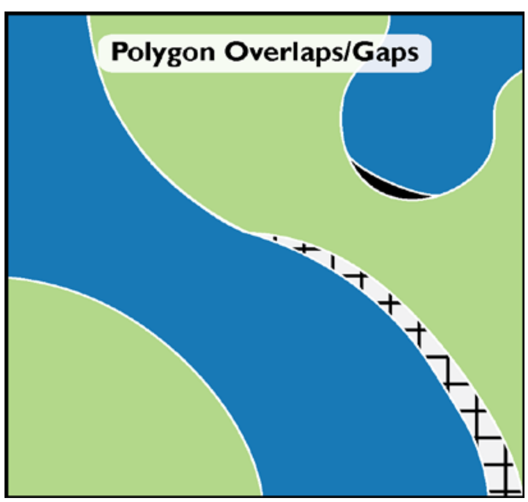


Figure 6.5 - *Slivers, gaps and overlaps*

Sliver polygons, resulting from overlaps or gaps 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 be edge-matched. Slivers are assessed in terms of the thinness, or regularity, of an object, expressed as the ratio (*T*) comparing the feature area (*A*) and perimeter (*P*):

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

Objects of regular shape have a higher thinness ratio than irregular shapes, expressed by a value ranging from 0 to a maximum value of 1 (for a circle) (Source: Microscope Image Processing, Link: https://www.elsevier.com/books/microscope-image-processing/wu/978-0-12-372578-3). Smaller 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 6.6**) 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 or breakwaters).

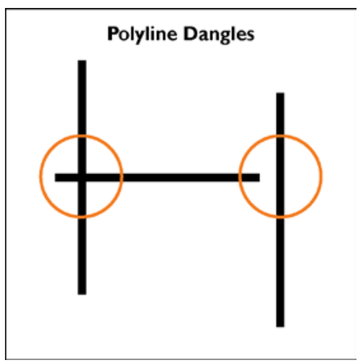


Figure 6.6 - *Example of polyline dangles*

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 schema exactly.

Content of Fields

Values assigned to the attribute fields must conform to the ESI standards, including the data type and range of acceptable values. Complete guidance is presented in Appendix B, the ESI Data Dictionary, as well as in a diagram of the 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) and feature (ID) identifiers assigned during data finalization are formatted according to convention. All **BIORES** table records should link through the RARNUM to the related BIOLOGY feature classes and the **BIO_LUT** table, and all secondary links to the **BREED**, **SPECIES**, **SEASONAL**, **STATUS**, and **SOURCES** tables must resolve. Similarly, all **SOC_DAT** table records should link through HUNUM to the related SOCECON feature classes and to the records in the **SOC_LUT** table, and secondary links to the **SOURCES** table must resolve. 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 EPA Region (EPA), Coast Guard District and Sector (CG), County (CO), FEMA Region (FEMA), and Army Corps of Engineers (ACE) information are included. Any discrepancies or omissions should be resolved prior to data delivery.

See **Figure 6.7** for standard checks to perform on the data table fields and values.

6.4.3 Generating the Regional 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 schema exactly. Check each of the following:

1) All feature classes and layer names match the standardized naming convention outlined in the Data Dictionary (Appendix B).
2) All feature attribute tables have the appropriate fields, that the fields are in the order listed in the data dictionary, that the fields are properly named and typed, and that all fields are appropriately populated.
3) All feature classes reside within the appropriate feature dataset.
4) That the source data are unprojected, using GCS North American 1983, Unit: Degrees, WKID (well-known ID)/Factory Code: 4269, Authority: EPSG.
5) That the Atlas ID number has been properly incorporated into the RARNUMs, HUNUMs, and feature IDs.

The final regional 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 regional database name must be pre-approved by the ESI Program Manager and the regional Atlas ID 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 in order to prevent simple schema mistakes. For final delivery, data that has 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. Upon completion, the data will be assembled into a flat-file format to simplify use. An ArcGIS Map Document 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).

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 (*BREED1-BREED5*) to ensure values are logical and conform to the required format. Where applicable, breed categories should reflect the mapping qualifier, for example, if a bird has a mapping qualifier of NESTING, the *BREED1* field should not be blank.
SEASON ID	A *SEASON_ID* number is assigned for each unique combination of monthly presence/absence within a species. This value, in combination with the element and species identifier (*EL_SPE_SEA*), represents the link to the **SEASONAL** and **BREED** tables. Review for similar seasonality representations for a given species and determine if generalizing a specific seasonal representation is appropriate. Generate the *EL_SPE_SEA* numbers once the *SEASON_ID* is finalized.
MAPPING QUALIFIER	Review all mapping qualifiers to assure they were assigned correctly and consistently according to the list of acceptable values for each element.
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.
EL_SPE/Name	The *EL_SPE* and *NAME* values for each record should be consistent and match the *EL_SPE* and species name in the most up-to-date Master Species List (*https://response.restoration.noaa.gov/esi_specieslist)*.
Sources	Ensure that all records in the **BIORES** 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".

Figure 6.7 - Checks for proper field values

CHAPTER 7

Creating ESI Metadata

7.1 CREATING ESI METADATA

7.1.1 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, but instructions for the development of metadata were not specifically provided in prior ESI Guidelines documents.

Metadata has 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 an essential 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 of 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.

7.1.2 Metadata Standards

NOAA and other Federal agencies recently adopted a new metadata standard which is used internationally, developed by the International Organization for Standardization (ISO) (NOAA/NCDDC 2012). Development of the current ISO Standard 19115 was initiated 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 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 new 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 applications which support the new ISO standard, as well as offer compatibility with the older FGDC/CSDGM standard and the ability to convert between the two standards. Most of the items documented in the FGDC/CSDGM standard are also addressed 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. A thorough comparison of the two standards is beyond the scope of this ESI Guidelines document, but the FGDC has developed an ISO-FGDC Metadata Crosswalk document (FGDC 2009) and other helpful resources (FGDC 2014, 2015). 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) to be covered by a single metadata record. Under the ISO-19115 standard, each feature class (or layer) and associated tables are considered as Entities or “Child Items” of the “Parent” metadata record. As such, each is given its own nested (or tiered) metadata record to document attributes (e.g. fields) within the entities (e.g. tables). In addition, the ISO-19115 standard enables layers or feature classes of multiple geometry types (e.g. points AND/OR lines AND/OR polygons).

7.1.3 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 recently adopted an online platform known as InPort*, 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. **Figure 7.1** illustrates the primary metadata sections under the CSDGM and ISO standards, as well as the sections enabled within the InPort system as of October 2017 (Release 3.9.2.0).

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* InPort (Information Portal) was developed by the Fisheries Information System (FIS) to give NOAA Fisheries and its partners the capability to catalog and search data holdings.

FGDC-CSDGM (MERMAid)	NOAA's InPort System	ISO-19115
Identification Information	Item Identification	Metadata Information
Data Quality Information	Keywords	Spatial Representation Information
Spatial Data Organization Information	Physical Location	Reference System Information
Spatial Reference Information	Data Set Information	Metadata Extension Information
Entity and Attribute Information	Support Roles	Identification Information
Distribution Information	Extents	Content Information
Metadata Reference Information	Spatial Information	Distribution Information
	Access Information	Data Quality Information
	Distribution Information	Portrayal Catalogue Information
	URLs	Metadata Constraint Information
	Activity Log	Application Schema Information
	Technical Environment	Metadata Maintenance Information
	Data Quality	
	Lineage	
	Child Items	
	Catalog Details	
	Issues	
	Data Management	
	FAQs	
	Related Items	

Figure 7.1 - *Key elements of the FGDC-CSDGM & ISO-19115 metadata standards, and the InPort Metadata System*

7.1.4 ESI Metadata Process and NOAA Requirements

The metadata for NOAA ESI products should reflect the data as they are delivered to the public, versus the format the contractor delivers to NOAA. These differences relate primarily to the data tables. For example, the **BIORES**, **SEASONAL**, **SPECIES**, and **STATUS** tables, required for the deliverable to NOAA, are compressed into a single file, the **BIOFILE**, to enhance usability. The **BREED** table is recompiled to produce the **BREED_DT** table, and the ID fields and **BIO_LUT** and **SOC_LUT** tables are eliminated. The **SOC_DAT** and **SOURCES** tables are the same for both deliverables. See Appendix C for a graphic comparison of the two data table structures.

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 will be requested within two weeks following the completion of the NOAA QA/QC and compilation of the ESI GIS data for public distribution. The processing time required by NOAA is generally between 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 the data acquisition and compilation. The final "revisit" of the metadata, after NOAA processing, 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 contractors to review and comment on the final ESI GIS product, prior to posting.

7.1.5 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 H) 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 Geodatabase. 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 BIOFILE, BREED_DT, 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 NATURAL HAZARD, 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_LINES, NAV_MARINE_POINTS, NAV_MARINE_POLYS, SOC_DAT, and SOURCES.

Step-by-step Guidance for Development of ESI Metadata

Appendix H 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 metadata standard.

7.1.6 Metadata References

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APPENDIX A

ESI Biological Elements and Subelements

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
BENTHIC				
	algae	Algal beds, important species	Concentration area, High ecological value	Areas of intertidal or subtidal algae may be mapped if identified as an important benthic habitat
	coral	Living, reef-building coral areas, rare species	Concentration area, High ecological value, Vulnerable occurrence	Corals are widely considered as important habitats, and may be mapped as groups, reef types, or species. Some corals have special status, e.g. ESA listed species
	hardbottom	Known distributions of colonized or uncolonized hard substrate	High ecological value	Generally includes 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.
	kelp	Beds or forests of kelp	Concentration area, High Ecological Value	Areas of kelp that are well-established, and not likely to vary year to year
	reef	Hardened substrate of unspecified relief formed by reef building corals and other organisms	High ecological value, Vulnerable occurrence	Generally includes areas that are not living coral reef, but provide substrate that may be colonized by sponges, algae, and/or corals.
	sav	Submerged aquatic vegetation	Concentration area, High ecological value, Vulnerable occurrence	Seagrass and other submerged aquatic vegetation are widely considered as important subtidal habitats, and are often mapped as polygons representing the dominant species in an area (e.g. eelgrass). SAV may also be mapped as a group of species, e.g., seagrass.
	softbottom	Where the seabed consists of fine-grained sediments (mud and sand)	High ecological value	Unconsolidated sediments may be mapped if critical to species using certain benthic habitat types in certain atlases.

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
BIRD				
	alcid	Rookeries, wintering/rafting areas, other concentration areas	Nesting, Concentration area, Rafting, Wintering	Occur in offshore waters and on islands or cliffs where they nest
	bird	Threatened, endangered, or rare occurrences, nesting sites	Nesting, Concentration area, Vulnerable occurrence	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.
	diving	Rookeries, feeding/ wintering areas, other concentration areas	Nesting, Concentration area, Roosting, Wintering	Typically shown in nearshore areas along shorelines and on tidal flats, islands, and in sheltered bays, estuaries, lagoons, etc.
	gulls and terns	Nesting sites, other concentration areas	Nesting, Concentration area	Usually shown as buffers along shorelines and on tidal flats, islands, and in sheltered bays, estuaries, lagoons, etc.
	landfowl	Nesting sites, other concentration areas	Nesting, Concentration area	Occur in terrestrial areas, sometimes in and around wetlands
	passerine	Threatened, endangered, or rare occurrences, nesting sites, other concentration areas	Nesting, Concentration area, Vulnerable occurrence	Endangered, threatened or rare passerines that rely on coastal or wetland habitats are included when appropriate especially if nesting occurs in the area
	pelagic	Rookeries, feeding, roosting, rafting, other concentration areas	Nesting, Concentration area, Roosting, Rafting	Occur in offshore waters and on islands or cliffs where they nest
	raptor	Nesting sites, migratory/feeding concentration areas	Nesting, Concentration area, Migration, Vulnerable occurrence	Occur along rivers, coastal shorelines, in wetlands, and in sheltered waters
	shorebird	Nesting sites, migratory stopover concentrations, other concentration areas	Nesting, Concentration area, Migration, Vulnerable occurrence	Typically mapped using a 75-100m buffer (onshore and offshore) along sand and gravel beaches. They are also mapped on tidal flats and in wetland habitats
	wading	Rookeries, feeding, roosting, other concentration areas	Nesting, Concentration area, Roosting	Usually restricted to wetlands, tidal flats, tidal creeks, and the margins of sheltered waters (bays, estuaries, lagoons, sloughs)

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
BIRD				
	waterfowl	Migratory and wintering areas, nesting sites, other concentration areas	Nesting, Concentration area, Migration, Wintering, Vulnerable occurrence	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	Mapping Qualifiers*	Unique Characteristics
FISH				
	anadromous	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Migration, Vulnerable occurrence	Includes species that spawn in fresh water (streams or lakes), but migrate to and from salt water (ocean or estuary)
	diadromous	Spawning runs, nursery areas, threatened, endangered or rare occurrences	Spawning area, Nursery area, Migration, Vulnerable occurrence	Includes species that migrate between fresh and salt water, such as American eel that spawns in salt water and lives a portion of its life cycle in fresh and estuarine waters, or stickleback, which can occur in fresh or salt water environments.
	e_nursery	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Concentration area	Includes species that inhabit estuarine waters for a portion of their life cycle, especially as nursery areas for juveniles
	e_resident	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Concentration area	Includes species that complete their entire life cycle in estuarine waters
	fish	Spawning runs, nursery areas, threatened, endangered or rare occurrences	Harvest area, Concentration area, Migration, Nursery area	Includes all fish for which no other specific subelement is assigned. May also be used as a subelement if common name is masked due to sensitivity
	freshwater	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Concentration area, Vulnerable occurrence	Includes species that complete their entire life cycle in fresh waters. Often includes small resident fish species with special conservation status
	m_benthic	Spawning and nursery areas, concentrations in reefs, SAV, and other habitats	Spawning area, Nursery area, Concentration area	Primarily marine species, typically occurring near the bottom in a demersal or benthic life mode
	m_pelagic	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Concentration area	Primarily marine species, typically occurring in the water column above the bottom, e.g. tunas and mackerels
	m_resident	Spawning, nursery, and other concentration areas	Spawning area, Nursery area, Concentration area	Includes species that complete their entire life cycle in marine waters

HABITAT				
	fav	Floating aquatic vegetation	Concentration area, High ecological value, Vulnerable occurrence	Listed species or species of high conservation concern
	plant	Special/rare plants, habitats, or communities	Concentration area, High ecological value, Vulnerable occurrence	Listed species or species of high conservation concern
	upland	Special/rare upland (terrestrial) plants, habitats, or communities	Concentration area, High ecological value, Vulnerable occurrence	Listed species or species of high conservation concern
	wetland	Special/rare wetland plants, habitats, or communities	Concentration area, High ecological value, Vulnerable occurrence	Listed species or species of high conservation concern

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
HERP				
	alligator	Concentration areas, especially nesting	Nesting, Concentration area, Vulnerable occurrence	Includes species of alligator, crocodile, and caiman
	amphibian	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations
	frog	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations
	lizard	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations
	reptile	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations
	snake	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations
	turtle	Nesting and concentration areas	Nesting, Concentration area, Vulnerable occurrence	Threatened, endangered, or rare occurrences, especially aquatic/wetland concentrations

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
INVERT				
	barnacle	Harvest areas, high concentrations	Concentration area, Harvest area	Includes ecologically and/or economically important species in estuarine or marine waters.
	bivalve	Harvest areas, high concentrations, threatened, endangered, or rare occurrences	Concentration area, Harvest area, Vulnerable occurrence	Includes ecologically important, fishery species, and listed species of clam, mussel, oyster, or scallop.
	cephalopod	Harvest areas, high concentrations	Concentration area, Harvest area	Includes ecologically and/or economically important species of squid or octopus.
	chordate	Harvest areas, high concentrations	Concentration area, Harvest area, Vulnerable occurrence	Includes ecologically and/or economically important species in estuarine or marine waters.
	crab	Harvest and nursery areas, high concentrations	Concentration area, Harvest area, Nursery area	Includes ecologically and/or economically important species of crab in estuarine or marine waters.
	crayfish	Nursery, spawning, and harvest areas, threatened/ endangered/rare occurrences	Harvest area, Nursery area, Spawning, Vulnerable occurrence	Includes ecologically and/or economically important crayfish species, and species with special conservation status
	echinoderm	Harvest areas, high concentrations	Harvest area, Concentration area	Includes ecologically and economically important species of sea stars, sea urchins, crinoids, and sea cucumbers.
	gastropod	Harvest areas, high concentrations, threatened, endangered, or rare occurrences	Harvest area, Concentration area, Vulnerable occurrence	Includes snails, whelks, and abalone species, some of which have special conservation status
	insect	Threatened, endangered, or rare occurrences	Vulnerable occurrence	Threatened, endangered, or rare occurrences of select species
	invert	Harvest areas, high concentrations, threatened, endangered, or rare occurrences	Harvest area, Concentration area, Vulnerable occurrence	Includes ecologically and economically important and vulnerable species of inverts, often when true subelement must be masked due to sensitivity of data.

