

5 ESI DATABASE ORGANIZATION

ESI data have been compiled digitally since 1994. Early digital versions focused primarily on easing production of hard-copy maps and today's ESI data structure still reflects this objective. As the GIS user community grew, so did efforts to provide more comprehensive and usable data tables. Tables and items within tables have been added to meet the needs of the communities using the atlases, leading to the current ESI data standard. The relational tables are normalized, eliminating the need to enter the same information multiple times, minimizing the likelihood of errors, and easing updates. The tables are also extensible if attributes specific to a geographic area need to be considered. A diagram of the relational database structure is shown in Figure 5. This may be a useful reference when reading through the following chapter, especially those parts pertaining to the biological and human-use data.

The Relational Database Structure –

Base Map Layers

The ESI data can be grouped into three general categories: base-map layers, biological layers, and human-use layers. The base-map layers do not link to any external data tables; rather all their attributes are self-contained. The primary base-map layers are ESI, HYDRO, and INDEX. Additional base map layers may be added for a particular atlas if the local user community has access to the information or has a particular need for a specialized data layer. In the past, such additional layers have included salinity bounds, bathymetric contours, and seasonal ice extents.

The ESI Data Layer

The ESI shoreline classification contains water and land features depicted as polygons and narrow rivers and streams displayed as arcs. The ESI polygon attributes are *ESI* (10, 10, C), *WATER_CODE* (1, 1, C), and *ENVIR* (1,1,C). *ESI* may be populated with any of the standard ESI types (see table 2) where an expanse of area is covered. Most commonly

it is populated with types “7” or “9A” (flats) or types “10A,” “10B,” “10C,” or “10D” (wetlands). When ESI-classified shorelines form polygons that are not classified, for instance around land, the item *ESI* should be populated with “U.” The polygon item *WATER_CODE* should be populated with “L,” land or “W,” water. In most environments, polygons classified as flats (*ESI* = “7” or “9A”) are water (*WATER_CODE* = “W”) and polygons classified as wetlands (*ESI* = “10A,” “10B,” “10C,” or “10D”) are land (*WATER_CODE* = “L”). The polygon item *ENVIR* should be populated with “E,” estuarine, “R,” riverine, “L,” lacustrine, or “P,” palustrine. See Figures 3 and 4, as well as the summary of coding rules at the end of the ESI section.

The ESI arc attributes are *ESI* (10, 10, C), *LINE* (1, 1, C), *SOURCE_ID* (6, 6, I), and *ENVIR* (1, 1, C). Table 21 shows a breakdown of acceptable values for each of these items. The arc item *ESI* contains a value reflecting the shoreline sensitivity to oiling with

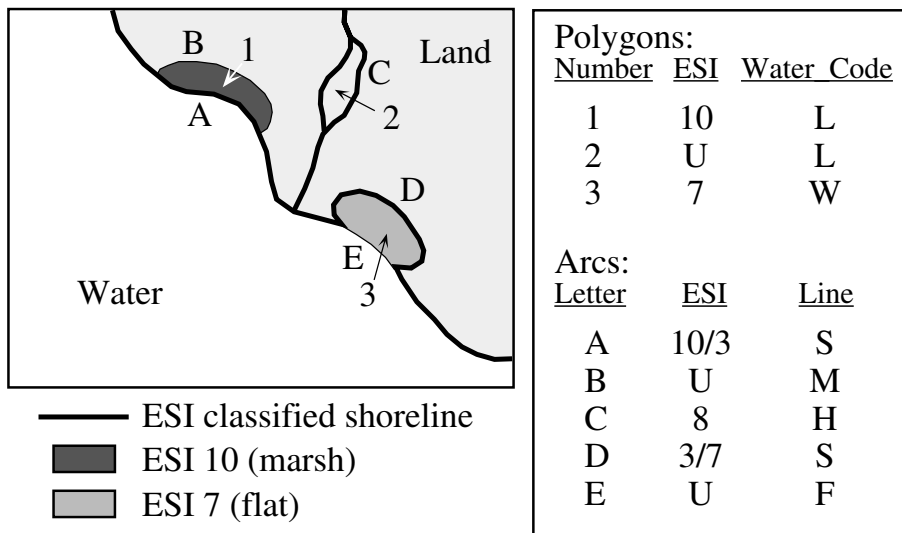


Figure 3. ESI shoreline with wetland (10) and flat (7) polygons

lower numbers reflecting low susceptibility and higher numbers indicating increasingly higher susceptibility. Each number also corresponds to a defined shoreline type (see Table 2). *ESI* may contain up to three shoreline types designating, in order, the landward, Shore, and seaward classifications. If an arc is unclassified, as in the case of the outer bounds of a flat, *ESI* should be assigned a value of “U.”

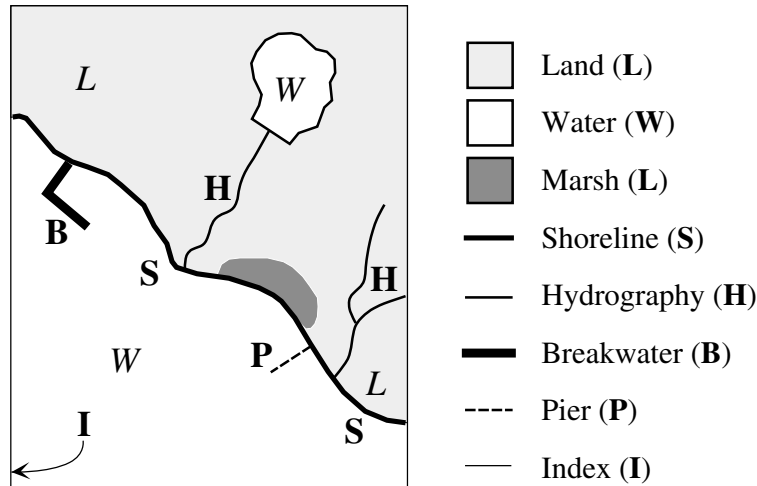


Figure 4. Polygon *WATER_CODE* and arc *LINE* coding rules for HYDRO and ESI.

