PREPARATION FOR BIOTICS

AND

IMPLEMENTATION OF THE REVISED EO METHODOLOGY

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Table of Contents

Introduction

The purpose of this document is to introduce the fundamental concepts of the revised Element Occurrence (EO) methodology and how they relate to the use of Biotics. The revised EO methodology was developed to provide a consistent approach to EO data management, including defining, delineating, ranking, and mapping EOs. Biotics is a tool that facilitates application of this revised methodology to the development of mapped representations of EOs in a geographic information system (GIS). However, the revised EO methodology can be implemented either with or without Biotics.

This document is divided into four major sections. Section 1 presents the fundamental concepts that must be understood in order to implement the revised EO methodology. Section 2 identifies data management tasks that should be completed by a program prior to the installation of Biotics. Section 3 provides information on how programs can begin implementing the revised EO methodology, regardless of whether migration to Biotics is intended. The Appendix in Section 4 is comprised of examples of field forms for collecting survey data.

1 Draft EO Data Standard

In order to effectively implement the revised methodology, biologists and data managers must be familiar with the underlying concepts, as described in the Draft EO Data Standard. The Draft Standard was developed by members of an EO Working Group consisting of representatives of the Central Science disciplines and the Heritage Network. The EO Design Project was begun in August 1996 to develop a comprehensive and uniform approach to EO data management to help ensure consistency and comparability of data among programs. The proposed model for defining, ranking, and tracking EOs has undergone extensive review by the Heritage Network, but the portion of the methodology related to the spatial representation of EOs has not undergone a formal review. However, since this spatial methodology is reflected in Biotics, it has been evaluated to some extent by NHPs/CDCs using the software.

The following is a summary of fundamental concepts from the Draft Standard. More detailed explanations of these concepts, along with examples, may be found in the Draft Standard document (located on the Web at http://whiteoak.abi.org/eodraft/index.htm). It should be noted that there are still several unresolved methodological issues related to the spatial representation of EOs; as a result, this document will continue to be revised until the EO spatial model is complete.

1.1 EO Definition

An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element – in other words, it is an area where the Element may potentially continue to be present, where it was known to persist in the past, and/or where it may regularly recur. For species, an EO is generally a local population, but in some cases may be a portion of a population (e.g., long distance dispersers) or a group of nearby populations (e.g., metapopulation). For communities, an EO may represent a stand or patch, or a cluster of stands or patches, of a natural community. Because the size and shape of an EO depends on the biology of the Element and various landscape characteristics, EOs can cross jurisdictional boundaries.

An EO record (in the previous methodology referred to as an EOR) is used for storing and managing both the spatial data (e.g., geographic coordinates, county, watershed) and qualitative textual information (e.g., description, directions) about an EO. Both types of data, along with a mapped feature representing the EO, are essential components of the EO record.

1.2 Principal and Sub-EOs

An EO may occur independently (a principal EO) or it may be contained by another occurrence of the same Element (a sub-EO). Any principal EO that meets the criteria for EO tracking (described in Section 6 of the Draft EO Data Standard) should be documented in an EO record. An EO record can also be created for any sub-EO that the program desires to track.

1.2.1 Principal EOs

Criteria for what constitutes a principal EO are defined in EO specifications developed for each Element. For species, a principal EO conceptually represents the full occupied habitat (or previously occupied habitat) that does or may contribute to the persistence of the species at that location. For communities, principal EOs represent a defined area that contains (or contained) the species composition and structure that characterize the community. Principal EOs are typically separated from each other by either specific distances across intervening habitat or areas, as defined in the EO specifications for each Element, or by barriers to movement or expansion of the Element.

Evidence for a particular EO may not necessarily be adequate for identifying the full extent of the occupied habitat or area. For example, an EO may be based on an observed nest, but that nest location does not actually include the full extent of the area utilized by the Element (i.e., the occupied area, which would likely include a feeding area and breeding territory). When the full extent or area of an occurrence is not known, the EO should delineate only the portion of the occupied habitat or area for which evidence is available (e.g., the nest site). Every EO record should contain an indicator that distinguishes between three situations with regard to whether the full extent of occupied habitat or area of an occurrence is known (i.e., the confidence extent): (1) confident that the full extent of the EO is known; (2) confident that the full extent of the EO is not known; and (3) uncertain whether the full extent of the EO is known.

1.2.2 Sub-EOs

Within a principal EO that conceptually represents the entire area occupied by the Element at that location, there may be smaller, geographically distinct areas about which specific information could be useful for conservation planning, biological monitoring, or biological management at local levels. These component areas are referred to as sub-EOs.

Sub-EOs must be contained within a principal EO of the same Element. A sub-EO record can be created for the following types of areas:

a) areas utilized by species for specific behaviors or life history functions (e.g., feeding, denning, nesting);

b) areas of differing composition, or higher density, quality, or conservation concern (e.g., demes or subpopulations, different age stands or successional phases, old growth patches, concentrated breeding areas);

c) discrete areas within a principal EO comprised of noncontiguous patches for which it is desirable to maintain information in separate records (e.g., to facilitate recording of monitoring data); or

d) areas demarcated by non-biological divisions assigned for convenience in mapping, monitoring, or management (e.g., geographic, political, and land survey map units).

Note that sub-EOs should not be created simply to represent different parts of a principal EO comprised of noncontiguous patches, unless one of the above situations applies. In addition, a single observation based on ephemeral circumstantial evidence, such as tracks or scat for wide-ranging carnivores, should not be recorded as a sub-EO. However, it may be desirable to record such information in a manual Element file or track as separate observations.

1.2.3 Relationship Between Principal and Sub-EOs

For information management purposes, records for principal EOs and sub-EOs have a parent-child relationship. A record for a principal EO may be linked to zero, one, or more records for sub-EOs. However, a record for a sub-EO must be linked to its one parent EO record; it cannot be created unless a parent record exists, and it cannot stand alone if the parent is removed. In the rare cases where it is appropriate to define a sub-EO within another sub-EO, all sub-EOs should be linked to the parent principal EO, not to each other.

The amount of information available can affect whether an area is defined as a principal EO or a sub-EO. Because knowledge about an occupied area may increase over time with additional field survey work, what was initially delineated as a principal EO may become a sub-EO (and therefore optionally tracked) as more information is obtained. For example, the nest of a pair of bald eagles could be a principal EO (if it meets the specified separation distance from other bald eagle EOs) when knowledge about the occupied area is limited. If additional field survey work identified a larger area surrounding the nest as the breeding territory of the pair, this breeding territory would become the principal EO (provided it still met the separation distance criteria), and a record for the original nest location could be optionally retained as a sub-EO.

1.2.4 Managing Multi-Jurisdictional EOs

Note: This section is not a part of the Draft EO Data Standard developed through a formal design and acceptance process by the EO Working Group. It is based on information obtained during an EO workshop convened in September 1999, to collect requirements for a Heritage Data Management System (HDMS) currently under development. Approximately half of the participants at this workshop were members of the EO Working Group.

The concept of principal and sub-EOs may be useful for managing data on EOs that span the boundaries between Heritage jurisdictions (multi-jurisdictional EOs). Each program that had a significant portion of a multi-jurisdictional EO within its boundaries would initially create a principal EO for its portion. One of the programs would assume responsibility for creating and maintaining a principal EO that encompassed the entire extent of the EO (i.e., across jurisdictions), and each of the other programs would provide a copy of their EO record to the designated lead program. The lead would create a single multi-jurisdictional principal EO based on the principal EO records received, and then each of the initial principal EOs would become sub-EOs. The multi-jurisdictional principal EO record would contain minimal attribute data since more detailed information would be retained in each program's sub-EO record. Key attributes for the multi-jurisdictional principal EO would need to be determined cooperatively, and any changes to the boundary of the EO would also require collaboration to keep the record up to date.

1.3 Labels for EOs

An EO may be categorized to help identify precisely what it represents, which may be useful in conservation planning. Two ways to categorize an EO are by assigning it a feature label or a location use class.

1.3.1 Feature Label

A feature label is an optional term that describes what that EO is (e.g., deme, nest, breeding territory). In practice, feature labels are most useful for sub-EOs, but they may also be useful for principal EOs that are based only on a component (e.g., den, feeding area) of the full occupied area. Feature labels are generally not recommended for principal EOs that represent simply "occupied habitat."

1.3.2 Location Use Class

For migratory species that utilize geographically disjunct locations at different times of the year, both principal and sub-EOs (and each of their component parts if they are composed of noncontiguous patches) should be assigned a location use class. This label is a descriptive name that indicates the "season" (in terms of the Element's annual cycle) in which the Element makes use of the EO (e.g., "breeding", "nonbreeding", and "migratory stopover"). Location use classes are not assigned for nonmigratory Elements and are generally not applicable to terrestrial or freshwater migratory Elements that move between contiguous areas.

Because the vulnerability of a species may be higher at some stages in its annual activity cycle than in others (for example, due to high population concentrations), EOs for a species at a particular season may have greater conservation value than EOs for the same species at another season. Specifying the location use class allows EOs from each vulnerable class to be identified and conserved, which is vital to the survival of such species.

1.4 Separation of EOs

Principal EOs are typically separated from other principal EOs either by barriers or breaks, or by specified distances across intervening areas. The purpose of specifying values for separation distances is to achieve consistency in the way EOs for the same Element are defined and mapped in different jurisdictions. Examples of typical barriers and appropriate separation distances between EOs are included in the EO specifications for a given Element.

1.4.1 Barriers

For species, barriers are physical obstacles that almost completely prevent movement or dispersal of the Element, thereby obstructing or severely limiting gene flow. These barriers are usually abrupt and may be relatively narrow. For community EOs, barriers may limit the expansion or alter the function of the community. By separating populations of most of the component species within the community, barriers obstruct or severely limit gene flow.

1.4.2 Separation Distances

In addition to abrupt barriers that totally, or almost totally, prevent movement, dispersal, and/or expansion, an intervening area of sufficient distance may result in significantly reduced gene flow between population units (including component species populations within communities). The degree to which the intervening area restricts movement, dispersal, and/or expansion of an Element determines the distance(s) required to separate one EO from another. Thus, separation distance varies according to the type of intervening area, as well as the degree of mobility of the Element. For species, two types of separation distances are specified: across unsuitable habitat, and across suitable but apparently unoccupied habitat. For communities, separation distances are specified for intervening areas of different natural or semi-natural communities and across cultural vegetation.

Minimum values for separation distance have been recommended as general guidelines to ensure that EOs are not separated by unreasonably small distances, which could lead to fragmented populations being identified as potential targets for conservation planning or action. According to the Draft EO Data Standard, the minimum separation distance for species Elements is at least 1 km for both unsuitable habitat and apparently suitable habitat that is not known to be occupied. (This is more than twice the ¼ mile distance suggested in the previous methodology.) For communities, the minimum separation distance across intervening areas of different natural or semi-natural communities is at least 1 km, and the recommended distance across areas of cultural vegetation is at least 0.5 km. However, a few Elements occur as truly separate populations at intervening distances of less than 1 km. In those cases, the appropriate separation distances might be less than the recommended minimum.

1.5 Developing an EO Representation

Representing an EO on a map makes it easier to see its relationship to other mapped features (e.g., habitat, watershed, Managed Areas, Sites, counties, observations, other EOs) than looking at the tabular data alone. The revised EO spatial model allows for mapping EOs either on paper maps or using a geographic information system (GIS); however, managing EO information in a GIS has many advantages, including the capability to perform analyses of relationships between EOs and other mapped features, and the production of a variety of map products.

There are four fundamental differences between the EO representations (EO reps) developed under the revised methodology and the EOs mapped by Heritage programs under the former guidelines. Specifically, EO reps:

- are polygons (instead of points)
- incorporate locational uncertainty (see Section 1.5.4)

- are developed from source features, each of which corresponds to a discrete observed area based on survey information (i.e., an observation[1])
- can be comprised of multiple source features.

In addition, the revised methodology lets a Heritage scientist develop EO reps that reflect the diverse, often complex ways that Elements actually occur on the landscape (as originally described by Patrick Gaul of the California Natural Diversity Database program in 1997). For example, EO reps of different Elements must be able to overlap and to share boundaries (such as the shoreline of a lake). An EO rep of a single Element must be able to contain “voids” (holes indicating areas that are not part of the EO), be made up of multiple separate areas/patches, and include different types of contiguous areas (e.g., an EO that includes both a stream and pond).

The boundaries of EO reps should be delineated to reflect only what has been actually observed during field surveys or derived from historical accounts. Despite the possibilities presented by detailed topographic base maps, EO reps should not be mapped to include appropriate but unsurveyed nearby habitat. Further field survey work would be needed to confirm the presence of the Element in the potentially occupied area.

The revised spatial methodology outlines five stages for developing an EO rep. Each of the stages results in a feature (either conceptual or mapped), as follows:

(1) observed feature
(2) conceptual feature
(3) source feature
(4) basic feature
(5) procedural feature

An EO rep is then developed from one or more procedural features, taking into account the separation guidelines provided in EO specifications for the Element. Figure 1.1 illustrates the process of developing an EO rep using the five stages, and a more detailed description follows in the text.

