Title
Enhancing protection for unusually sensitive ecological areas from pipeline releases

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ENHANCING PROTECTION FOR UNUSUALLY SENSITIVE ECOLOGICAL AREAS FROM PIPELINE RELEASES

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Abstract: The Research and Special Programs Administration (RSPA) of the Department of Transportation is required to identify areas unusually sensitive to environmental damage in the event of a hazardous liquid pipeline accident. Pipeline operators that can affect these "unusually sensitive areas" (USAs) must develop and follow an integrity management program to continually assess and evaluate the integrity of their pipelines. After extensive consultation and pilot testing with conservation biologists, government agencies, drinking water experts, and other stakeholders, a process has been developed to identify USAs for both ecological resources and drinking water. The process begins by designating and assessing environmentally sensitive areas (ESAs), then determining which ESAs are potentially more susceptible to permanent or long-term damage from a hazardous liquid release. Finally, criteria were identified to determine which resources can be affected by a release and sustain permanent or long-term damage. Ecological USAs are defined and mapped based on the presence of critically imperiled species, assemblages of multiple imperiled or endangered species, the presence of sensitive species that are aquatically dependent or have a limited terrestrial range, and concentrations of migratory waterbirds.Mapping these areas nationwide made use of ecological data from several sources, the majority coming from the Association for Biodiversity Information (ABI). Once created, maps of the USAs are posted on the RSPA Internet website in viewable format (http://www.npms.rspa.dot.gov/), and electronic versions of the GIS data layers are made available to pipeline operators for use with their GIS pipeline mapping systems. To identify and locate USAs, RSPA needed ecological data in a timely and standardized format. This included the location of imperiled, threatened, and endangered species. ABI aggregated data on the location and condition of species produced by its member organizations—the Natural Heritage Programs. This project represents the first time that detailed natural heritage data on specific locations of imperiled and endangered species have been aggregated nationwide for natural resource protection purposes. Previously, accomplishing this would have required a planning or regulatory agency to seek data from over fifty organizations across the country. ABI's aggregated dataset represents the most authoritative collection of locational information on imperiled species available. This paper focuses on the process developed to identify USAs, development and provision of ecological data, and the mapping of USAs across the country.

Introduction

The pipeline safety statute (49 U.S.C. § 60109) requires the U.S. DOT's Office of Pipeline Safety (OPS) to prescribe standards for identifying hazardous liquid (petroleum, petroleum products) pipelines in areas that OPS describes as unusually sensitive to environmental damage in the event of a hazardous liquid pipeline accident. These are termed unusually sensitive areas (USAs). When describing USAs, the statute asked OPS to consider areas where a pipeline rupture would likely cause permanent or long-term environmental damage.

Pipeline operators that can affect USAs must develop and follow an integrity management program to continually assess and evaluate the integrity of the pipeline through internal inspection or pressure testing and data integration and analysis. This includes a comprehensive evaluation of the entire range of threats to the integrity of the pipeline by analyzing all available information about the pipeline and the consequences of a failure. Pipeline operators must consider potential for damage due to excavation, data gathered through the required integrity assessment, results of other inspections and tests, and information about how a failure could affect an USAs. Pipeline operators must also consider USAs that are adjacent to navigable waters for oil spill response planning.

OPS held a series of public meetings, technical workshops and pilot tests to define USAs. Federal and state agencies, the hazardous liquid pipeline industry, drinking water experts, conservation biologists, and the public participated in these events and provided input. Using this information, OPS developed a model to identify USAs for both drinking water and ecological resources. It was decided that the creation of USAs would rely on readily available data and that OPS, with the help of other agencies, would define, identify, and locate USAs to avoid subjectivity and keep resource sensitivity uniform on a national basis.

The USA ecological model begins by identifying ecological resources that are more sensitive to a hazardous liquid release, termed “ecological areas of primary concern.” Filter criteria are then applied to the areas of primary concern to determine which resource areas could suffer permanent or long-term effects from a potential hazardous liquid release. Filter criteria are designed to consider the ability of the resource to be impacted by a release, the uniqueness of the resource, if the resource is irreparable or irreplaceable, if there are substitutes for the resource, and the criticality of the resource.

On December 21, 2000, OPS published a final rule defining USAs. The following focuses on defining the ecological areas of primary concern, the filtering criteria that defines USAs, how OPS is mapping these ecological USAs, and background information on the development of the ecological data developed by the Association for Biodiversity Information.

Defining Ecological Areas of Primary Concern

Ecological areas of primary concern focus on characteristics of rarity, imperilment, or the potential for loss of large segments of an abundant population during periods of migratory concentration. These include threatened and endangered (T&E) species, critically imperiled and imperiled species and ecological communities, depleted marine mammals, and migratory waterbird concentration areas.

- Areas Containing Federally Listed Threatened and Endangered (T&E) Species: These areas contain known occurrences of animal and plant species that have been listed and are protected under the Endangered Species Act of 1973, as amended (ESA73). There are currently more than 1,000 listed T&E species in the United States. The term species includes species, subspecies, and distinct vertebrate populations. In addition, a species that has been proposed or is a candidate to become a T&E species will become an ecological area of primary concern upon its final listing as a T&E species in the Federal Register.
- Areas Containing Critically Imperiled and Imperiled Species and Subtaxa: These areas contain known occurrences of animal and plant species or ecological communities that have such limited distribution that a hazardous liquid pipeline release could affect a significant percentage of the species. There are a number of species that are at risk of extinction due to their extremely restricted distribution or limited numbers. These resources are identified, ranked, and inventoried by Natural Heritage Programs (NHP) and Conservation Data Centers (CDC) in conjunction with The Nature Conservancy (TNC) and the Association for Biodiversity Information (ABI). These groups assign a Global (or range-wide) Conservation Status Rank (GRANKs) to each species. This rank is based on several specific factors, including the number of known occurrences or populations, number of individuals, health of the population, its extinction potential, whether it is experiencing an increasing or decreasing trend, and if there are known threats to the species. Ecological areas of primary concern include occurrences of species and subtaxa with the following Global Ranks. Additional information on Conservation Status Ranks is provided in the section on data development at the end of this paper.
    A. Critically imperiled: These species demonstrate extreme rarity (5 or fewer occurrences or fewer than 1,000 individuals) or extreme vulnerability to extinction due to some natural or man-made factor. About 4,300 species in the United States are ranked as critically imperiled globally. Rare or extremely vulnerable subtaxa that are critically imperiled are included in this category, despite the conservation status of the species as a whole.
    B. Imperiled: Imperiled species demonstrate rarity (6 to 20 occurrences or 1,000 to 3,000 individuals) or vulnerability to extinction due to some natural or man-made factor. About 3,700 species in the United States are ranked as imperiled. Rare or vulnerable subtaxa that are imperiled are included in this category, despite the conservation status of the species as a whole.
- Areas containing Depleted Marine Mammal Species: These areas contain known occurrences of depleted species identified and protected under the Marine Mammal Protection Act (MMPA) of 1972, as amended. The term "depleted" refers to marine mammal species that are listed as T&E or are below their optimum sustainable populations (16 U.S.C. 1362). The term "species" includes species, subspecies, or population stocks. Currently 18 species are listed as "depleted" under the MMPA.
- Areas Containing a Large Percentage of the World's Population of a Migratory Waterbird Species: These areas contain very high concentrations of the world's population of a species for a short time. As an example, there are portions of the Delaware Bay where a major portion of the world population of red knot (a shorebird species) stop-over to feed during migration. Two programs of international significance are