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
INVERT				
	lobster	Nursery, spawning, harvest areas, threatened/ endangered/rare occurrences	Harvest area, Nursery, Spawning, Vulnerable occurrence	Includes lobster species important in fisheries, or with special conservation status
	shellfish	Harvest areas, high concentrations, threatened, endangered, or rare occurrences	Concentration area, Harvest area, Vulnerable occurrence	Includes ecologically important harvested species
	shrimp	Harvest and nursery areas, high concentrations	Harvest area, Nursery, Concentration area	Includes shrimp species important in fisheries, or with special conservation status
	worm	Harvest areas, high concentrations	Harvest areas, high concentrations	Includes ecologically and economically important species and those that are subsistence harvested or culturally valued

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
M_MAMMAL				
	dolphin	Concentration areas, migratory routes	Concentration area, Calving, Migration	Known areas of concentration, calving, or migration for dolphins and porpoises; may be mapped in marine and estuarine waters
	manatee	Concentration areas, cold weather refugia	Concentration area, Thermal refuge	Known areas of concentration and winter refugia; may be mapped in freshwater, estuarine and marine areas
	pinniped	Haul outs, pupping sites, concentration areas	Concentration area, Haul out, Pupping	Known concentration areas, haul outs, and pupping sites; may be mapped both in water and on land
	polar_bear	Concentration areas, denning concentrations	Concentration area, Denning	Known concentration and denning areas; may be mapped both in water and on land
	sea_otter	Concentration areas, breeding areas	Concentration area	Known concentration areas; may be mapped both in water and on land
	whale	Migratory or other concentration areas	Concentration area, Migration, Calving	Known areas of concentration, calving, or migration may be mapped in marine waters.

Element	Subelement	Areas/Sites to be Mapped	Mapping Qualifiers*	Unique Characteristics
T_MAMMAL				
	bat	Colonies for threatened and endangered species	Colony, Vulnerable occurrence	Known areas of colonies or concentrations for species of special conservation concern
	bear	Intertidal feeding or aquatic/wetland concentrations, hazard areas for spill responders	Concentration area, Hazard	Coastal, wetland, or aquatic concentration areas, and hazard areas for spill responders
	canine	Threatened/endangered or rare species	Vulnerable occurrence	Known areas of concentration for species with special conservation status
	feline	Threatened/endangered or rare species	Vulnerable occurrence	Known areas of concentration for species with special conservation status
	sm_mammal	Aquatic fur-bearer concentration, other special areas	Concentration area, Vulnerable occurrence	Known areas of concentration for species with special conservation status
	ungulate	Migratory or other concentration areas	Concentration area, Migration, Vulnerable occurrence	Known areas of concentration or migration for species with special conservation status

*MAPPING QUALIFIERS: Although Mapping Qualifiers are defined by Element, those most commonly associated with the specified Subelement are listed here. General distribution is always an acceptable value when a more specific qualifier is not appropriate.

APPENDIX B

ESI Data Dictionary

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

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-23 and B-24 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 numeric 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-23 and B-24 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute)**
	SEAWARD_SHORETYPE1 (Text, 60 Characters)	**The numeric representation and physical description of the second ESI type in the ESI field (if applicable)**	**Same as LANDWARD_SHORETYPE, above**
	SEAWARD_SHORETYPE2 (Text, 60 Characters)	**The numeric 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-23 and B-24 for the ESI to GENERALIZED_ESI_TYPE crosswalk.**
	GENERALIZED_ESI_TYPE (Text, 180 Characters)	**The numeric 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-23 and B-24 for the ESI to GENERALIZED_ESI_TYPE crosswalk. Use a forward slash "/" without spaces to separate combinations of Values.**

Base Layers *cont'd*

Geographic Themes	Attribute Names	Description	Attribute Values
ESIL (ESI LINES) ***cont'd***	**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, and 10D (Marshes) U = Unclassified holes See pages B-23 and B-24 for a list of acceptable attribute values. Acceptable attribute values are based on the physiographic region (ENVIR attribute).**
	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 R = Riverine**
	ESI_DESCRIPTION (Text, 60 Characters)	**The numeric representation and the physical description of the polygon's ESI type**	**7: Exposed Tidal Flats 9A: Sheltered Tidal Flats Etc. See pages B-23 and B-24 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
ANNO (GNIS)	TYPE (Text, 25 Characters)	The Type of annotation	GEOG = Geography annotation HYDRO = Hydrography annotation SOC = Human use annotation
	NAME (Text, 50 Characters)	The feature name	Names of islands or points (GEOG) Names of inlets, rivers, ponds, lakes, bays, oceans, & coves (HYDRO) Names of beaches, wildlife reserves & preserves, state & country, marine sanctuaries, cities, & parks (SOC)
INDEX (POLYS) – maps OR	TILE_NAME (Text, 32 Characters)	Map number	1-N: N = # maps in atlas
AOI (POLYS)– no maps	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 denominator is entered.
	UTM_ZONE (Text, 60 Characters)	UTM Projection	Full projection definition for the appropriate UTM zone. (i.e. NAD_1983_UTM_Zone_18N; WKID=26918)
	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.noaa.gov/sites/default/files/esimaps/NorthernCalifornia_ESI_039.pdf

Biology			
Geographic Themes	**Attribute Names**	**Description**	**Attribute Values**
BENTHIC (POLYS)	ID (Double)	Unique identifier that links to BIO_LUT (biology lookup table)	An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230800025, would represent a feature where the atlas id = 23, the layer number = 08, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id. The layer number for BENTHIC is 08.
	RARNUM (Long Integer)	Direct link to BIORES table (or NOAA generated BIOFILE); eliminates the need to pass through the BIO_LUT lookup table	A 9-digit integer representing a unique combination of species, their seasonalities, their concentrations, their mapping qualifier and their geographic & seasonality sources. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases
BENTHICL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 28 Same as RARNUM in BENTHIC	
BENTHICPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 38 Same as RARNUM in BENTHIC	
BIRDS (POLYS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 01 Same as RARNUM in BENTHIC	
BIRDSL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 21 Same as RARNUM in BENTHIC	
BIRDSPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 31 Same as RARNUM in BENTHIC	
FISH (POLYS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 02 Same as RARNUM in BENTHIC	
FISHL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 22 Same as RARNUM in BENTHIC	
FISHPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 32 Same as RARNUM in BENTHIC	
HABITATS (POLYS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 03 Same as RARNUM in BENTHIC	
HABITATSL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 23 Same as RARNUM in BENTHIC	
HABITATSPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 33 Same as RARNUM in BENTHIC	
HERP (POLYS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 06 Same as RARNUM in BENTHIC	
HERPL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 26 Same as RARNUM in BENTHIC	
HERPPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 36 Same as RARNUM in BENTHIC	
INVERT (POLYS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 07 Same as RARNUM in BENTHIC	
INVERTL (LINES)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 27 Same as RARNUM in BENTHIC	
INVERTPT (POINTS)	ID (Double) RARNUM (Long Integer)	Same as ID in BENTHIC, except the layer number is 37 Same as RARNUM in BENTHIC	

Biology *cont'd*

Geographic Themes	Attribute Names	Description
M_MAMMAL (POLYS)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 04** **Same as RARNUM in BENTHIC**
M_MAML (LINES)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 24** **Same as RARNUM in BENTHIC**
M_MAMPT (POINTS)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 34** **Same as RARNUM in BENTHIC**
T_MAMMAL (POLYS)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 09** **Same as RARNUM in BENTHIC**
T_MAML (LINES)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 29** **Same as RARNUM in BENTHIC**
T_MAMPT (POINTS)	**ID (Double)** **RARNUM (Long Integer)**	**Same as ID in BENTHIC, except the layer number is 39** **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-32 for additional information on the human use feature grouping by type. *See pages B-33 to B-38 for the human use type explanations.**	**ACE = Army Corps of Engineers CG = Coast Guard (District and Sector) CI = City CO = County EPA = EPA Region FEMA = FEMA Region IB = International Boundary ST = State SW = State Waters TL = Tribal Lands**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id. The layer number for POLITICAL_POLY is 40.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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**	
	ID (Double)	**Same as ID in POLITICAL_POLY, except the layer number is 41**	
	HUNUM (Long Integer)	**Same as HUNUM in POLITICAL_POLY**	
POLITICAL_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in POLITICAL_POLY**	
	ID (Double)	**Same as ID in POLITICAL_POLY, except the layer number is 42**	
	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-32 for additional information on the human use feature grouping by type.** ***See pages B-33 to B-38 for the human use type explanations.**	**FO = National Forest** **MA = Management Area** **MI = Military** **MS = Marine Sanctuary** **NC = Nature Conservancy** **NERR = National Estuarine Research Reserve** **NG = National Guard** **NL = National Landmark** **NP = National Park** **P = Park (Regional or State)** **SPA = State Protected Area** **WR = Wildlife Refuge**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id.** **The layer number for MANAGED_POLY is 50.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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**	
	ID (Double)	**Same as ID in MANAGED _POLY, except the layer number is 51**	
	HUNUM (Long Integer)	**Same as HUNUM in MANAGED _POLY**	
MANAGED_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in MANAGED _POLY**	
	ID (Double)	**Same as ID in MANAGED _POLY, except the layer number is 52**	
	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-32 for additional information on the human use feature grouping by type.** ***See pages B-33 to B-38 for the human use type explanations.**	**AQ = Aquaculture** **AR = Artificial Reef** **CF = Commercial Fishing** **CH = Critical Habitat** **EH = Essential Habitat** **FA = Fishery Area** **INVS = Invasive Species** **LS = Log Storage** **M2 = Mine Site** **RF = Recreational Fishing** **RMS = Repeated Measurement Site** **S = Subsistence** **WI = Water Intake**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id.** **The layer number for RESOURCE_POLY is 60.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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**	
	ID (Double)	**Same as ID in RESOURCE_POLY, except the layer number is 61**	
	HUNUM (Long Integer)	**Same as HUNUM in RESOURCE_POLYS**	
RESOURCE_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in RESOURCE_POLY**	
	ID (Double)	**Same as ID in RESOURCE_POLY, except the layer number is 62**	
	HUNUM (Long Integer)	**Same as HUNUM in RESOURCE_POLY**	

Human Use *cont'd*

Geographic Themes	Attribute Names	Description	Attribute Values
NAT_HAZARD_POLY (POLYS)	**TYPE (Text, 4 Characters)**	**Code identifying a natural hazard feature that is mapped as a polygon** ***See pages B-32 for additional information on the human use feature grouping by type.** ***See pages B-33 to B-38 for the human use type explanations.**	**CAT1 = Category 1 Storm Inundation** **CAT2 = Category 2 Storm Inundation** **CAT3 = Category 3 Storm Inundation** **CAT4 = Category 4 Storm Inundation** **CAT5 = Category 5 Storm Inundation** **SSIA = Storm Surge Inundation Area** **TIA = Tsunami Inundation Area**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id.** **The layer number for NAT_HAZARD_POLY is 70.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases.**
NAT_HAZARD_LINE (LINES)	**TYPE (Text, 4 Characters)**	**Same as TYPE in NAT_HAZARD_POLY**	
	ID (Double)	**Same as ID in NAT_HAZARD_POLY, except the layer number is 71**	
	HUNUM (Long Integer)	**Same as HUNUM in NAT_HAZARD_POLY**	
NAT_HAZARD_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in NAT_HAZARD_POLY**	
	ID (Double)	**Same as ID in NAT_HAZARD_POLY, except the layer number is 72**	
	HUNUM (Long Integer)	**Same as HUNUM in NAT_HAZARD_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-32 for additional information on the human use feature grouping by type.** ***See pages B-33 to B-38 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** **MO = Mooring** **PT = Port** **RM = River Mile** **SL = Shipping Lane**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id.** **The layer number for NAV_MARINE_POLY is 80.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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**	
	ID (Double)	**Same as ID in NAV_MARINE_POLY, except the layer number is 81**	
	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**	
	ID (Double)	**Same as ID in NAV_MARINE_POLY, except the layer number is 82**	
	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 socecon feature that is mapped as a polygon** ***See pages B-32 for additional information on the human use feature grouping by type.** ***See pages B-33 to B-38 for the human use type explanations.**	**A = Airport** **AS = Archaeological Site** **AV = Abandoned Vessel** **B = Beach** **C = Campground** **EPAF = EPA Facility (RMP)** **EQ = Equipment (Response)** **F2 = Factory** **F3 = Facility** **HP = Heliport** **HS = Historical Site** **HWR = Historic Wreck** **LF = Landfill** **NOAA = NOAA Facility** **OF = Oil Facility** **OS = Oil Seep** **PF = Platform** **PL = Pipeline** **R = Road (or Bridge)** **RE = Renewable Energy (Solar, Tidal, Wind, etc.)** **RR = Rail Route** **STG = Staging** **S2 = Surfing** **TU = Tunnel** **WD = Waste Disposal** **WO = Wash Over**
	ID (Double)	**Unique identifier that links to SOC_LUT (socecon lookup table)**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id.** **The layer number for SOCECON_POLY is 90.**
	HUNUM (Long Integer)	**Identification number that links to HUNUM in the SOC_DAT data table**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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**	
	ID (Double)	**Same as ID in SOCECON_POLY, except the layer number is 91**	
	HUNUM (Long Integer)	**Same as HUNUM in SOCECON_POLY**	
SOCECON_POINT (POINTS)	**TYPE (Text, 4 Characters)**	**Same as TYPE in SOCECON_POLY**	
	ID (Double)	**Same as ID in SOCECON_POLY, except the layer number is 92**	
	HUNUM (Long Integer)	**Same as HUNUM in SOCECON_POLY**	

Data Tables	Attribute Names	Description	Attribute Values
BIORES	**RARNUM (Long Integer)**	**Resource at risk number which links to RARNUM in BIO_LUT or directly to the RARNUM listed in the feature attribute table. *Multiple records can share the same RARNUM.**	**A 9-digit integer representing a unique combination of species, their seasonalities, their concentrations, their mapping qualifier and their geographic & seasonality sources. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases**
	SPECIES_ID (Long Integer)	**Species identification number**	**An integer ranging from 1 – 99,999. Numbers are unique within elements and are universal across atlases**
	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-25 for a list of the most commonly used qualitative concentration attribute values.**
	MAPPING_QUALIFIER (Text, 25 Characters)	**An indication of why this feature was mapped in the ESI; values will vary at a subelement level**	**See pages B-26 to B-31 for acceptable attribute values**
	SEASON_ID (Long Integer)	**Numerical code used to identify varying seasonalities within a particular species**	**An Integer ranging from 1 to 99 (this value is combined with the first letter of the element and the species number to generate EL_SPE_SEA – the link to the seasonal and breed tables)**
	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**
	S_SOURCE (Long Integer)	**Unique key that links to the seasonal 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**
	ELEMENT (Text, 10 Characters)	**Category of species**	**BENTHIC BIRD FISH HABITAT HERP INVERT M_MAMMAL T_MAMMAL The character for each ELEMENT that is used in EL_SPE and EL_SPE_SEA as identified below: X = BENTHIC B = BIRD F = FISH**

Data Tables	Attribute Names	Description	Attribute Values
BIORES *cont'd*	**ELEMENT *cont'd* (Text, 10 Characters)**	**Category of species *cont'd***	**H = HABITAT R = HERP I = INVERT M = M_MAMMAL T = T_MAMMAL**
	EL_SPE (Text, 6 Characters)	**Concatenation of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP) and the SPECIES_ID that links to the SPECIES table and the STATUS tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5 X00001-XNNNNN B00001-BNNNNN F00001-FNNNNN H00001-HNNNNN I00001-INNNNN M00001-MNNNNN R00001-RNNNNN T00001-TNNNNN**
	EL_SPE_SEA (Text, 8 Characters)	**Concatenation of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP), the SPECIES_ID, and the SEASON_ID that links to the SEASONAL and BREED tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5; if needed, SEASON_ID should be padded with a leading zero to a length of 2 X0000101-XNNNNNNN B0000101-BNNNNNNN F0000101-FNNNNNNN H0000101-HNNNNNNN I0000101-INNNNNNN M0000101-MNNNNNNN R0000101-RNNNNNNN T0000101-TNNNNNNN**

Data Tables	Attribute Names	Description	Attribute Values
SOURCES	**SOURCE_ID (Long Integer)**	**Unique key that links to the BIORES, BIOFILE 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 MANAGEMENT and SOCECON 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, you would 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**
	ONLINE_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**

Data Tables	Attribute Names	Description	Attribute Values
STATUS	**ELEMENT (Text, 10 Characters)**	**Category of species**	**BENTHIC BIRD FISH HABITAT HERP INVERT M_MAMMAL T_MAMMAL The character for each ELEMENT that is used in EL_SPE and EL_SPE_SEA as identified below: X = BENTHIC B = BIRD F = FISH H = HABITAT R = HERP I = INVERT M = M_MAMMAL T = T_MAMMAL**
	SPECIES_ID (Long Integer)	**Species identification number**	**An integer ranging from 1 – 99,999. Numbers are unique within elements and are universal across atlases**
	STATE (Text, 2 Characters)	**State abbreviation**	**Standard two-letter code**
	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**
	F (Text, 1 Character)	**Federal species status code at time of ESI publication**	**Same as S, above**
	S_DATE (Long Integer)	**Date the associated S status ranking was accessed**	**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 accessed**	**Same as S_DATE, above**
	EL_SPE (Text, 6 Characters)	**Concentration of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP) and the SPECIES_ID that links to the SPECIES and the BIORES tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5 X00001-XNNNNN B00001-BNNNNN F00001-FNNNNN H00001-HNNNNN I00001-INNNNN M00001-MNNNNN R00001-RNNNNN T00001-TNNNNN**

Data Tables	Attribute Names	Description	Attribute Values
SEASONAL	**ELEMENT** **(Text, 10 Characters)**	**Category of species**	**BENTHIC** **BIRD** **FISH** **HABITAT** **HERP** **INVERT** **M_MAMMAL** **T_MAMMAL** **The character for each ELEMENT that is used in EL_SPE and EL_SPE_SEA as identified below:** **X = BENTHIC** **B = BIRD** **F = FISH** **H = HABITAT** **R = HERP** **I = INVERT** **M = M_MAMMAL** **T = T_MAMMAL**
	SPECIES_ID (Long Integer)	**Species identification number**	**An integer ranging from 1 – 99,999. Numbers are unique within elements and are universal across atlases**
	SEASON_ID (Long Integer)	**Numerical code identifying varying seasonalities within a particular species**	**An Integer ranging from 1 to 99 (this value is combined with the first letter of the element and the species number to generate EL_SPE_SEA – the link to the seasonal and breed tables)**
	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 Jul y**	**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**
	EL_SPE_SEA **(Text, 8 Characters)**	**Concatenation of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP), the SPECIES_ID, and the SEASON_ID that links to the BIORES and the BREED tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5; if needed, SEASON_ID should be padded with a leading zero to a length of 2** **X0000101-XNNNNNNN** **B0000101-BNNNNNNN** **F0000101-FNNNNNNN** **H0000101-HNNNNNNN** **I0000101-INNNNNNN** **M0000101-MNNNNNNN** **R0000101-RNNNNNNN** **T0000101-TNNNNNNN**