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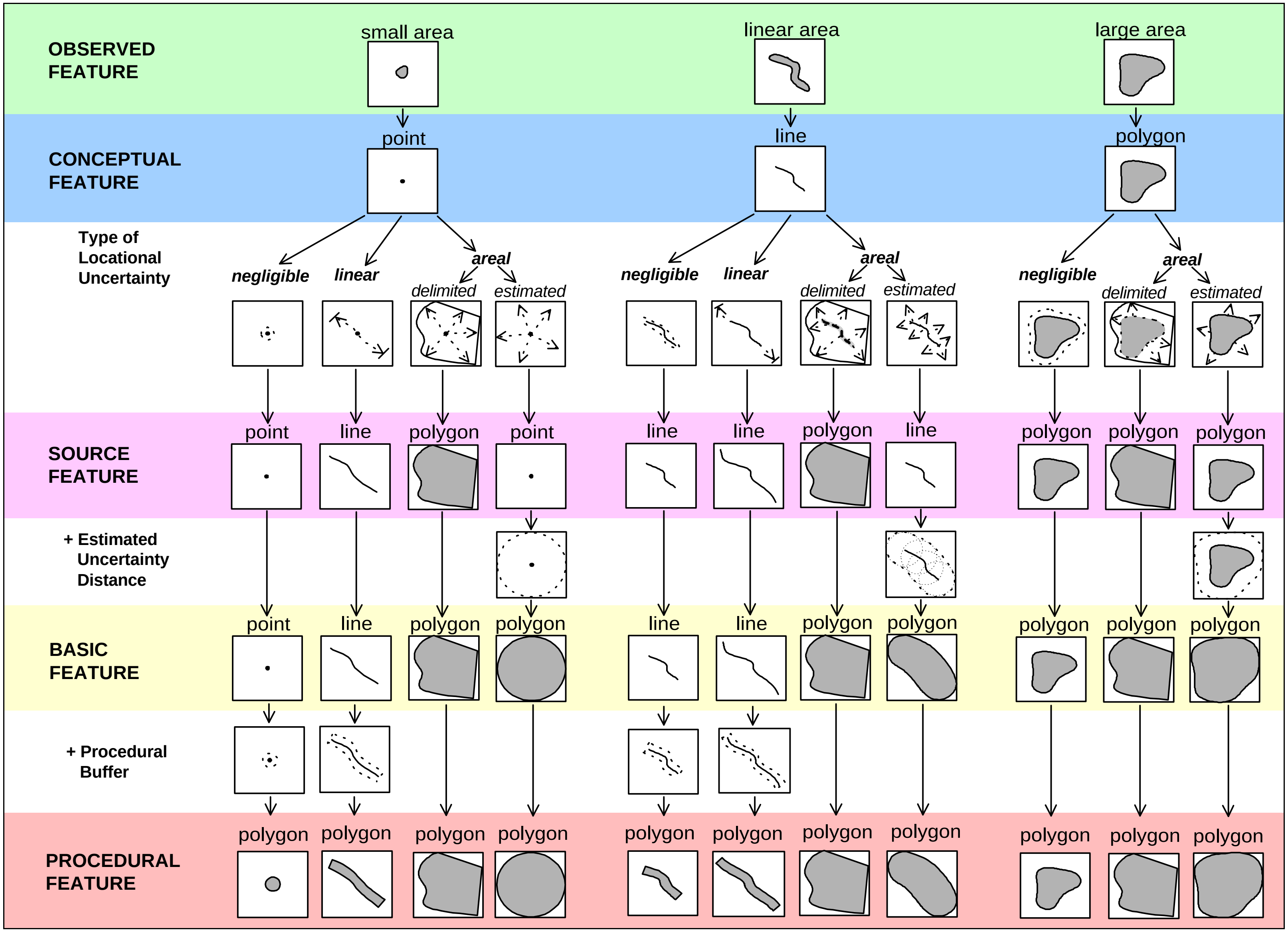
[1] Until further analysis and design related to observation data occurs, the interim solution for managing observation data in conjunction with the EO model is based on the assumption that an observed area is equivalent to an observation.

Figure 1.1 – Summary of Procedural Feature Derivation



1.5.1 Observed Feature

The process for developing an EO rep begins with figuring out how the size of the observed area relates to the scale of the map on which the feature will appear. The observation, either obtained directly from a field survey or indicated by a historical account, is categorized as an observed feature and can be classified as one of three types: small area, linear area, or large area. An observed feature is a small area or a large area depending on whether the size of the observation (in both length and width) is smaller or larger, respectively, than the minimum mapping unit (mmu—see next paragraph) for the scale map being used. Observed areas having a length greater than the mmu but having a width less than the mmu (such as an area along a ridge or stream) are linear area features.

The minimum mapping unit is the smallest measurement that can be delineated on a map as a shape with boundaries. The mmu varies with map scale; the larger the map scale, the smaller the area that can be represented as a polygon. For example, the recommended mmu for a 1:24,000 map is 12.5 m (approximately 40 feet). In that case:

- if the observed feature is based on an observation of a bald eagle's nest 1.5 m in diameter, the observed feature is a small area;
- if it is based on multiple samples of a fish collected over a distance of 30 m along a stream 8 m wide, it is a linear area;
- if it is based on information on a breeding territory 50 m in diameter in all dimensions, it is a large area.

The recommended minimum mapping units for the various map scales used by Heritage programs are shown in Table 1.1.

Table 1.1 – Recommended MMUs

Map Scale	Diameter of Minimum Mapping Unit	
	meters	feet (approx.)
1:12,000	6	20
1:20,000	10	35
1:24,000 1:25,000	12.5	40
1:50,000	25	80
1:62,500 1:63,360	30	100
1:100,000	50	165
1:250,000	125	400

1.5.2 Conceptual Feature

After an observed feature is categorized, it can be mentally translated into a simplified cartographic object that could be drawn on a map or input into a GIS. The three types of conceptual features are point, line, and polygon, and they relate to the type of observed feature as follows:

- point: conceptualization of a small area observed feature
- line: conceptualization of a linear area observed feature
- polygon: conceptualization of a large area observed feature

1.5.3 Source Feature

A source feature is the translation of a conceptual feature onto a map or into a GIS. It serves as the initial mapped representation of a discrete unit of observation data. During the remainder of the process of developing an EO rep, one or more source features are translated or modified to become the procedural feature(s) that make up an EO rep.

There are three types of source features: point, line, and polygon. However, source feature type does not have a one-to-one correspondence with the type of conceptual feature. Source feature type also depends on the amount of locational uncertainty associated with the conceptual feature, which is determined from the underlying survey information. For every source feature, it is important to record both the type of conceptual feature and type of uncertainty.

1.5.4 Locational Uncertainty

Many factors may affect the quality and reliability of locational data for an EO, including the level of expertise of the data collector, survey techniques and equipment used, and the amount and type of information obtained. Therefore, the location recorded for an observed area may not allow its actual location to be pinpointed on a map. A certain amount of uncertainty will be associated with the mapped representation of that location. (The accuracy of the base map is a separate issue and is not considered in evaluation of locational uncertainty, which deals with accuracy of the data.)

The revised EO methodology has defined four types of locational uncertainty:

(a) negligible
(b) linear
(c) areal delimited
(d) areal estimated

In developing an EO rep, locational uncertainty comes into play when it is time to map the source feature. The type of locational uncertainty assigned to a source feature depends on both the magnitude and the direction of the uncertainty associated with a location. These factors are determined through evaluation of the underlying field data or historical information. A more detailed description of the four types of locational uncertainty follows.

(a) Negligible uncertainty is assigned when the location of the observation is very precisely known – for example, the underlying data is from a comprehensive survey with high-quality mapping based on corrected GPS data. In order for a source feature to qualify as having negligible uncertainty, the difference between the recorded location and the actual location must be judged to be ≤ one-half of the minimum mapping unit along all the boundaries of the feature (e.g., ≤ 6.25 m for a mmu of 12.5 m on a 1:24,000 scale map).

A point, line, or polygon conceptual feature with negligible uncertainty will give rise to a source feature of the same type. Since the underlying information is very precise, the boundaries of the feature as it was conceptualized do not change when it is translated into a source feature. So, a point conceptual feature with negligible uncertainty results in a point source feature, a line conceptual feature results in a line, and a polygon conceptual feature results in a polygon.

Below are some examples of data that would qualify for negligible uncertainty:

Data	***Translation***
A plant specimen location based on corrected GPS data	Point conceptual feature mapped as point source feature
Mussel specimens observed along a measured distance of a stream at a known location	Line conceptual feature mapped as line source feature
Habitat occupied by a rodent species; boundaries of the occupied area determined through field survey work	Polygon conceptual feature mapped as polygon source feature

(b) Linear uncertainty is assigned when the recorded location differs from the actual location of an observation along only one axis and the difference is judged to be greater than half the mmu (e.g., >6.25 m on a 1:24,000 scale map). The endpoints of a source feature that incorporates linear uncertainty are mapped/digitized on the basis of:

- physical features on the map (e.g., roads, township/county boundaries, bridges, dams, shorelines, trails);
- the biologist’s determination (e.g., “I did the survey along this part of the trail”); and/or
- an educated guess about the magnitude of the uncertainty by the biologist.

The two ends of the source feature can be based on different types of information; for example, one end may be delimited by a mapped dam, and the other end determined by a biologist. However, regardless of the type of information used to determine the source feature’s endpoints, the associated uncertainty is included in the length of the line drawn on the map.

Both point and line conceptual features may give rise to source features that incorporates linear uncertainty. The resultant source feature is a line in both cases.

Below are examples of data that would qualify for linear uncertainty:

Data	***Basis of Endpoints***	***Translation***
Fish specimen observed at a poorly determined position in a stream; location known to be somewhere between two bridges	Mapped physical features at both ends	Point conceptual feature mapped as line source feature
Dragonfly specimen observed at a poorly determined position along a shoreline	Biologist's determination of the location	Point conceptual feature mapped as line source feature
Plant specimens observed on a ridge along a stretch known to begin at a particular trail and go about 1 km	Mapped physical feature at one end and an estimate by the biologist at the other	Line conceptual feature mapped as line source feature

(c) Areal delimited uncertainty is assigned to a source feature when (1) the uncertainty about the actual location of an observation is judged to be greater than negligible in any direction and (2) the observed area is known to be located within a larger area with identifiable boundaries. The source feature is then delimited by those boundaries, which can be based on:

- physical features on the map (e.g., roads, township/county boundaries, bridges, dams, shorelines, trails); and/or
- the biologist's determination (e.g., "I did the survey in this area").

Different portions of the boundary of the source feature can be based on different types of information; for example, one section of the boundary may be delimited using a mapped shoreline, and the remainder determined by a biologist. However, regardless of the type(s) of information used to determine the source feature's boundaries, the uncertainty associated with the underlying information is included in the mapped feature.

Point, line, and polygon conceptual features can give rise to source features that incorporate areal delimited uncertainty. The resultant source feature is always a polygon.

Below are examples of data that would qualify for areal delimited uncertainty:

Data	***Basis of Boundaries***	***Translation***
Orchid specimen observed at an indeterminate location within a particular swamp	The boundaries of the mapped physical feature (the swamp)	Point conceptual feature mapped as polygon source feature
Mussel specimens observed along a small stream that does not appear on any map but is known to be in county X.	The boundaries of the known area (county X).	Line conceptual feature mapped as polygon source feature
Three hectares of rodent occupied habitat within a known area bounded on two sides by roads	The roads for two sides of the feature and the biologist's determination of the location of the observed area for the rest.	Polygon conceptual feature mapped as polygon source feature

(d) Areal estimated uncertainty is assigned when uncertainty about the actual location of an observation is judged to be greater than negligible in any direction, but the extent of uncertainty cannot be delimited by boundaries on a map or boundaries determined by a biologist. In such cases, the biologist must estimate a distance of uncertainty that will be applied to the entire feature, extending in all directions. This estimate should be recorded as data about the feature.

Point, line, and polygon conceptual features may give rise to source features with areal estimated uncertainty. However, areal estimated uncertainty is <u>not</u> incorporated in the source features, so conceptual features do not change during translation to source features. Thus, a point conceptual feature with this uncertainty results in a point source feature, a line conceptual feature results in a line, and a polygon results in a polygon. This is because the uncertainty is most easily added by putting a buffer around the source feature, usually through the use of GIS tools. Since a buffer can only be applied to a feature that is already on the map, the source feature is digitized (or mapped by hand if a GIS is not in use) to capture only the locational information from the conceptual feature. In this case, the source feature is essentially a construction device that will have a measure of uncertainty applied at a later step.

For this type of uncertainty, the underlying data is typically historical or from secondary sources, and the location of the observation is only very generally known. Below are examples of data that would qualify for areal estimated uncertainty:

Data	*Mapped Source Feature*
A historical record of a plant specimen with location information: "North of Lake A"	Point
Plant specimens observed along a small intermittent stream that doesn't appear on any map	Line
Information on a prairie dog town located "southwest of Z-ville."	Polygon

1.5.5 Basic Feature

A basic feature is the translation of a source feature to a basic geometric shape (point, line, or polygon) that represents the observation data with locational uncertainty incorporated. A source feature with negligible, linear, or areal delimited uncertainty is unchanged during translation to a basic feature since it is developed with uncertainty included. However, a source feature with areal estimated uncertainty is developed without uncertainty incorporated, and must be modified to encompass the locational uncertainty during conversion to a basic feature.

To incorporate uncertainty when developing a basic feature with areal estimated uncertainty, the biologist estimates the extent of the area within which the observed area is most likely to be located by either specifying a custom distance or selecting a distance range from a set of uncertainty distance classes. The specified distance (or the highest distance in a selected uncertainty class) is then used to buffer the source feature using GIS tools, resulting in a basic feature. Value ranges for uncertainty distance classes are shown in Table 1.2.

Table 1.2 – Uncertainty Distance Classes

Value Range (in meters)
>6.25 – 25
>25 – 50
>50 – 100
>100 – 200
>200 – 400
>400 – 800
>800 – 1500
>1500 – 4000
custom distance (specify units)

1.5.6 Procedural Feature

A procedural feature is the translation of a basic feature to a shape that represents the observation data (including locational uncertainty) as a polygon on a standard scale map. A basic feature that is a polygon is unchanged during translation to a procedural feature. However, line and point basic features, because they are smaller than the minimum mapping unit (mmu) in one or more dimensions, require that a procedural buffer (equal to half the diameter of the mmu) be added using GIS tools during translation to a procedure feature in order to produce a polygon on a standard scale map.

An EO rep is developed from one or more procedural features. Whether procedural features should be grouped into a single EO depends on whether the underlying basic features are within the separation distance specified for the intervening habitat/landscape in the EO specifications for the Element, and whether there is a barrier between the features.