responsible for identifying and delimiting areas where significant populations of migratory waterbirds congregate during critical periods. First, the Western Hemisphere Shorebird Reserve Network (WHSRN) ranks migratory shorebird concentration areas into four categories: Hemispheric Reserves, International Reserves, Regional Reserves, and Endangered Species Reserves. Hemispheric reserves host at least 500,000 shorebirds annually or 30% of a species flyway population. International reserves host 100,000 shorebirds annually or 15% of a species flyway population. Regional reserves host 20,000 shorebirds annually or 5% of a species flyway population. Endangered species reserves include areas critical to the survival of endangered species and no minimum number of birds is required. Second, The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar) identifies globally critical wetland areas supporting migratory waterfowl. Ramsar sites are globally critical wetland areas that support migratory waterfowl. These include wetland areas that regularly support 20,000 waterfowl; wetland areas that regularly support substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity, or diversity; and wetland areas that regularly support 1% of the individuals in a population of one species or subspecies of waterfowl.

Filter Criteria that Define an Ecological USA

The following filter criteria are applied to the ecological resource areas of primary concern to identify unusually sensitive areas. The filters identify areas that contain species that are vulnerable to extinction, are critical to multiple sensitive species, or could impact a large percent of a species population:

- Areas containing critically imperiled species or ecological communities shall be USAs;
- Areas containing multi-species assemblages are USAs. Multi-species assemblage areas are areas where three or more different critically imperiled or imperiled species or ecological communities, threatened and endangered species, depleted marine mammals, or migratory waterbird concentrations co-occur;
- Migratory waterbird concentration areas, other than regional WHSRN sites, shall be USAs;
- Areas containing candidate species (critically imperiled and imperiled species, threatened and endangered species, and depleted marine mammals) or ecological community (critically imperiled and imperiled ecological communities) occurrences of excellent quality and good quality (identified using rounded Element Occurrence Ranks of "A" and "B") shall be USAs (see discussion of Element Occurrence Rank in the data development section at the end of this paper); and
- Areas containing candidate species and ecological communities that are aquatic or aquatic-dependent, or are terrestrial with a limited range shall be USAs.

The filter criteria are applied in a multi-tiered process where all ecological areas of primary concern receive repetitive consideration for USA status. For example, an ecological area of primary concern is first subjected to Filter Criterion 1, areas with critically imperiled species, and may be designated an USA at this point. If the ecological area of primary concern does not meet Filter Criteria 1, the process continues for the remaining filter criteria. If the ecological area of primary concern does not meet any filter criteria, it remains an ecological area of primary concern. All ecological areas of primary concern will be periodically reviewed to consider changes in resource information or status.

Identifying Ecological USAs

A multitude of data have to be collected and processed in order to identify and map ecological USAs. These data include point, polygon, and region species locations and attributes; polygon boundaries for management areas and other features identified as migratory waterbird concentrations; linear and polygonal hydrography; state boundaries; etc.

A Geographic Information System (GIS) is used to integrate the data and apply the USA filter criteria. OPS developed a GIS computer model to integrate the gathered information and automate USA identification. The GIS application of filter criteria is the most complex portion of the process. This section discusses the ecological data that were collected and how the data were processed.

Collecting Data

OPS has acquired various datasets in order to identify ecological USAs. These include a "Multi-Jurisdictional Dataset" (MJD) of plant and animal species from ABI and the Natural Heritage Network; biological resource data from the Environmental Sensitivity Index (ESI) datasets; habitat association and life-history information for each species and ecological community represented in the ESIs and for each species represented in the ABI

dataset; descriptions, maps, and spatial data for Ramsar and WHSRN sites; a hydrography data layer depicting surface water features; a digital layer depicting state boundaries; and descriptions, maps or data delineating the limit of state waters.

TNC and ABI are working with the natural heritage network to create the MJD. OPS entered into a cooperative agreement with TNC and ABI to obtain access to the MJD. ABI compiles and aggregates state heritage data on a national scale into the MJD. The MJD includes element occurrence records (locations and attributes for the species or community) and supporting element classification data for T&E, critically imperiled, and imperiled species. The spatial component of the MJD consists primarily of points. For some states, the spatial data included region or polygon data in addition to or in place of the point data. A variety of attribute fields are provided with the MJD, and are described in more detail in the data development section of this paper. These include (listed alphabetically): ELCODE (unique identifier for each element, e.g. species or community), EOCODE (unique identifier for each occurrence), EODATA (various information unique to occurrence), EORANK (quality rank for occurrences), EORANKROUND (rounded EORANK), EOTYPE (type of occurrence), GCOMNAME (global common name), GNAME (global scientific name), GRANK (global conservation status rank), PRECISION (spatial precision by occurrence), ROUNDEDGRANK (rounded GRANK), SRANK (state conservation status rank), USESA (federal T&E listing status, by species), and USESA_EO (federal T&E listing status, by occurrence). ABI performed quality control/quality assurance and data standardization, generated summary statistics and descriptive metadata, and projected the data prior to its delivery to OPS. For more information on natural heritage datasets and programs, see Stein et al. (Stein 2000), http://www.abi.org/, and http://www.abi.org/nhp/us_programs.htm.