Table 21. Features of the ESI data layer.

DESCRIPTION	ITEM	VALUE
ESI classification	ESI (10, 10, C)	see Table 2
Type of linear feature	LINE (1, 1, C)	B (breakwater) E (extent) F (flat) G (glacier) H (hydrography) I (index) S (shoreline) M (marsh) P (pier)
Source code	SOURCE_ID (1, 1, I)	1 (original digital information) 2 (low-altitude overflight) 3 (aerial photograph) 4 (digitized from 1:24,000-USGS topographic quadrangle) 5 (digitized from scanned 1:24,000-USGS topographic quadrangle) 6 (National Wetlands Inventory) N (6 plus the number of additional sources)

Table 21. Cont.

Environment	ENVIR (1, 1, C)	E (estuarine) L (lacustrine) R (riverine) P (palustrine)
Water and land polygons	WATER_CODE (1, 1, C)	W (water) L (land)

The ESI arc *LINE* item defines the type of linear feature being mapped. Acceptable values include “B” – breakwater, “E” – study area extent, “F” – flat, “G” – glacier, “H” – hydrography, “I” – index, “S” – shoreline, “M” – marsh, and “P” – pier. The *SOURCE_ID* indicates the originating source of the mapped line. Values are integers ranging from one to N where N is six plus the number of non-standard sources. See Table 21 for definitions. The item *ENVIR* is indicative of the regional environment of the mapped ESI type. Environments mapped include estuarine – “E,” lacustrine (lake) – “L,” riverine – “R,” and palustrine – “P.” The ESI shoreline definition may vary slightly, depending on the environment (Table 2).

Summary of coding rules for the ESI attributes:

- ➔ When ESI-classified shorelines form polygons that are unclassified (i.e., land), the *ESI* value for the polygon is “U” for unranked.
- ➔ Unranked arcs not designating shoreline, whose left or right polygon is a flat (*ESI* = “7” or “9A”) or marsh (*ESI* = “10A,” “10B,” “10C,” “10D,” or “10E”), have a *LINE* value of “F” or “M” respectively.
- ➔ In most environments, polygons classified as flats (*ESI* = “7” or “9A”) are water and have a *WATER_CODE* of “W.” They have ESI arc attributes on the inland side of the polygon.
- ➔ In most environments, polygons classified as wetlands (*ESI* = “10A,” “10B,” “10C,” “10D,” or “10E”) are land and have a *WATER_CODE* of “L.” They have ESI arc attributes on the water side of the polygon.
- ➔ Arcs that form the boundary between open water and land are shoreline and have a *LINE* value of “S.”
- ➔ Arcs that have land on both sides are hydrography and have a *LINE* value of “H.”
- ➔ Arcs that form an inland water polygon have a *LINE* value of “H.”
- ➔ Quad/map boundaries have a *LINE* value of “I.”

- Polygons or arcs that are on the water side of the shoreline have a *LINE* value of “B” (breakwater) or “P” (pier).

In some ESI atlases, National Wetlands Inventory (NWI) data are reclassified to attribute some of the ESI polygons. The interpretation of the NWI data is outlined in Table 22.

Table 22. Reclassification of National Wetlands Inventory data

ESI	NWI DEFINITION	NWI CODE
10A	Estuarine, intertidal, emergent wetland	E2EM
10B	Riverine, tidal, emergent wetland	R1EM
	Riverine, lower perennial, emergent wetland	R2EM
	Lacustrine, littoral, emergent wetland	L2EM
	Palustrine, emergent wetland	PEM
10C	Estuarine, intertidal, forested wetland	E2FO
	Palustrine, forested wetland	PFO
10D	Estuarine, intertidal, scrub-shrub	E2SS
	Palustrine, scrub-shrub	PSS

To ensure that the shoreline is consistent, the ESI layer is the starting point for the HYDRO layer. Arcs defining flat and marsh boundaries are deleted so that only arcs and polygons defining shoreline and hydrography remain. The ESI *LINE*, *SOURCE_ID*, and *WATER_CODE* attributes are retained in the HYDRO layer.

The HYDRO Data Layer

The HYDRO data layer contains polygons, such as land bodies and lakes, and linear features, such as streams and creeks. As mentioned, the arc attributes *LINE* (1,1,C) and *SOURCE_ID* (6,6,I) and the polygon attribute *WATER_CODE* (1,1,C) are copied from the ESI data layer. Depending on the source information used, the hydrography may extend to all areas of the USGS quads or other base maps, or it may stop where the ESI shoreline classification ends.

The HYDRO layer also contains all annotation used in producing the atlas. The annotation is generally digitized from the USGS quadrangles and is used for producing the hard-copy map product. The annotation features are grouped into three subclasses:

hydro (water body names), geog (geographic places of interest), and soc (parks, city and town names, etc.).

The INDEX Data Layer

The data layer INDEX contains the map boundary polygons for each hard-copy map (usually the USGS 1:24,000 quadrangles) in the atlas. The polygon attributes are *TILE-NAME* (32,32,C), a map number based on the layout of the atlas; *TOPO-NAME* (255,255,C), the USGS map name and latest publication date; *SCALE* (7,7,I), the scale denominator; *MAPANGLE* (4,8,F,3), a cartographic value used to rotate the map so the hard-copy product is straight up and down; and *PAGESIZE* (11,11,C), the width and height of the printed map page. There are no attributes associated with the arcs in the INDEX layer.