1.6 Accuracy of EO Representations

The procedural features that comprise EOs are derived from observed features through a series of steps that translate data into spatial representations. This translation process may complicate interpretation of the data since the final polygon EO reps include locational uncertainty that is not readily apparent in the mapped features. In many cases, EO reps will appear to be similar on a map despite having incorporated very different amounts of locational uncertainty. In order to ensure that features are accurately compared, a rating (estimated representation accuracy) that indicates the relative amount of an EO rep that was actually observed to be occupied by the Element (i.e., not attributable to uncertainty) should be provided for all EOs. Use of estimated RA by Heritage Programs would provide a common index for the consistent comparison of EO reps, thus helping to ensure that data are correctly analyzed and interpreted.

A value for estimated RA (specifically, a percentage range selected from a scale) is assigned for an EO by the biologist. The estimated RA scale is comprised of five categories: “very high accuracy”, “high accuracy”, “medium accuracy”, “low accuracy”, and “unknown”. Table 1.3 illustrates the percentage ranges associated with categories in the estimated RA scale.

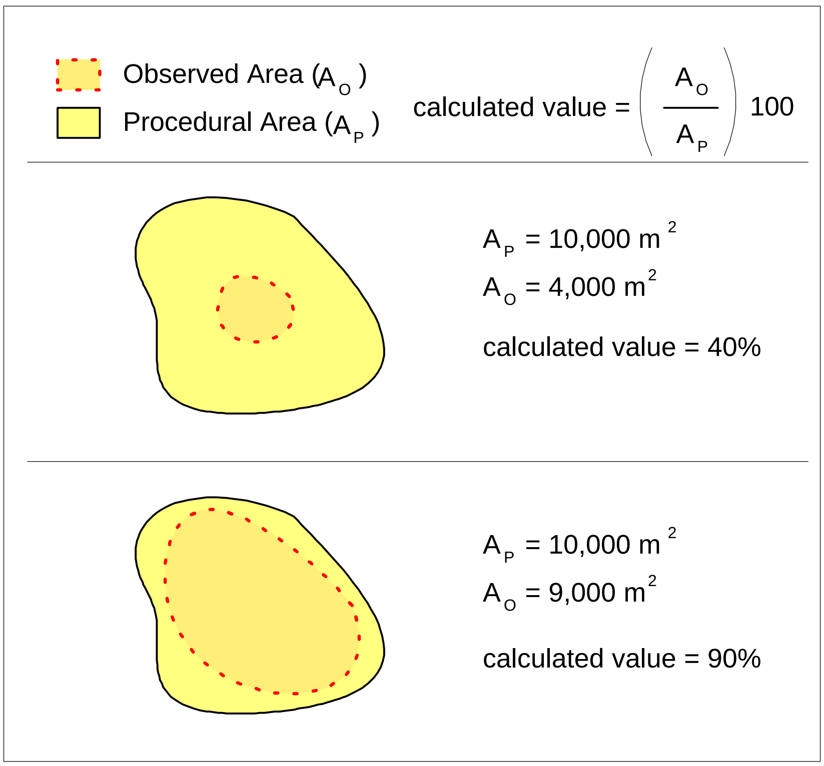
Table 1.3 – Estimated RA Scale

Categories of Accuracy	Percentages
very high accuracy	>95%
high accuracy	>80% - 95%
medium accuracy	>20% - 80%
low accuracy	0 - 20%
unknown	?

Features developed with minimal added locational uncertainty have “very high accuracy”, and the accuracy category declines as a greater portion of an EO rep is attributable to added uncertainty. Thus, an EO with all underlying source features having negligible uncertainty has very high accuracy, while a low estimated RA value indicates that the feature was modified to encompass a significant amount of locational uncertainty. The use of the “unknown” category should be restricted to only those few cases when none of the other categories can be reasonably assigned by a biologist. For example, a venus flytrap specimen found in a marsh would likely be categorized as low representation accuracy, whereas patches of venus flytrap found in a marsh could be categorized as unknown since one cannot determine from the data what portion of the marsh is covered by the patches.

Although estimated RA is a subjective assessment by the biologist, it is recognized that expertise and familiarity with the data generally enable the biologist to assign an appropriate value indicating the "goodness" of an EO (that is, the percentage not due to added uncertainty). Ideally there would be a method for calculating a RA value to minimize subjectivity, but due to variations in available data and characteristics of different EOs, it has been found that a simple calculation will not result in a valid RA value for many EOs. However, in some cases, a computation utilizing two areas associated with an EO – the observed area determined through field survey and the procedural area (the area of the EO rep including uncertainty) – could be evaluated and used to help assign the appropriate estimated RA. Specifically, a ratio between the areas, converted to a percentage by multiplying by 100, would indicate the percentage of the EO rep that reflects the actual size of the initial field observation.[2] Figure 1.2 illustrates how two EO representations with the same procedural area could have different resulting calculated values.

Figure 1.2 - Example Showing Similar EO Representations Having Different Calculated Values



An EO rep with a procedural area that closely approximates the observed area has a calculated value that approaches 100%; there is little locational uncertainty associated with the occurrence and the feature has high accuracy. Conversely, a feature with a larger procedural area relative to observed area has a relatively low calculated value since the feature was modified to encompass a significant measure of associated locational uncertainty.

[2] Note that this computation is simply a ratio expressed as a percentage, and does not represent the probability of finding the Element at any single specific location within the boundaries of the EO rep.

While calculation of a value for use in assigning estimated RA might be useful for some features, it is not feasible for EO representations derived from point features. Because the observed area of such an occurrence is so small, the addition of even a limited amount of area to reflect locational uncertainty results in a calculated value that would indicate low estimated RA despite the overall insignificant amount of area added for uncertainty.

1.7 Developing a Complex EO Representation

Complex EO reps may be comprised of multiple discrete patches or differing contiguous areas (e.g., a stream and pond). In either case, developing a complex EO rep requires that each distinct feature comprising the occurrence proceeds through the five stages described in Section 1.5 above. Thus, every component is first categorized as an observed feature according to its size, conceptually characterized, digitized as a source feature according to locational uncertainty, translated to a basic feature, and finally translated to a procedural feature. After all of the component features have been processed through these steps, the EO rep is created by grouping the resulting procedural features together.

Some complex EOs may be comprised of a very large number of source features due to many underlying observations. In cases where the number of features comprising an EO is excessive, it may be more practical (particularly for mobile animals) to define a single boundary for the EO rep. This is accomplished by creating an additional source feature for the EO, with boundaries delineated to include only the other component features and intervening appropriate habitat (i.e., interpolation). Decisions as to whether to delineate a single EO boundary or retain distinct features defining a complex EO are dependent on many factors, including characteristics of the Element, the nature of the intervening area between the features, and resource considerations of the program.

1.8 Multiple EO Representations of a Single Element

1.8.1 Principal and Sub-EOs

Regardless of whether an EO is a principal or sub-EO, the process for developing a spatial representation is exactly the same (as described in Section 1.5 above), resulting in an EO rep and associated EO record. After EO reps have been created, parent and sub-EO relationships between occurrences of the same Element are identified. Sub-EOs are identified and linked to the parent EO through insertion of the parent identification number in each sub-EO record.

In order to be considered a sub-EO, the underlying procedural feature(s) must be located entirely within the boundaries of another procedural feature for that Element. When the potential parent is a complex principal EO comprised of discrete features, the procedural feature must have the same boundary as at least one of the procedural features of the parent EO to be considered a sub-EO. In cases when both the potential parent and sub-EO are comprised of multiple features, each of the procedural features must have the same boundaries as a procedural feature of the parent EO to be considered a sub-EO.

A sub-EO should be identified only when there is specific information related to a component of an occurrence that is better tracked in a record separate from that of the parent EO.

Otherwise, it is preferable to simply create a complex EO from multiple source features rather than processing each source into a separate EO and then establishing a parent – sub-EO linkage.

1.8.2 Overlapping Principal EOs

In some situations a principal EO can overlap or contain another principal EO of the same Element. However, in such cases, the features have different types of associated locational uncertainty and/or different levels of representation accuracy. Such a situation generally occurs when an initial principal EO (typically based on historical or secondary source information) has greater associated uncertainty and less accuracy than subsequent principal EOs. However, as additional survey work is performed over the area delineated by the original principal EO, more current principal EOs with less associated uncertainty and greater accuracy may eventually replace the older occurrence.

1.9 EO Point Representations

Every EO rep should have an associated reference point located within the boundaries of an underlying procedural feature. A point representation (i.e., the reference point) is used to represent an EO at any map scale small enough that the boundary of the occurrence is not visible.

1.10 Generalized EO Representations

In cases when maps distributed to clients and/or the public should not show the precise locations for sensitive Elements, a generalized representation that blurs the boundaries and/or offsets the position of EOs may be used to protect information on the locations of such Elements.

1.11 Detailed Features

For some EOs, very precise locational information is known, but when the feature is mapped at the scale of a standard map, that detailed information is not discernible (e.g., a circular polygon may result from very precise information for a small area). In such cases, a detailed feature may be used to represent the data at a scale larger than that of a standard map, thus retaining the most complete, accurate, and specific spatial information for that occurrence.

The process for generating a detailed feature differs from the standard procedure for developing an EO rep (described in Section 1.5 above) only in the use of a larger scale map and smaller minimum mapping unit. Thus, a detailed feature begins as one or more large area observed features, characterized as polygon conceptual features, and then translated according to locational uncertainty (either negligible or areal delimited) to polygon source features. The source features are translated without modification to basic and procedural features, with evaluation of separation distances according to EO specifications determining if and how features should be grouped to denote an EO.

Because a detailed feature is developed on a larger scale map than the standard, it is not comparable with EOs developed using the process for developing an EO rep. If a detailed feature is to become an EO rep on a standard scale map, the underlying information for the feature must be processed through the EO rep development procedure a second time using the standard map scale and minimum mapping unit.

1.12 Observations

Note: This section is not a part of the Draft EO Data Standard developed through a formal design and acceptance process by the EO Working Group. It is based on information obtained during an EO workshop convened in September 1999, to collect requirements for a Heritage Data Management System (HDMS) currently under development. Approximately half of the participants at this workshop were members of the EO Working Group.

In order to constitute a valid EO, information on an Element must meet minimal criteria provided in the EO specifications for that Element. However, it may be useful to track the spatial location and minimal data on an observation that does not meet the specifications, and is thus, not a component of an EO. Over time, such independent observations may ultimately be combined with other data on observed areas to define an EO.

Although a formal methodology for creating and managing observation data has yet to be developed, an interim solution has been proposed that would utilize source features to track observed areas, regardless of whether such observations are to be associated with an EO in the foreseeable future. This model is based on the assumption that an observed area (i.e., observation) is represented by a single source feature. Minimal information could be associated with the source feature (e.g., observer, date, brief description of the observation), and the feature would be identified as an independent observation rather than a feature that is to be linked immediately to an EO rep. The observation/source feature could later become a component of an EO when deemed appropriate based on EO specifications, typically when further information on the Element at that location is obtained, or when sufficient additional observations of the Element within the appropriate separation distance have been made to accurately define the boundaries of an EO.

1.13 Spatial Requirements for Animals

Note: This section is not a part of the Draft EO Data Standard developed through a formal design and acceptance process by the EO Working Group. It is based on information obtained during an EO workshop convened in September 1999, to collect requirements for a Heritage Data Management System (HDMS) currently under development. Approximately half of the participants at this workshop were members of the EO Working Group. Subsequent information on this topic has been provided by zoologists Larry Master and Geoff Hammerson.

Many animal species, especially terrestrial vertebrates, have significant requirements for space in order to find sufficient food for themselves and/or their offspring. These spatial requirements are sometimes referred to as the animal's "home range". Considerable research has been conducted to characterize the movement patterns of animal species, and results indicate that the spatial requirements (or home range size) for an individual of a particular species may vary temporally and spatially depending on a number of factors, including availability of resources, season, and sex of the individual. Despite this variability, it is possible to determine an average home range requirement for many species that would be included in the characterization abstract for the Element.

Frequently, the spatial requirement of an individual (based on evaluation of the home range) exceeds the size of the EO that is being developed from field survey information. In most cases, the EO rep is developed according to the process described in Section 1.5 above, and the fact that the EO rep delineates an area less than the likely extent of the Element (based on average spatial requirements) is generally indicated through a confidence extent of "N" = confidence that the full extent of the EO is not known. (See Section 1.2.1 for further discussion on principal EOs and confidence extent.)

1.13.1 Inferred Extent (IE)

Most EOs are located in an area of suitable habitat that exceeds the spatial requirements for the Element. However, EO reps are developed on the basis of what was actually observed in the field, without inclusion of any unsurveyed but available suitable habitat at that location (see Section 1.13.2 for the single exception to this model). While EO reps accurately reflect what is known from underlying survey information, an EO rep with a confidence extent = "N" (or perhaps "?") may not effectively illustrate the likely extent of the Element at that location. In such cases, after the EO rep has been developed, a separate inferred extent (IE) feature could be generated to better represent potentially/probably occupied habitat for some species, and could be utilized in analyses for which estimates of occupied area would be useful (e.g., conservation planning, environmental review).