ABI and TNC also provided a "master species database". This database included information on ELCODEs, common names, scientific names, GRANKs, federal T&E status, and habitat associations for all potential candidate species tracked by the various NHPs. Habitat fields included with this dataset were GHABCOM (habitat comments) and ALL_HAB_TYPES (a list of habitats used).

OPS obtained additional information on candidate species habitats and ranges using ABI's NatureServe on-line database (ABI 2000, http://www.natureserve.org/). OPS also used introductory text, references, and metadata associated with the ESI databases; U.S. Department of Agriculture's (USDA) PLANTS database (USDA NRCS 1999, http://plants.usda.gov/plants/); and various other sources specific to each state.

ABI frequently updates T&E species and occurrence information, and did so for the datasets used in the model prior to their delivery to OPS. In addition, OPS checked the status of T&E species using on-line databases maintained by the U.S. Fish and Wildlife Service (USFWS) (http://endangered.fws.gov/) and the NMFS Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html). The NMFS site was also used to obtain depleted marine mammal listings.

The National Oceanographic and Atmospheric Administration (NOAA), the Minerals Management Service (MMS), and various state agencies develop and publish ESI datasets. Biological resources data from the ESIs include polygon or region data as well as point data. Each dataset contains several GIS coverages, each treating a different biological resource type (birds, reptiles, marine mammals, etc.). The following relational database tables are required for data preprocessing and GIS model runs: BIORES, SPECIES, STATUS, BREED and various look-up tables (e.g., POLY_LUT, PNTS_LUT, etc.). Key attribute fields needed for USA identification include RARNUM (unique spatial identifier linked to various attribute tables), SPECIES_ID (unique species identifier), EL_SPE (concatenation of element type and SPECIES_ID), EL_SPE_SEA (concatenation of element type, SPECIES_ID, and SEAS_ID), NAME (common name), GEN_SPEC (scientific name), and T_E (federal T&E status). For more information on NOAA ESI datasets, see http://response.restoration.noaa.gov/esi/esiintro.html.

OPS obtained a list of current Ramsar sites and site descriptions from the Ramsar Convention (http://www.ramsar.org/). OPS contacted the USFWS Office of International Affairs for maps and data on these areas. They provided a list of Ramsar site coordinators or managers for the U.S., who were in turn contacted for digital data depicting Ramsar site boundaries. OPS obtained hardcopy maps when digital data were not available directly from a Ramsar site contact. Based on the site names and hardcopy maps, OPS was able to obtain digital site boundaries for most locations from the U.S. Geological Survey (USGS) 1:100,000-scale Digital Line Graph (DLG) Boundary files. The DLG data are digital representations of points, lines, and

areas. OPS digitized hardcopy boundaries when digital boundaries were not available in the DLGs, or when hardcopy maps or site descriptions indicated additional areas not shown in the DLGs.

OPS obtained a list of current WHSRN sites and site descriptions from the Manomet Center for Conservation Sciences (http://www.manomet.org/). The coordinator of the WHSRN program at Manomet was also contacted to obtain maps, data, additional descriptions, and local site managers or contacts. OPS obtained hardcopy maps for all sites and available digital boundaries from local contacts for a few sites. Based on the site names and hardcopy maps, OPS was able to obtain site boundaries for most locations from the USGS 1:100,000-scale DLG Boundary files. OPS digitized hardcopy boundaries when digital boundaries were not available in the DLGs, or when hardcopy maps or site descriptions indicated additional areas not shown in the DLGs.

OPS obtained the hydrography (or surface water features) data from the USGS 1:100,000 scale DLGs. The DLGs contain a full range of attribute codes, have full topological structuring, and have passed certain quality-control checks described in the Federal Geographic Data Committee's (FGDC) Content Standards for Digital Geospatial Metadata. These files were downloaded from USGS's web site: http://edcwww.cr.usgs.gov/glis/hyper/guide/100kdlgfig/states.html.

OPS obtained state and county boundaries from the U.S. Census Bureau TIGER data files (1990 State and Equivalent Areas). These files were downloaded from http://www.census.gov/geo/www/cob/st.html. For coastal states, the shoreline portion of the state boundary was updated using the DLG hydrographic data because it was much more detailed. State waters boundaries were incorporated for coastal and Great Lakes states as well, based on data available in the DLGs or other sources. In some cases, state waters were not available digitally and had to be digitized from NOAA nautical charts or USGS maps, or generated using buffers based on boundary descriptions (e.g., state waters extend 3 nautical miles from the shoreline).

Processing the Data to Create USAs

OPS used the GIS software ArcInfo to develop the USA GIS model used in this project. The ecological USA model has several phases:

A. Prepare data for model entry;
B. Identify records meeting data quality criteria;
C. Identify records meeting candidate criteria;
D. Apply filter criteria;
E. Generate USA boundaries;
F. Final USA QA/QC, maps, and statistics; and
G. Final data preparation.

Phase 1 - Prepare Data for Model Entry

During data preparation, OPS reviews the original data that have been obtained from all sources to make sure the required data fields are present and there are no peculiarities in the data. Most of the USA ecological data comes from the ABI and the ESI datasets. If any peculiarities are identified, OPS contacts the entity that provided the data and any questions or difficulties are addressed.

For the ecological model, data from adjacent states can be accepted into the model as well. When data from adjacent states are available, OPS generates a 5-mile buffer around the state that is being processed. The ecological data contained within this 5-mile buffer is incorporated into the model and processed.

ESA Status. The USESA_EO field from the ABI dataset is initially used to populate a new field referred to as UPDATED_TE for each element occurrence. Depending on the date of the ESI datasets and the geographic area covered, T&E information from the ESI status table may also be used to populate UPDATED_TE for ESI species records. UPDATED_TE is checked, particularly for the ESI species records, as described below. A new field called DEPLETED_MM is also created for the MJD and ESI datasets. This field is updated with depleted marine mammal status, as described below.

Habitat Determination. The attributes of the ABI dataset are used to generate two spreadsheets. The first spreadsheet is a short form containing all species found in the state dataset and all element level attributes.

The second spreadsheet is a long form containing all occurrences and occurrence level attributes. Scientific staff use these forms to develop habitat, aquatic-dependency, and limited range assignments. T&E and depleted marine mammal status are also evaluated at this time. A "notes" section is completed that indicates any questions or difficulties encountered during the assignment of habitat and range, review of T&E information, etc. Source information is noted as appropriate.