Biological Map Layers and Associated Relational Attribute Tables

The biological data layers are generally titled by element, the ESI equivalent of a biological category. Most are mapped with polygons showing the expected geographic extent of an assemblage of species with particular seasonal characteristics and other unique attributes. A typical ESI atlas will include the polygonal layers BIRDS, FISH, HABITATS, INVERT (invertebrates, including shellfish and, occasionally, endangered insects), REPTILES (reptiles and amphibians), T_MAMMAL and M_MAMMAL (terrestrial and marine mammals, respectively). Most atlases also include a biological layer, NESTS, where point objects are used to indicate the general vicinity of bird-nesting areas. Occasionally, it may be appropriate to map some or all locations of other elements as point or even line data. In such cases, the layer name indicates the element and data type. For example, FISHPT would be fish locations mapped as points and FISHL would be fish locations mapped as lines. The atlas-specific metadata will provide a thorough discussion of each map layer, the types of objects it contains, and listings of the mapped species.

Each biological layer has two internal attributes associated with it. These are the items *ID* (10,10,I) and *RARNUM* (9,9,I). *ID* is an identifier that is unique to a polygon across map layers and even atlases. It is a ten-digit number composed of three parts. The first three digits are the atlas id number (see Appendix C), while the next two digits specify the element number (see below), and the final five digits are the polygon id unique to the

layer where the object resides. Elements (including those specific to the socecon layers) have been assigned the following numbers:

1 BIRDS	4 M_MAMMAL	7 INVERT	10 SOCECON
2 FISH	5 NESTS	8 SPECIAL	11 MGT
3 HABITATS	6 REPTILES	9 T_MAMMAL	

If an element that is typically mapped as a polygon is mapped using lines, a value of 20 is added to the element number. Likewise, when an element typically mapped with polygons is mapped using points, a value of 30 is added to the element number. This protocol assures that the *ID* of each map object will remain unique. Some sample *ID* values are shown below.

0360100005	➔	atlas# 036 element# 01 object# 00005
	➔	Georgia, <i>BIRDS</i> , polygon number 5
0452200036	➔	atlas# 045 element# 22 object# 00036
	➔	Massachusetts, <i>FISHL</i> , line number 36
0073400106	➔	atlas# 007 element# 34 object# 00106
	➔	Northern California, <i>M_MAMPT</i> , point number 106

The element *SPECIAL* (8) is used particularly in some of the older atlases where a non-standard biological data layer was included. These are documented in the atlas-specific metadata.

The second attribute associated with the biological layers, *RARNUM*, is the essence of the ESI data structure. A *RARNUM* defines a unique combination of species (all of the same element type), concentrations, seasonalities, and sources. These values may be repeated across multiple polygons within the same data layer. The use of the *RARNUM* helps us produce the hard-copy maps and can reduce redundancy within the data tables when like distribution of species occur at different sites across the atlas.

The item *RARNUM* is also designed to be unique across atlases. It is a nine-digit number where the first three digits again reflect the atlas number (Appendix C) and the last six digits indicate the unique species or resource group within the atlas. Some examples include:

036000007	➔	atlas# 036 resource group 7
007000007	➔	atlas# 007 resource group 7

In these examples, we show both Georgia and Northern California with the same resource group number (7), but see that the RARNUM remains unique since the atlas number is embedded. This ensures that there is no redundancy when viewing multiple atlases at the same time.

Biology Attribute Tables

The richness of the biological attributes makes the ESI data set a unique and valuable resource, but it also results in the need for a fairly complex data structure. The tables have been arranged to eliminate redundant data entry and allow extension when data specific to a region or atlas needs to be added. Figure 5 provides a graphic of the relationships between tables.

The first step is linking the map objects to the data tables. This may be done in either of two ways. The first entails the use of a lookup table, BIO_LUT, using the item *ID* to link from the map object. This method is provided for those using mapping software that requires a unique map object id and allows for no other internal map object attributes. The BIO_LUT table provides the *RARNUM*, the link to the BIORES table where all supporting attributes and links reside. The item *RARNUM* is also provided as an internal attribute for each of the biological points, polygons, and lines. With mapping software that supports internal map object attributes or, alternatively, does not require unique map object ids, the *RARNUM* can link directly to the *BIORES* table.

BIORES Data Table:

The BIORES table contains the items *RARNUM* (9,9,I), *SPECIES_ID* (5,5,I), *CONC* (20,20,C), *SEASON_ID* (2,2,I), *G_SOURCE* (6,6,I), *S_SOURCE* (6,6,I), *ELEMENT* (10,10,C), *EL_SPE* (6,6,C), and *EL_SPE_SEA* (8,8,C). The *RARNUM*, described above in some detail, ultimately provides the link from the biological map objects.

SPECIES_ID is a NOAA-assigned species number unique within each element. A list of all the current *SPECIES_ID* values is provided in Appendix A, as well as the element, sub-element, and scientific and common names of the species they represent. As additional geographic regions are mapped, the NOAA species list will be updated to include previously unmapped species. The latest version of the species list is always available from the NOAA Office of Response and Restoration website at <http://response.restoration.noaa.gov/esi/species.pdf>.