Data Tables	Attribute Names	Description	Attribute Values
BREED	**EL_SPE_SEA (Text, 8 Characters)**	**Concatenation of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP), the SPECIES_ID, and the SEASON_ID that links to the SEASONAL and the BIORES tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5; if needed, SEASON_ID should be padded with a leading zero to a length of 2 X0000101-XNNNNNNN B0000101-BNNNNNNN F0000101-FNNNNNNN H0000101-HNNNNNNN I0000101-INNNNNNN M0000101-MNNNNNNN R0000101-RNNNNNNN T0000101-TNNNNNNN**
	MON (Long Integer)	**Specifies a month (can have up to 12 records per EL_SPE_SEA)**	**1-12**
	BREED1 (Text, 1 Character)	**Reproductive or life-stage activities varying by element, there are no life stage activities recorded for BENTHIC, HABITATS, or T_MAMMAL:** **BIRD = nesting** **FISH = spawning** **INVERT = spawning** **HERP = nesting** **M_MAMMAL = mating**	**Y = occurring** **N = not occurring** **- = not applicable**
	BREED2 (Text, 1 Character)	**Same concept as BREED1 except:** **BIRD = migrating** **FISH = eggs** **INVERT = eggs** **HERP = hatching** **M_MAMMAL = calving**	**Y = occurring** **N = not occurring** **- = not applicable**
	BREED3 (Text, 1 Character)	**Same concept as BREED1 except:** **BIRD = molting** **FISH = larvae** **INVERT = larvae** **HERP = internesting** **M_MAMMAL = pupping**	**Y = occurring** **N = not occurring** **- = not applicable**
	BREED4 (Text, 1 Character)	**Same concept as BREED1 except:** **BIRD = not applicable** **FISH = juveniles** **INVERT = juveniles** **HERP = juveniles** **M_MAMMAL = molting**	**Y = occurring** **N = not occurring** **- = not applicable**
	BREED5 (Text, 1 Character)	**Same concept as BREED1 except:** **BIRD = not applicable** **FISH = adults** **INVERT = adults** **HERP = adults** **M_MAMMAL = not applicable**	**Y = occurring** **N = not occurring** **- = not applicable**

Data Tables	Attribute Names	Description	Attribute Values
SPECIES	**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.**
	ELEMENT (Text, 10 Characters)	**Category of species**	**BENTHIC BIRD FISH HABITAT HERP INVERT M_MAMMAL T_MAMMAL The character for each ELEMENT that is used in EL_SPE and EL_SPE_SEA as identified below: X = BENTHIC B = BIRD F = FISH H = HABITAT R = HERP I = INVERT M = M_MAMMAL T = T_MAMMAL**
	SUBELEMENT (Text, 10 Characters)	**Element subgroup**	**Subelement of species. Must be lowercase.**
	GRANK (Text, 8 Characters)	**Global Rank**	**Global Rank of the species as defined by NatureServe**
	GRANKDATE (Long Integer)	**Date the associated global 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**
	EL_SPE (Text, 6 Characters)	**Concatenation of the first character of the ELEMENT (or 'X' in the case of BENTHIC and 'R' in the case of HERP) and the SPECIES_ID that links to the BREED and the BIORES tables**	**If needed, SPECIES_ID should be padded with leading zeros to a length of 5 X00001-XNNNNN B00001-BNNNNN F00001-FNNNNN H00001-HNNNNN I00001-INNNNN M00001-MNNNNN R00001-RNNNNN T00001-TNNNNN**

Data Tables	Attribute Names	Description	Attribute Values
SOC_DAT	**HUNUM (Long Integer)**	**Human use resource at risk number which links to HUNUM in SOC_LUT or directly to the HUNUM listed in the feature attribute table. *Multiple records can share the same HUNUM**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute 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 the human-use features**	**POLITICAL MANAGED RESOURCE NAT_HAZARD NAV_MARINE SOCECON**
	TYPE (Text, 35 Characters)	**Value of the abbreviated TYPE attribute found in the POLITICAL, MANAGED, RESOURCE, NAT_HAZARD, NAV_MARINE and SOCECON feature layers**	**A = AIRPORT ACE = ARMY CORPS OF ENGINEERS AN = ANCHORAGE AQ = AQUACULTURE AR = ARTIFICIAL REEF AS = ARCHAEOLOGICAL SITE AV = ABANDONED VESSEL A2 = ACCESS B = BEACH BR = BOAT RAMP C = CAMPGROUND CAT1 = CATEGORY 1 STORM INUNDATION CAT2 = CATEGORY 2 STORM INUNDATION CAT3 = CATEGORY 3 STORM INUNDATION CAT4 = CATEGORY 4 STORM INUNDATION CAT5 = CATEGORY 5 STORM INUNDATION CF = COMMERCIAL FISHING CG = COAST GUARD CH = CRITICAL HABITAT CI = CITY CO = COUNTY DV = DIVING EH = ESSENTIAL HABITAT EPA = EPA REGION EPAF = EPA FACILITY EQ = EQUIPMENT F = FERRY FA = FISHERY AREA FEMA = FEMA REGION FO = NATIONAL FOREST FR = FERRY ROUTE F2 = FACTORY F3 = FACILITY HP = HELIPORT HS = HISTORICAL SITE HWR = HISTORIC WRECK IB = INTERNATIONAL BOUNDARY INVS = INVASIVE SPECIES LD = LOCK AND DAM LF = LANDFILL LS = LOG STORAGE M = MARINA MA = MANAGEMENT AREA**

Data Tables	Attribute Names	Description	Attribute Values
SOC_DAT *cont'd*	**TYPE *cont'd* (Text, 35 Characters)**	**Value of the abbreviated type attribute found in the POLITICAL, MANAGED, RESOURCE, NAT_HAZARD, NAV_MARINE and SOCECON feature layers *cont'd***	**MI = MILITARY MO = MOORING MS = MARINE SANCTUARY M2 = MINE SITE NC = NATURE CONSERVANCY NERR = NATIONAL ESTUARINE RESEARCH RESERVE NG = NATIONAL GUARD NL = NATIONAL LANDMARK NOAA = NOAA FACILITY NP = NATIONAL PARK OF = OIL FACILITY OS = OIL SEEP P = PARK PF = PLATFORM PL = PIPELINE PT = PORT R = ROAD RE = RENEWABLE ENERGY RF = RECREATIONAL FISHING RM = RIVER MILE RMS = REPEATED MEASUREMENT SITE RR = RAIL ROUTE S = SUBSISTENCE SL = SHIPPING LANE SPA = STATE PROTECTED AREA SSIA = STORM SURGE INUNDATION AREA ST = STATE STG = STAGING SW = STATE WATERS S2 = SURFING TIA = TSUNAMI INUNDATION AREA TL = TRIBAL LAND TU = TUNNEL WD = WASTE DISPOSAL WI = WATER INTAKE WO = WASH OVER WR = WILDLIFE REFUGE**
	NAME (Text, 50 Characters)	**The name of the mapped resource, such as park name, facility 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 web-page**	**URL. Must be copied as is from the address bar & must be fully qualified (begin with http://) & contain no “<” or “>” characters**

Data Tables	Attribute Names	Description	Attribute Values
SOC_DAT *cont'd*	**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**
	A_SOURCE (Long Integer)	**Unique key that links to the attribute source in the sources table**	**Same as G_SOURCE, above**

Lookup Tables	Attribute Names	Description	Attribute Values
BIO_LUT	**RARNUM (Long Integer)**	**Links to the BIORES table and/or the BIOFILE table, and to the biological feature attribute tables**	**A 9-digit integer representing a unique combination of species, their seasonalities, their concentrations, their mapping qualifier and their geographic & seasonality sources. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases**
	ID (Double)	**Links to the biological feature attribute tables**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id**

Lookup Tables	Attribute Names	Description	Attribute Values
SOC_LUT	**HUNUM (Long Integer)**	**Unique identifier that links the SOC_DAT table to the POLITICAL, MANAGED, RESOURCE, NAT_HAZARD, NAV_MARINE and SOCECON feature attribute tables**	**A 9-digit integer representing a unique or unique combination of human use features, based on their type, their name, their geographic source, & their attribute source. This region unique number is added to the atlas number *100,000 to generate a number that is unique across atlases**
	ID (Double)	**Links to the MGT, SOCECONL, and SOCECONPT feature attribute tables**	**An integer that is the sum of the (atlas id * 10,000,000), the (layer number *100,000), and the feature id. As an example, an id of 230100025, would represent a feature where the atlas id = 23, the layer number = 1, and the feature id = 25. The number will range from 8 to 10 digits, depending on the atlas id**

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	3A: Fine- to Medium-Grained Sand Beaches		3	Beaches (Sand/Gravel)
3B	E	3B: Scarps and Steep Slopes (Sand)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
3B	L	3B: Eroding Scarps (Unconsolidated Sediment)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
3B	R	3B: Exposed, Eroding Banks (Unconsolidated Sediment)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
3C	E	3C: Tundra Cliffs		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
4	E	4: Coarse-Grained Sand Beaches		3	Beaches (Sand/Gravel)
4	L	4: Sand Beaches		3	Beaches (Sand/Gravel)
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	E	6A: Gravel Beaches (Granules/Pebbles) – used in Alaska		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: Gravel Beaches (Cobbles/Boulders) – used in Alaska		3	Beaches (Sand/Gravel)
6D	E	6D: 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 Tidal Flats		4	Flats (Mud/Sand)
7	R	7: Exposed Sand Flats		4	Flats (Mud/Sand)
8A	E/L/R	8A: Sheltered Scarps (Bedrock/Mud/Clay)		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
8A	E	8A: Sheltered, Impermeable, Rocky Shores – used in Alaska		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
8B	E/L/R	8B: Sheltered, Solid Man-Made Structures		1	Armored
8B	E	8B: Sheltered, Permeable, Rocky Shores – used in Alaska		2	Rocky and Steep Shorelines (Bedrock/Sand/Clay)
8C	E/L/R	8C: Sheltered Riprap		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	9A: Sheltered Tidal Flats		4	Flats (Mud/Sand)
9A	L/R	9A: Sheltered Sand and Mud 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 Tidal Flats		4	Flats (Mud/Sand)
10A	E	10A: Salt- and Brackish-Water Marshes		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10B	E/L/P/R	10B: Freshwater Marshes		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10C	E/L/P/R	10C: Swamps		5	Vegetated (Grass/Marsh/Mangroves/Scrub-Shrub)
10D	E/L/P/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

MAPPING QUALIFIERS AND GUIDELINES:

Element	Qualifier	Guidelines
BENTHIC	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. "coral reef" or "rocky reef"), or may indicate species-specific distributions.
	HIGH ECOLOGICAL VALUE	For use in areas where benthic organisms provide high ecological services (e.g., kelp and seagrasses), high quality habitat, or known areas of high biodiversity. Some areas (e.g. highly productive oyster reefs) may be considered "High Ecological Value" compared to less-viable but also mapped reef areas.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that are not mapped as a general distribution of the species.

Element	Qualifier	Guidelines
BIRDS	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier. May be used when other qualifiers do not apply. May indicate concentrations for foraging or other activities not covered by other qualifiers.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes); may or may not include specific life history information.
	MIGRATION	Use when an area is a known staging area of high importance to the species. Migration periods may be split into separate records for spring migration and fall migration, at the discretion of the data provider and/or contractors).
	NESTING	Applicable to all nesting birds: colonial nesters, solitary nesters, waterfowl, and secretive nesters.
	RAFTING	Similar to 'CONCENTRATION AREA' qualifier, but specific to large, on-water concentrations.
	ROOSTING	Used to designate areas where waterbirds are communally resting on land.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.
	WINTERING	Designates known areas of importance to wintering birds. Examples include wintering waterfowl and wintering shorebirds.

Element	Qualifier	Guidelines
FISH	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes). May or may not include specific life history information.
	HARVEST AREA	May be used as a qualifier for fish distributions in special cases, where the general distribution was not mapped and/or widespread and the distribution of the harvested resources is used to depict important areas.
	NURSERY AREA	Refers to a specific areas of known importance for early life history stages (e.g. larvae, juveniles) of a species. This is not intended to be applied to the entire distribution of those life stages.
	MIGRATION	Used for areas that are important to a species because they are migration corridors. May apply at any life stage. It is not restricted to "SPAWNING" as it was defined in the previous ESI guidelines.
	SPAWNING AREA	Areas where fish are spawning. Spawning is loosely defined as the release of gametes or eggs from the adult. This can also refer to pupping for species that bear live young (e.g. sharks).
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.

Element	Qualifier	Guidelines
HABITAT	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes).
	HIGH ECOLOGICAL VALUE	For use in areas where habitats provide high ecological services, are a high quality habitat, or are known areas of high biodiversity.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that are not mapped as a general distribution of the species.
HERP	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes); may or may not include specific life history information.
	MIGRATION	Potential or known sea turtle migration corridors in the marine environment.
	NESTING	Applicable to all sea turtle, crocodilia, and estuarine/freshwater turtle nesting areas. Should represent known nesting areas rather than all potential nesting habitat.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.

Element	Qualifier	Guidelines
INVERTEBRATES	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes); may or may not include specific life history information.
	HARVEST AREA	May be used as a qualifier for invertebrate distributions in special cases, where the general distribution was not mapped and the distribution of the harvested resources is used to depict important areas.
	MIGRATION	Areas that are important to a species because they are migration corridors. May apply at any life stage. It is not restricted to "SPAWNING" as it was defined in the previous ESI guidelines.
	NURSERY AREA	Refers to a specific area being used by early life history stages (e.g. larvae, juveniles) of a species, not necessarily the entire distribution of those life stages.
	SPAWNING AREA	Area where invertebrates are spawning. Spawning is loosely defined as the release of gametes or eggs from the adult.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.

Element	Qualifier	Guidelines
MARINE MAMMALS	CALVING	Known marine mammal calving areas.
	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	DENNING	Specific to known polar bear denning areas.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes); may or may not include specific life history information.
	HAUL OUT	Represents discrete, known haul-out sites of marine mammals.
	MIGRATION	Potential or known mammal migration corridors in the marine environment.
	PUPPING	Known marine mammal pupping areas.
	THERMAL REFUGE	Areas used by manatees as warm water refuges.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.
TERRESTRIAL MAMMALS	COLONY	Used to identify known bat colonies.
	CONCENTRATION AREA	Areas where concentrations are considerably higher than other records of the same species in the AOI. Completion of the concentration field is mandatory for records with this qualifier.
	GENERAL DISTRIBUTION	Used for broad, general distributions of species that are often mapped to landscape- or habitat-scale features (e.g. bays or marshes); may or may not include specific life history information.
	HAZARD	Areas where mammals that are potentially hazardous to spill responders may be found.
	MIGRATION	Potential or known mammal (ungulate) migration corridors in the terrestrial environment.
	VULNERABLE OCCURRENCE	Intended for records of rare species with discrete occurrences, where the conservation value of the species should be highlighted for spill response. Can also be used for T/E records that lack discrete life history information or for T/E records that are not mapped as a general distribution of the species.

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 broken into up to 6 distinct feature classes with types distributed as shown below

2) Likewise, the SOCECON (point and line layers) will be broken into up to 6 distinct feature classes each

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 layers

ELEMENT = POLITICAL
Layer Description: POLITICAL/JURISDICTIONAL MANAGEMENT
Feature Class Name / Layer #: POLITICAL_POLY = 40, POLITICAL_LINE = 41, POLITICAL_POINT = 42
SOCEON TYPES: ACE – Army Corps of Engineers, CG - Coast Guard, CI – City, CO – County, EPA – Environmental Protection Agency Region, FEMA – Federal Emergency Management Agency Region, IB – International Boundary, ST – State (or State Border), SW – State Waters, TL – Tribal Land

ELEMENT = MANAGED
Layer Description: PARKS/MANAGED AREAS
Feature Class Name / Layer #: MANAGED_POLY = 50, MANAGED_LINE = 51, MANAGED_POINT = 52
SOCEON TYPES: FO – National Forest, MA – Management Area, MI – Military, MS – Marine Sanctuary, NC – Nature Conservancy, NERR – National Estuarine Research Reserve, NG – National Guard, NL – National Landmark, NP – National Park, P – Park (Regional or State), SPA – State Protected Area, WR – Wildlife Refuge

ELEMENT = RESOURCE
Layer Description: RESOURCE MANAGEMENT
Feature Class Name / Layer #: RESOURCE_POLY = 60, RESOURCE_LINE = 61, RESOURCE_POINT = 62
SOCEON TYPES: AQ – Aquaculture, AR – Artificial Reef, CF - Commercial Fishing, CH - Critical Habitat, EH – Essential Habitat, FA - Fishery Area, INVS – Invasive Species, LS – Log Storage, M2 – Mine Site, RF – Recreational Fishing, RMS - Repeated Measurement Site, S – Subsistence, WI – Water Intake

ELEMENT = NAT_HAZARD
Layer Description: NATURAL HAZARD
Feature Class Name / Layer #: NAT_HAZARD_POLY = 70, NAT_HAZARD_LINE = 71, NAT_HAZARD_POINT = 72
SOCEON TYPES: CAT1-5 - Category 1-5 Storm Inundation, SSIA – Storm Surge Inundation Area, TIA – Tsunami Inundation Area

ELEMENT = NAV_MARINE
Layer Description: NAVIGATION/MARINE - RECREATIONAL/MARITIME
Feature Class Name / Layer #: NAV_MARINE_POLY = 80, NAV_MARINE_LINE = 81, NAV_MARINE_POINT = 82
SOCEON TYPES: AN – Anchorage, A2 – Access, BR – Boat Ramp, DV – Diving, F – Ferry, FR – Ferry Route, LD – Lock and Dam, M – Marina, MO – Mooring, PT – Port, RM – River Mile, SL – Shipping Lane

ELEMENT = SOCECON
Layer Description: OTHER SOCECON FEATURES
Feature Class Name / Layer #: SOCECON_POLY = 90, SOCECON_LINE = 91, SOCECON_POINT = 92
SOCEON TYPES: A – Airport, AS – Archaeological Site, AV – Abandoned Vessel, B – Beach, C – Campground, EPAF – Environmental Protection Agency Facility (RMP), EQ – Equipment (Response), F2 – Factory, F3 – Facility, HP – Heliport, HS – Historic Site, HWR – Historic Wreck, LF – Landfill, NOAA – National Oceanic Atmospheric Administration Facility, OF – Oil Facility, OS – Oil Seep, PF – Platform, PL – Pipeline, R – Road (or Bridge), RE – Renewable Energy, RR – Rail Route, STG – Staging, S2 – Surfing, TU – Tunnel, WD – Waste Disposal, 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 refer to: Heliport (HP).