The attributes of the ESI dataset(s), particularly common name, scientific name, federal status, GRANK (if available), and a unique identifier are used with the ABI dataset to generate a query that matches species from the ESI data to species tracked by the NHPs. The goal of this process is to assign ELCODEs, GRANKS, and derived EOCODEs to the ESI species ("mock" ELCODE and EOCODEs consisting of the site name are used for Ramsar and WHSRN sites, and no GRANKS are applied). The results of this query are transformed into a spreadsheet that is reviewed by scientific staff. Automated matches are evaluated and either accepted or rejected. If rejected, a more appropriate match is selected and entered into the spreadsheet manually. Potential candidates not identified during the automated match are also evaluated and manual matches assigned as appropriate. T&E information for the ESI data are also updated at this time, and habitat and range assignments determined. In certain cases, preliminary ELCODE and/or T&E assignments are made and the spatial data reviewed in ArcView to determine final assignments based on geography (for species that can be assigned to several ELCODES at the infra-specific level, and for species with partial T&E status based on distinct population segments, e.g. anadromous salmonids in western coastal states). A "notes" section is completed during this process that indicates any questions or difficulties encountered. Source information is also noted as appropriate.

For point data, habitat assignments are made by scientific staff based on habitat information provided by ABI with the MJD and supplemental habitat sources mentioned above. When available information is not sufficient to make a habitat assignment, ABI is contacted to provide assistance or additional information. ABI may in turn contact the state NHP for assistance. In most cases, habitat assignments are the same for all occurrences of a species. For a few types of species, habitat types can vary by the type of occurrence. Where information is available, assignments are made at the occurrence level. This situation applies for species such as seabirds (nesting vs. feeding areas), aquatic or marine reptiles (nesting vs. adult areas), and certain amphibians (breeding/larval vs. adult areas).

Habitat assignments are used to define buffers to be drawn in creating USAs, and are limited to the following categories: Aquatic Open Water (AOW), Aquatic Isolated Water (AIW), and Terrestrial (TER). AOW habitats include open and flowing water bodies such as oceans, estuaries, lakes, ponds, pools, streams, and certain wetland types that are typically permanently flooded. AIW habitats include most wetlands, temporary or seasonal ponds and pools, seeps, beaches, bars, flats, floodplain habitats, riparian habitats and subterranean waters. These habitats are generally intermittently wet or flooded, and are often located adjacent to AOW habitats that have relatively permanent standing water or flowing water. Habitats that are described only as "moist" or "mesic" or not included in the aquatic categories, and are treated as terrestrial. All other non-aquatic habitats are treated as terrestrial as well. It is important to differentiate between AOW and AIW/TER habitats, since this determines the spatial area depicted for each USA occurrence. AOW and AIW/TER occurrences are treated differently during the generation of USA polygons, while AIW and TER occurrences are treated the same. Habitat assignments are typically consistent across states. Habitat assignments may vary where different occurrence types exist or are mapped in a state (breeding/larval vs. adult areas), where habitats associated with the occurrence differ between states (nesting on cliffs vs. wetland vegetation), or where more state-specific information is available for one state versus another (in California, species generally occurs in habitat X but in Wyoming, species is restricted to habitat Y). All habitat assignments are checked by a second biologist prior to the model runs.

Aquatic and aquatic dependent (AD) and terrestrial limited range (LR) assignments needed for Filter Criteria 5 are usually assigned at the species level. Species with occurrences classified as AOW or AIW are always assigned to the AD category. Species with occurrences classified as TER are assigned to the AD category if they are dependent on aquatic habitats during some critical portion of their life-history. As an example, occurrences for a seabird species that uses cliff or upland forest nesting sites would be classified as TER, but the species would be classified AD if its feeding areas were marine waters. Species that are not assigned to the AD category are evaluated to determine if they have a limited range. Species with a limited range have home ranges or inferred extents of no more than five (5) acres. When available information is not sufficient to

make an AD or LR determination, ABI is contacted to provide assistance or additional information. ABI may in turn contact the state NHP for assistance as needed. Aquatic-dependency and limited range assignments are checked by a second biologist prior to the model runs.

Precision. When the ABI dataset contains ACCURACY_CLASS or a similar spatial data quality descriptor, in place of or in addition to PRECISION, a new precision field is created and updated to incorporate this information. This occurs in a few states and primarily where element occurrences are represented wholly or in part as regions or polygons. The GIS model will accept the following values in the updated precision field: G (general, precision within five miles or to quad or place name), M (minutes, accuracy within a one-minute radius), S (seconds, accuracy within a three-second radius), U (unmappable), 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. The numeric values correspond to accuracy class used in a few states: 1 and 2 represent specific-bounded areas, 3 represents non-specific bounded areas, 4-9 and 0 (10) represent accuracy values based on radii associated with point locations or regions/polygons generated by buffering points.

Creating Polygons. The DLG hydrography layers (polygons and arcs) are pre-processed prior to the model runs. For the ecological model, the majority of hydrographic features are classified as "open-water", while a few feature types are classified as "other" hydrographic features. These hydrographic "open-water" features are used in the model during the generation of USA polygons from point occurrences identified as ecological USAs.

Occurrences from the ABI or ESI datasets that are represented as arcs (lines) are buffered by a quarter mile to generate polygons or regions. These are added to the existing polygon or region coverages. Unless otherwise specified in the original datasets or metadata, these occurrences are treated as specific-bounded areas.

Phase 2 - Identify Records Meeting Data Quality Criteria

All data records are examined to determine if they meet data quality criteria. A data record is not used if it does not meet the criteria. The first data quality criterion is spatial, pertaining to precision or accuracy and regions or polygons vs. points. If the occurrence is a "specific-bounded area" or has a precision value of S or M, the polygon or region is retained and any point data that corresponds to the same occurrence is omitted. If the occurrence is not classed in this manner, the polygon or region is omitted from the model. If there is point data corresponding to the same occurrence, it is retained for evaluation. Point data with updated precision values of M, S, or 1-9 are retained in the model, while point occurrences with values of G, U, and 0 are excluded. The ESI data represent "specific-bounded areas" and points with minutes are better precision unless otherwise noted in the metadata.