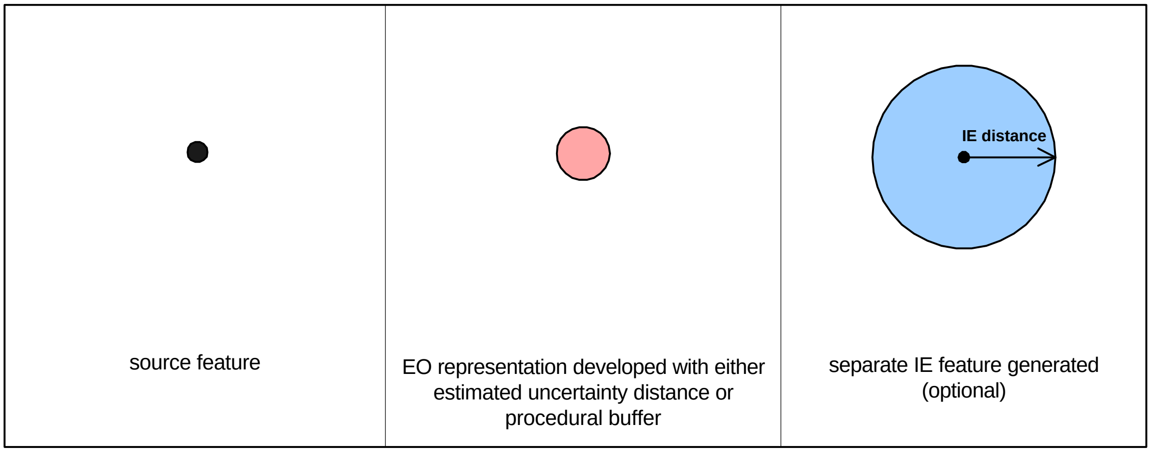
In order to generate an IE feature, the following criteria must be met:

- the EO specifications for the Element provide an IE distance value; and
- the size of the final EO rep (incorporating an uncertainty distance or procedural buffer) is smaller than the IE feature will be.

An IE feature is generated by buffering the underlying source feature(s) of an EO rep by the specified IE distance for the Element. IE distance is an approximate spatial requirement for a particular species, typically based on the average home range (specifically, a distance equal to the diameter of the median home range). However, for some species (e.g., pond-breeding amphibians, rattlesnakes moving from a den) the IE distance represents the distance from an initial location (in any direction) that would encompass the ultimate destination of 75-90% of the dispersing adult individuals.

Habitat known to be unsuitable and/or unused can be edited (removed) from an IE feature after it has been generated. Note that IE features are retained and managed in a GIS separately from EO reps. Figure 1.3 illustrates the process for generating an IE feature from a point source feature.

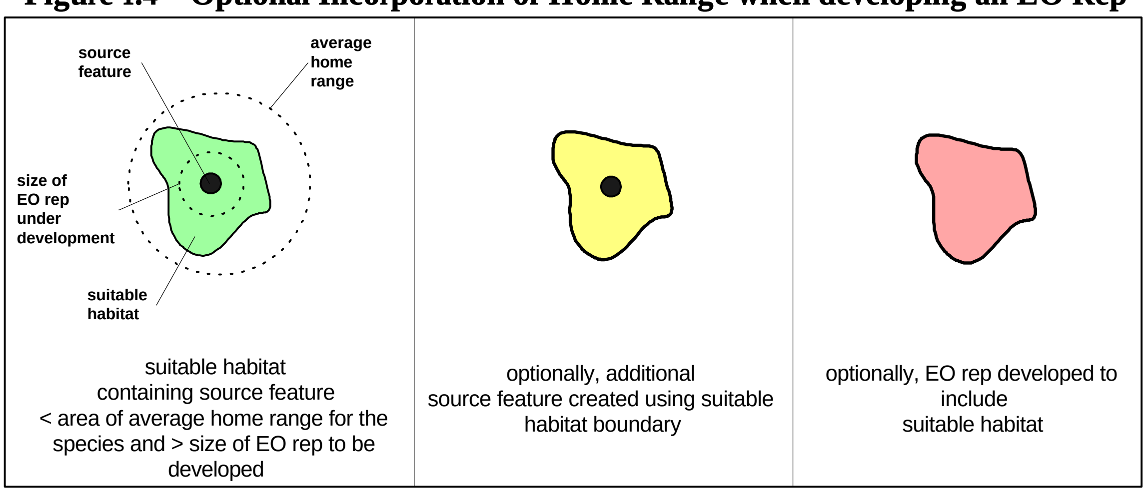
Figure 1.3 – Generating an IE Feature



1.13.2 Inclusion of Home Range

In rare cases, a source feature is located in an area of known suitable habitat smaller than the average home range for the Element; further, the EO rep being developed from that source feature (including either an estimated uncertainty distance or procedural buffer) may still be smaller than the available suitable habitat. Since the average spatial requirement of the individual exceeds the available suitable habitat surrounding such an EO rep, it would be appropriate to assume that the individual is utilizing all of the suitable habitat at that location to survive. In such cases only, an additional source feature matching the boundary of the available suitable habitat could be included when developing the EO rep. If the available suitable habitat is comprised of discrete patches, only the patch within which the source feature is located could be used as an additional source feature, since it cannot be determined which other patches are being utilized by the Element without additional survey work. Figure 1.4 illustrates the rare case when an additional source feature based on available suitable habitat could be included when developing an EO rep.

Figure 1.4 – Optional Incorporation of Home Range when developing an EO Rep



1.14 Symbology for EO Representations

Recommendations for symbology related to EO representations have not yet been made, however programs that are utilizing the Biotics application are working to develop possible symbology for representing various attributes, e.g., Representation Accuracy, Element group, etc.

1.15 Map Scale Considerations

Note: This section is not a part of the Draft EO Data Standard developed through a formal design and acceptance process by the EO Working Group. Information on map scale issues was obtained during an EO workshop convened in September 1999, to collect requirements for a Heritage Data Management System (HDMS) currently under development. Approximately half of the participants at this workshop were members of the EO Working Group.

Features digitized in a GIS may have different levels of associated map accuracy, depending on the scale of the reference maps utilized for mapping the observation locations. Generally, the larger the scale of a map, the higher its accuracy. The scale at which an observation is mapped is important information that needs to be recorded with the associated source feature.

Different jurisdictions frequently utilize different scale reference maps for mapping spatial data. Currently, in the United States, most Heritage Programs map observed area locations based on 1:24,000 reference maps; however, in Canada, most Conservation Data Centres map observed area locations based on 1:50,000 reference maps. In addition, some programs utilize other reference map data, such as satellite imagery or aerial photography, which can be at any scale (e.g., 1:10,000; 1:30,000).

Differences of map scale can also occur within a jurisdiction. For example, a state may have large scale aerial photography available for a portion of state, and utilize 1:24,000 USGS topographic quadrangle maps for the remainder of the state. In this case, data mapped using the aerial photography will be more accurate than data mapped using the quadrangle maps.

When comparing spatial representations, it is important to ensure that all the features have been mapped at the same scale. Data mapped using different scale reference maps have different levels of associated map accuracy, and cannot be compared without first translating all the features to the smallest scale map utilized for mapping any of the data under evaluation. This translation would be accomplished by processing the observation data through the stages described in Sections 1.5.1 through 1.5.6. Note that translation of features to a smaller scale map may result in the loss of detailed boundary information associated with features originally mapped at a larger scale. For example, a large area observed feature translated to a polygon source feature with a precisely delineated boundary may be replaced by a small area observed feature translated to a point source feature, and eventually a circular polygon due to the larger minimum mapping unit associated with the smaller scale map.

1.16 EO Ranks

EO ranks provide a succinct assessment of estimated viability, or probability of persistence of occurrences of a given Element. In other words, EO ranks provide an assessment of the likelihood that if current conditions prevail, an occurrence will persist for a defined period of time, typically 20-100 years.

1.16.1 Basic EO Ranks

The basic EO ranks that are used to prioritize EOs for conservation planning purposes are shown in Table 1.4.

Table 1.4 - Basic EO Ranks

EO Rank	Description
A	excellent estimated viability
B	good estimated viability
C	fair estimated viability
D	poor estimated viability
E	verified extant (viability not assessed)
H	historical
F	failed to find
X	extirpated

The basic "A" through "D" ranks are based on current information on the three EO rank factors (size, condition, and landscape context). The more viable an EO is, the higher its EO rank and the higher its conservation value. Range ranks (two-point spreads, e.g., AC) and the "?" qualifier may be used to indicate uncertainty about "A", "B", "C", or "D" ranks. When evidence of presence is lacking, or when field information is not sufficient to assign an "A", "B", "C", or "D" rank, one of the other basic ranks, "E", "H", "F", or "X" may be used.

The "E" (extant) EO rank should be used for an EO that has been recently verified as still existing, but sufficient information on the factors used to estimate viability of the EO has not yet been obtained. The "H" (historical) EO rank should be used when there is a lack of recent field information verifying the continued existence of an EO. The "F" (failed to find) EO rank (which replaces the "O" rank in the previous methodology) should be assigned to an EO that has not been found despite a search, but that still might be confirmed to exist with additional field survey efforts. The "X" (extirpated) EO rank should be assigned to an EO for which there is documented destruction of its habitat or environment, or evidence of its eradication based on survey.

1.16.2 Origin Status Subranks

Although the majority of EOs represent naturally occurring native species populations or communities, Elements may be found at locations where they are not native and/or not naturally occurring.[3] In such cases, it may be desirable to track these occurrences if the Element is very rare, or if the occurrence is critical to the survival of the species.

Knowledge of the origin status of an EO may be useful in prioritizing occurrences for conservation purposes, since natural occurrences have inherently higher conservation value relative to both non-native occurrences and those which are not natural in origin. If an EO is

[3] Categorization of an occurrence as "natural" at a particular location is independent of whether the habitat at that location is natural or anthropogenic. For example, bats in a mine can be a natural occurrence (i.e., not introduced or reintroduced), even though the mine is an anthropogenic habitat.

not native or not natural in origin, its origin status can be indicated through the use of an origin status subrank (shown in Table 1.5) following the assigned basic EO rank or range rank.

Table 1.5 – Origin Status Subranks

Origin Status Subrank	Description
r	reintroduced / restored
i	introduced

The “r” (reintroduced/restored) subrank indicates that an EO has been established within the present or historical native range of the Element by anthropogenic means. The “i” (introduced) subrank indicates that an EO has been introduced outside of the present or historical native range of the Element; thus, EOs having an “i” subrank are neither native nor natural in origin. The “?” qualifier may be used to indicate uncertainty about an origin status subrank.

1.17 EO Rank Factors

Because EO ranks are used to represent the relative conservation value of an EO as it currently exists, EO ranks are based solely on factors that reflect the present status, or quality, of that EO. Three EO rank factors have been identified, each reflecting what is currently known (in an ideal situation) about an EO: size, condition, and landscape context. These factors are used as the basis for estimating the viability of an EO, which is essentially its EO rank. Thus:

$$\text{Size} + \text{Condition} + \text{Landscape Context} \Rightarrow \text{Estimated Viability} \approx \text{EO Rank}$$

In order to ensure that EO ranks are based on the current information needed to assess estimated viability, efforts should be made to collect data on each of the EO rank factors (size, condition, and landscape context) during field survey work. The components of the three EO rank factors are summarized in Table 1.6 below.

Table 1.6 – EO Rank Factors and Components

FACTOR	COMPONENT	species	comm.
Size	area of occupancy	√	√
	population abundance	√	
	population density	√	
	population fluctuation (average population and minimum population in worst foreseeable year)	√	
Condition	reproduction and health (evidence of regular, successful reproduction; age distribution for long-lived species; persistence of clones; vigor, evidence of disease affecting reproduction/survival)	√	
	development/maturity (stability, old-growth)		√
	species composition and biological structure (richness, evenness of species distribution, presence of exotics)	√	√
	ecological processes (degree of disturbance by logging, grazing; changes in hydrology or natural fire regime)	√	√
	abiotic physical/chemical factors (stability of substrate, physical structure, water quality) [excluding processes]	√	√
Landscape Context	landscape structure and extent (pattern, connectivity, *e.g.*, measure of fragmentation/ patchiness, measure of genetic connectivity)	√	√
	condition of the surrounding landscape (*i.e.*, development/maturity, species composition and biological structure, ecological processes, abiotic physical/chemical factors)	√	√

1.18 Ranking EOs

1.18.1 Species

In order to rank species EOs, field data on the current size, condition, and landscape context of the occurrence are generally considered together. The criteria for what constitutes an “A”, “B”, “C”, and “D”-ranked EO are found in EO rank specifications for the Element. The specifications for each rank should provide criteria that address each of the rank factors, but in many cases, size is the primary factor influencing EO rank, with condition and landscape context used secondarily (or not at all for some vertebrates). This is because a large size (i.e., number) of breeding individuals would generally not occur without favorable a condition and landscape context, especially for relatively short-lived species. For species where little information on size is available to develop rank specifications (especially for many plants and invertebrates), condition and landscape context factors may be relied upon more heavily.

1.18.2 Ecological Communities

Because of the greater complexity of communities, due in part to the interaction of species and successional change, it is difficult to consider the influence of all three rank factors concurrently when determining an EO rank for a community. Thus, each rank factor (i.e., size, condition, and landscape context) is first assigned a separate "A", "B", "C" or "D" rating, based on current field data assessed according to criteria provided in the EO rank specifications for the Element. These ratings are then sequenced and weighted according to their relative influence on the viability of occurrences of the Element, which is also specified in the EO rank specifications. To simplify the process for determining an EO rank from separate factor ratings, the sequence and weightings to be applied to the ratings are incorporated in a combination rule matrix provided in the rank specifications. To determine a final EO rank, the ecologist simply looks up the assigned ratings values in the specified sequence in the matrix, which then corresponds to a suggested EO rank. The suggested EO rank can be either accepted or revised by the ecologist; in the latter case, an explanation of the reason(s) for revising the suggested EO rank should be specified.

2 Preparation for Biotics

Making the transition to Biotics involves an initial upload of the existing EO records to the new application. Included in this upload are both spatial and tabular attributes for the existing EOs. Once the initial upload is completed, all new EOs will be developed using Biotics.

Because Biotics incorporates the revised EO methodology, there are certain preparatory tasks that need to be completed by a program to ensure that existing EOs created under the previous methodology are accurately translated into the revised methodology. Some of these tasks involve decisions on the attribute values to be associated with each EO, which should be made by the program with assistance from the Biotics Team. This section describes the preparatory tasks and decisions necessary to successfully migrate to Biotics, including the preparation of spatial and tabular data for existing EOs, the process for digitizing EOs not yet in a GIS, and other decisions related to migration.