ACE – Army Corps of Engineers: Mapped as polygons, this refers to the jurisdictional boundaries for the USACE. The data may come from federal, state, or regional programs.

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 out 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 in order 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 and derelict vessels. These data come from NOAA's Office of Response and Restoration. Also refer 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, life guard 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.

CAT1 – Category 1 Storm Inundation: Mapped as polygons, these represent the anticipated storm surge during a storm classified as Category 1. These data were derived from National Hurricane Center SLOSH model. Polygons are attributed based on modeled inundation - <= 3ft, >3ft, > 6ft, or > 9ft.

CAT2 – Category 2 Storm Inundation: Mapped as polygons, these represent the anticipated storm surge during a storm classified as Category 2. These data were derived from National Hurricane Center SLOSH model. Polygons are attributed based on modeled inundation - <= 3ft, >3ft, > 6ft, or > 9ft.

CAT3 – Category 3 Storm Inundation: Mapped as polygons, these represent the anticipated storm surge during a storm classified as Category 3. These data were derived from National Hurricane Center SLOSH model. Polygons are attributed based on modeled inundation - <= 3ft, >3ft, > 6ft, or > 9ft.

CAT4 – Category 4 Storm Inundation: Mapped as polygons, these represent the anticipated storm surge during a storm classified as Category 4. These data were derived from National Hurricane Center SLOSH model. Polygons are attributed based on modeled inundation - <= 3ft, >3ft, > 6ft, or > 9ft.

CAT5 – Category 5 Storm Inundation: Mapped as polygons, these represent the anticipated storm surge during a storm classified as Category 5. These data were derived from National Hurricane Center SLOSH model. Polygons are attributed based on modeled inundation - <= 3ft, >3ft, > 6ft, or > 9ft.

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 jurisdictional boundaries (districts or sectors), mapped as polygons, or USCG stations locations, generally 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 euchalon), etc. The data may come from federal, state, regional, or programs.

CI – City: Typically mapped as points but may also be mapped as polygons, this refers to the jurisdictional boundaries for major cities (polygon) or the locations for major cities (point). Data mapped as a polygon should edge-match with the ESI shoreline if appropriate. The data may come from federal or state programs.

CO – County: Mapped as polygons, this refers to the jurisdictional boundaries for coastal counties. Data mapped as a polygon should edge-match with the ESI shoreline if appropriate. The data may come from federal or state 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.

EPA – Environmental Protection Agency Region: Mapped as polygons, this refers to the jurisdictional boundaries for EPA regions. The data comes from the USEPA.

EPAF – **Environmental Protection Agency Facility:** Mapped as points, this refers to EPA regulated and permitted facilities that use extremely hazardous substances that may result in a chemical accident (Risk Management Plan - RMP). The data comes from the USEPA. Facilities may be required to file multiple plans depending on the materials they store and/or produce. Also refer to: Oil Facility (OF) and Facility (F3).

EQ – Equipment (Response): Mapped as points, this refers storage locations for oil spill clean-up equipment, such as Marine Spill Response Corporation (MSRC) facilities. 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.

FEMA – **Federal Emergency Management Agency Region:** Mapped as polygons, this refers to the jurisdictional boundaries for FEMA regions. The data may come from federal or state 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).

F2 – **Factory:** Mapped as points, this refers to private or commercial processing facilities such as fish or shellfish processors. The data may come from federal, state, regional, or local programs.

F3 – **Facility:** Mapped as points, this refers to commercial facilities such as paper mills and other chemical processing facilities that may not be included in the EPA facilities data. The data may come from federal, state, regional, or local programs. Also refer to: EPA Facility (EPAF).

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 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 and 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 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.

INVS – **Invasive Species:** Mapped as points or polygons, this refers to locations where invasive plant species may occur. Knowledge of these locations may help mitigate the potential for disturbing/spreading undesirable plant material, or may aid responders in evaluating appropriate actions where these species occur. The name field of the SOC_DAT table should list the species name, and, if possible, a brief description of the plant's hazard. Contact information should be included whenever available. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

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.

LF – **Landfill:** Mapped as points, this refers to permanent waste and debris disposal locations. The data may come from state or local programs. Also refer to: Waste Disposal (WD).

LS – **Log Storage:** Mapped as points, this refers to timber transfer and storage locations in maritime areas. The data may come from state or local programs and may be supplemented with expert knowledge.

M – **Marina:** Mapped as points, this refers to publically 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.

MI – **Military:** Typically mapped as polygons but may also be mapped as points, this refers to jurisdictional boundaries (polygons) or military installations (points) that fall under the responsibility of the Department of Defense (DOD). The data may come from federal or state programs.

MO – **Mooring:** Mapped as points or polygons, this refers to locations (or areas) where boats and vessels can be secured that are not categorized as a Marina. The data may come from federal, state, regional, or local programs.

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.

M2 – **Mine Site:** Mapped as points, this refers to commodity mines such as gold or silver mines in Alaska or gravel, sand, top soil (surface) mining. The data may come from federal, state, regional, or local programs.

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. These data come from the NOAA's National Estuarine Research Reserve System.

NG – **National Guard:** Mapped as points or polygons, this refers to the locations (or areas) of National Guard Facilities. The data may come from federal, state, regional, or local programs.

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. These data come from the National Park Service.

OF – **Oil Facility:** Mapped as points, this refers to the locations of oil and gas facilities. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. These are facilities that are not mapped as a part of the EPA Facility data types. Also refer to: EPA Facility (EPAF)**.**

OS – **Oil Seep:** Mapped as points, this refers to the locations of natural offshore oil seeps. The data may come from BOEM (Bureau of Ocean Energy Management), federal, state, regional, or local programs and may be supplemented with expert knowledge**.**

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

PF – **Platform:** Mapped as points, this refers to the locations of offshore oil and gas platforms. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge**.**

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.

R – **Road (or Bridge):** Mapped as lines, these refer to roads and/or bridges. The data may come from state, regional, or local programs and may be supplemented with expert knowledge.

RE – **Renewable Energy:** Mapped as points or polygons, these refer to facilities that generate renewable energy and are sited in locations that may be disturbed by oiling or cleanup activity. Examples include wind energy (wind farms), wave energy (wave energy converters), solar energy (solar panels), etc. The data may come from federal, 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.

RMS – **Repeated Measurement Site:** Typically mapped as points but may also be mapped as polygons, this refers to locations where oceanographic data is routinely recorded, and/or sites routinely visited by scientists to observe and record biological and contaminant trends. Some examples include: Data Buoys (DB), Tide Gauges (TG), Mussel Watch Sites (MWS), Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), Long-term Ecological Research Site (LTER), Water Quality Stations (WQ), etc. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge**.**

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.

SSIA – **Storm Surge Inundation Area:** Mapped as polygons or lines, these are areas inundated by an abnormal rise in water level, above and beyond the expected tidal range due to wind, waves, or other forces. The data may come from federal, state, regional, or local programs and supplemented with expert knowledge. Also refer to: Category 1 – 5 Storm Inundation (CAT1, CAT2, CAT3, CAT4, CAT5).

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.

STG – **Staging:** Mapped as points, this refers to an area where people, equipment, or material can be assembled before use. The data may come from federal, state, regional, or local programs and supplemented with expert knowledge.

SW – **State Waters:** Mapped as polygons, this refers to waters that a state has jurisdiction over, commonly derived from the low-water mark of each state extending approximately 3 nautical miles (nm) offshore. The data may come from federal, state, regional, or local programs.

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.

TIA – **Tsunami Inundation Area:** Mapped as polygons, these are areas that may be inundated by an abnormal rise in water level, above and beyond the expected tidal range due to a tsunami (seismic sea wave). The data may come from federal, state, regional, or local programs.

TL – **Tribal Land:** Mapped as polygons or lines, these depict areas managed by a Native American tribe under the United States Bureau of Indian Affairs (BIA). 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.

TU – **Tunnel:** Mapped as lines, these depict locations where tunnels can be found, usually in conjunction with a road system. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge.

WD – **Waste Disposal:** Mapped as points, these locations represent facilities for waste collection, compaction, recycling, and disposal. The data may come from federal, state, regional, or local programs and may be supplemented with expert knowledge. Also refer to: Landfills (LF).

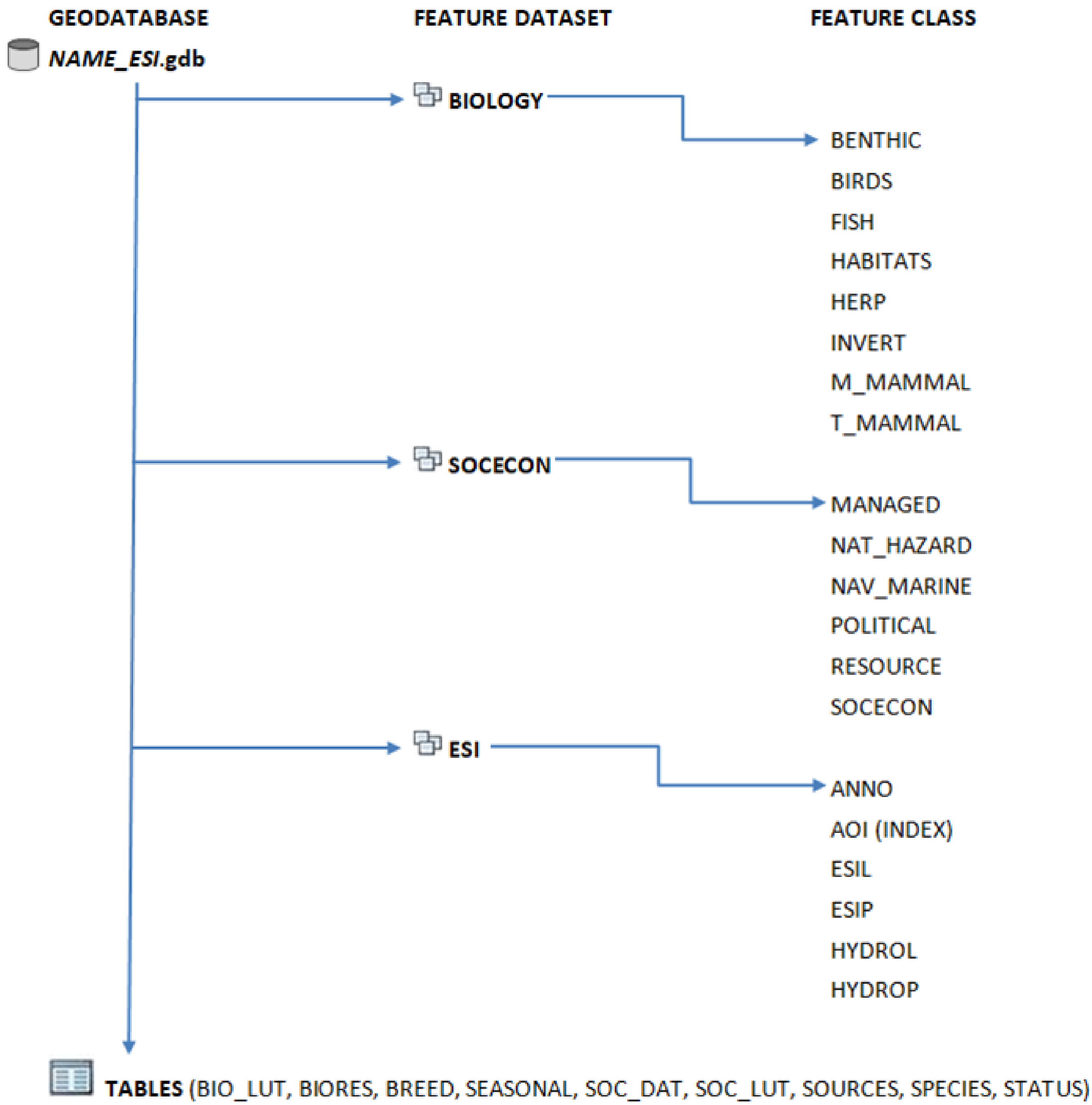
WI – **Water Intake:** Mapped as points, these locations represent sites that withdraw water from streams, lakes, rivers, and reservoirs such as drinking water intakes, industrial intakes, and aquaculture intakes. The data may come from federal, state, regional, or local programs and may be supplemented 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 spit complex that slopes gently landward. It is usually created when water, forced landward by breaking waves, flows across the top of the barrier spit 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.

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.



APPENDIX C

Diagram of ESI Data Table Structure

and Associated Relationships

Table Structure for ESI Deliverables to NOAA

Feature Classes (Layer Names)

ESI Feature dataset

ESIL (ESL LINES)
- ESI (Text, 12)
- LINE (Text, 2)
- ENVIR (Text, 1)
- MOST_SENSITIVE (Text, 4)
- LANDWARD_SHORETYPE (Text, 60)
- SEAWARD_SHORETYPE1 (Text, 60)
- SEAWARD_SHORETYPE2 (Text, 60)
- GENERAL_SYMBOL (Short Integer)
- GENERALIZED_ESI_TYPE (Text, 180)
- SOURCE_ID (Long Integer)
- ESI_SOURCE (Long Integer)

ESIP (ESI POLYS)
- ESI (Text, 12)
- WATER_CODE (Text, 1)
- ENVIR (Text, 1)
- ESI_DESCRIPTION (Text, 60)
- SOURCE_ID (Long Integer)
- ESI_SOURCE (Long Integer)

HYDROL (HYDRO LINES)
- LINE (Text, 2)
- SOURCE_ID (Long Integer)

HYDROP (HYDRO POLYS)
- Water_Code (Text, 1)

INDEX (MAP INDEX)
- TILE_NAME (Text, 32)
- NAME (Text, 255)
- SCALE (Long Integer)
- UTM_ZONE (Text, 60)
- PAGE_SIZE (Text, 11)
- VIEW_PDF (Text, 255)

AOI (AREA OF INTEREST)

BIOLOGY Feature dataset[1]

- BENTHIC (BENTHIC POLYS)
- BIRDS (BIRD POLYS)
- FISH (FISH POLYS)
- HABITATS (HABITAT POLYS)
- HERP (REPTILE & AMPHIBIAN POLYS)
- INVERT (INVERTEBRATE POLYS)
- M_MAMMAL (MARINE MAMMAL POLYS)
- T_MAMMAL (T_MAMMAL POLYS)
  - ID (Double)
  - RARNUM (Long Integer)

SOCECON Feature dataset[1]

- MANAGED_POLY (PARKS-MANAGED AREA POLYS)
- NAT_HAZARD_POLY (NATURAL HAZARED POLYS)
- NAV_MARINE_POLY (NAVIGATIONAL-MARINE POLYS)
- POLITICAL_POLY (POLITICAL POLYS)
- RESOURCE_POLY (RESOURCE MANAGEMENT POLYS)
- SOCECON (SOCECON POLYS)
  - TYPE (Text, 4)
  - ID (Double)
  - HUNUM (Long Integer)
  - *INUNDATION (Text, 10)

*applies only to NAT_HAZARD_POLY, when mapping storm inundation

Data Tables

SOURCES
- SOURCE_ID (Long Integer)
- ORIGINATOR (Text, 255)
- DATE_PUB (Long Integer)
- TITLE (Text, 255)
- DATA_FORMAT (Text, 80)
- PUB_PLACE (Text, 255)
- PUBLISHER (Text, 255)
- PUBLICATION (Text, 255)
- ONLINE_LINK (Text, 255)
- SCALE (Text, 20)
- TIME_PERIOD (Text, 34)

SEASONAL
- ELEMENT (Text, 10)
- SPECIES_ID (Long Integer)
- SEASON_ID (Long Integer)
- JAN (Text, 1)
- FEB (Text, 1)
- MAR (Text, 1)
- APR (Text, 1)
- MAY (Text, 1)
- JUN (Text, 1)
- JUL (Text, 1)
- AUG (Text, 1)
- SEP (Text, 1)
- OCT (Text, 1)
- NOV (Text, 1)
- DEC (Text, 1)
- EL_SPE_SEA (Text, 8)

BIORES
- RARNUM (Long Integer)
- SPECIES_ID (Long Integer)
- CONC (Text, 20)
- MAPPING_QUALIFIER (Text, 25)
- SEASON_ID (Long Integer)
- G_SOURCE (Long Integer)
- S_SOURCE (Long Integer)
- Element (Text, 10)
- EL_SPE (Text, 6)
- EL_SPE_SEA (Text, 8)