The second data quality criterion removes elements or occurrences that are extirpated. For the ABI dataset, the state conservation status (SRANK) and the EORANK are evaluated. All occurrences with an SRANK value of SX (state extirpated) or a rounded EORANK value of X are omitted from the model. For the ESI data, all records are considered extent unless otherwise stated in the metadata.

Phase 3 - Identify Records Meeting Candidate Criteria

Next, the model determines which occurrences or data records meet the ecological candidate USA criteria. The model evaluates each occurrence and record to identify candidate USA resources. The model reviews the values found in the ROUNDEDGRANK, UPDATED_TE, and DEPLETED_MM fields. Occurrences with any of the following are considered candidates: ROUNDEDGRANK = G1, G2, T1, or T2; UPDATED_TE = LE, LT, XE, or XN (listed endangered, listed threatened, essential experimental population, or experimental nonessential population, respectively); or DEPLETED_MM = Y. The model treats all Ramsar and WHSRN sites as candidates. The model retains candidate resources for consideration as USAs. Resources not identified as candidates are omitted.

Phase 4 - Apply Filter Criteria

Under Filter Criteria 1, all critically imperiled candidates are USAs. These are identified by a GRANK value of G1 or T1.

The model moves to Filter Criteria 3 next, migratory waterbird concentration areas, where all Ramsar sites are identified as USAs. WHSRN sites are then evaluated and sites classified as hemispheric, international, and

endangered species reserves are identified as USAs. Regional WHSRN sites are not considered USAs, but are retained for evaluation under Filter Criteria 2.

Filter Criteria 4 evaluates the viability of the species. Within the ABI dataset, all occurrences with rounded EORANK values of A or B are identified as USAs. The ESI data are not evaluated unless EORANK values are provided in the ESI datasets and described and defined in the metadata.

Filter Criteria 5 evaluates if the occurrence is aquatic, aquatic dependent, or terrestrial with a limited range. All occurrences with Y values in either the AQUATIC_DEPENDENT or RANGE fields are identified as USA resources.

Filter Criteria 2 is the final filter criteria evaluated by the model. Under Filter Criteria 2, the model generates 1-mile buffers around all candidate data points. Data represented as polygons or regions are evaluated using their existing boundaries. Next, the GIS model evaluates whether the candidate area is overlapped by at least two resources of a different type (different species, ecological communities, or migratory waterbird sites). The ELCODE is used to identify different resource types. Each occurrence or record that contributes to a combination of three or more overlapping resource types is identified as a USA resource in its entirety. Note that data from adjacent states that are included in the model run can interact with data from the state being processed to create Filter Criteria 2 USAs.

Phase 5 - Generate USA Boundaries

Occurrences or data records identified as USAs and represented as polygons or regions in the original data (or arcs converted to polygons or regions) retain their original or generated boundaries. Point occurrences or data records identified as USAs receive derived boundaries based on habitat assignment, a pre-determined buffer distance, and in the case of AOW species, overlap with hydrography features. USAs for point occurrences assigned to either the AIW or TERR categories are defined by a model-generated 1-mile buffer around the point. USAs for point occurrences assigned to the AOW category are generated by the model selection of all polygonal and linear "open-water" hydrographic features falling within a 5-mile buffer around the point. In addition to the selected features, the model generates 1/4-mile buffers along all "land/open-water" interface boundaries within the 5-mile buffer. The AOW USAs are thus defined as all hydrographic features classed as "open water" plus a 1/4-mile buffer falling within a 5-mile radius of the original point.

Phase 6 - Final USA QA/QC, Maps, and Statistics

After the model run, a draft version of the final USAs and interim coverages generated by the model are reviewed by scientific and GIS staff. An ArcView project generated by scientific staff is used to check the model output by evaluating all steps in the process described above. GIS staff members perform several routine checks on the data as well using ArcInfo and ArcView. Once the final USAs are approved, a map is produced for each state using a standardized layout and statistics are generated. Currently, statistics include calculating the percentage of state occupied by ecological USAs.

Phase 7 - Final Data Preparation

During the model run several new items are generated and associated with the USA resources and polygons: FILTER, SOURCE, and ECOUNIQUE_ID. Filter is populated with information indicating which filter criteria created the USA. Source refers to the original source of each data record that became a USA. Source is generated by the model using information contained in the EOCODE field. An example of a source value would be "LANHP", referring to the Louisiana Natural Heritage Program. ECOUNIQUE_ID is a unique identifier for each ecological USA, generated using EOCODE, but containing no specific information about the USA (taxonomy, status, source, etc. cannot be determined using this identifier alone). Final ecological USAs are converted regions and dissolved on ECOUNIQUE_ID. The only attributes on the final USAs are ECOUNIQUE_ID and SOURCE. The actual identities of the USAs can only be determined using a reference table that is generated to link ECOUNIQUE_ID to EOCODE. This table is provided only to OPS, ABI and the state NHPs.

Creation of USA Maps

The final USA maps are placed on OPS's National Pipeline Mapping System (http://www.npms.rspa.dot.gov) to allow pipeline operators and others to view USAs in relation to pipelines and other resources. OPS has begun to create USA maps for all 50 states. The National Pipeline Mapping System allows individuals to "zoom" and "pan" to the area(s) of interest and turn USA and other data layers "on" and "off" depending on their needs.

Additional data layers are also available, such as pipeline locations, populated areas, and high-hazard natural disaster areas. Individuals have the ability to print maps or download data representing high population areas, navigable waterways, pipelines, drinking water USA's, and other data layers to their local machines for use in their own GIS maps. Ecological USA data are proprietary and can not be downloaded. As of September 2001, OPS has completed identifying and mapping ecological USAs in over half of the states and expects to finish all 50 states by February 2001.

Development and Provision of Ecological Data

As described above, ABI generated the majority of ecological data used to create USAs. This section describes ABI, the Natural heritage Network and Natural Heritage Data Methodology.

Roles of the Association for Biodiversity Information and the Natural Heritage Network

ABI is a non-profit organization working in partnership with the network of Natural Heritage Programs (NHPs) to gather, organize, and distribute high-quality biodiversity information. ABI builds upon work begun by The Nature Conservancy, America's largest environmental nonprofit organization, which began forming state NHPs over 25 years ago. The Nature Conservancy worked with state and federal agencies to establish NHPs in each state and make biodiversity information available. Each state program is independent and typically operated by a state agency with responsibilities for wildlife, natural area, or natural resource management.