2.1 Preparation of Spatial EO Data

2.1.1 Migrating Locations of Existing EOs to Biotics

The process for translating the spatial locations of existing mapped EOs into features in Biotics varies according to how the occurrences have been mapped by the program (e.g., points vs. polygons, paper quadrangle maps vs. a GIS). Depending on the appropriate migration process, there are certain decisions to be made that will determine the spatial attributes of the EO and the underlying source feature(s). A summary of the processes for migrating the spatial locations of existing EOs (along with the required attribute decisions) follows in Table 2.1, organized according to how the EOs are currently mapped.

Table 2.1 – Summary of Methods for Migrating the Spatial Locations of Existing EOs

existing EOs	choices of methods for migrating existing EOs to Biotics			source feature type			possible conceptual feature type(s)			possible locational uncertainty type(s) *			
	source features to be created by importing lat/long coordinates from tabular data into Biotics	digitize source features in a GIS	digital theme to be imported into Biotics to create source features	point	line	polygon	point	line	polygon	negligible	linear	areal delimited	areal estimated
dots on paper quadrangle maps	X			X			X			X			X
lines on paper quadrangle maps	X			X			X						X
		X	X		X		X	X		X	X		
polygons on paper quadrangle maps	X			X			X						X
		X	X			X	X	X	X	X		X	
digitized points in a GIS			X	X			X			X			X
digitized lines in a GIS			X		X		X	X		X	X		
digitized polygons in a GIS			X			X	X	X	X	X		X	

*Features with areal estimated locational uncertainty will require an estimated uncertainty distance to be used for buffering the source feature.

Following are additional details on decisions related to feature types and locational uncertainty.

(a) Source Feature Type

Source features can be developed in Biotics by either importing lat/long coordinates from the tabular database, or by importing digital point, line, and/or polygon themes (see Section 2.1.4 for details on how to digitize EOs not yet in a GIS). In cases where the decision is made to simply import coordinates for line and/or polygon EOs drawn on paper quadrangle maps, resources may later be needed to replace the resulting point source features in Biotics with digitized lines/polygons that better represent the actual spatial extent of the EO.

Note that any point source features with negligible uncertainty, and all line source features, will have a procedural buffer applied (e.g., 6.25 m on a 1:24,000 scale map) in order to create an EO rep.

(b) Conceptual Feature Type

For point source features, the only option for conceptual feature type is a point. However, in cases where the decision was made to import line and/or polygon features from paper quadrangle maps into Biotics as source points, the conceptual feature type will need to be reevaluated if and when the point source features are replace with digitized lines and/or polygons.

For digitized line source features, a decision needs to be made whether the conceptual feature is a point or line, based on the underlying survey information. For digitized polygon source features, a decision needs to be made whether the conceptual feature is a point, line, or polygon, based on the underlying survey information.

(c) Locational Uncertainty Type

For all point source features, a decision needs to be made whether the locational uncertainty is negligible or areal estimated. While it is likely that most existing data will not meet the criteria for negligible uncertainty (i.e., locational variability ≤ 6.25 m on a 1:24,000 scale map), any EOs that do will have a procedural buffer applied to create EO reps. However, most existing EOs derived from point source features will have areal estimated uncertainty. In such cases an estimated uncertainty distance (to be used as a radius for buffering each source feature when developing an EO rep) needs to be specified. In most cases it is reasonable to assign distances based on the PRECISION value associated with each EO, and the program can either determine distances appropriate for their data, or utilize the guidelines provided in the previous methodology, approximately S=100 m; M=2000 m; G=8000-15,000 m (according to the Heritage Operations Manual, 1982 [updated 1988], developed by The Nature Conservancy). In other cases, it may be more accurate to specify a unique (custom) uncertainty distance on the basis of the underlying data for each EO.

For digitized line source features a decision needs to be made whether the locational uncertainty is negligible or linear. Similarly, for digitized polygon source features a decision needs to be made whether the locational uncertainty is negligible or areal delimited. Although it is likely that most existing line features will have associated linear uncertainty and most existing polygon features will have areal delimited uncertainty, some EOs may meet the criteria for negligible uncertainty.

Note that if a general decision is made for a group of EOs with the same PRECISION (e.g., all EOs with PRECISION = M will be imported as point source features with areal estimated uncertainty, and buffered using an uncertainty distance of 2000 m), then the import to Biotics can be done in batches with a select based on the PRECISION attribute.

2.1.2 Migrating Digitized Multi-Source (Complex) EOs

If existing EOs are comprised of multiple digitized features, there are certain preparatory steps that must be taken to ensure accurate import into Biotics. If the digitized source features that comprise a single EO are the same type (i.e., points, lines, or polygons) and have the same locational uncertainty type, then the set of features should be grouped into a region in ArcInfo (or into a multi-point feature or multi-ringed polygon in ArcView) and tagged with the appropriate EOCODE. Care should be taken to ensure that there is not more than a single record (e.g., region) for each EOCODE. In addition, when the Element has location use classes, it should be confirmed that each of the underlying source features that comprise a single EO has the same class.

If existing complex EOs are comprised of different types of source features, the Biotics preparation process becomes more complicated since features of different types often must be stored in separate themes (i.e., point theme, line theme, polygon theme). Complex EOs comprised of source features having different types of locational uncertainty also complicate the Biotics preparation process since these features cannot be bulk loaded into Biotics during the initial data transfer, but must be manually entered. Accordingly, programs should consult with the Biotics Team before processing complex EOs comprised of different types of source features and/or source features with different uncertainty types.

2.1.3 Other Decisions Related to the Migration of Existing EOs

In addition to the procedures for migrating locations of existing EOs to Biotics (described in Sections 2.1.1 and 2.1.2 above), there are other details related to source feature and EO attributes that need to be considered that may affect the upload of EO records. Descriptions of these items, along with the associated decisions that are required to ensure successful migration of the EOs to Biotics, follow.

a) Source Feature Decisions

- Observed Area – In cases when a SIZE value is indicated in the tabular record, a decision needs to be made whether this value should be entered as the observed area attribute for the underlying source feature after the Biotics import, provided the EO is comprised of a single source feature. Note that with Biotics, the procedural area (i.e., the GIS-calculated size of the EO rep including locational uncertainty) can be automatically calculated and stored in the spatial attribute table, but should not be used as the SIZE attribute in the tabular record (which is the actual size of the field observation, without added uncertainty).

- Observations – For programs that track observations, a decision needs to be made whether to include the data in the Biotics migration. If so, source features could potentially be created in Biotics. The "independent source feature" attribute would need to be checked to indicate that each feature is an "observation not a component of an EO", and associated attributes (i.e., observer, date, and data) would need to be entered for the source feature after import to Biotics.

b) EO Decisions

- Principal/Sub-EO Relationships – In cases when EOs are nested, a decision needs to be made whether sub-EOs should be created for each of the contained EOs. If so, the parent EO id (i.e., EOCODE) associated with each sub-EO would need to indicated in order to establish record linkages during the upload to Biotics. If reevaluation of the data shows that a contained EO has little associated information in the tabular record, it may be more appropriate to drop the EO, but retain the location and associated data as a component source feature of the EO that contains it.
- Archive Coverage – In cases when existing EOs represent Elements that are Watch Listed, partially EO tracked, or no longer EO tracked, a decision needs to be made whether such occurrences should be retained with the records for currently tracked EOs in Biotics, managed as a separate theme, or simply held in manual files. If such EOs are not to be included in the EO coverage in Biotics, they need to be removed from the EO data to be uploaded, and if determined to be useful, should be stored in a separate coverage that can be pulled up as a theme in Biotics as needed.

When existing EOs are evaluated according to the revised methodology during preparation for import to Biotics, values for other attributes may be obtained during the process. While not required for migration to Biotics, it may be more efficient to record this information when these initial evaluations are made rather than revisiting the records later. In some cases, it may be possible to load these attributes during the install; generally, however, the information will need to be entered later. Such attributes include, for EOs: estimated representation accuracy (RA), confidence extent, and the separation distance used to define principal EOs (stored as separation comments); for source features: location use class and feature label (see Section 3.2, Recording Additional New Attributes for more detailed information on these attributes).

2.1.4 Digitizing EOs Not Yet in a GIS

For some EOs that have not been digitized in a GIS (or even mapped on paper quadrangle maps), it may be desirable to digitize them for upload into Biotics. In order to ensure that digitized features associated with existing EOs are migrated to Biotics correctly, the features must be created according to certain guidelines. Following is a description of the guidelines for digitizing EOs in a GIS for eventual upload into Biotics.

a) Digitizing Features

- Digitize features without adding any buffers. For example, do not add uncertainty distance buffers (even those based on PRECISION values) or procedural buffers to point features. The digitized features will be used as the underlying source features for the EOs, and all buffers needed to create the EOs will be added to the features when they are uploaded into Biotics.

- When digitizing features, refrain from creating an unreasonable number of vertices; digitize an amount of vertices that is appropriate for the map scale utilized.

b) Grouping Features

- To group multiple polygon features with the same type of locational uncertainty to create a single EO, create either a multi-ringed polygon using ArcView or a region using ArcInfo.
- To group multiple point features with the same type of locational uncertainty to create a single EO, create a multi-point feature using ArcView.
- To group multiple line features with the same type of locational uncertainty to create a single EO, create a region using ArcInfo.
- If an EO is to be comprised of multiple features of different types (points, lines, polygons) and/or different types of locational uncertainty, programs should consult with the Biotics Team before grouping the features.

c) Non-Spatial Attributes in GIS Coverage

Attributes of the digitized features to be included in the GIS coverage are

- ELCODE
- EOCODE
- EONUM
- MAPPER (optional)
- MAPDATE (optional)
- locational uncertainty type
- uncertainty distance (for features with areal estimated uncertainty only)
- parent EO id (for sub-EOs only)
- spatial QC completed [yes/no]

In cases where new data are being digitized (and, thus, there is no existing EOCODE or EONUM for the feature), the EOCODE and EONUM columns can optionally be left blank in the GIS coverage, and an EOCODE will automatically be assigned by the system when the feature is uploaded into Biotics.

d) Spatial Attributes from BCD in GIS Coverage (optional)

If the spatial attributes associated with the features are to be recorded in Biotics exactly as they exist in the BCD (i.e., spatial attributes are not to be calculated by the GIS), the attributes and values from the BCD need to be included in the GIS coverage.

e) Uniqueness of Record

Confirm that there is only one spatial record for each EO; there cannot be more than one record with the same EOCODE.

2.2 Preparation of Tabular EO Data

In order to ensure that the tabular data associated with existing EOs are uploaded into Biotics correctly, there are certain fields in the EO records that should be checked. Any errors or omissions in these fields should be identified and corrected before the Biotics migration. If errors in tabular EO data are not identified until after the upload to Biotics, corrections will need to be made both in Biotics and the EO database (BCD or other), which is a duplication of effort. Following is a list of tasks to be completed in order to prepare tabular EO data for migration to Biotics.

a) Non-Spatial Attributes

Confirm that every record has valid data in the following fields:

- EOCODE
- EONUM
- MAPPER
- PRECISION

b) Spatial Attributes

Using a GIS, confirm that every record with PRECISION ≠ "U" has valid data in the following fields:

- LAT and LONG (specifically, confirm that the coordinates reference a point within the appropriate jurisdiction and within a more specific location [e.g., county, watershed])
- COUNTYCODE
- LOCALJURIS
- QUADCODE
- TOWNRANGE
- SECTION
- MERIDIAN
- WATERSHED
- Any other spatial attributes stored in OPTIONAL fields

If the values in the GIS are not the same as those in the tabular record, determine which is correct and make the required changes.

c) Least Rectangles

Decide how to migrate EOs with least rectangle coordinates that have not been digitized in a GIS.

The first option is to simply import the EOs as points using the LAT/LONG coordinates from the tabular data. These EOs would be imported into Biotics as point source features with areal estimated uncertainty. For this option, decide on the values for locational uncertainty and if appropriate, uncertainty distance, for each underlying source feature. (For a more detailed description of these decisions see Section 2.1.)

The second option is to develop EO reps using the least rectangle coordinates. These EOs would be imported into Biotics as polygon source features with areal delimited uncertainty. For this option, first check the least rectangle coordinates (as described in [e] above). Then, digitize a polygon for each EO using the least rectangle coordinates, and store them in a polygon or regions coverage. Finally, decide whether the conceptual feature type for each EO is a point, line, or polygon, based on the underlying survey information.

d) Unmappable EOs

Decide how to migrate existing EOs with a PRECISION = "U".

The first option is to not have them developed into EO reps during the initial migration to Biotics. For this option there is no required action; records having a PRECISION = "U" will not be loaded into Biotics. However, EO reps for these occurrences could later be created in Biotics after the system is in production.

The second option is to develop these occurrences into EO reps using the revised methodology. For this option, first decide how the EO would be digitized. This decision is most easily made by evaluating the underlying data and determining how the EO could be delineated, as follows:

- using a polygon (e.g., an EO location described as "in ___ county" could be represented using the boundary of that county);
- using a line (e.g., an EO location described as "in a stream" could be represented using the appropriate reach[es]); or
- using a point, because a polygon or line cannot be digitized based on the information available.

Next, digitize the feature according to guidelines provided in Section 2.1.4, Digitizing EOs Not Yet in a GIS. Then decide on the locational uncertainty type for the feature. If a point was digitized, the uncertainty type would be areal estimated and an uncertainty distance would need to be assigned (see Section 2.1 for a more complete description of locational uncertainty decisions). For the other features, generally if a polygon was digitized the locational uncertainty type would be areal delimited, and if a line was digitized the type would likely be linear. Finally, decide on whether the underlying conceptual feature type is a point, line, or polygon.

e) Geographic Manual File (GMF)

Decide how to organize the GMF so that information on a particular EO can be efficiently stored and located.

- Dominant quadcode – In programs where the GMF is currently organized using the dominant quadcode to reference which quadrangle in the GMF contains information (e.g., field forms) on a particular EO, this system will not work once the migration to Biotics is complete. Biotics automatically lists the quadcodes for an EO in the order in which the system encounters them in the theme containing that attribute; further, this order can change each time an EO rep is regenerated. As a result, specifying the dominant quadcode (that which contains the centroid of an EO) is no longer feasible.