SOC_DAT
- HUNUM (Long Integer)
- ELEMENT (Text, 10)
- TYPE (Text, 35)
- NAME (Text, 50)
- CONTACT (Text, 80)
- PHONE (Text, 12)
- LINK (Text, 255)
- G_SOURCE (Long Integer)
- A_SOURCE (Long Integer)

BREED
- EL_SPE_SEA (Text, 8)
- MON (Long Integer)
- BREED1 (Text, 1)
- BREED2 (Text, 1)
- BREED3 (Text, 1)
- BREED4 (Text, 1)
- BREED5 (Text, 1)

STATUS
- ELEMENT (Text, 10)
- SPECIES_ID (Long Integer)
- STATE (Text, 2)
- S (Text, 1)
- F (Text, 1)
- S_DATE (Long Integer)
- F_DATE (Long Integer)
- EL_SPE (Text, 6)

SPECIES
- SPECIES_ID (Long Integer)
- NAME (Text, 35)
- GEN_SPEC (Text, 45)
- ELEMENT (Text, 10)
- SUBELEMENT (Text, 10)
- GRANK (Text, 8)
- GRANKDATE (Long Integer)
- EL_SPE (Text, 6)

Look-up Tables

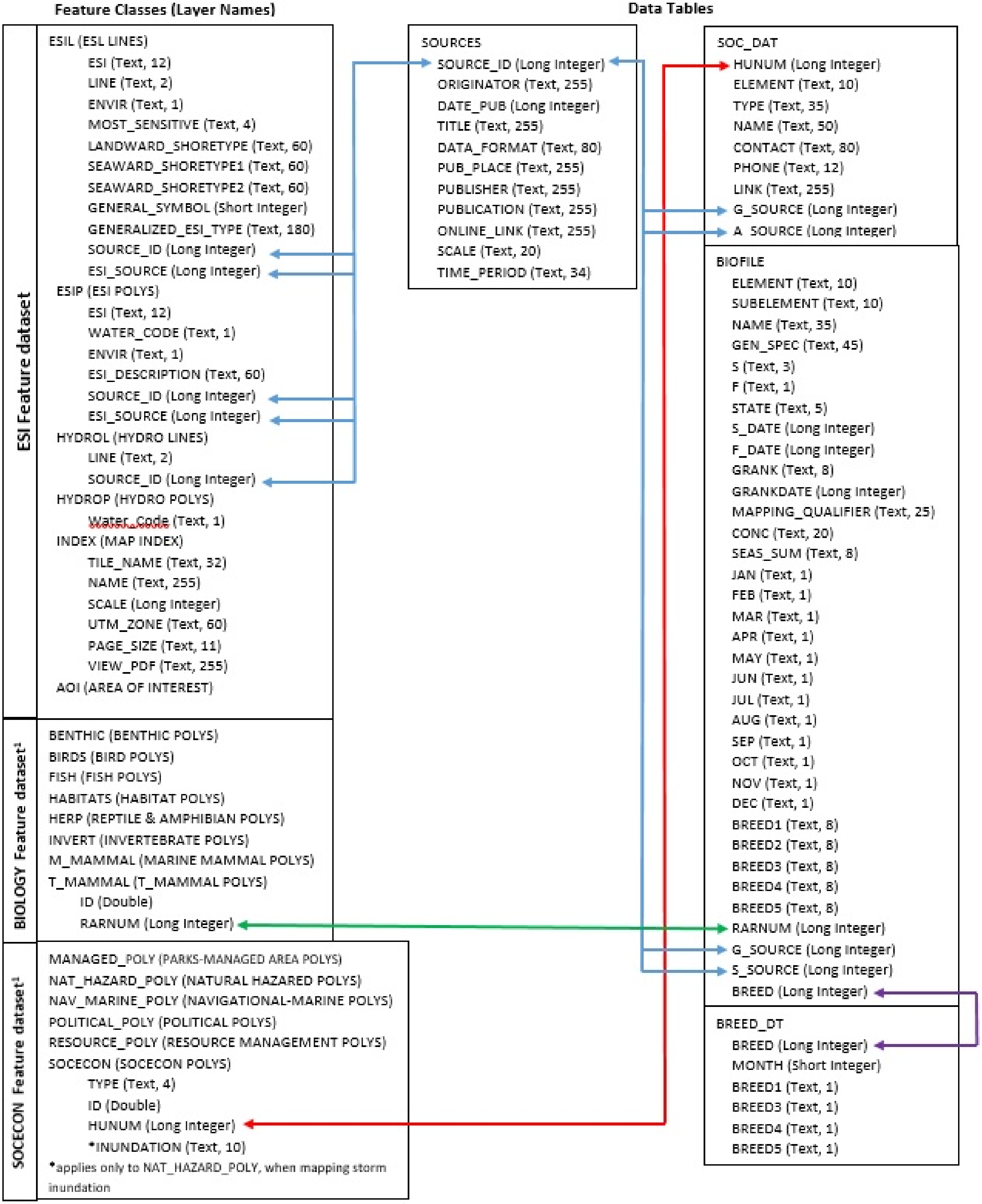
(The lookup tables can be bypassed using RARNUM or HUNUM directly from the feature classes to the data tables, however these tables and the ID field are still required for the NOAA deliverable)

BIO_LUT
- RARNUM (Long Integer)
- ID (Double)

SOC_LUT
- HUNUM (Long Integer)
- ID (Double)

[1] Biology and Socecon features may be represented with polygon, line and/or point features. The names in this figure correspond to the polygonal feature classes. For BIOLOGY: line feature classes use the base name shown, with the addition of "L" (BIRDSL); point feature classes have "PT" appended (BIRDSPT). For SOCEON: _POLY is replaced by _LINE (lines) or _POINTS (points) as appropriate.

Table Structure for ESIs Distributed by NOAA



[1] Biology and Socecon features may be represented with polygon, line and/or point features. The names in this figure correspond to the polygonal feature classes. For BIOLOGY: line feature classes use the base name shown, with the addition of "L" (BIRDSL); point feature classes have "PT" appended (BIRDSPT). For SOCEON: _POLY is replaced by _LINE (lines) or _POINTS (points) as appropriate.

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 all inclusive. Often, states have geographic data portals that may be good sources of ESI source 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) can help identify some of these experts; additionally, ESIs mapped previously for the region and/or adjacent regions, will include information about regional experts and contributing agencies.

The following list is broken into 3 main sections: Common Biological Sources, Common Socioeconomic Sources, and Common Shoreline and ESI Habitat Sources. The Biology 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:

Alaska Ocean Observing System, *AOOS Data Resources*, http://www.aoos.org/aoos-data-resources/ (Alaska)

Governor's South Atlantic Alliance (GSAA), *GSAA portal*, http://gsaaportal.org (South Atlantic)

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

IOOS - Integrated Ocean Observing System, *Regional Data Portals*, https://ioos.noaa.gov/data/regional-data-portals/

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

NatureServe, *Map of At-Risk Species by County and Watershed,* http://www.natureserve.org/conservation-tools/map-risk-species-county-and-watershed (Coastal U.S.)

NOAA/NCEI, *Gulf of Mexico Data Atlas*, https://www.ncddc.noaa.gov/website/DataAtlas/atlas.htm (Gulf of Mexico)

NOAA/NMFS Greater Atlantic Region, *Data Download,* https://www.greateratlantic.fisheries.noaa.gov/educational_resources/gis/data/index.html (North/Mid-Atlantic)

NOAA/NOS/OCM, *Digital Coast*, https://coast.noaa.gov/digitalcoast/ (Coastal U.S.)

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

Marine-Life Data and Analysis Team (MDAT), *Marine-Life Data to Support Regional Ocean Planning and Management* http://seamap.env.duke.edu/models/mdat/ (Northeast U.S.)

OBIS-SEAMAP, *Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations*, http://seamap.env.duke.edu/ (Global)

Duke Univ. Marine Geospatial Ecology Laboratory, *Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico (2015 Version)*, http://seamap.env.duke.edu/models/Duke-EC-GOM-2015/ (Atlantic and Gulf of Mexico)

Duke Univ. Marine Geospatial Ecology Laboratory, *Habitat-based cetacean density models for the U.S. Navy Atlantic Fleet Training and Testing Area (2015 Version*), http://seamap.env.duke.edu/models/AFTT-2015/ (Atlantic, Gulf of Mexico, Caribbean)

Scripps Institute of Oceanography, and NOAA/NMFS, *California Cooperative Oceanic Fisheries Investigations (CALCOFI)*, http://calcofi.org/ (California)

U.S. Fish and Wildlife Service, *Endangered Species,* https://www.fws.gov/endangered/ (Coastal U.S.)

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

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

Birds:

Manomet Center for Conservation Sciences, *International Shorebird Survey,* 2009, https://www.manomet.org/program/shorebird-recovery/international-shorebird-survey-iss (Coastal U.S.)

U.S. Geological Survey, *Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States, Final Report (Database Section - Seabirds),* 2011, https://www.boem.gov/ESPIS/5/5193.pdf , (Atlantic Coast)

Fishes and Invertebrates:

Atlantic States Marine Fisheries Commission, *Northeast Area Monitoring and Assessment Program*, http://www.neamap.net/projects.html (Atlantic Coast)

California Dept. Fish and Wildlife, *Life History Database: Biological Characteristics of Nearshore Fishes of California*, 2000, https://www.wildlife.ca.gov/Conservation/Marine/Life-History-Database (West Coast)

Florida Fish and Wildlife Research Institute, *Species accounts and stock assessments*, http://myfwc.com/research/saltwater/ (Florida)

NOAA/NMFS *EFH Mapper*, http://www.habitat.noaa.gov/protection/efh/habitatmapper.html (Coastal U.S.)

NOAA/NMFS Alaska Regional Office, *Nearshore Fish Atlas of Alaska*, https://alaskafisheries.noaa.gov/habitat/fishatlas (Alaska)

NOAA/NMFS Northeast Fisheries Science Center, *Essential Fish Habitat (EFH) Source Documents: Life History and Habitat Characteristics*, 1999-2008, https://www.nefsc.noaa.gov/nefsc/habitat/efh (Northeast U.S.)

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

NOAA/NOS National Centers for Coastal Ocean Science, *Estuarine Species Database for the NOAA Estuarine Living Marine Resources Program*, https://www.coastalscience.noaa.gov/projects/detail/theme/theme/https/coastalscience.noaa.gov/publications/ccehbr/detail?key=107 (Coastal U.S.)

Pacific Fishery Management Council, *Groundfish Fishery Management Plan, Appendix B, Pacific Coast Groundfish Essential Fish Habitat*, 2005, http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-appendices/#appb (Pacific Coast)

Pacific Fishery Management Council, *Life history, geographic distribution, and habitat associations of 82 West Coast groundfish species: A literature review*, 2005, http://www.pcouncil.org/wp-content/uploads/GF_FMP_App_B2.pdf (Pacific Coast)

Benthic and Habitat:

NOAA/NOS National Centers for Coastal Ocean Science, *Benthic Habitat Mapping*, https://products.coastalscience.noaa.gov/collections/benthic/default.aspx (Florida, Hawaii, Puerto Rico, U.S. Virgin Islands, other areas)

NOAA/NOS Office for Coastal Management, *Benthic Cover*, https://coast.noaa.gov/digitalcoast/data/benthiccover.html (Selected bays and coastal waters)

NOAA/NOS Office for Coastal Management, *Seagrasses*, https://inport.nmfs.noaa.gov/inport/item/48920 (Coastal U.S.)

Pacific Marine and Estuarine Fish Habitat Partnership, *West Coast USA Estuarine Biotic Habitat*, http://www.pacificfishhabitat.org/data/estuarine-biotic-habitat (Pacific U.S. Coast)

PaCOOS Network, *West Coast Habitat Server*, http://pacoos.coas.oregonstate.edu/ (Pacific U.S. Coast)

U.S. Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI), *Classification of Wetlands and Deepwater Habitats of the United States (1:24,000)*, http://www.fws.gov/wetlands/Data/State-Downloads.html (Coastal U.S.)

Common Socioeconomic Sources:

Alaska Ocean Observing System, *AOOS Data Resources*, http://www.aoos.org/aoos-data-resources/ (Alaska)

Esri, *World Imagery Basemap*, http://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer (Coastal U.S.)

Federal Emergency Management Agency, *FEMA Regional Boundaries*, https://www.fema.gov/regional-contact-information (Coastal U.S.)

Governor's South Atlantic Alliance, *GSAA Coast and Ocean Portal*, http://www.gsaaportal.org/ (Southeastern U.S.)

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

IOOS - Integrated Ocean Observing System, *Regional Data Portals*, https://ioos.noaa.gov/data/regional-data-portals/

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

National Park Service, *National Register of Historic Places*, https://irma.nps.gov/App/Reference/Profile/2210280 (Coastal U.S.)

The Nature Conservancy, *Conservation GIS Data*, http://maps.tnc.org/gis_data.html (Coastal U.S.)

NOAA/NOS 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, *Mussel Watch Site Locations*, https://products.coastalscience.noaa.gov/collections/ltmonitoring/nsandt/default.aspx (Coastal U.S.)

NOAA/NMFS, *EFH Mapper*, http://www.habitat.noaa.gov/protection/efh/efhmapper/ (Coastal U.S.)

NOAA/NOS Office for Coastal Management, *Coastal and Marine Spatial Planning – Regional Activities*, https://cmsp.noaa.gov/activities/ (Coastal U.S.)

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

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

NOAA/NOS 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/NOS Office of Coast Survey, *Wrecks and Obstructions Database*, https://nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html (Coastal U.S.)

NOAA/NWS National Hurricane Center, *National Storm Surge Hazard Maps - Version 2*, http://www.nhc.noaa.gov/nationalsurge/ (Atlantic, Gulf Coast)

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*, 2005, http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-appendices/#appb (West Coast; Management)

U.S. Army Corps of Engineers, *District Boundaries,* https://www.sciencebase.gov/catalog/item/4f4e4779e4b07f02db47f17f (Coastal U.S.)

U.S. Census Bureau, *Military Installation National Shapefile*, http://www2.census.gov/geo/tiger/TIGER2014/MIL/tl_2014_us_mil.zip (Coastal U.S.)

U.S. Census Bureau, *TIGER/Line Shapefiles*, https://www.census.gov/cgi-bin/geo/shapefiles2014/main (Coastal U.S.)

U.S. Environmental Protection Agency, *EPA Regional Boundaries,* https://edg.epa.gov/data/public/ (Coastal U.S.)

U.S. Environmental Protection Agency, *Power Facility Locations*, http://www.epa.gov/enviro/html/fii/fii_query_java.html (Coastal U.S.)

U.S. Fish and Wildlife Service, *Endangered Species,* https://www.fws.gov/endangered/ (Coastal U.S.)

U.S. Fish and Wildlife Service, *ECOS - Environmental Conservation Online System,* https://ecos.fws.gov/ecp/report/table/candidate-species.html (Coastal U.S.)

U.S. Fish and Wildlife Service, *FWS Regional, Refuge, and Other Boundaries,* https://gis.fws.gov/arcgis/rest/services/ (Coastal U.S.)

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

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

Common Hydrology and Shoreline Sources:

NOAA/NMFS Alaska Regional Office, *Alaska ShoreZone Coastal Mapping and Imagery*, https://alaskafisheries.noaa.gov/habitat/shorezone (Alaska)

NOAA/NOS National Geodetic Survey, *Continually Updated Shoreline Product (CUSP) (1:24,000),* http://www.ngs.noaa.gov/RSD/shoredata/NGS_Shoreline_Products.htm (Coastal U.S.)

U.S. Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI), *Classification of Wetlands and Deepwater Habitats of the United States (1:24,000),* http://www.fws.gov/wetlands/Data/State-Downloads.html (Coastal U.S.)

U.S. Geological Survey (USGS), *National Hydrography Dataset (NHD),* https://www.usgs.gov/core-science-systems/ngp/national-hydrography/about-national-hydrography-products (Coastal U.S.)

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 name 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.

Birds

AOS. 2014. Checklist of North and Middle American Birds. American Ornithological Society, Chicago, IL. List may be browsed or downloaded for free at: http://checklist.aou.org/ .

Fish

Page, L.M., H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, N.E. Mandrak, R.L. Mayden, and J.S. Nelson. 2013. Common and Scientific Names of Fishes from the United States, Canada, and Mexico, 7th edition. Special Publication 34. American Fisheries Society, Bethesda, MD. April 2013. 243 pp.
Book for sale from AFS at: https://fisheries.org/bookstore/all-titles/special-publications/51034c/
Free pdf of Part 1 available at: https://fisheries.org/wp-content/uploads/2015/11/Part-1.pdf

Terrestrial Mammals

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

Smithsonian NMNH. 2015. North American Mammals. Smithsonian National Museum of Natural History. https://naturalhistory.si.edu/mna/search_name.cfm

Marine Mammals

SMM Committee on Taxonomy. 2016. . List of marine mammal species and subspecies. Society for Marine Mammalogy, Anacortes, WA.
Species list online at: https://www.marinemammalscience.org/species-information/list-marine-mammal-species-subspecies/

Reptiles and Amphibians

SSAR. 2012. Checklist of the Standard English and Scientific Names of Amphibians and Reptiles, 7th Edition.
May be downloaded for free at: https://ssarherps.org/publications/north-american-checklist/

Invertebrates

McLaughlin, P.A., D.K. Camp, 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/

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/

NOAA Fisheries. 2015. Corals listed under the Endangered Species Act. http://www.nmfs.noaa.gov/pr/species/invertebrates/corals.htm

WoRMS. 2017. World Register of Marine Species. Vlaams Instituut voor de Zee, Oostende, Belgium. http://www.marinespecies.org/

Habitats (Plants)

USACE. 2017. NWPL - National Wetland Plant List. U.S. Army Corps of Engineers. Downloadable lists and information at: http://wetland-plants.usace.army.mil/nwpl_static/index.html

USDA. 2017. PLANTS Database. U.S. Dept. Agriculture, Natural Resources Conservation Service. https://plants.usda.gov/java/

ITIS. 2017. Integrated Taxonomic Information System (ITIS), Reston, VA. Searchable and downloadable data at: https://www.itis.gov/

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). Gaps in digital (GIS) availability are marked with an asterisk for the atlas number. If no ESI data exists, the publication date is also marked with an asterisk. Some regions have been published in GIS format more than once. These are indicated with earlier versions noted in parenthesis. As new atlases are published, this list will be updated.