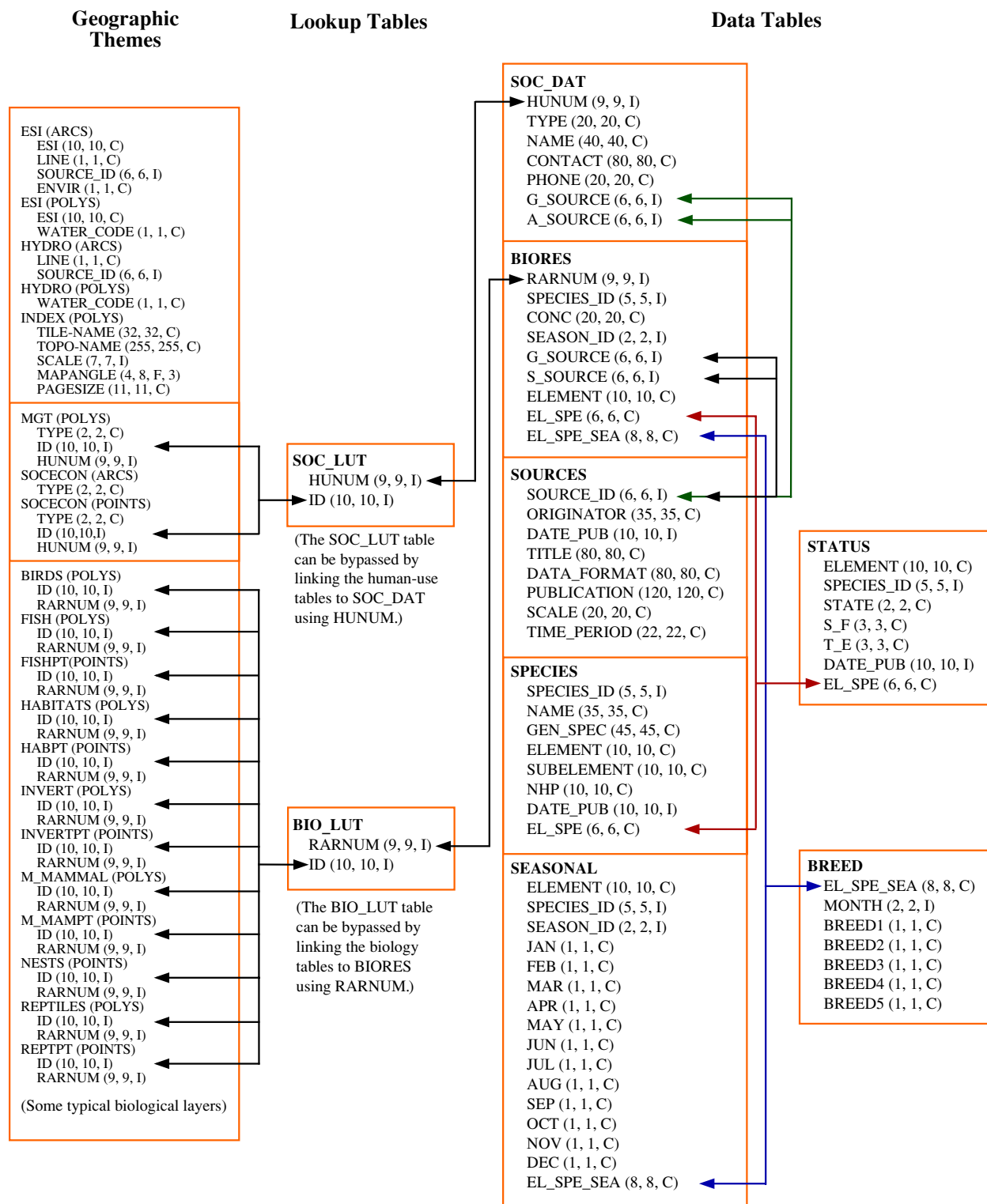


Figure 5. Relationships between spatial data layers and attribute data tables.

The *CONC* item is a 20-character field providing concentration information for that particular species within the mapped objects of the corresponding *RARNUM*. Concentration may be provided qualitatively, such as HIGH, MEDIUM, and LOW, or it may list numeric counts or ranges provided by local experts. The associated metadata should explain concentration values used in each atlas. If no concentration information was available or, as is the case in some of the older atlases, no concentration information was collected, a value of ‘-’ is used to populate this field.

SEASON_ID is an element- and species-specific seasonality reference. Since the seasonal presence or breeding activities of a species may vary from one mapped polygon to another, the *SEASON_ID* is modified to reflect this. *SEASON_ID* is concatenated with *ELEMENT* and *SPECIES_ID* to provide the link to the seasonal and breed tables.

G_SOURCE (geographic source) and *S_SOURCE* (seasonality source) link from the BIORES to the SOURCE table where feature level metadata is provided. These values are atlas-specific. Each source contributing to an atlas is assigned a unique integer value.

The next item in the BIORES table is *ELEMENT*. As mentioned, *ELEMENT* is an ESI biological category. Acceptable values are:

BIRD	M_MAMMAL (Marine Mammals)
FISH	RÉPTILE (Reptiles & Amphibians)
HABITAT (Habitats & Plants)	T_MAMMAL (Terrestrial Mammals)
INVERT (Invertebrates – Shellfish & Insects)	

EL_SPE and *EL_SPE_SEA* are links to other supporting data tables. Both are character items that combine parts of other items defined in the BIORES tables. *EL_SPE* takes the first letter of *ELEMENT* and concatenates it to the five-digit *SPECIES_ID* number. It provides the link from BIORES to the SPECIES and STATUS tables. Likewise, the item *EL_SPE_SEA* takes the first letter of *ELEMENT* and concatenates it with the *SPECIES_ID* and *SEASON_ID*. This is the link from BIORES to the SEASONAL and BREED tables. Some sample *EL_SPE* and *EL_SPE_SEA* values follow.

<u><i>EL_SPE</i> value</u>	→	<i>ELEMENT</i> ‘BIRD’ <i>SPECIES_ID</i> = 5
B00005	→	<i>ELEMENT</i> ‘FISH’ <i>SPECIES_ID</i> = 37
F00037		
<u><i>EL_SPE_SEA</i> value</u>	→	<i>ELEMENT</i> ‘BIRD’ <i>SPECIES_ID</i> = 5 <i>SEASON_ID</i> = 1
B0000501	→	<i>ELEMENT</i> ‘FISH’ <i>SPECIES_ID</i> = 37 <i>SEASON_ID</i> = 3
F0003703		

The supporting data tables are SOURCES, SPECIES, SEASONAL, STATUS, and BREED.

SOURCES Data Table:

The SOURCES data table provides feature-specific metadata for both the biology and human-use map layers. In addition to providing citations for the map data, the SOURCES table can help identify local experts.