  In order to resolve this issue, it is recommended that the program utilize an optional field (FILINGQUAD) in the tabular database (BCD or other) to store the quadcode that indicates where information on an EO is located in the GMF. This field is then populated with the dominant quadcode in records of existing EOs, which is uploaded into Biotics as a spatial attribute of the EO. (For new EOs later created in Biotics, this attribute would be automatically generated by the system based on the location of the centrum of the EO rep.) After the FILINGQUAD attribute in Biotics has an assigned value from the upload (or automatically generated, for new EOs), in order to ensure that this value does not change if the EO rep is subsequently regenerated the "recalculate" box will need to be manually unchecked.

- DOTNUM – In programs where the GMF is currently organized according to DOTNUM, this system will no longer be appropriate once the migration to Biotics is complete. Since DOTNUM will no longer be necessary or utilized in Biotics, another scheme for filing information needs to be developed (for example, organizing the GMF by quadcode or site).

3 Implementation of the Revised EO Methodology

Developing EOs according to the revised methodology will affect many aspects of heritage business, including the data that are collected in the field, the spatial and tabular attributes that are tracked for EOs, the method for mapping EOs, and the dataflow process for EO information. A description of the changes that a program would need to make in order to fully implement the revised EO methodology (regardless of whether an installation of Biotics is planned) is provided in this section. In addition, recognizing that full implementation of the revised methodology requires a level of rigor that may be difficult to attain all at once, this section also provides information on a recommended process for incrementally adopting the methodology.

3.1 Collecting Data on New Attributes

In addition to data that are currently collected (according to the previous methodology), there is other information that needs to be obtained during field surveys and recorded in the database in order to fully implement the revised EO methodology. The following additional data should be collected during field surveys:

a) EO Rank Factor Attributes

Current data on the EO rank factors (size, condition, and landscape context) should be collected and recorded in the tabular database for every potential occurrence in order to have the information needed to rank EOs using the revised methodology. Note that it may not be possible to obtain complete information on all three of the factors for some Elements. Brief descriptions of the EO rank factors are as follows:

- Size – A quantitative measure of the area and/or abundance of an EO. Components of this factor are
  - area of occupancy
  - population abundance, (i.e., total count or qualitative estimate, for species)
  - population density (for species)
  - population fluctuation (for species)

- Condition – An integrated measure of the quality of biotic and abiotic factors, structures, and processes within the EO. Components of this factor are
  - reproduction and health (for species)
  - development/maturity (for communities)
  - ecological processes
  - species composition and biological structure
  - abiotic physical/chemical factors

Landscape Context – An integrated measure of the quality of biotic and abiotic factors, structures, and processes surrounding the EO. Components of this factor are
  - landscape structure and extent, including genetic connectivity
  - development/maturity
  - ecological processes
  - species composition and biological structure
  - abiotic physical/chemical factors

b) Locational Attributes

Observed Area – The actual area of each observation, measured or estimated during field work. This information is an attribute of the source feature. For EOs comprised of a single source feature, this information is analogous to the SIZE attribute, currently collected and recorded under the previous methodology. However, for EOs comprised of multiple sources, it would be the sum of observed areas for all component source features that would correspond to the current SIZE attribute. This information may be useful in determining the type of observed feature, and thus conceptual feature, that should be used in developing an EO rep. In addition, observed area values may be useful in determining the appropriate estimated representation accuracy (RA) category.

Observed Length – The actual length of each observation, measured or estimated during field work. This information is an attribute of the source feature. This information may be useful in determining the type of observed feature, and thus conceptual feature, that should be used in developing an EO rep.

c) Additional Notes Related to Field Surveys

In order to best implement the EO spatial model, observations drawn on field maps should not include locational uncertainty; instead, boundaries should be mapped to represent only what was actually observed during the survey. Locational uncertainty will be incorporated later, once the source feature has been digitized and the locational uncertainty type specified.

Examples of general field survey forms for species and ecological communities can be found in Section 4, Appendix. These forms include both data currently collected under the previous methodology, as well as new information needed for implementation of the revised EO methodology. Use of such forms, customized by programs as appropriate for their needs, could help ensure that information required to apply the revised methodology is recorded during field surveys.

3.2 Recording Additional New Attributes

In addition to the new information to be collected during field surveys, various other attributes have been identified as necessary to fully implement the revised EO methodology. These additional attributes will need to be recorded in a tabular database, although if utilized, Biotics provides fields in which to record them.

For programs not using Biotics, all new attributes (including those described in Section 3.1 above) can be recorded in a separate database, in a spreadsheet, or even in manual files. If the database utilized is BCD, the attributes can be stored in EOR.OPT fields, if available. Attributes that relate to the underlying source feature(s) that comprise an EO (e.g., observed area, observed length) must be recorded in multi-valued fields and associated with the appropriate EO. In BCD, the optional fields used for source feature attributes should be those with associated multi-valued sets (specifically EOR.OPT fields 8, 9, 10 or 18, 19, 20). The additional attributes needed to fully implement the revised EO methodology are as follows:

a) EO Attributes

Estimated Representation Accuracy (RA) – The category of estimated representation accuracy should be recorded, selected from the following scale:

very high accuracy (>95%)
high accuracy (>80% - 95%)
medium accuracy (>20% - 80%)
low accuracy (0% - 20%)
unknown accuracy

Confidence Extent – Whether the full extent of occupied habitat or area of an EO is known should be recorded, as follows:

Y = confidence that the full extent of the EO is known
N = confidence that the full extent of the EO is <u>not</u> known

? = uncertainty whether the full extent of the EO is known

Size, Condition, and Landscape Context Ratings – "A", "B", "C", or "D" ratings assigned for each of the EO rank factors individually based on current field survey data, for communities only.

Separation Comments – Description of how EOs were delineated, including separation distance(s) used.

Parent EO ID – The identifier (i.e., EOCODE) of the parent principal EO, to be recorded for each sub-EO.

Multi-jurisdictional EO – An indication whether the EO crosses any jurisdictional boundaries:

Y = yes, the EO crosses at least one jurisdictional boundary

N = no, the EO does not cross any jurisdictional boundaries

unknown = uncertainty whether the EO is multi-jurisdictional

Multi-jurisdictional Spatial Rep – An indication whether the mapped representation delineates the full (multi-jurisdictional) extent of the EO:

Y = yes, the EO rep delineates the full extent

N = no, the EO rep does not delineate the full extent

unknown = uncertainty whether the EO rep delineates the full extent

Multi-jurisdiction Collab. Comments – Comments on collaborative efforts in data exchange and management between jurisdictions that share an EO.

Additional Inventory Needed – A checkoff indicating whether further inventory work is needed for the EO.

Additional Inventory Needed Comments – Comments related to the additional inventory work needed.

b) Source Feature Attributes

Conceptual Feature Type – The cartographic feature that would result from mapping the underlying field data, based on comparison of the size of the observed area with the minimum mapping unit for the scale map used:

point

line

polygon

Locational Uncertainty – Type of uncertainty associated with the location of the underlying field data, dependent on the amount and direction of uncertainty:

negligible
linear
areal delimited
areal estimated

Distance Class – If the locational uncertainty is areal estimated, the estimated uncertainty distance to be used as a radius for buffering each source feature should be indicated by selecting from the following distance classes (in meters):

>6.25 – 25
>25 – 50
>50 – 100
>100 – 200
>200 – 400
>400 – 800
>800 – 1500
>1500 – 4000
custom distance

If a custom distance is specified (i.e., a unique, single value rather than a range), the units for this distance must be specified.

Location Use Class – For migratory animal Elements that have classes, the Element location use class should be recorded for each source feature. Appropriate location use classes for an Element will be provided in the EO specifications.

Source Feature Label – Any label describing the source feature that would be useful to the program. This is particularly helpful in differentiating between the various source features that comprise a multi-source (complex) EO.

Digitizing Base – The base data used when digitizing the source feature (or a description of the accuracy of the coordinates if using GPS). Values are customizable by program, but may include the following:

1:24,000 quad – paper
1:24,000 quad – digital
1:50,000 NTS – paper
1:50,000 NTS – digital
1:250,000 NTS – paper
1:250,000 NTS – digital
1:30,000 Ortho Photo
10 meter Satellite Imagery
3 meter GPS

- Digitizing Comments – Comments that explain any anomalies regarding the digitizing of the source feature (e.g., "this source feature was created using a combination of GPS data and 1:24,000 quads")
- Mapping Comments – Comments related to how the source feature has been mapped. For example, the comments might explain that due to limited locational information, the west boundary of the source feature was generalized to a straight line. Mapping comments are more general than the digitizing comments, and are typically specific to the EO associated with that source feature.

Independent Source Feature – A checkoff indicating that the source feature is an independent observation (i.e., not a component of an EO).

Observer – Person(s) that conducted the field survey and recorded the observation.

Observation Date – Date the observation was made.

Observation Data – Information recorded on the observation.

c) Spatial Attributes

If the program is in the process of migrating to Biotics, it will not be necessary to manually record certain spatial attributes since the application has the capability to automatically calculate them based on available reference data (e.g., county, watershed, ecoregion, latitude/longitude for the reference point). However, if any of the underlying reference coverages to be used with Biotics have questionable accuracy, it may be desirable to manually record those spatial attributes rather than relying on the application to calculate them.
For programs not planning to move to Biotics, it will be necessary to manually record spatial attributes in appropriate fields in BCD or whatever database is being utilized.

3.3 Mapping New EOs

In order to fully implement the revised EO methodology, EOs should be mapped as polygons that are developed from mapped source features. Source features are essentially the fundamental units reflecting what was actually observed in the field, in most cases including locational uncertainty to give a better picture of where the observation might be located based on limitations of the spatial information. EO reps then build upon the source features, adding uncertainty if not yet included, adding procedural buffers based on limitations of the map due to scale, and grouping features according to biologically defined separation distances. Utilizing source features to develop EOs provides the means to retain and compare the initial locations of field observations with the final EO reps. In addition, for complex EOs, retaining the underlying source features as discrete units allows the linkage of selected attributes to each feature (as opposed to stringing them all together as a single attribute in the EO record, e.g., EO data).

There are slightly different processes for implementing the revised EO methodology when mapping new EOs, depending on whether the program is moving to Biotics, and if not, whether or not a GIS will be used to map EOs. These processes are described in the following three sections.

3.3.1 Mapping with Biotics

For programs moving to Biotics, the revised EO methodology will be fully adopted during transition to the application. All new EOs will then be mapped using Biotics, which will essentially walk the user through the process for developing EO reps according to the revised methodology. In addition, Biotics automatically creates and maintains separate themes for different feature types, along with associated attributes. In order to map a new EO using Biotics, the process is as follows:

a) Digitize and Evaluate Source Feature(s)

- digitize the appropriate source feature (point, line, or polygon), based on the size of the observed area (compared with the minimum mapping unit for the scale map being used), and the amount and direction of uncertainty associated with that location
- assign attributes to source feature by entering fields in source feature window
- if the source feature has areal estimated locational uncertainty, buffer with a graphic using the specified uncertainty distance class as the radius
- repeat the preceding three steps for each additional observed area for the Element
- evaluate separation distances (obtained from the EO specifications) between source feature(s) and other EO reps and independent source features of the same Element using circular graphics tool with diameter equal to appropriate separation distance
- indicate which feature(s) are to comprise an EO; when completed, remove uncertainty buffer graphics

b) Develop EO Reps

- based on the grouping of source features and their associated attributes, Biotics will automatically create EO reps, adding any uncertainty or procedural buffers as appropriate
- Biotics will automatically assign a unique identifier and calculate spatial attributes, storing them with the appropriate themes
- periodically, batch import the spatial attributes for EO reps into the tabular EO database (BCD or other), and batch export tabular attributes from the tabular database back into Biotics

3.3.2 Mapping in a GIS without Biotics Migration Intended

In order to fully implement the revised EO methodology using a GIS, all of the processes performed by Biotics must be replicated manually. More specifically, the steps to be executed in GIS are

a) Create and Maintain Separate Digital Themes

- point source feature theme
- line source feature theme

- polygon source feature theme
- EO rep theme
- EO rep point theme (optional)

b) Prepare for Storage of New Attributes

Source feature and EO attributes can be stored in whatever location best suits the program – either with the appropriate digital themes, or in a separate database or spreadsheet. However, if storage is in a separate database/spreadsheet, there must be the capability to associate the attributes with the appropriate theme. Further, there must be the ability to associate multiple source features and their attributes with a single EO. Attributes to be recorded during the process of digitizing source features and developing EO reps are as follows:

- source feature attributes:
    - ELCODE
    - conceptual feature type
    - locational uncertainty
    - uncertainty distance class
- attribute for EO reps:
    - EOCODE

Additional source feature and EO attributes (as described in Section 3.1 and 3.2 above) are recorded after the mapping process is complete. These attributes should also be included when the program sets up the fields for storing new attributes.

c) Digitize and Evaluate Source Feature(s)

- digitize the appropriate source feature (point, line, or polygon), based on the size of the observed area (compared with the minimum mapping unit for the scale map being used), and the amount and direction of uncertainty associated with that location
- assign attributes to source feature
- if the source feature has areal estimated locational uncertainty, apply uncertainty buffer using the specified uncertainty distance class as the radius
- repeat the preceding three steps for each additional observed area for the Element
- evaluate separation distances (obtained from the EO specifications) between source feature(s) and other EO reps and independent source features of the same Element

d) Develop EO Reps

- buffer any point or line features having negligible or linear locational uncertainty with a procedural buffer (½ the diameter of the minimum mapping unit, specifically 6.25 m on a 1:24,000 scale map)
- if creating a multi-source (complex) EO rep, group source features into a region in ArcInfo (or into a multi-ringed polygon in ArcView) based on the previous evaluation of separation distances

- assign EOCODE and calculate spatial attributes for the EO rep
- store values for the spatial attributes in the associated themes, or record in the tabular EO database (BCD or other)
- periodically, batch import the spatial attributes for EO reps into the tabular EO database (BCD or other), and batch export tabular attributes from the tabular database back into Biotics