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	2018 (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
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

Atlas Name/Region	Publication Date(s)	Atlas Number(s)
Gulf of Mexico:		
Alabama	2007 (1996)	231 (31)
Florida – Northwest Peninsular (W. Pen 1)	2016 (1996)	219 (19)
Florida – Panhandle (West)	2012 (1995)	218 (18)
Florida – South	2013 (1996)	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	*	*
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
California – Central	2006	8
California – Northern	2008	207
California – San Francisco Bay	1998	30
California – Southern	2010 (1995)	209 (9)
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
Great Lakes:		
Lake Erie System	1985	*
Lake Huron	1994	3
Lake Michigan (Eastern)	1985	*
Lake Michigan (Northern)	1994	4
Lake Michigan (Southern)	1994	5
Lake Michigan (Western)	1993	2
Lake Ontario	1993	1
Lake Superior	1994	6
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

APPENDIX G

Hard Copy Map Production

Data Filtering, Presentation, and Symbology

ESI Map Production Process and Cartographic Considerations

For over forty years, ESI data have been shared via hard-copy, and later the addition of, PDF maps. In the 1990s, NOAA began distributing the ESI data in various GIS formats, though maps remained the most requested ESI product. Today, though the digital ESI Geodatabase format is widely used, we still strive to meet the needs of the map-based user community. One of the most difficult parts of this task is how to best present the vast quantity of complex data contained in the current ESIs.

In the early days, the ESI shoreline was hand drawn with color markers onto the USGS quad maps. The focus was on the outer coast, with very limited detail on smaller bays and inland waters. The complexity and extent of the shoreline mapped has increased over the years. Current ESI maps are compiled based on a 1:10,000 – 1:24,000 scale shoreline, extending five miles inland of the shoreline and thirteen miles offshore.

The ESI biology data have also increased in quantity and complexity. The first ESI maps indicated the occurrence of a species with dot icons depicting a subelement; each of these icons was specific to a single, or a 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 are often associated with several species, and a single species may have multiple seasonalities. This is all reported on the "back of the map", in a table that may span several pages. The growing complexity is obvious when comparing data collected in the 1980s vs. contemporary ESI data. For example, the Maine/New Hampshire ESI prepared in 1983 had just 37 species represented, while the ESI for this area, published in 2016, included 315 species. (See **Figure G.1**)

As the ESI maps evolved, the "resource at risk" number (RARNUM) was introduced to simplify reporting details of what was shown on the map. Geographic features were associated with an icon and the RARNUM which linked the features to tabular information (species, concentration, listing status, monthly presence, and life history seasonality) on the back of the maps. On recent maps, the term RARNUM was replaced by Map ID, to differentiate it from the RARNUM field in the Geodatabase. In both cases, the numbers refer to species assemblages that share the same geographic boundaries. The numbering is consistent throughout the atlas, meaning a Map ID (or RARNUM) of 120 on map 1, will reference the same assemblage as Map ID 120 on map 66. This system helps minimize redundancy in the reports.

In addition to the biology and shoreline content, it is essential to provide reliable human-use information. As ESI data have evolved to reach a larger user community, the number of features represented has increased, and the focus has broadened.

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. The goal of the map product is to display the most critical features, while retaining the other information contained within the ESI. With this in mind, several changes were made to the ESI map product starting in 2014.

1) Each ESI region/atlas is subdivided by 2 map grids. The first grid is tiled at a scale of 1:100,000 and reflects the layout for the mapped human-use features, shorelines, and coastal habitats. The

second grid is tiled to produce a set of maps at a 1:50,000 scale for mapping of the biological features along with the shoreline and coastal habitats. The biology maps are inset in the 1:100,000 human-use maps, so there may be up to four that correspond to a single human-use map.

2) As before, the map tiles emphasize the land/water interface. The move to an irregular map grid encourages the capture of logical geographic features. For example, if a small island can be presented on a single map that is preferable to splitting the island onto two or more maps. Overlapping tiles are discouraged.
3) Biological data are filtered to display the most vulnerable species or life stages (threatened/endangered, critical life stages, discrete occurrences). The human-use maps are filtered by feature type, removing features that typically cover a large expanse, such as county and other jurisdictional boundaries. Filtered information is not shown on the map, but is reported in the map summary pages.
4) The "back of the map" biological tables are divided into three sections: 1) Displayed on Map; 2) Widespread in Mapped Area; and 3) Also Present in Mapped Area (General Distribution)
5) All map production is automated and based on the final Geodatabase as publically distributed by NOAA.
6) Electronic versions of the biology PDF maps are now distributed as layered PDFs. The biological features can be turned off, increasing the visibility/readability of the color-coded shoreline features.

An explanation of the filtering criteria follows. It is essential that ESI Biologists understand how their data will be displayed and reported. For example, biological data attributed with the mapping qualifier “General Distribution” will be filtered off the map by the 'General Distribution Filter' (with the exception of federally or state listed species), but will be included in the "back of the map" summary report. Species occurrences with mapping qualifiers other than General Distribution may also be filtered off a map if their coverage is more than 10% of the map area; the "back of the map" summary report will include tabular data for these polygons under the 'Widespread in Area' section. Data that have not been filtered out, based on the above criteria, will be displayed on the map; their corresponding Map ID and attribute data will appear in the summary report under the ‘Displayed on Map’ section.

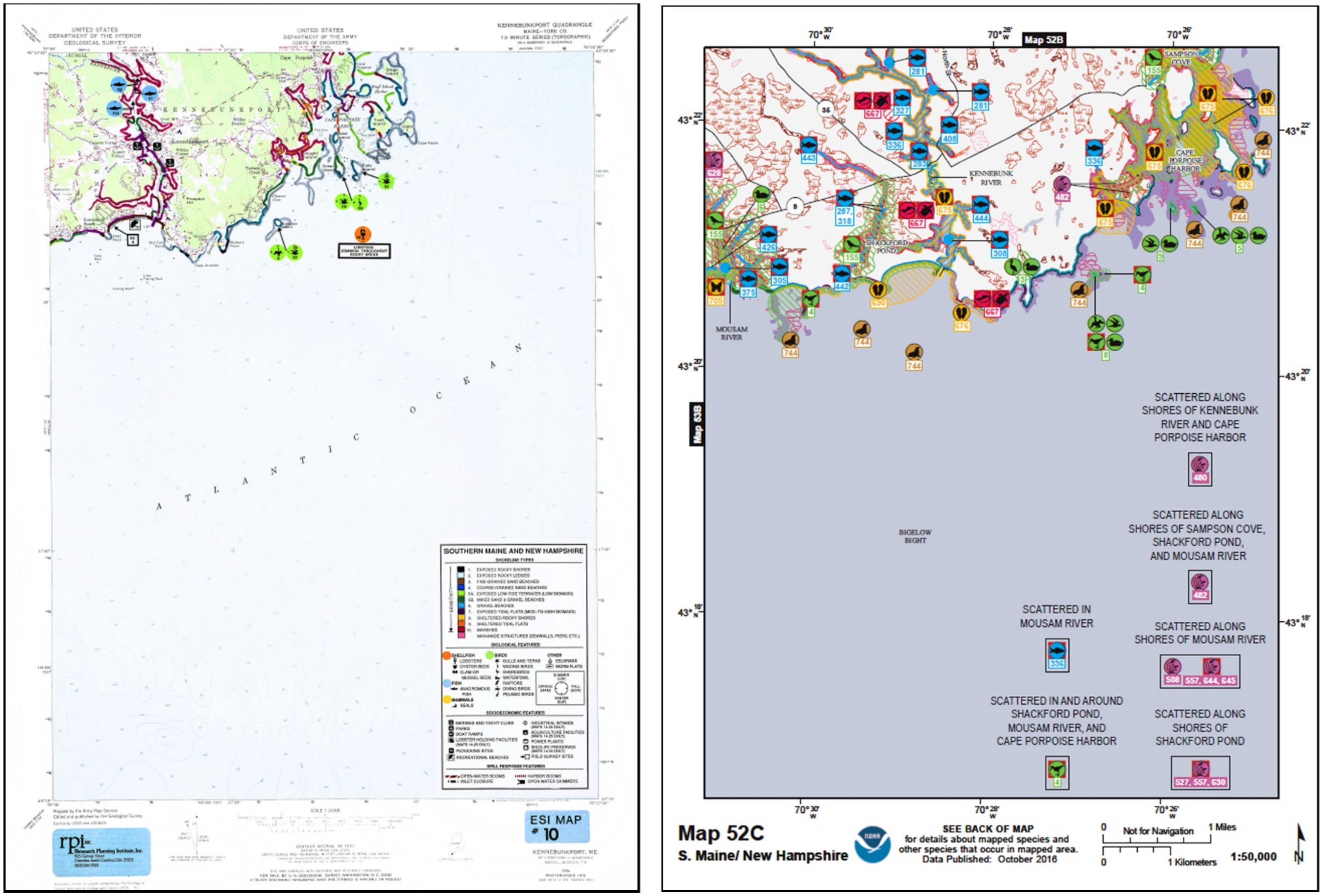


Figure G.1: *Comparison of biological complexity shown in 1983 vs. 2016.*

Biological Resources: Filtering and Map Presentation

Filtering of the biological data is essential to reduce the number of features displayed on the map. The goal is a readable presentation, focusing on the most critical, discrete occurrences of species populations. Filtering is based on the feature geometry as well as the feature's corresponding attribution. Filtered records are not shown graphically on the maps, but are included in the map summary report ("back of the map" tables). **Figure G.2** outlines the filtering criteria for the biological data. All filtering is done programmatically.

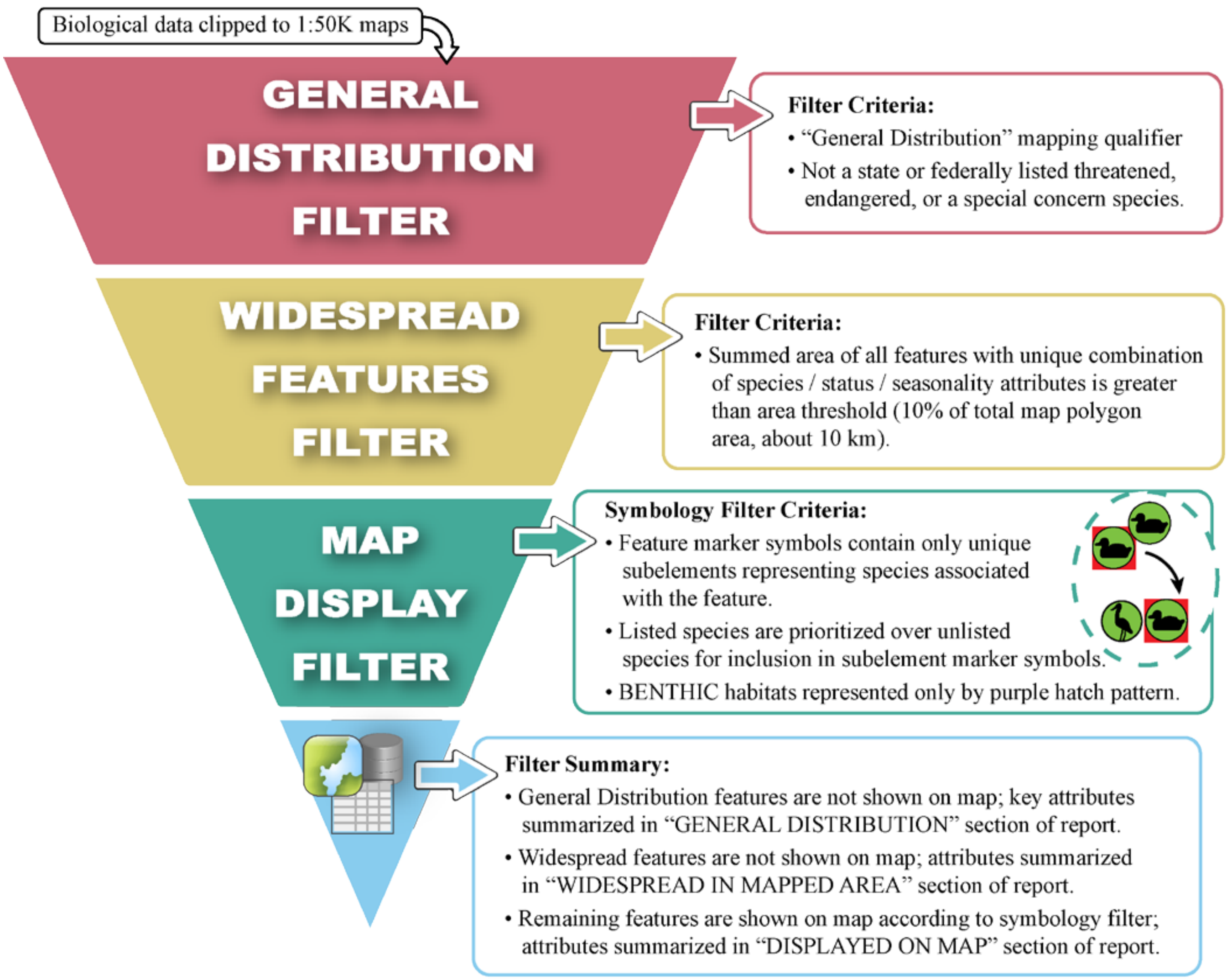


Figure G.2: *Filtering Guidelines – Biological Datasets. 'Filtered' records are removed from graphical display.*

Explanation of Filter Criteria

General Distribution

The General Distribution filter isolates features associated with non-status species, attributed with the mapping qualifier “General Distribution”. These occurrences are often mapped to landscape- or habitat-scale features (e.g., bays or marshes). Such features will be eliminated from the map display when the corresponding attributes match all filtering criteria (**Figure G.3**). These species, and their associated attributes (other than concentration), will appear in the summary report under "Also Present in Mapped Area (General Distribution)” (**Figure G.4**).

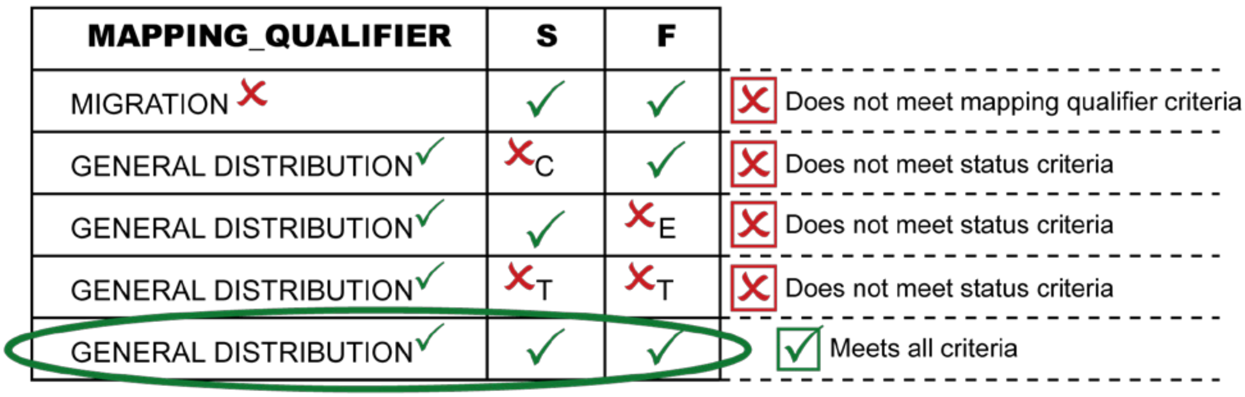
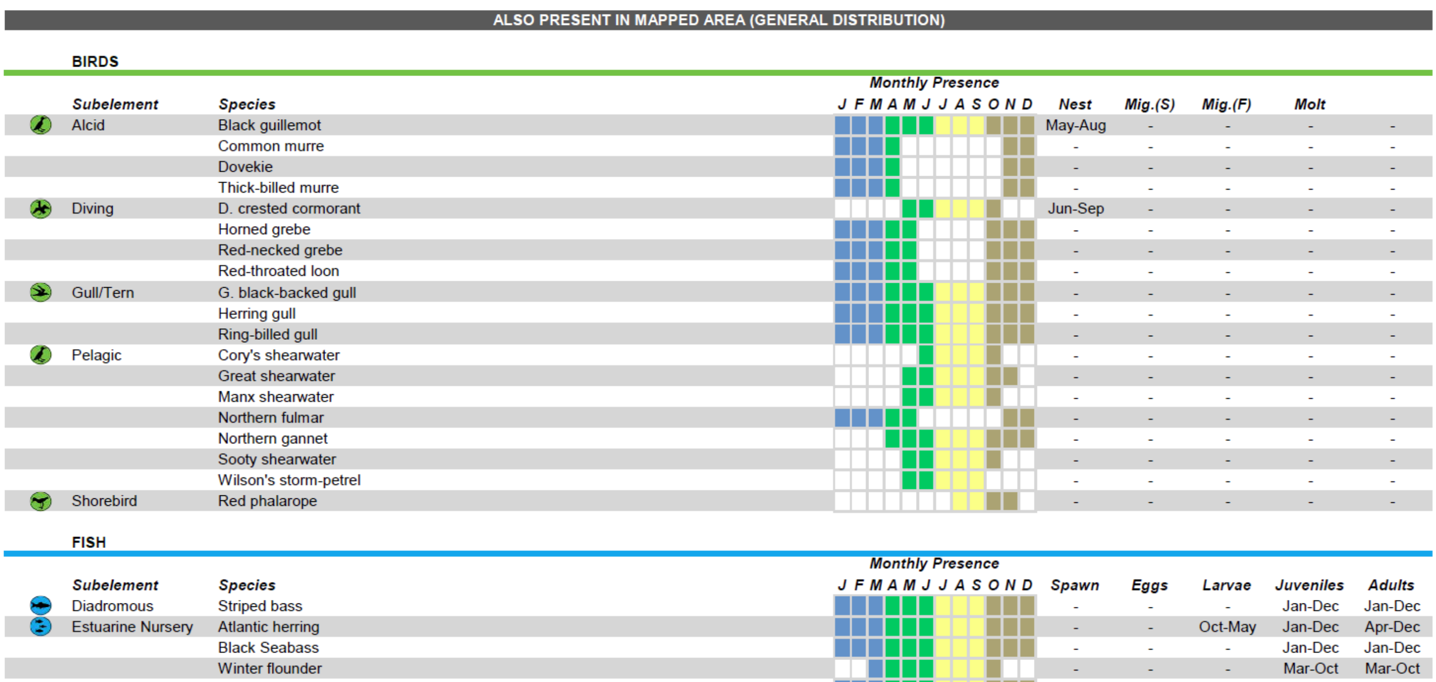