As the NHPs matured, the need for network-wide collaboration and cooperation grew and led to ABI's establishment. ABI is now an independent, non-profit organization devoted to supporting and representing the needs and interests of NHPs and CDCs throughout the hemisphere. The organization has an active role in planning future heritage inventory efforts, creating the institutional framework for broader network-wide coordination, and helps to support the on-going efforts to catalogue our nation's biological riches.

Role of Natural Heritage Programs

In its most basic terms, NHPs are involved in three distinct activities:

- gathering information, through documenting existing knowledge and carrying out new inventory and research work;
- organizing, analyzing, managing, and updating this information by using structured methods and standard database and mapping procedures; and
- distributing information and knowledge, through sharing data and providing products and services to users.

But how are determinations made as to what data should be gathered, and how it should be organized?

Data Collected by the Natural Heritage Programs. A NHP's primary function is to fill the information void for those species that are of greatest significance from a conservation perspective. As discussed previously, rare species are in need of specific inventory and targeting for two reasons. First, by their very nature they are not uniformly distributed across the landscape and tend to be very localized. Second, their rarity confers an inherently greater risk of extinction and consequently they become of particular interest to those devoted to "saving all the pieces."

NHPs gather data designed to address a series of basic questions important to carrying out biodiversity conservation efforts. What species and ecological communities exist in the area of interest? Which are at greatest risk of extinction, or are otherwise significant from a conservation perspective? What are their biological and ecological characteristics, and where precisely are these priority elements found? What is their condition at those locations, and what processes or activities are sustaining or threatening them? Where are the most important sites to protect? Who owns or manages those places deemed important to protect and what is threatening these places? What actions are needed for the protection of those places and the significant elements of biodiversity they contain? And how can we measure our progress towards conservation goals?

The biological information important for species-level work are basic taxonomy, general species distributions, the locations of priority taxa, their relative rarity or abundance, population trends, ecological relationships, and

habitat requirements. Information useful for ecosystem- and natural community-level work includes vegetation structure and composition, key environmental factors, successional status, disturbance regimes, and the spatial distribution and integrity of communities across the landscape.

Key to the functioning of NHPs is the concept of setting priorities for information gathering and inventory. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Therefore, there is a premium on devising systems that are both effective in providing information meeting users' needs, and efficient in the manner by which that information is gathered. Most NHPs use a Conservation Ranking System to achieve these twin objectives of effectiveness and efficiency. In an effort to balance global and local conservation concerns, global, national, and subnational (provincial or state) ranks are used to select the elements which should receive priority for research and conservation by a NHP.

Ranking species and ecological communities according to their conservation status provides a means to apply a "coarse filter/fine filter" approach to conservation. Using these rankings, a state NHP can keep track of the entire suite of species within its jurisdiction—the rare and the common—but target intensive information gathering and inventory efforts towards those highly ranked species that require concerted conservation attention. NHPs have developed tools for applying an ecological filter to define and identify particular ecological communities occurring within their states and assess the extent and status of each.

Before any new field inventories are carried out in search of a particular target species or ecological community, all available knowledge about that element is gathered, organized, and mapped. This process relies on many different secondary sources of information, including museum collections, primary scientific literature, "gray literature," and interviews with knowledgeable biologists. In many instances, simply compiling what already is known about a species is enough to demonstrate that it is more common than previously thought, and not in immediate need of either additional inventory work or specific protection measures. When this is not the case, the process of exhaustively compiling existing data helps define where and when heritage biologists and their collaborators should carry out field work to seek out new populations, or to revisit existing populations and assess their current condition.

Data Organization by the Natural Heritage Program. A distinguishing feature of the heritage effort is the close attention to the details of organizing and managing the voluminous data being gathered. The NHPs have constituted an on-going and dynamic inventory process from the beginning. The NHP network developed software tools to codify the standards and protocols by which the network operates and have promoted the consistent application of these methods. The use of consistent information management tools has greatly facilitated the ability to compare and aggregate data across states, as has been done in the production of USAs.

Role of the Association for Biodiversity Information

The NHPs are designed to function in a decentralized fashion, with local programs responsible for their own data holdings. Information about basic species taxonomy, life history characteristics, and rangewide distribution are needed across the network but it would be inefficient for each program to develop and manage such information independently. Further, global or rangewide assessments of species status frequently transcend the bounds of single states, so it is necessary to manage this information centrally. ABI's Natural Heritage Central Databases provide this hub function for the heritage network, maintaining global and national-level information that pertains broadly to species and ecological communities. Through a data exchange process, state programs periodically provide summaries of state-level information to the central databases (for instance state conservation status) and receive the most current global level information for species and communities in their jurisdiction.

Description of Natural Heritage Data Methodology

The goal of documenting and mapping rare or otherwise at-risk species has a practical implication. To be useful for on-the-ground conservation and environmental planning such species must be mapped at a very precise level of detail. If the alignment of a road is at stake, a builders' permit is in jeopardy, or the requirements of the pipeline safety standard will be triggered, one must be able to identify with exactitude where the sensitive resources occur. For these types of real world applications merely knowing the general

vicinity is not enough. For the rarest of the rare, mapping at a fine scale of resolution is essential. It becomes possible to attempt not just a statistical sample of the species, but an actual census—that is a complete enumeration of the species' populations.

The Natural Heritage Programs function to inventory each state or subnation (e.g. Navajo Nation) for biological features in need of conservation attention (Jenkins 1985, 1988, 1996). Because these features may include more than just the locations of individual species, the inclusive phrase 'elements of natural diversity' was put into use with the creation of the first NHP in 1974. The concept and term 'element' still remains in use today. A strength of the ABI dataset is the consistent use of Natural Heritage Data methodology used by its member NHPs.

An element is defined as a unit of natural biological diversity, representing species (or infraspecies taxa), ecological communities, or other non-taxonomic biological entities, such as migratory species aggregation areas. For the purposes of the ecological USA map, these elements of diversity refer to the locations of species and infrataxa only. No ecological communities were included in the datasets provided.