The item *SOURCE_ID* (6,6,I) links to *G_SOURCE* and *S_SOURCE* in the BIORES table, as well as to *G_SOURCE* and *A_SOURCE* in the SOC_DAT table. *ORIGINATOR* (35,35,C) indicates the person or organization that provided the data. The item *DATE_PUB* gives the production or publication date. If the information is from a published data source, *TITLE* (80,80,C) lists the name of the original publication. If a source is a local expert and doesn't reference any published document, a descriptive phrase citing the type of information provided and geographic extent of expertise is given. *DATA_FORMAT* (80,80,C) provides an indication of the format of the original data. Some likely values include 'text,' 'hard-copy map,' 'digital (arc, polygons, and/or points),' and 'expert,' indicating personal communications between the local source and the data collector. *PUBLICATION* (120,120,C) may cite the document that is referenced or may list 'unpublished' in the case of information gathered verbally from local sources. *SCALE* (20,20,C) lists the denominator of the scale for digital or hard-copy maps, when available. For other source types, this is generally populated by 'N/A.' The final item in the SOURCES table is *TIME_PERIOD*. This field contains the year(s) in which a source was published or the time span over which personal interviews were conducted.

SPECIES Data Table:

The SPECIES data table contains a record for each species found in the ESI atlas. Items include *SPECIES_ID* (5,5,I), *NAME* (35,35,C), *GEN_SPEC* (45,45,C), *ELEMENT* (10,10,C), *SUBELEMENT* (10,10,C), *NHP* (10,10,C), *DATE_PUB* (10,10,I), and *EL_SPE* (6,6,C). *SPECIES_ID* is described above in the BIORES section. *NAME* refers to the common name or a local variation. *GEN_SPEC* lists the scientific name – genus and species – of the mapped biology. *ELEMENT* has been described as an ESI-defined biological grouping. *SUBELEMENT* goes a step further, delineating a logical group of species within an element based on such things as habitat preference or feeding styles.

NHP lists the Natural Heritage Program global ranking. These rankings are not a legal designation, but rather an indicator of a species' rarity throughout its total range. Values range from 'G1' for extremely rare to 'G5', defined as very common. *DATE_PUB* gives the date of the Natural Heritage listing. The final item in the SPECIES table is *EL_SPE*, the link from the BIORES and STATUS tables. *EL_SPE* is described in the BIORES section.

SEASONAL Data Table:

The SEASONAL table contains the monthly presence information for each species. The discussion of the BIORES table explains the first three items, *ELEMENT* (10,10,C), *SPECIES_ID* (5,5,I) and *SEASON_ID* (2,2,I). The next twelve items are the three-letter abbreviations for each month, e.g., *JAN* (1,1,C) – *DEC* (1,1,C). These items are populated with 'X' if the species is present in the mapped area during that particular month. Months in which the species is not present are left blank. The last item in SEASONAL is *EL_SPE_SEA* (8,8,C), again the link from BIORES to and from the BREED table. *EL_SPE_SEA* is further described in the BIORES section.

BREED Data Table:

For each month that a species is listed as present ('X') in the SEASONAL table, there is an associated record entered in the BREED table. The items in the BREED table are *EL_SPE_SEA* (8,8,C), *MONTH* (2,2,I), *BREED1* (1,1,C), *BREED2* (1,1,C), *BREED3* (1,1,C), *BREED4* (1,1,C), and *BREED5* (1,1,C). *EL_SPE_SEA*, described in the BIORES section, provides the link either from BIORES or SEASONAL. The *MONTH* item is populated with the numeric representation for the month described, e.g., January = 1 through December = 12. *BREED1* through *BREED5* indicate life activities specific to each element. A listing of these activities, by element, appears below.

	<u>BREED1</u>	<u>BREED2</u>	<u>BREED3</u>	<u>BREED4</u>	<u>BREED5</u>
BIRD	nesting	laying	hatching	fledging	-
FISH	spawning	eggs	larvae	juveniles	adults
HABITAT	-	-	-	-	-
INVERT	spawning	eggs	larvae	juveniles	adults
M_MAMMAL	mating	calving	pupping	molting	-
REPTILE	nesting	hatching	internesting	juveniles	adults
T_MAMMAL	-	-	-	-	-

The *BREED* items are populated with ‘Y’ when that life activity is occurring during the specified month, ‘N’ when it is not, or ‘-’ when there is no life activity defined for that breed column for the element referenced. The breeding activities collected for the ESI maps have varied over time. For example, in many of the early atlases, the breeding activities listed for fish were limited to spawning and outmigration. Similarly, the activities recorded for invertebrates were simply mating and spawning. In the Hawaii atlas, it was appropriate to list spawning activity for certain corals. Due to these types of exceptions, we recommend that the atlas-specific metadata be checked for the actual meanings of the breed activity categories on an atlas-by-atlas basis.

STATUS Data Table:

STATUS is the final biology table in the relational database. This table has a record for each species that is listed as threatened or endangered by a state that is mapped in the atlas or by the federal government. The items in the STATUS table are *ELEMENT* (10,10,C), *SPECIES_ID* (5,5,I), *STATE* (2,2,C), *S_F* (3,3,C), *T_E* (3,3,C), *DATE_PUB* (10,10,I), and *EL_SPE* (6,6,C). *ELEMENT* and *SPECIES_ID* have the same definition here as in the BIORES table. *STATE* is populated with the two-letter state abbreviation for the mapped state that lists the species as threatened or endangered. If an atlas spans multiple states and a species is listed by more than one of those states, additional records will be added for each state listing the species. The *S_F* column is populated with ‘S’ if there is simply a state listing for the species, ‘F’ if there is only a federal listing, or ‘S/F’ if it is listed by both the state and federal governments. The *T_E* item indicates whether the species is listed as threatened or endangered. If the *S_F* item is populated with only ‘S’ or ‘F,’ only one value will appear in the *T_E* column: ‘T’ for threatened, ‘E’ for endangered, or ‘C’ for species of special concern (a state designation only). These values refer to the agency listed under ‘*S_F*. If both the state and federal governments list the species, the listing status for the state will be given first, followed by a slash (‘/’), then the federal listing status. Acceptable values include ‘T/T,’ ‘E/T,’ ‘T/E,’ ‘E/E,’ ‘C/E,’ and ‘C/T.’ The *DATE_PUB* column will give the year, or the month and the year, in which the threatened or endangered status was published.