Figure G.3: *General Distribution Filter. “S” and “F” refer to state and federal listing statuses, respectively. “E”, “T”, and “C” refer to endangered species, threatened species, and species of concern, respectively.*



ALSO PRESENT IN MAPPED AREA (GENERAL DISTRIBUTION)

BIRDS

Subelement	Species	Nest	Mig.(S)	Mig.(F)	Molt	
Alcid	Black guillemot	May-Aug	-	-	-	-
	Common murre	-	-	-	-	-
	Dovekie	-	-	-	-	-
	Thick-billed murre	-	-	-	-	-
Diving	D. crested cormorant	Jun-Sep	-	-	-	-
	Horned grebe	-	-	-	-	-
	Red-necked grebe	-	-	-	-	-
	Red-throated loon	-	-	-	-	-
Gull/Tern	G. black-backed gull	-	-	-	-	-
	Herring gull	-	-	-	-	-
	Ring-billed gull	-	-	-	-	-
Pelagic	Cory's shearwater	-	-	-	-	-
	Great shearwater	-	-	-	-	-
	Manx shearwater	-	-	-	-	-
	Northern fulmar	-	-	-	-	-
	Northern gannet	-	-	-	-	-
	Sooty shearwater	-	-	-	-	-
	Wilson's storm-petrel	-	-	-	-	-
Shorebird	Red phalarope	-	-	-	-	-

FISH

Subelement	Species	Spawn	Eggs	Larvae	Juveniles	Adults
Diadromous	Striped bass	-	-	-	Jan-Dec	Jan-Dec
Estuarine Nursery	Atlantic herring	-	-	Oct-May	Jan-Dec	Apr-Dec
	Black Seabass	-	-	-	Jan-Dec	Jan-Dec
	Winter flounder	-	-	-	Mar-Oct	Mar-Oct

Figure G.4: *Summary Report Showing “Also Present in Mapped Area (General Distribution)”.*

Widespread in Mapped Area

The Widespread filter sums the area of all polygon features associated with the same unique combination of species, concentrations, seasonality, and mapping qualifiers (Map ID). Features for each Map ID where the summed area is greater than the widespread threshold are not shown on the map. The corresponding species records are shown in the "Widespread in Mapped Area (> 10 square kilometers)" section of the summary report (**Figure G.5**). A secondary check is then performed to remove "border" polygons adjacent to the map edge, or AOI, that are smaller than the minimum mapping unit. The widespread and minimum mapping unit thresholds for the 1:50,000 scale biology maps are illustrated below (**Figure G.6**).

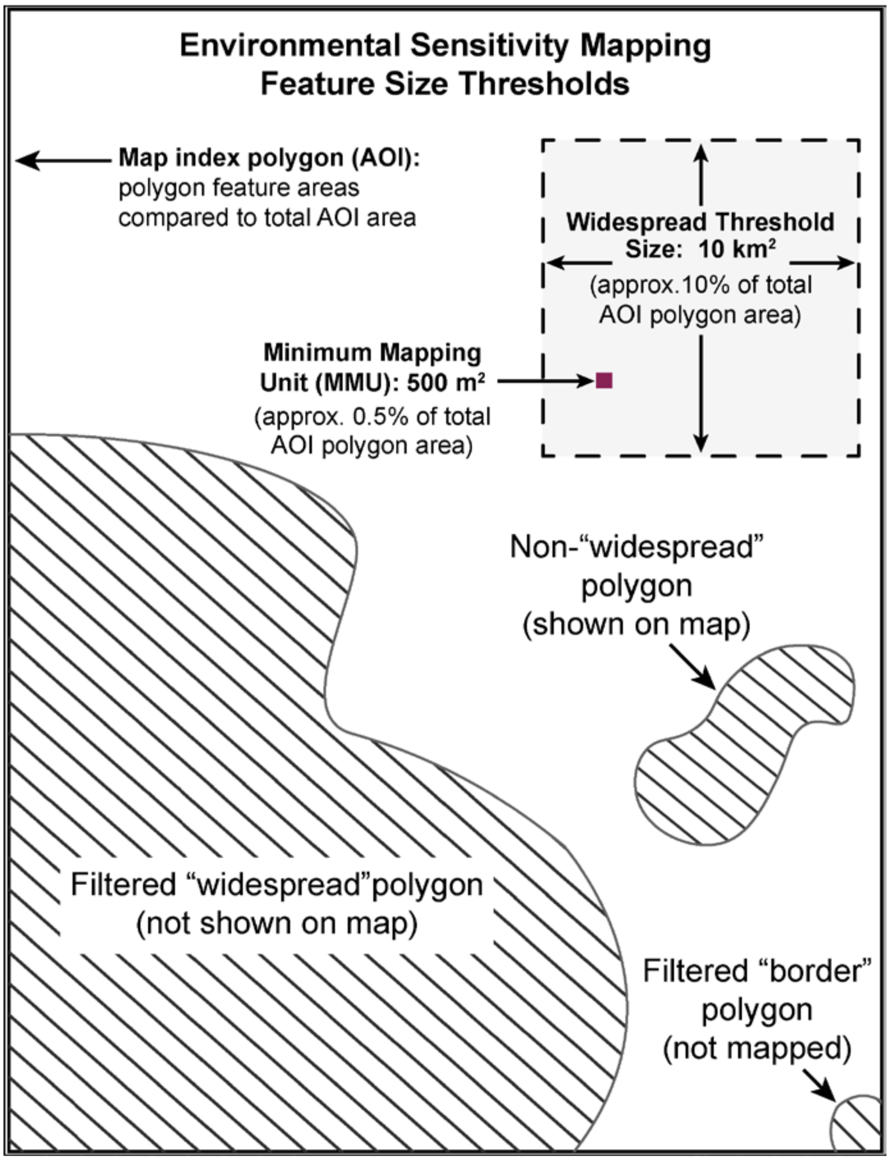


Figure G.5: *Widespread in Mapped Area Filter*
Note that the filtered "border" polygon is not to scale. The threshold specifies smaller than the mmu, so actual size would not be visible at this scale. It has been enlarged here for demonstration only.

WIDESPREAD IN MAPPED AREA (> 10 SQUARE KILOMETERS)

BIRDS

Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D	Nest	Mig.(S)	Mig.(F)	Molt	
Wading	King rail	Concentration Area			High		-	-	-	-	-
	Least bittern	Migration	C		-		-	Apr-May	-	-	-
	Least bittern	Nesting	C		6 Pairs		Apr-Aug	-	-	-	-
	Virginia rail	Concentration Area			High		-	-	-	-	-
Waterfowl	American black duck	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	American coot	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	American wigeon	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Bufflehead	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Canada goose	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Gadwall	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Green-winged teal	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Hooded merganser	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Mallard	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Northern pintail	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Redhead	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Ring-necked duck	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Ruddy duck	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-
	Scaup	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Snow goose	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Tundra swan	Wintering			1000S		-	Feb-Mar	Oct-Nov	-	-
	Waterfowl	Wintering			100S		-	Feb-Mar	Oct-Nov	-	-

FISH

Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D	Spawn	Eggs	Larvae	Juveniles	Adults
Diadromous	Alewife	Nursery Area			Present		-	-	May-Aug	Jul-Oct	-
	American shad	Spawning Area			Present		Apr-Jun	Apr-Jun	May-Jul	Feb-May	-
	Atlantic sturgeon	General Distribution	C		-		-	-	-	Jan-Dec	Jan-Dec
	Blueback herring	Nursery Area			Present		-	-	May-Jul	Jul-Oct	-

Figure G.6: *Summary Report Showing "Widespread in Mapped Area".*

Displayed on Map

The remaining biological features are shown on the map. Mapped features are symbolized by a hatched area, line, or point symbol, color-coded to match the ESI standardized symbolset (**Figure G.13**). The corresponding attribute information is summarized in the "Displayed on Map" section of the report (**Figure G.8**).

Biological features (other than Benthic polygons) are accompanied by marker symbols (icons) representing the unique biological subelements found in the mapped feature. **Figure G.7** illustrates how the symbology is determined. If any state or federally listed species appears within a feature, the corresponding subelement marker symbol will include the red background square denoting a status species (**Figure 6.7-A**). Only one icon per subelement is shown, even if multiple species of the subelement are present (**Figure G.7-B**). If species from more than one subelement are present in a feature, icon symbols are grouped and include each unique subelement (**Figure G.7-C**). In addition to the subelement markers, the Map ID, corresponding to the attributes on the back of the map, is shown (**Figure G.7 - D**).

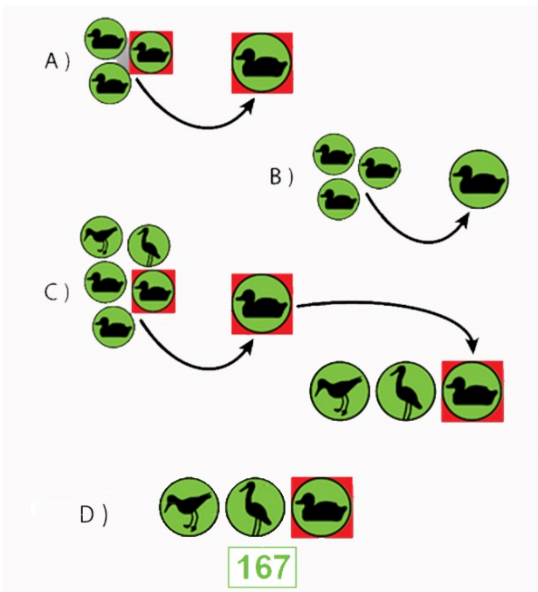


Figure G.7*: Application of Symbology Filter.*

BIOLOGICAL RESOURCES

Note: An asterisk (*) indicates that life stage occurs in this range but not in all months included

DISPLAYED ON MAP

BENTHIC

Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D
SAV	Submerged aquatic veg	High Ecological Value			Present	

BIRDS

Map ID	Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D	Nest	Mig.(S)	Mig.(F)	Molt	
69	Raptor	Bald eagle	Nesting	T		1 Pair		Jan-Jun	-	-	-	-
70	Wading	Black rail	Nesting	C		-		May-Aug	-	-	-	-
76	Shorebird	Black-necked stilt	Nesting			-		May-Aug	-	-	-	-

FISH

Map ID	Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D	Spawn	Eggs	Larvae	Juveniles	Adults
587	Diadromous	Alewife	Spawning Area			Present		Mar-Jul	Mar-Jul	May-Aug	-	-
	Diadromous	Blueback herring	Spawning Area			Present		Mar-Jul	Mar-Jul	May-Jul	-	-
591	Diadromous	Alewife	Migration			Present		-	-	May-Aug	Jul-Mar	-
	Diadromous	Blueback herring	Migration			Present		-	-	May-Jul	Aug-Oct	-
607	Diadromous	Striped bass	Concentration Area			Medium		Apr-Jun	Apr-Jun	Apr-Jun	Jan-Dec	Jan-Dec

REPTILES & AMPHIBIANS

Map ID	Subelement	Species	Mapping Qualifier	S	F	Concentration	Monthly Presence J F M A M J J A S O N D	Nest	Hatch	Internest	Juveniles	Adults
743	Snake	Rainbow snake	Vulnerable Occurrence			-		May-Sep	Aug-Nov	-	Jan-Dec	Jan-Dec

Figure G.8: *Summary Report Showing "Displayed on Map".*

Human-use Data: Filtering and Map Presentation

Human-use (socioeconomic) elements are also represented with icon symbols depicting the type of resource mapped (**Figure G.14**). The filtering methodology for human-use data focuses on reducing the amount of data presented on the map to maximize readability. In this case, the data are filtered by their corresponding *Type* attribute. Several human-use feature types are not shown on the map nor in the report, but are available for viewing and querying within the GIS geodatabase. The remaining features are shown on the map and/or are reported on the back of the map summary. **Figure G.9** shows an example of a "back of the map" report for the human-use maps. **Figure G.10** illustrates the *Type* attribute queries used to determine what features are mapped and/or reported in the map summary.

HUMAN USE RESOURCES

DISPLAYED ON MAP (POINTS)

Map ID	Type	Name	Contact	Phone
1	BOAT RAMP	BRUMLEY ROAD, KNOTTS ISLAND	HERTFORD DEPOT	252-426-2255
2	CAMPGROUND	SANDY POINT RESORT		252-429-3415
3	FERRY	KNOTTS ISLAND FERRY TERMINAL		

DISPLAYED ON MAP (POLYGONS)

Map ID	Type	Name	Contact	Phone
4	WILDLIFE REFUGE	CURRITUCK NATIONAL WILDLIFE REFUGE	US FISH AND WILDLIFE SERVICE	252-429-3100
5	WILDLIFE REFUGE	MACKAY ISLAND NATIONAL WILDLIFE REFUGE	US FISH AND WILDLIFE SERVICE	252-429-3100

ALSO PRESENT IN MAPPED AREA (POLYGONS)

Type	Name	Contact	Phone
ESSENTIAL HABITAT	ESSENTIAL FISH HABITAT; COASTAL MIG. PELAGICS	DAVID DALE, SOUTHEAST REGION	727-824-5317
ESSENTIAL HABITAT	ESSENTIAL FISH HABITAT; SHRIMP	DAVID DALE, SOUTHEAST REGION	727-824-5317
ESSENTIAL HABITAT	ESSENTIAL FISH HABITAT; SNAPPER GROUPER	DAVID DALE, SOUTHEAST REGION	727-824-5317
ESSENTIAL HABITAT	ESSENTIAL FISH HABITAT; SPINY LOBSTER	DAVID DALE, SOUTHEAST REGION	727-824-5317

JURISDICTIONS

COUNTY:	CURRITUCK	*FEMA:*	REGION I
COAST GUARD:	DISTRICT 5, SECTOR NORTH CAROLINA	*EPA:*	REGION 4
USACE:	NORTH ATLANTIC DIVISION, SOUTH ATLANTIC DIVISION, NORFOLK DISTRICT, WILMINGTON DISTRICT		

Figure G.9: *Summary Report Sample for Human Use Features.*

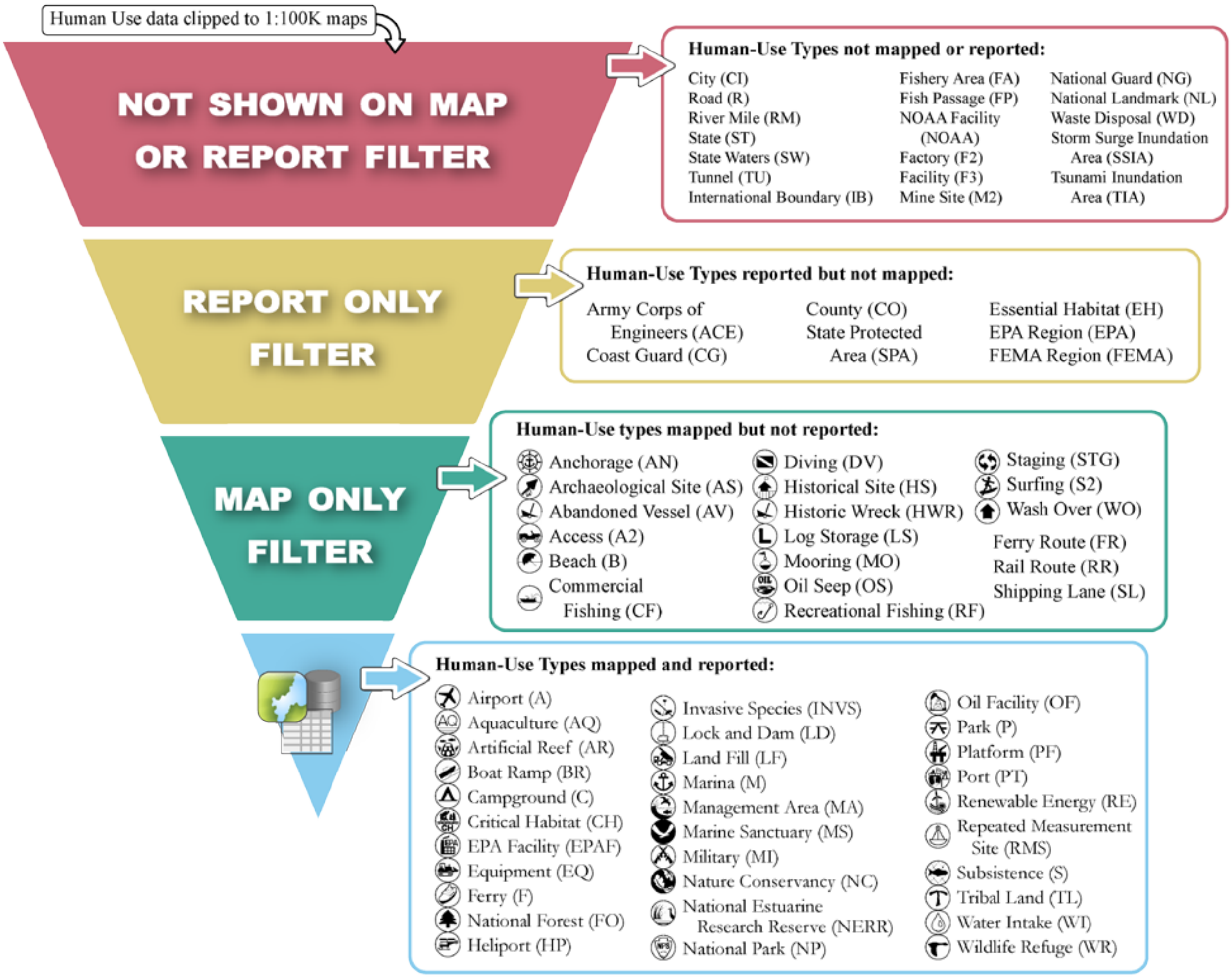


Figure G.10: *Filtering of Human-use ESI data for map production.*

ESI Shoreline and Polygon Mapping

The ESI shoreline and habitat polygons are shown on both the human-use and biology maps. The standardized color scheme (**Figure G.15**) 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.