Assigning Conservation Status Ranks

An element is assigned one global rank (called a GRANK), which applies across its entire range; a national rank (NRANK) for each nation in its range; and a subnational rank (SRANK) for each state, province, or other subnational jurisdiction in its range. In general, ABI scientists assign global ranks and U.S. and Canadian national ranks. These scientists receive guidance from subnational data centers, especially for endemic elements, and from experts on particular taxonomic groups. Local data centers assign subnational ranks for elements in their respective jurisdictions and contribute information for national and global ranks. New information provided by field surveys, monitoring activities, consultation, and literature review improves accuracy and keeps ranks current. ABI's centrally aggregated data are stored in the Natural Heritage Central Databases. These databases are updated continually with revisions, corrections, and information on ranked elements. Species' conservation status ranks are updated annually in the data exchange process between local data centers and ABI's central office.

What the Ranks Mean. The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty. The global ranks are defined in Table 1 below.

Table 1.
Definition of Global Ranks

Rank	***Definition***
GX	Presumed Extinct (species)—Believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
GH	Possibly Extinct (species)—Known from only historical occurrences, but may nevertheless still be extant; further searching needed.
G1	Critically Imperiled—Critically imperiled globally because of extreme rarity or because of some factor(s)making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10).
G2	Imperiled—Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or linear miles (10 to 50).
G3	Vulnerable—Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.
G4	Apparently Secure—Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5	Secure—Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
Variant Global Ranks	
G#G#	Range Rank—A numeric range rank (e.g., G2G3) is used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
GU	Unrankable—-Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.
G?	Unranked—Global rank not yet assessed.
HYB	Hybrid—(species elements only) Element not ranked because it represents an interspecific hybrid and not a species. (Note, however, that hybrid-derived species are ranked as species, not as hybrids.)
Rank Qualifiers	
?	Inexact Numeric Rank—Denotes inexact numeric rank
Q	Questionable taxonomy that may reduce conservation priority. Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.
C	Captive or Cultivated Only—Taxon at present is extant only in captivity or cultivation, or as a reintroduced population not yet established.

Ranking Factors. Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups–thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows ABI scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process - it takes into account several factors, which function as guidelines rather than arithmetic rules. The ranker's overall knowledge of the element allows him or her to weigh each factor in

relation to the others and to consider all pertinent information for a particular element. The factors considered in ranking species and communities are similar, but the relative weight given to the factors differs.

For species elements, the following factors are considered in assigning a rank:

- total number and condition of element occurrences
- population size
- range extent and area of occupancy
- short- and long-term trends in the foregoing factors
- threats
- environmental specificity
- fragility

Element Occurrence Data and Ranking

Given the focus of NHPs on documenting patterns of biodiversity, mapping the distribution of species, ecological communities, and land units is central to their work. A variety of mapping tools and techniques are employed to record spatial features with accuracy and precision. Undoubtedly the most important geographic feature that NHPs map is the element occurrence (EO). An element occurrence depicts the geographic location for a species population or ecological community. Formally defined as "an area of land and/or water in which a species or natural community is, or was, present," an element occurrence ideally reflects species population units; either a distinct population, part of a population (subpopulation), or a group of populations (metapopulation). These occurrences constitute the principal source of detailed information about the distribution of rare or imperiled species and ecological communities, and are the most widely used type of information gathered and managed by NHPs.

Applying this concept across a wide array of organisms and ecological types raises issues of consistency. What might constitute an appropriate area measure for a highly mobile bird species, may be quite different from that needed for a firmly rooted tree species. For this reason, element-specific definitions are essential for determining what constitutes a valid "occurrence" and is therefore appropriate to map. These definitions are embodied in element occurrence specifications, which are developed on a species-by-species and community-by-community basis, and which become part of the permanent heritage computer registry for any given species or community.

Specifications for a particular organism might include the minimum required size of population or habitat area needed to sustain or contribute to that species' survival. To help differentiate and delineate distinct occurrences, total barriers to dispersal as well as distances sufficient to impede between population movements are factored into these specifications. To a bog turtle (*Clemmys muhlenbergii*), for example, a four-lane divided highway may represent a complete barrier to movement, while dams exceeding 20 feet in height may similarly restrict the movement of salmon. Appropriate separation distances may depend on a variety of factors, such as the species' dispersal ability, home range size, and spatial and temporal patterns, but as a general guideline, one kilometer is the minimum recommended separation distance for defining two distinct occurrences.

Once the location of the element is determined and delineated based on the biology of the species, the quality or viability of each occurrence is assessed in the form of an element occurrence rank (EORANK). In general, EO ranks are designed to represent the relative conservation value of an occurrence and are assigned on the basis of the population's size, condition and landscape context. The EORANK is a code which represents a comparative evaluation of the EO summarizing quality, condition, viability, and defensibility range-wide. If the rank is not known, the field is left blank.
It is important to note that EORANK is considered a "supplemental" field and is not developed by all NHPs as a high-priority field. Consequently, EORANKs are not provided by all state NHPs. In those programs that use EORANKs, the use of EORANK is not yet standardized and well-coordinated between NHPs nor have all Eos been assigned an EORANK within some states. Due to the "uneven" quality of the EORANK data, it should be used in a supplemental manner, and not compare Eos across state borders.

Element Occurrence Rank Values. The EORANK, used in Filter Criteria 4, represents a comparative evaluation based on recent field work by a knowledgeable individual and summarizes several factors including:

- Quality – how representative the occurrence is, especially as compared to element occurrence specifications and including maturity, size, numbers, etc.;
- Condition - how much has the site and the element occurrence itself been damaged or altered from its optimal condition and character;
- Viability - the long-term prospects for continued existence of the occurrence; and
- Defensibility - the extent to which the occurrence can be protected from extrinsic human factors that might otherwise degrade or destroy it.

The best occurrence of an Element in a particular state is not necessarily assigned an "A" rank; it may be assigned a "B", "C" or "D" rank, if somewhere else in the Element's global range, there are occurrences that merit a higher rank. EORANKS are defined in Table 2.

Table 2
Element Occurrence Ranks

EORANK	Value
A	Excellent
B	Good
C	Marginal
D	Poor
X	Extirpated
H	Historical
O	Obscure
E	Extant (present)
_I	Introduced (used only as a qualifier of the ranks above)

A slash may be added to a 2- or 3-letter code combination making a 3- or 4-character code (e.g. "A/B" or "A/BI") without changing the significance of the slash-less code.

Rounded Element Occurrence Rank. The rounded element occurrence ranks represent the "basic ranks" described in the EORANK field definition above and are intended to simplify complex element occurrence rank values for use in analyses. Rounded ranks serve as an approximate substitute only; they are not intended as a replacement for the detailed information contained in the actual EORANK fields. The rounded element occurrence ranks are generated by a calculated field, EORANK.ROUND.