Figure 6 shows a sample of each of the biology tables and how they are populated. This, as well as the ESI relational table diagram, Figure 5, may be a helpful supplement to the above discussion.

BIRDS.PAT:

ID	RARNUM
650100002	65000102
650100003	65000102
650100004	65000123
650100005	65000105

FISHL.AAT:

ID	RARNUM
652200002	65000306
652200003	65000313
652200004	65000308
652200005	65000306

BIO LUT:

RARNUM	ID
65000102	650100002
65000102	650100003
65000102	650100010
65000306	652200002

BIORES:

RARNUM	SPECIES_ID	CONC	SEASON_ID	G_SOURCE	S_SOURCE	ELEMENT	EL_SPE	EL_SPE_SEA
65000102	17	-	3	21	9	BIRD	B00017	B0001703
65000103	126	LOW	1	20	20	BIRD	B00126	B0012601
65000103	260	8 PAIR	1	20	20	BIRD	B00260	B0026001
65000104	251	112	1	25	27	BIRD	B00251	B0025101

SPECIES:

SPECIES_ID	NAME	GEN_SPEC	ELEMENT	SUBELEMENT	NHP	DATE_PUB	EL_SPE
17	Northern pintail	Anas acuta	BIRD	waterfowl		0	B00017
126	Brown noddy	Anous stolidus	BIRD	pelagic		0	B00126
260	Red-footed booby	Sula sula	BIRD	pelagic		0	B00260
251	Great frigatebird	Fregata minor	BIRD	pelagic		0	B00251

SEASONAL:

ELEMENT	SPECIES_ID	SEASON_ID	JAN	FEB	MAR	APR	MAY	NOV	DEC	EL_SPE_SEA
BIRD	17	3	X	X	X					X	B0001703
BIRD	126	1	X	X	X	X	X	X	X	X	B0012601
FISH	13	2				X	X	X			F0001302

SOURCES:

SOURCE_ID	ORIGINATOR	DATE_PUB	TITLE	DATA_FORMAT	PUBLICATION	SCALE	TIME_PERIOD
9	USGS	0	Topographic Quadrangles	Hard Map	USGS, Denver, CO	24000	Varies
20	Hawaiian Electric Co.	2001	Locations of Water Intakes	EXPERT	Unpublished	N/A	2001

STATUS:

ELEMENT	SPECIES_ID	STATE	S_F	T_E	DATE_PUB	EL_SPE
BIRD	242	HI	S/F	E/E	2001	B00242
BIRD	621	HI	F	T	2001	B00621
HABITAT	534	HI	S/F	T/T	2001	H00534

BREED:

EL_SPE_SEA	MONTH	BREED1	BREED2	BREED3	BREED4	BREED5
B0001703	3	Y	Y	N	N	-
B0012601	1	N	Y	N	N	-
F0001302	5	Y	Y	Y	N	N

Figure 6. Sample biology data for data layers, lookup tables and data tables.

Human-Use Data Tables

The ESI atlases include several human-use features. In the SOCECON layer there are locational points for socioeconomic resources, such as airports, aquacultures, boat ramps, marinas, and water intakes. In the management (MGT) layer there are polygonal boundaries for such things as wildlife refuges, marine sanctuaries, and regional and national parks. These points and polygons are linked to the SOC_DAT table in much the same way as the biological layers are linked to the BIORES table.

Internally, SOCECON and MGT store the attributes *ID* (10,10,I) and *HUNUM* (9,9,I). As with the biological *ID*, the *ID* found in the human-use tables is an identifier that is unique to a point or polygon across map layers and atlases. It is a ten-digit number composed of three parts. The first three digits are the atlas id number (see appendix C); the next two digits specify the element number (or in this case layer number); and the final five digits consist of the polygon or point id value unique to the layer where the object resides.

Some sample human-use id values are shown below.

0361000022	➔	atlas# 036 layer# 10 object# 00022
	➔	Georgia, <i>SOCECON</i> , point number 22
0451100004	➔	atlas# 045 layer# 11 object# 00004
	➔	Massachusetts, <i>MGT</i> , polygon number 4

The MGT and SOCECON layers also store the *HUNUM* item internally. This item is similar to the biological *RARNUM* in that it is a value that multiple map objects can share. On occasion, a *HUNUM* value may even link to more than one record in the SOC_DAT table in a fashion similar to the grouping of species found with the *RARNUM*. The link to the SOC_DAT table may be made directly from the *HUNUM* attribute, or the link can be made through the SOC_LUT using the unique *ID*.

Both the MGT polygons and SOCECON points also store the attribute *TYPE* (2,2,C). *TYPE* is a one- or two-letter abbreviation of the more explicit *TYPE* item found in SOC_DAT. Following are a few examples that list the internal value for *TYPE*, followed in parentheses by the corresponding *TYPE* value in the SOC_DAT table: “A” (“Airport”), “CG” (“Coast Guard”), “HS” (“Historical Site”), and “WI” (“Water Intake”). Appendix B lists all acceptable values.

Finally, the SOCECON layer may also include some line objects representing things like state boundaries, pipelines, and streets. These objects do not link to the SOC_DAT data table, but they do use the two-character *TYPE* attribute. They are included primarily as cartographic features for the production of the paper maps. For GIS analysis, there are more appropriate sources, such as the U.S. Bureau of the Census TIGER files, for these types of data.