The shoreline is symbolized with lines wide enough to represent multiple types, since ESI shorelines may be classified with up to three distinct beach types. **Figure G.11**. shows a sample labeled to point out a homogenous shoreline (type 10A - Salt- and Brackish- Water Marshes), and a shoreline segment with two types (Vegetated Low Banks – 9B, 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 must also share the ESI type of the polygon it abuts.

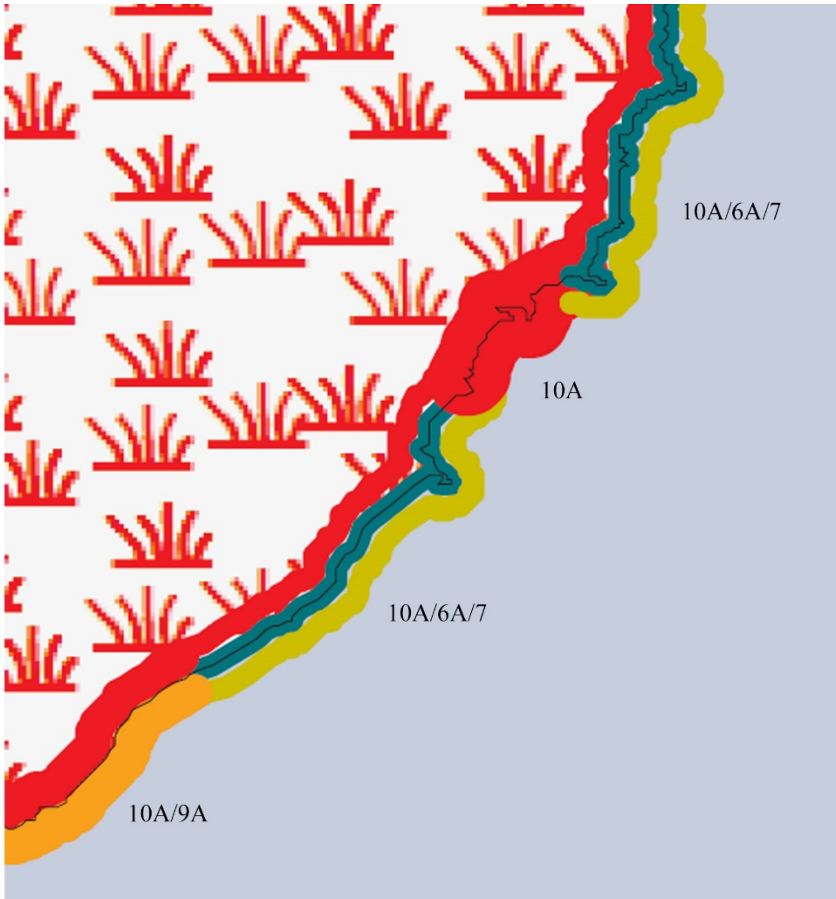


Figure G.11: *Example of Shoreline Symbolization.*

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.

In order 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 (*Type* = '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. **Figure G.11** shows an example where the biology layers have been turned off.

The map report provides a summary of all shoreline types found in the mapped region (**Figure G.12**). ESI polygon areal coverage is included, as is the length of individual shoreline types and the overall shoreline length. The potential discrepancy between the ESI shoreline length and that of the actual shoreline occurs when shorelines reflect more than one ESI type.

SHORELINE RESOURCES

ESI POLYGON HABITAT TYPES

ESI Rank	Habitat Classification	Area (Acres)	Area (Sq. Miles)
10A	Salt and Brackish Water Marshes	291.88	0.46
10B	Freshwater Marshes	25.83	0.04
10C	Swamps	1,352.80	2.11
10D	Scrub and Shrub Wetlands	201.31	0.31
7	Exposed Tidal Flats	1.04	0.00

ESI SHORELINE HABITAT TYPES

ESI Rank	Shoreline Habitat Classification	Length (Meters)	Length (Miles)
10A	Salt- and brackish-water marshes	38,707.96	24.05
10B	Freshwater marshes	530.84	0.33
10C	Swamps	33,352.17	20.72
10D	Scrub-shrub wetlands	1,047.13	0.65
9B	Sheltered, vegetated low banks	15,460.93	9.61
8B	Sheltered, solid man-made structures	3,209.85	1.99
8C	Sheltered riprap	58.82	0.04
7	Exposed tidal flats	335.55	0.21
6B	Exposed riprap	5,954.77	3.70
3A	Fine- to medium-grained sand beaches	8,833.42	5.49
1B	Exposed, solid man-made structures	6,078.70	3.78
	Total ESI Shoreline:	113,570.14	Total ESI Shoreline: 70.57
	Total Shoreline:	106,380.42	Total Shoreline: 66.10

Figure G.12: *Summary of ESI Shoreline and Polygons.*

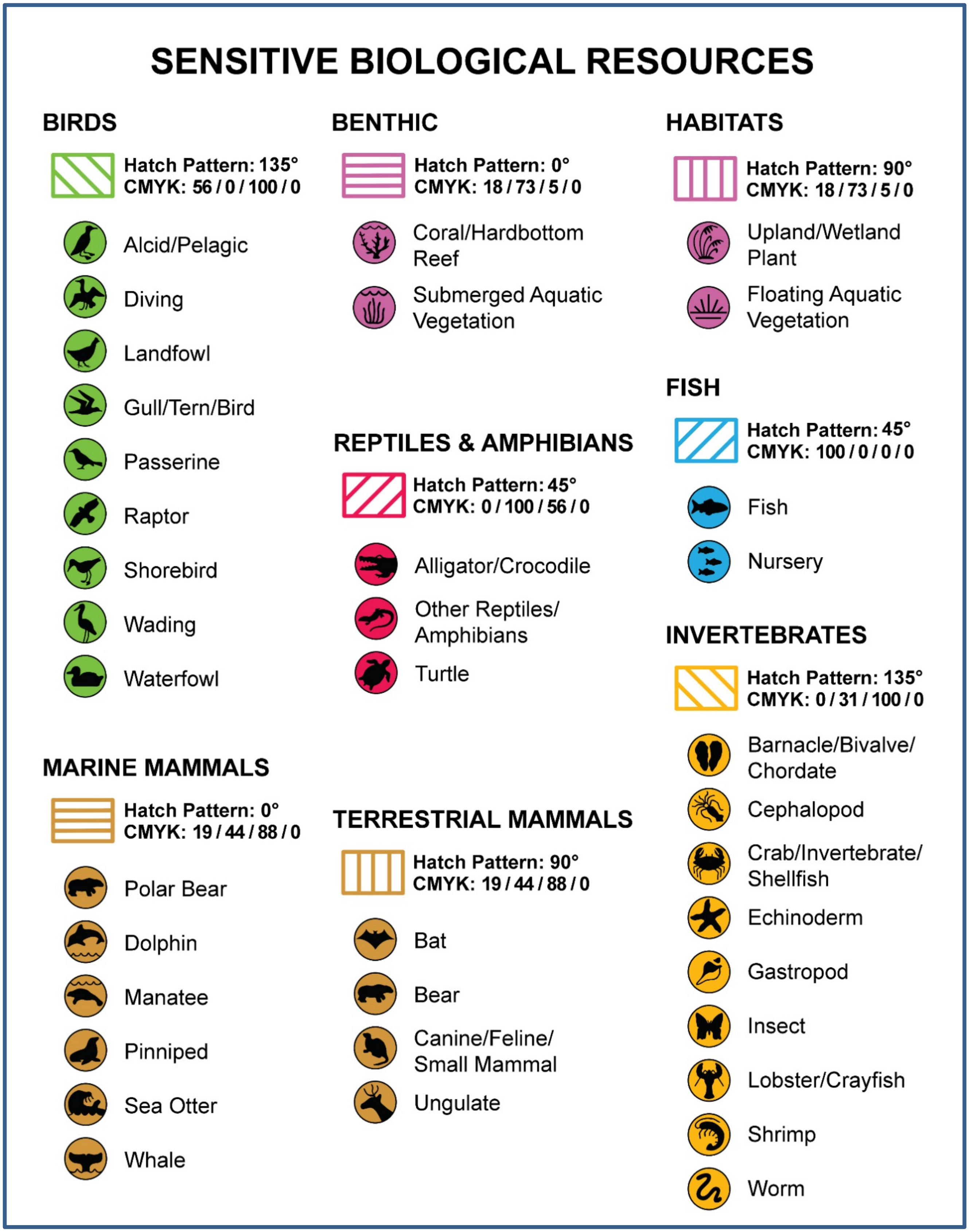


Figure G.13: *Biology symbol set, icons and hatch patterns.*

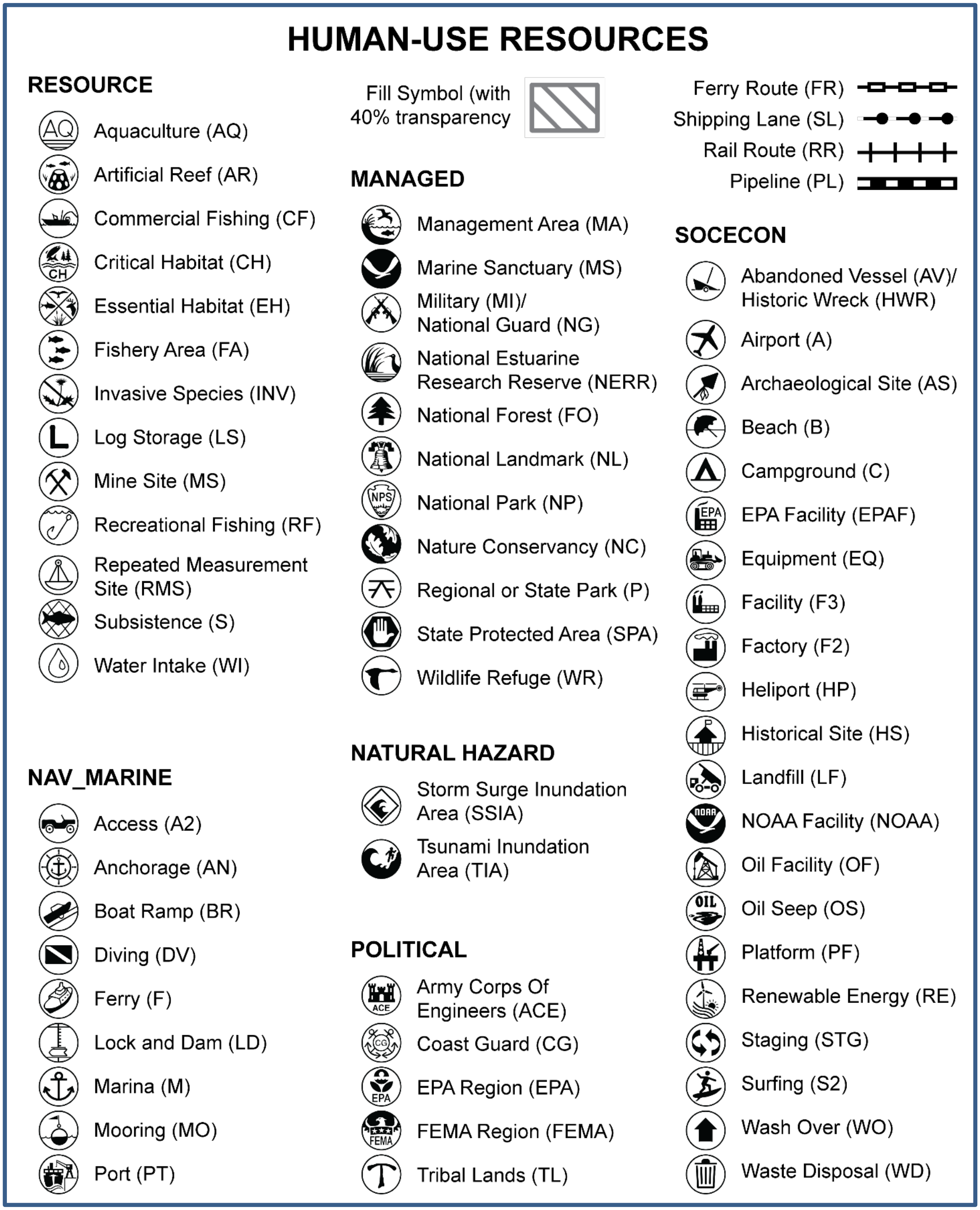


Figure G.14: *Human use symbol set*

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) Fine to Medium Grained Sand Beaches (E) 3B) Scarps and Steep Slopes (Sand) (E) 3B) Eroding Scarps (Unconsolidated Sediment) (L) 3B) Exposed, Eroding Banks (Unconsolidated Sediment) (R)	100 / 65 / 15 / 0
	3C) Tundra Cliffs (E) 4) Coarse-Grained Sand Beaches (E) 4) Sand Beaches (L) 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 Beaches (Granules/Pebbles) (E) 6A) Gravel Bars and Gently Sloping Banks (R)	100 / 45 / 53 / 0
	6B) Riprap (E/L/R) 6B) Gravel Beaches (Cobbles/Boulders) (E) 6D) Boulder Rubble (E)	78 / 34 / 100 / 0
	7) Exposed Tidal Flats (E/L)	0 / 0 / 100 / 25
	8A) Sheltered Scarps (Bedrock/Mud/Clay) (E/L) 8A) Sheltered, Impermeable, 55 / 100 / 100 / 0	0 / 0 / 100 / 0
	8B) Sheltered, Solid Man-Made Structures (E/L/R) 8B) Sheltered, Permeable Rocky Shores (E)	2 / 8 / 85 / 0
	8C) Sheltered Riprap (E/L/R) 8D) Sheltered, Rocky, Rubble Shores (E) 8E) Peat Shorelines (E) 8F) Vegetated, Steeply Sloping Bluffs (R)	0 / 17 / 81 / 0
	9A) Sheltered Tidal Flats (E) 9A) Sheltered Sand and Mud Flats (L) 9B) Vegetated Low Banks (E/L/R) 9C) Hyper-Saline Tidal Flats (E)	1 / 42 / 99 / 0
	10A) Salt and Brackish Water Marshes (E)	0 / 100 / 100 / 0
	10B) Freshwater Marshes (E/L/P/R)	0 / 50 / 0 / 0
	10C) Swamps (E/L/P/R)	20 / 90 / 80 / 0
	10D) Scrub and Shrub Wetlands (E/L/P/R)	55 / 100 / 100 / 0
	10E) Inundated Low Lying Tundra (E)	20 / 90 / 80 / 0
	10F) Mangroves (E)	55 / 100 / 100 / 0

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

Figure G.15: *Shoreline line and poly symbol set, including CMYK color values*.

APPENDIX H

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 ESI child record metadata template (entity) – one for polys, one for lines
  - HYDRO metadata template (DS) - will describe both HYDRO LINE and HYDRO POLY feature sets
    - Sample HYDRO child record metadata template (entity) – one for polys, one for lines
- 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
    - BREED_DT metadata template (entity) – Include as a child item for all biological DS records
- SOCECON Feature Dataset
  - NATURAL HAZARDS metadata template (DS)
  - NAVIGATION-MARINE metadata template (DS)
  - PARKS-MANAGED AREAS metadata template (DS)
  - POLITICAL-JURISDICTIONAL metadata template (DS)
  - RESOURCE MANAGEMENT metadata template (DS)
  - 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

InPort 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

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 is 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 be reflect the final object counts in the publically 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.	http://www.dec.ny.gov/animals/29338.html
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 include, 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 BIOFILE, BREED_DT, 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)	BIOFILE
	Entity (ENT)	BREED_DT
	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	9
Minimum Length	Not applicable to ESI data	
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 9-digit identifier that links records in the BIOFILE 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 BIOFILE table, for example.	
Allowed Values	Range of values for this column. Must be completed after creation of final Geodatabase is processed by NOAA.	283000001-283000515
Default Value	Value to be placed in a column when no data is entered	
Foreign Key Relations	Tables with which this column has key relationships.	BIOFILE
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		David Moe Nelson
Metadata Record Created		2017-09-08 10:59+0000
Metadata Record Last Modified by		David Moe Nelson
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.	

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
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 Of 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

The U.S. DEPARTMENT OF COMMERCE

Wilbur L. Ross, Jr., Secretary

National Oceanic and Atmospheric Administration
Dr. Neil Jacobs,
Assistant Secretary of Commerce for Environmental Observation and Prediction, Performing the duties of Under Secretary of Commerce for Oceans and Atmosphere

National Ocean Service
Nicole LeBoeuf,
Acting Assistant Administrator for Ocean Services and Coastal Zone Management