3.3.3 Mapping on Paper Quadrangle Maps without Biotics Migration Intended

Implementing the revised EO spatial methodology without a GIS will be both challenging and a bit cumbersome. One of the impetuses behind development of the revised EO spatial methodology was to enable programs to utilize new technologies that would result in more consistent and accurate EO representations on a map. Continued use of paper maps for recording EO locations fails to capitalize on the tools available and compromises, to some degree, the quality of mapped EO data. However, there may be instances when moving to a GIS is not possible for some programs. In such cases, the revised EO spatial methodology could be implemented as follows:

a) Draw and Evaluate Source Feature(s)

- draw the appropriate source feature (point, line, or polygon), based on the size of the observed area (compared with the minimum mapping unit for the scale map being used), and the amount and direction of uncertainty associated with that location; there will need to be a method for labeling the source feature so that tabular attributes can be associated with it
- record attributes for source feature (i.e., ELCODE, conceptual feature type, locational uncertainty, and if appropriate, uncertainty distance class) in a separate database, a spreadsheet, or on a manual form
- if the source feature has areal estimated locational uncertainty, using a compass apply uncertainty buffer using the specified uncertainty distance class as the radius
- repeat the preceding three steps for each additional observed area for the Element
- evaluate separation distances (obtained from the EO specifications) between features and other EO reps of the same Element

b) Develop EO Reps

- buffer any point or line features having negligible or linear locational uncertainty with a procedural buffer (½ the diameter of the minimum mapping unit, specifically 6.25 m on a 1:24,000 scale map) using a compass; note that it may not be particularly difficult to apply a buffer of this size on paper maps unless they are at a scale smaller than 1:24,000
- if creating a multi-source (complex) EO rep, group source features into a single EO rep based on the previous evaluation of separation distances; there will need to be a method for indicating which source features are linked to the EO rep
- assign EOCODE and determine spatial attributes for the EO rep
- record values for the spatial attributes in the tabular EO database (BCD or other)

It is recognized that having both source features and EO reps on paper maps will result in very complicated maps. However, EOs mapped without underlying source features do not represent the revised methodology. Without source features, the attributes associated with each observation made in the field cannot, particularly in cases of complex (i.e., multi-source or multiple "patch") EOs, be linked easily to the appropriate specific location, and there is no way to simultaneously view and compare the original observation to the EO rep with added locational uncertainty.

One approach that could make mapping both source features and EOs more manageable and legible would be to draw only the source features on the paper maps, and then draw all EO reps on an acetate overlay. Although Mylar could also work as an overlay sheet, it does not photocopy well.

3.4 Incremental Implementation

The preferred approach to implementing the revised EO methodology is comprehensive – collecting, developing, and maintaining EO data with full rigor according to all guidelines provided in the methodology. This approach has been described throughout this document, and is what every program should aspire to in order to have EO data of the highest quality and consistency for leveraging effective conservation planning and action. However, for some programs an incremental approach to implementing the methodology may be more practical and achievable in the short term. In such cases, the level of rigor would increase over time until the revised EO methodology is fully incorporated.

Three tiers of information collection and management have been identified in an incremental approach to implementing the revised methodology. The implementation of "Tier 1 – Initial" is essential by any program beginning to adopt the methodology; the representation of EOs as polygons developed from source features and the most critical associated attributes forms the foundation of the spatial portion of the revised methodology. The remaining new EO and source feature attributes have been prioritized in "Tier 2 – Secondary" and "Tier 3 – Final". Programs should plan to add these attributes over time, selecting first those included in the second tier before moving to the third. The three tiers developed for use in adopting an incremental approach to implementation of the revised EO methodology are as follows:

Tier 1 - Initial

Map new EOs according to the revised EO methodology

Develop polygon principal EOs from source features corresponding to discrete observed areas		
Assign Conceptual Feature Type	• point • line • polygon	
Assign Locational Uncertainty Type	• negligible • linear	• areal delimited • areal estimated
Assign Estimated Uncertainty Distance Class (in meters)	• >6.25 – 25 • >25 – 50 • >50 – 100 • >100 – 200 • >200 – 400	• >400 – 800 • >800 – 1500 • >1500 – 4000 • custom distance (specify units)
Assign Estimated Representation Accuracy (RA) for principal EOs	• very high (> 95%) • high (>80% - 95%) • medium (>20% - 80%) • low (0% - 20%) • unknown	

Tier 2 - Secondary

Collect new attributes during field surveys

EO Rank Factor Information *(collected for each potential EO)*	
Size	• area of occupancy *for species:* • population abundance • population density • population fluctuation
Condition	• ecological processes • abiotic physical/chemical factors • species composition and biological structure *for species:* • reproduction and health *for communities:* • development/maturity
Landscape Context	• landscape structure and extent, including genetic connectivity • ecological processes • abiotic physical/chemical factors • development/maturity • species composition and biological structure

Locational Information *(collected for each source feature)*	
Observed Area	• area of each observation, measured or estimated • currently collected and recorded as SIZE under previous methodology • used to determine conceptual feature type
Observed Length	• length of each observation, measured or estimated • used to determine conceptual feature type

Record new attributes

EO Attributes	
Confidence Extent	• Y = confident full extent of EO is known • N = confident full extent of EO is <u>not</u> known • ? = uncertain if full extent of EO is known
Size, Condition, and Landscape Context Ratings for community EOs	• A = excellent • B = good • C = fair • D = poor
Separation Comments	• refer to EO specifications, if available • use 1 km minimum separation distance if no EO specifications available

Source Feature Attributes	
Location Use Class for some migratory animals	• appropriate classes are described in the EO specifications for the Element

Tier 3 - Final

Record New Attributes

EO Attributes	
Parent EO ID	• record the EOCODE of the parent principal EO for each sub-EO
Multi-Jurisdictional EO	• yes • no • ? *If Yes, specify:* • whether mapped representation delineates full extent of EO • collaboration comments
Additional Inventory Needed (and associated Comments)	• checkoff, indicates further inventory is needed for the EO

Source Feature Attributes	
Source Feature Label	• use labels to differentiate between multiple patches
Digitizing Base (and associated Digitizing or Mapping Comments)	• 1:24,000 quad – paper • 1:24,000 quad – digital • 1:50,000 NTS – paper • 1:50,000 NTS – digital • 1:250,000 NTS – paper • 1:250,000 NTS – digital • 1:30,000 Ortho Photo • 10 meter Satellite Imagery • 3 meter GPS
Independent Source Feature	• checkoff, indicates features are observations and are not components of an EO *If Yes, optionally specify:* • observer • observation date • observation data

Other

Inferred Extent (IE) Features	
Develop IE Features (for animals having a home range greater than the extent of the EO representation)	• create by buffering source features by IE distance provided in the EO specifications • store IE features in a separate layer

4 Appendix – Field Survey Forms

Following are examples of field survey forms for species and communities. These are intended to be generic forms that include data currently collected by most Heritage Programs, as well as new information needed for implementing the revised EO methodology. In many cases, programs may find it useful to customize the forms as appropriate to meet their needs.

SPECIES FIELD SURVEY FORM – EXAMPLE

SURVEY INFORMATION

Survey date _________ - _______ -______ (YYYY MM DD) | Time: from ______ am pm to ______ am pm | Weather conditions ___________________________

Surveyor(s) (first & last name[s], principal surveyor listed first) ____

____

Additional survey work needed? Y N if Y, explain ____

Previously sought at this location? Y N if Y, date of last survey ________ Previously found at this location? Y N if Y, date last observed _______

IDENTIFICATION

Scientific name ____

Common name ____

Identification problems? Y N if Y, explain ____

Photo/slide taken? Y N Where has photo/slide been deposited?____

Specimen/voucher collected? Y N Collection # ____________________ Repository ____

LOCATIONAL INFORMATION

DIRECTIONS: Provide detailed directions to the observation (rather than the survey site). Include landmarks, roads, towns, distances, compass directions.

____

____

____

____

____

Landowner contact ____________________________ Landowner comments ____

Site name ____ Managed area ____

County(ies):	USGS quadrangle name(s), and code(s), if known:	Township / Range / section / ¼ sec of ¼ sec:
____________________	____________________ ____________	____________________
____________________	____________________ ____________	____________________
____________________	____________________ ____________	____________________
Elevation ______________ m ft If elevation is a range: Minimum: ____________ m ft Maximum: ____________ m ft	If using a GPS unit: Latitude ______________________ Longitude______________________ Type of unit ______________________	UTM: Zone______________________ Northing ______________________ Easting ______________________ USFS sect/subsect ______________________

TOPOGRAPHIC MAP (mandatory)

1. Attach a photocopy of the appropriate part of a USGS topographic map (1:24,000 scale if available) and write the map scale on the photocopy. Please do NOT enlarge or reduce the map.
2. Indicate on the map the exact location of the observation(s):
   a. When the observed area is *no larger than a pen point* on the map (i.e., only a small number of individuals or extremely small patches), place <u>small points</u> on the map indicating the location(s) of the individuals or patches, and label each point with an arrow so they are more easily seen.
   b. When the observed area is *larger than a pen point* on the map, (e.g., a population of plants, foraging birds):
      (1) Draw a <u>thin solid boundary line showing the extent of the observed area</u> occupied by the individuals.
      (2) Indicate disjunct patches (polygons) by drawing the boundary for each patch separately.
      (3) If the boundary follows the edge of a lake, stream, road, marsh or other feature, draw the boundary <u>precisely on the edge</u> of the feature.
      (4) Where needed, add notes to the map with instructions on where the boundary line is located or if the boundary is shared with other observations.
3. A hand drawn sketch may be included for finer details.

LOCATIONAL CERTAINTY

Is your depiction of the observed area on the map within 6.25 m (approximately 20ft) of its actual location on the ground? Y N
If N, complete the following:

a. Estimate of uncertainty distance: based on landmarks, elevation, etc., the location of the observed area on the map is accurate to within ___________ meters kilometers feet miles of its actual location on the ground.

b. Is the observed area known to be located within some feature(s) on the map (e.g., wetland boundary, lake, road, trail, highway, contour lines)? Y N
If Y, indicate the boundary within which the observed area is known to be located on the map with a <u>dashed line</u>, and if applicable, identify the feature ________________________________ (e.g., marsh).

FIELD DATA FOR THE ELEMENT

CONFIDENCE EXTENT

Indicate whether there is confidence that the observed area represents the full extent of occupied habitat or area for the Element at that location.

Y N ? (Y = confidence that the full extent is known; N = confidence that the full extent is not known; ? = uncertainty whether full extent is known)

Animals

AGE STRUCTURE

by type of individuals observed, if known
(e.g., pair, adult, male, female, juvenile, chick, nest, hatchling):

observation type	*actual # observed*	*# estimated*
____________	________	________
____________	________	________
____________	________	________
____________	________	________
____________	________	________
____________	________	________

Census technique
____
____

Basis for estimate______________________________
____
____

Kind of observation: sight song/vocalization road kill trapped
other (explain)______________________

Location use class, if appropriate (e.g., breeding, nonbreeding)
____

Site use (e.g., foraging, roosting) ______________________

Feature label (e.g., den, tracks) ______________________

Plants

PHENOLOGY

indicate # (or use checkmark to indicate presence if # unknown)

- in leaf ____________
- in bud ____________
- in flower ____________
- immature fruit ____________
- mature fruit ____________
- seed dispersing ____________
- dormant ____________
- seedling ____________

Color of flowers (if observed) __________________

Do other members of this genus or look-alike plants co-occur at this survey site? Y N if yes, explain
____
____

Animal pollinators______________________________
____

Density description (e.g., scattered, dense clumps, evenly distributed)
____
____

Feature label (e.g., deme)__________________________

SIZE - a quantitative measure of the area and/or abundance of the Element at the observed location. Components of size are 1) area of occupancy, 2) population abundance, 3) population density and 4) population fluctuation.

Observed area / area of occupancy _____ sq. meters hectares sq. feet sq. yards acres sq. miles *Type of measurement:* precise estimate

Observed length __________ meters kilometers feet miles *Type of measurement:* precise estimate

Animals

Abundance:

total # of individuals __________ precise count estimate

Plants

Abundance (total size of the observation):

ramets (total # of individuals) __________ precise count estimate

genets (total # of groups) __________ precise count estimate

Census technique____

Basis for estimate____

Population density (if practical): #________ per unit: sq. meters hectares sq. feet acres sq. miles

Does population fluctuate? (may be particularly relevant to invertebrates and seed banking plants) Y N ? Explain______________________
____
____

CONDITION - an integrated measure of the quality of biotic and abiotic factors, structures and processes within the observed area, and the degree to which they may affect the continued existence of the Element at that location. Components of condition for species are: 1) reproduction and health, 2) species composition and biological structure, 3) ecological processes, and 4) abiotic physical/chemical factors. Factors to consider include evidence of regular successful reproduction, richness/distribution of species, presence of exotic species, degree of disturbance, changes to ecological processes, stability of substrate, and water quality.

Evidence of reproduction? Y N if Y, describe____________________

Evidence of disease, predation, injury? Y N if Y, describe____________________

List associated taxa, species, and plant communities within the observed area ____________________

Comment on evenness of species distribution within the observed area____________________

List any exotics present within the observed area and describe resulting impacts____________________

Comment on evidence of existing disturbance (either natural or caused by humans) and changes to ecological processes (e.g., hydrologic and fire regimes) within the observed area

General Habitat: Information on abiotic physical/chemical factors of specific habitat or micro habitat within the observed area. (circle all that apply)

Slope:	Aspect:	Moisture:	Light:	Topographic position:
flat 0-10 10-35 35+ vertical	N NE E NW S SE W SW	hydric (inundated) wet-mesic (saturated) mesic (moist) dry-mesic xeric (dry)	open partial filtered shade	crest upper slope mid slope lower slope bottom

Describe other abiotic factors within the observed area, including land forms, aquatic features, soils/substrate, geological formations, and water quality.