SOC_DAT Data Table:

The SOC_DAT table contains the supporting attribute information for the two socioeconomic map layers. The items include *HUNUM* (9,9,I), *TYPE* (20,20,C), *NAME* (40,40,C), *CONTACT* (80,80,C), *PHONE* (20,20,C), *G_SOURCE* (6,6,I) and *A_SOURCE* (6,6,I). As explained above, *HUNUM* links to the SOC_DAT table.

In *TYPE*, map objects are classified using standardized values based on function or usage. Sample values include “Airport,” “Historical Site, (?) and “Marina.” (Appendix B) . The *NAME* field will list a proper name if appropriate, or may be a more descriptive type entry. If it is available, a contact name will be given in the *CONTACT* field. This is used most often for features like aquacultures, water intakes, and managed areas. A contact number may also be given for these types of features in the *PHONE* field. *G_SOURCE* (geographic source) and *A_SOURCE* (attribute source) are links to the same SOURCES data table previously discussed in the biology section.

Summary of the Relational Data Tables

All current ESI atlases use the above data structure and all fields are populated if data are available. For compatibility reasons, we have updated some of the older atlases that used earlier versions of this structure. For these atlases, fields for which data were not collected may be left blank. In these cases, as well as for any other atlas-specific peculiarities, it is always best to reference the corresponding metadata.

The Desktop Database Structure

While the relational structure is robust and well-suited for data collection and updates, it is a complicated structure that can be cumbersome for simple data queries and analysis. For this reason, we have also developed a desktop standard that meets the needs of many users. The following section will focus on the desktop structure. Figure 7 may be helpful for visualizing the links between these files.

The desktop data structure simplifies the complex biological data tables to a flat file format. All of the information found in the relational BIORES, SPECIES, SEASONAL, STATUS, and BREED tables is compressed into the desktop BIOFILE table. There is a one-to-one correspondence between the records in the BIORES and BIOFILE tables. One record is present for each unique *RARNUM*, *ELEMENT*, *SPECIES_ID*, *CONC*, and *SOURCE* combination. The items in BIOFILE are *ELEMENT* (10,10,C), *SUBELEMENT* (10,10,C), *NAME* (35,35,C), *GEN_SPEC* (45,45,C), *S_F* (3,3,C), *T_E* (3,3,C), *NHP* (10,10,C), *DATE_PUB* (10,10,I), *CONC* (20,20,C), *JAN* (1,1,C), *FEB* (1,1,C), *MAR* (1,1,C), *APR* (1,1,C), *MAY* (1,1,C), *JUN* (1,1,C), *JUL* (1,1,C), *AUG* (1,1,C), *SEP* (1,1,C), *OCT* (1,1,C), *NOV* (1,1,C), *DEC* (1,1,C), *BREED1* (8,8,C), *BREED2* (8,8,C), *BREED3* (8,8,C), *BREED4* (8,8,C), *BREED5* (8,8,C), *RARNUM* (9,9,I), *G_SOURCE* (6,6,I), *S_SOURCE* (6,6,I), and *BREED* (4,4,I). Most of these items correspond directly to the definitions described in the relational data section. The *ELEMENT* and *CONC* values in the BIOFILE are the same as those found in the relational table BIORES. *SUBELEMENT*, *NAME*, *GEN_SPEC*, *NHP* and *DATE_PUB* are populated with the values found in the SPECIES table. Similarly, the *S_F* and *T_E* fields are filled with the values in the STATUS table, if a corresponding record is present. The abbreviated month columns *JAN-DEC* are filled with 'X' if present, or left blank when not present, as found in the relational *SEASONAL* table.

The *BREED1-BREED5* columns do vary slightly from the items of the same name found in the relational BREED table. In BIOFILE, these fields are populated with a textual monthly summary of the corresponding breeding activity. For example, for an element of 'BIRD,' *BREED2* would be populated with 'FEB-APR' if the *RARNUM* corresponded to a point or polygon where a species of bird was laying in February through April. This summary is useful to the human user but, unfortunately, does not make it easy to query a computer about monthly activities. For this reason, we provide an auxiliary BREED table for the desktop data user. This table is organized in a manner similar to the relational