Description of ABI Dataset

The following description summarizes the information found in each of the state datasets from ABI delivered to DOT. The completeness of ABI's data varies between species. ABI's data is particularly strong and very complete in tracking the terrestrial and freshwater vertebrate species, vascular plants and entities with federal status under the Endangered Species Act (ESA). Many invertebrate groups are completely tracked, but the databases on these elements continue to expand. The non-vascular plant data (lichens, mosses, liverworts & hornworts, fungi) is being actively developed and element occurrences of these groups will expand over the next few years. Marine species, even in coastal areas are not completely tracked and documented with element occurrences, however this varies across NHPs.

Data Quality

All the data fields which are considered necessary to create the ecological USA maps were quality controlled either by the individual NHP or ABI staff to meet minimum standards for spatial representation, taxonomy and status as defined below:

- Conservation Status Ranks: ABI has conducted quality control checks to assure that the global conservation status ranks of the individual state datasets are consistent with the most current ranks in the Natural Heritage Central Databases.

- Federal Status Designations: ABI has conducted quality control checks to assure that the federal listed status for each species and element occurrence correlates with the most recent U.S. Fish and Wildlife Service listing of Threatened and Endangered species. Where species have a partial or mixed federal status designation, the correct federal status has been assigned at the element occurrence level and only those occurrence records that are federally listed have been provided.
- Spatial Data: All element occurrence records are mapped as accurately as recorded by NHPs with at least a General precision. Any element occurrences known to be incorrectly identified or mapped have been excluded.

Data Field Definitions

Included below in Table 3 are definitions for fields provided in the master list of species and in the state-by-state- EO datasets from ABI.

Table 3
Data Fields Provided by ABI

Field	Definition
Master List of Rare or Federally Listed Species	
ELCODE	A unique identifier for the taxa assigned by the ABI central database staff. It can be used to create relationships between all data provided.
GNAME	The standard global (i.e. range-wide) scientific name (binomial nomenclature) adopted for use in the Natural Heritage Central Databases based on standard taxonomic references.
GCOMNAME	The standard global (i.e. range-wide) common name adopted for use in the ABI Central Databases.
GRANK	The conservation status of a species from a global (i.e. range-wide) perspective, characterizing the relative rarity or imperilment of the species.
GRANKDATE	The date the Global Conservation Status Rank of an element was last reviewed and updated by ABI scientists.
ROUNDED.GRANK	A rounding algorithm has been applied to the conservation status rank to systematically produce conservation status values which are easier to interpret and summarize.
USESA	Official federal status assigned under the U.S. Endangered Species Act of 1973.
USESADATE	The date of publication in the Federal Register of notification of an official status for a taxon or population. Dates appear only for taxa and populations which are specifically named under the U.S. Endangered Species Act.
STATE.SNAME	The standard state scientific name adopted for use by the state / subnation NHP based on selected taxonomic references used by the state. These are usually previously published state floras or faunas.
STATE.SCOMNAME	The state common name of species adopted for use by the state / subnation NHP.
TAX.NONSTD	For plant records only, identifies taxa which are not based on the standard taxonomic references used by the ABI central database staff.
GHABCOM	A text summary of the habitats and microhabitats commonly used range-wide describing any daily, seasonal, and geographic variation in habitat use.
ALL.HAB.TYPES	For animal records only, a text field that combines the values from several fields which characterize habitat at a global or range-wide level. These values are selected from a set of standardized “drop down” lists.
Additional Fields Specific to Each State Element Occurrence Sets	
EOCODE	A unique record identifier for each element occurrence. This code consists of: ELCODE*EONUM*STATE where EONUM is a counter used to identify unique occurrences and STATE is the state in which the occurrence is located.
LATITUDE	The Y coordinate of the element occurrence centrum, expressed in decimal degrees.
LONGITUDE	The X coordinate of the element occurrence centrum, expressed in decimal degrees.

Field	Definition
USESA-EO	Federal Status as assigned under the Endangered Species Act at the EO level to accommodate species with varying status across their range.
PRECISION	A code for EO mapping precision. Primary values: S = seconds: accuracy within a three second radius, M = minutes: accuracy within a one-minute radius, G = general: precision within 8 kilometers, 5 miles, or to quad or place name, and U = unmappable. Any additional values will be included in documentation for each state.
LASTOBS	The date the element occurrence was last observed to be extant at the site.
State Datasets Also Include the Following Data Fields as Available	
SRANK	The conservation status of a species from the state/subnation perspective, characterizing the relative rarity or imperilment of the species.
SPROT	Abbreviation used by state/subnation for the level of legal protection afforded to the element by that entity. Abbreviations will vary by state or subnation.
EOTYPE*	A descriptive term used to categorize the type of location where a species is found. Used primarily for animals (especially migratory species), common EO types include: breeding site, wintering site, roosting area, staging area, bachelor colony, hibernaculum, nursery colony, communal use site.
EODATA*	Data collected on the biology of the EO, which may include the number of individuals, vigor, habitat, soils, associated species, particular characteristics, etc.
EORANK*	A code which represents a comparative evaluation of the element occurrence summarizing quality, condition, viability, and defensibility.
EORANK.ROUND*	An algorithm has been applied to the element occurrence rank to systematically produce values which are easier to interpret and summarize.
COUNTYCODE	A six digit code indicating the county in which the EO is located. If the element occurrence spans more than one county, the code for the centrum county is listed first.
COUNTYNAME	The official full name for the county designated in the COUNTYCODE field.
FIPS_CODE	A numerical code assigned by the U.S. government to uniquely identify each state and county in the country
WATERSHED	The 8-digit code from the U.S. Geological Survey Hydrologic Unit Map for each watershed where the EO is located. If the EO spans more than one watershed, the code for the centrum watershed is listed first.
SURVEYDATE*	The date of the most recent field survey. If the species was found, the LASTOBS field will also be changed. Otherwise the SURVEYDATE serves as a means to identify negative survey results.
FIRSTOBS*	The date the element occurrence was first reported at the location with the same precision as the current EO has been mapped.
* - Fields are defined as: • Data not standardized between states • Data provided "as is," data in some of these fields have not been systematically reviewed by ABI and thus should be used in a supplemental manner.	

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