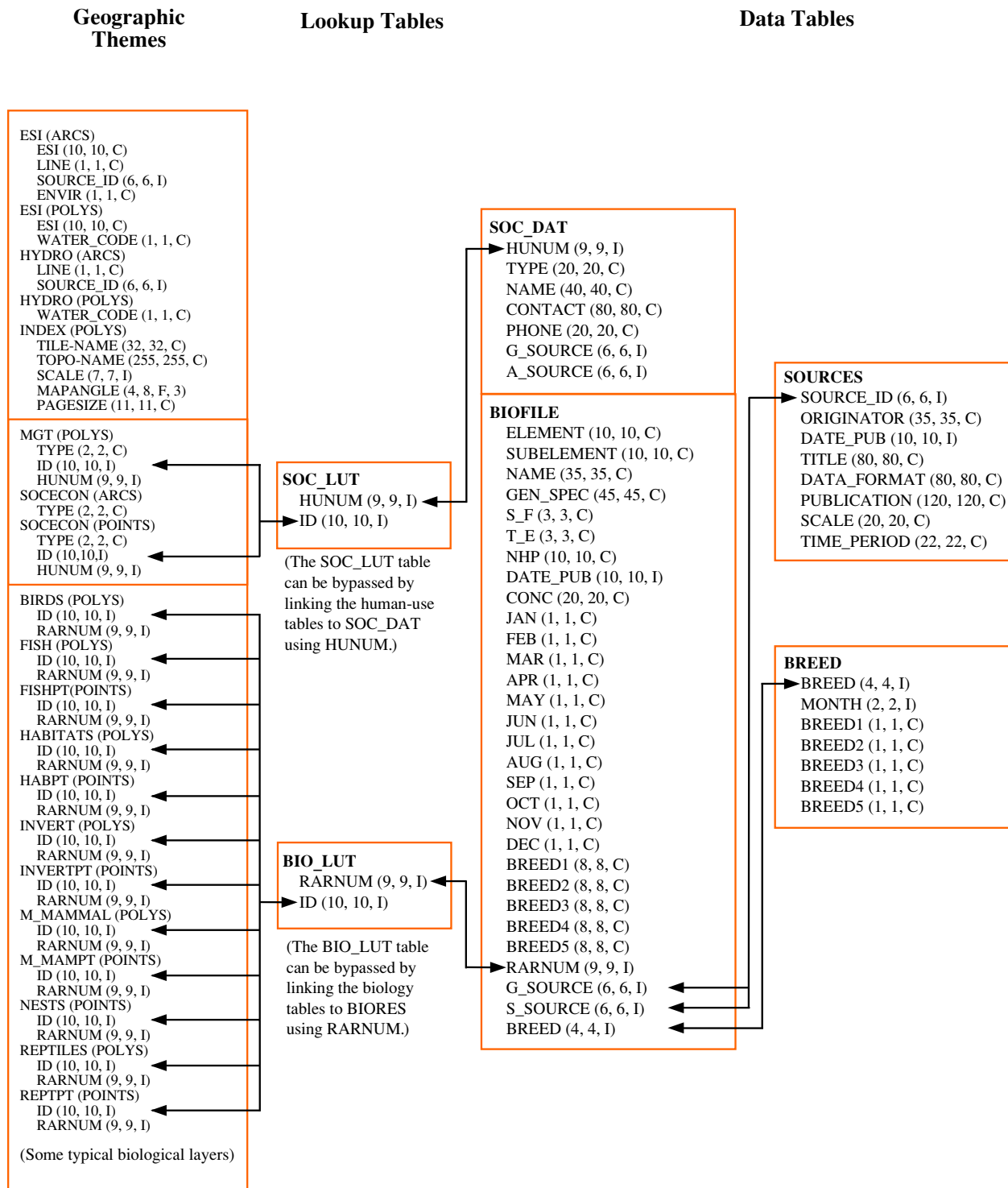


Figure 7. Relationships between spatial data layers and desktop data tables.

BREED table, with a few exceptions. All records in the BIOFILE link to twelve monthly breed summary records, whether or not the species is listed as present for each of the twelve months. This allows many more species to share the same breed records, condensing the size of the desktop BREED table. If a species is not present, all of the relevant breed activities are set to no –‘N.’ The BIOFILE is linked to the BREED table through the *BREED* item.

We also provide the SOURCE data as an auxiliary table for the desktop structure. The SOURCE table found here is an exact replicate of the relational SOURCE table. It is linked to the BIOFILE through the *SOURCE_ID* back to the *G_SOURCE* and *S_SOURCE* items.

The desktop BIOFILE is useful for those working in an environment where the principal goals are viewing and querying the data. However, if the goal is to update or change the ESI data in any way, these changes should be made first within the relational database, and the desktop files should be updated from that structure.

ESI Distribution Formats

The goal of the ESI digital product is to meet the needs of as many users as possible. To achieve this goal, data are distributed in a number of different formats. Following is a brief description of each format headed by the name of the directory where the data are found on the ESI CDs. All data are provided in Geographic coordinates and in the horizontal datum at which they were collected. The atlas-specific metadata will include datum information.

SOURCE:

Data are provided in double-precision, uncompressed, ARC export format. These data can be imported directly into ARC/INFO or there may be translators that will enable their import into other mapping programs. These files should be used with the relational database files by those responsible for maintenance and updates to the atlas. They may be used with the desktop files by users who simply need to view or query the data.

AVPROJ:

In this directory, data are provided as ArcView shape files together with an ArcView 3.x-project file. The project consists of a single view where each ESI data layer is represented as a theme. Each theme is depicted with the standard ESI colors, symbols, and hash patterns. Biology data layers link to the desktop BIOFILE in .dbf format. The SOURCES and desktop BREED tables are also included as .dbf files and there are menu items in the project that link and unlink these tables. The human use layers, MGT and SOCECON, link to the SOC_DAT table that likewise can be linked to the SOURCES table. At startup, the links to the SOURCES and BREED tables are disabled to optimize response to data queries.

MOSS:

Data are also provided in MOSS file format. This is a non-proprietary, ASCII file format that may be imported directly into MOSS GIS. Its simple text format is also well suited to those who choose to write translators to bring the ESI data into a mapping program that doesn't accept any of the other file formats provided. The attribute associated with the biology data layers is a special version of the *ID* item that embeds the *RARNUM*. It is a fifteen-digit number that can be broken down as follows:

001200360100005	→ rarnum 120 atlas# 036 element# 01 object# 00005
	→ Resource group 120, Georgia, <i>BIRDS</i> , polygon number 5
000070452200036	→ rarnum 7 atlas# 045 element# 22 object# 00036
	→ Resource group 7, Massachusetts, <i>FISHL</i> , line number 36

The human use files also use a modified ID value that embeds the *HUNUM* value. Special lookup tables in the MOSS directory should be used in place of the BIO_LUT and SOC_LUT tables found in the DBFILES directory. The *RARNUM* linked to these lookup tables can then be linked to either the standard desktop or relational tables.

ESI_VIEW

This is a free ESI viewer for either the Macintosh or PC platform. Installers create an ESI_VIEW directory that contains a runtime version of the ESI map files and the desktop database files. The viewer uses MARPLOT®, a mapping application produced by NOAA, and a stand-alone version of FileMaker Pro® to handle the data tables. All of the map layers are presented with standard ESI colors, hatch patterns, and symbolization. This is a useful program for those wanting to do simple data queries and analysis,

particularly if they do not have a GIS system in place. A tutorial is included to help users get started with the viewer.

PDF

The ESI data are also distributed in Portable Document Format (PDF). A guide demonstrating the easy navigation of the maps from the index and to the data tables on the back of the map is included. The PDFs may be used on-line or are excellent for printing out individual atlas pages.