LANDSCAPE CONTEXT - an integrated measure of the quality of biotic and abiotic factors, structures and processes surrounding the observed area, and the degree to which they may affect the continued existence of the Element at that location. Components of landscape context for species are: 1) landscape structure and extent, 2) condition of the surrounding landscape (i.e., community development/maturity, species composition and biological structure, ecological processes, and abiotic physical/chemical factors.) Factors to consider include connectivity, fragmentation/patchiness, stability/old growth of communities, richness/distribution of species, presence of exotic species, degree of disturbance, changes to ecological processes, stability of substrate, and water quality.

Comment on connectivity of the observation with other surrounding occurrences of the Element, including relative fragmentation/patchiness

LANDSCAPE CONTEXT (continued)

List taxa, species, and plant communities in area surrounding the observation_______________

____

Comment on stability/old growth of communities in area surrounding the observation _______________

____

Comment on evenness of species distribution in area surrounding the observation _______________

____

List any exotics present in area surrounding the observation _______________

____

Comment on evidence of existing disturbance (either natural or caused by humans) and changes to ecological processes (e.g., hydrologic and fire regimes) in area surrounding the observation

____

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____

General Habitat: Information on abiotic physical/chemical factors of specific habitat or micro habitat surrounding the observation. (circle all that apply)

Slope:	Aspect:	Moisture:	Light:	Topographic position:
flat 0-10 10-35 35+ vertical	N NE E NW S SE W SW	hydric (inundated) wet-mesic (saturated) mesic (moist) dry-mesic xeric (dry)	open partial filtered shade	crest upper slope mid slope lower slope bottom

Describe other abiotic factors in area surrounding the observation, including land forms, aquatic features, soils/substrate, geological formations, water quality.

____

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MISCELLANEOUS DATA

PAST IMPACTS on the Element, both within and surrounding the observed area (e.g., grazing, logging, mining, plantations, ATVs, dumping)

____

____

MANAGEMENT, MONITORING and RESEARCH NEEDS for the Element at this location (e.g., burn periodically, open the canopy, ensure water quality, control exotics, ban ATVs, study effects of browsing)

____

____

____

PROTECTION NEEDS for the Element at this location (e.g., protect the entire marsh, the slope and crest of slope)_______________

____

____

ADDITIONAL COMMENTS: _______________

____

____

Data sensitive? Y N Sourcecode _______________ Best reference _______________

ECOLOGICAL COMMUNITY FIELD SURVEY FORM – EXAMPLE

SURVEY INFORMATION

Survey date ________ - _______ - ______ (YYYY MM DD)	Time: from ______ am pm to ______ am pm	Weather conditions __________________________

Surveyor(s) (first & last name[s], principal surveyor listed first) ____

____

Additional survey work needed? Y N if Y, explain ____

Previously sought at this location? Y N if Y, date of last survey _______ Previously found at this location? Y N if Y, date last observed_________

IDENTIFICATION (Identify community if known positively, or provide closest alliance/association if not known)

Closest Alliance or State/Subnational type ____

Closest Association or Provisional name ____

Classification problems? Y N if Y, explain ____

Photo/slide taken? Y N Where has photo/slide been deposited?__________________________ If associated plot, reference #__________________

LOCATIONAL INFORMATION

DIRECTIONS: Provide detailed directions to the observation (rather than the survey site). Include landmarks, roads, towns, distances, compass directions.

____

____

____

____

____

Landowner contact ___________________________ Landowner comments ______________________________

Site name ____ Managed area ______________________________

County(ies):	USGS quadrangle name(s), and code(s), if known:	Township / Range / section / ¼ sec of ¼ sec:
Elevation ______________ m ft If elevation is a range: Min: ____ m ft Max: ____ m ft Via: topo map altimeter DEM GPS	If using a GPS unit: Latitude ________________________ Longitude________________________ Type of unit ________________________	UTM: Zone________________________ Northing ________________________ Easting ________________________ USFS sect/subsect ____________________

TOPOGRAPHIC MAP (mandatory)

1. Attach a photocopy of the appropriate part of a USGS topographic map (1:24,000 scale if available) and write the map scale on the photocopy. Please do NOT enlarge or reduce the map.
3. Indicate on the map the exact location of the observation(s):
   a. When the observed area is *no larger than a pen point* on the map (i.e., extremely small patches), place small points on the map indicating the location(s) of the patches, and label each point with an arrow so they are more easily seen.
   b. When the observed area is *larger than a pen point* on the map:
      (1) Draw a thin solid boundary line showing the extent of the observed area for the community.
      (2) Indicate disjunct patches (polygons) by drawing the boundary for each patch separately.
      (3) If the boundary follows the edge of a lake, stream, road, marsh or other feature, draw the boundary precisely on the edge of the feature.
      (5) Where needed, add notes to the map with instructions on where the boundary line is located or if the boundary is shared with other observations.
4. A hand drawn sketch may be included for finer details.
5. Indicate whether aerial photos are available for reference:____.

LOCATIONAL CERTAINTY

Is your depiction of the observed area on the map within 6.25 m (approximately 20ft) of its actual location on the ground? Y N
If N, complete the following:

b. Estimate of uncertainty distance: based on landmarks, elevation, etc., the location of the observed area on the map is accurate to within ___________ meters kilometers feet miles of its actual location on the ground.

b. Is the observed area known to be located within some feature(s) on the map (e.g., wetland boundary, lake, road, trail, highway, contour lines)? Y N
If Y, indicate the boundary within which the observed area is known to be located on the map with a dashed line, and if applicable, identify the feature ____.

FIELD DATA FOR THE ELEMENT

CONFIDENCE EXTENT

Indicate whether there is confidence that the observed area represents the full extent of the community Element at that location. Y N ?

(Y = confidence that the full extent is known; N = confidence that the full extent is not known; ? = uncertainty whether full extent is known)

QUALITATIVE ASSESSMENT OF THE ELEMENT:

Provide a brief "word picture" of the community. Describe variation within the observed area in terms of vegetation structure and environment. Describe dominant and characteristic species and any inclusion communities. If a mosaic, describe spatial distribution and associated community types.

____

____

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QUALITATIVE DESCRIPTION OF THE ELEMENT:

Structure:

- Forest (closed tree canopy)
- Woodland (open tree canopy)
- Shrubland
- Herbaceous (<25% woody layers)
- Sparse vegetation (<10% cover of vascular plants)

Leaf phenology (dominant stratum):

- generally evergreen-dominated
- generally mixed (about 25 – 75% each)
- generally deciduous-dominated
- herb – perennial
- herb – annual

Density:

	Tree canopy	Shrub layer	Herb layer
closed			
open			
patchy			
sparse			
absent			

QUANTITATIVE VEGETATION DATA FOR THE ELEMENT:

STRATA	COVER CLASS	DOMINANT SPECIES
T2 -Tree Canopy		
T3 - Subcanopy		
S1 - Tall Shrub		
S2 - Low Shrub		
H - Herb		
N - Nonvascular		
V - Vine		
E - Epiphyte		

Cover Class *

1	trace
2	0.1 – 1%
3	1 – 2%
4	2 – 5%
5	5 – 10%
6	10 – 25%
7	25 – 50%
8	50 – 75%
9	75 – 95%
10	>95%

*this is a widely-used scale included as a guideline

Method used (e.g., ocular estimation, quantitative transect, plot)______________________________

____

Feature label (e.g., old growth) ______________________________

Note: *For recording more detailed information on species composition and cover/abundance class by stratum, see last page of survey form.*

SIZE - a quantitative measure of the area of the Element at the observed location.

Observed area _____ sq. meters hectares sq. feet sq. yards acres sq. miles *Type of measurement:* precise estimate

Basis for estimate______________________________

CONDITION - an integrated measure of the quality of biotic and abiotic factors, structures and processes within the observed area, and the degree to which they may affect the continued existence of the Element at that location. Components of condition for species are: 1) development/maturity, 2) species composition and biological structure, 3) ecological processes, and 4) abiotic physical/chemical factors. Factors to consider include evidence of stability/presence of old growth, richness/distribution of species, presence of exotic species, degree of disturbance, changes to ecological processes, stability of substrate, and water quality.

Evidence of stability/old growth? Y N if Y, describe ______________________________

____

Evidence of disease, predation, injury to composite species? Y N if Y, describe ______________________________

____

List associated taxa, species, and plant communities within the observed area ______________________________

____

____

Comment on evenness of species distribution within the observed area ______________________________

____

____

____

Natural and Anthropogenic Disturbance: Information on existing disturbance(s) (either natural or caused by humans) within the observed area

- logging
- grazing/browsing
- agriculture
- mining
- dumping
- trails/roads
- ORV/vehicular disturbance
- plant disease ______________
- insect damage ______________
- exotic animal activity (e.g., hog, nutria) ______________
- exotic plants ______________
- erosion
- fire
- wind/ice damage
- other ______________

Comment on existing disturbance(s) and changes to ecological processes (e.g., hydrologic and fire regimes) within the observed area ______________

____

____

____

Comment on exotics present within the observed area and describe resulting impacts ______________________________

____

General Habitat: Information on abiotic physical/chemical factors of specific habitat or microhabitat within the observed area. (check all that apply)

Slope:

Measured Slope ________° ________%

Flat	0°	0%
Gentle	0 - 5°	1–9%
Moderate	6 – 14°	10–25%
Somewhat steep	15 – 25°	26–49%
Steep	27 – 45°	50–100%
Very Steep	45 – 69°	101–275%
Abrupt	70 – 100°	276-300%
Overhanging/sheltered	>100°	>300%

Aspect:

Measured Aspect _____° (N = 0°)

Flat	
Variable	
N	338 – 22°
NE	23 – 67°
E	68 – 112°
SE	113 – 157°
S	158 – 202°
SW	203 – 247°
W	248 - 292°
NW	293 - 337°

Topographic position:

- Ridge, summit, or crest
- High slope (upper slope, convex slope)
- Midslope (middle slope)
- Lowslope (lower slope, footslope)
- Toeslope (alluvial toeslope)
- Low level (terrace)
- Channel
- other ______________

Geology:

Igneous Rocks:

- Granitic (Granite, Schyolite, Syenite, Trachyte)
- Dioritic (Diorite, Dacite, Andesite)
- Gabbroic (Gabbro, Basalt, Pyroxenite, Peridotite, Diabase, Traprock)
- other ______________

Sedimentary Rocks:

- Conglomerates and Breccias
- Sandstone and Conglomerate
- Siltstone (calcareous or noncalcareous)
- Limestone and Dolomite
- Gypsum
- other ______________

Metamorphic Rocks:

- Felsic Gneiss and Schist (Granitic)
- Mafic Gneiss and Schist
- Slate and Phyllite
- Marble
- Ultramafic (Serpentine)
- Metasedimentary
- other______________

Geology (continued):

Organic Deposits:
- Peat (with clear fibric structure)
- Muck
- Marsh (high mineral content due to regular flooding by lake or river)
- other ______________________

Slope & Modified Deposits:
- Talus and scree slopes
- Colluvial
- Solifluction, landslide
- other ____________

Aeolian Deposits:
- Dunes
- Aeolian sand flats
- Cover sands
- other ____________

Other:
- Unconsolidated Sediments (e.g., coastal plain sediments)
- River-deposited Sediments
- other ___________________

Soil Depth ______ cm (avg)

Surface Soil:
- Sand
- Loamy sand
- Sandy clay
- Loam
- Silt loam
- Clay loam
- Sandy loam
- Silt
- Silty clay
- Clay
- Organic
- other ___________

Soil Series ___________

Hydrologic Regime:

Wetlands:
- Intermittently flooded
- Permanently flooded
- Semipermanently flooded
- Temporarily flooded (e.g., floodplains)
- Seasonally flooded (e.g., seasonal ponds)
- Saturated (e.g., bogs, perennial seeps)
- Unknown

Non-Wetlands:
- Mesic (moist)
- Dry-Mesic
- Xeric (dry)

Groundcover:
(with >5% cover, 20 m x 20 m area)

_______% Bedrock
_______% Wood (>1 cm)
_______% Litter, duff
_______% Large rocks (cobbles, boulders >10cm)
_______% Small rocks (gravel, 0.2–10 cm)
_______% Sand (0.1–2 mm)
_______% Bare soil
_______% other
__________ (total = 100%)

Light:
- Open
- Partial
- Filtered
- Shade

Cowardin System:
- Upland
- Riverine
- Lacustrine
- Palustrine

Landform:

alluvial fan	cuesta	hills	periglacial boulderfield	slide
alluvial flat	debris slide	hills bedrock outcrop	piedmont	slope
alluvial terrace	desert pavement	hogback	pinnacle	stream terrace (undifferentiated)
badlands	dike	hoodoo	plain	streambed
basin	dune (undifferentiated)	lava flow (undifferentiated)	plateau	talus
basin floor	dune field	ledge	ravine	toe slope
bench	fan piedmont	mesa	ridge	valley
butte	fault scarp	mid slope	ridgetop bedrock outcrop	valley floor
canyon	fault terrace	mountain valley	rim	other
cliff	gap	mountain(s)	scarp	______________________
colluvial shoulder	gorge	mountain-valley fan	scarp slope	______________________
colluvial slope	gulch	noseslope	seep	

Describe other abiotic factors within the observed area, including geological formations, aquatic features, and water quality. [Programs should define a checklist for each of these factors that is appropriate for their jurisdiction.]

____
____
____
____
____
____

LANDSCAPE CONTEXT - an integrated measure of the quality of biotic and abiotic factors, structures and processes surrounding the observed area, and the degree to which they may affect the continued existence of the Element at that location. Components of landscape context for species are: 1) landscape structure and extent, 2) condition of the surrounding landscape (i.e., community development/maturity, species composition and biological structure, ecological processes, and abiotic physical/chemical factors.) Factors to consider include integrity/fragmentation/, stability/old growth, richness/distribution of species, presence of exotic species, degree of disturbance, changes to ecological processes, stability of substrate, and water quality.

Comment on the relative integrity/fragmentation of the Element

____
____

List taxa, species, and plant communities in area surrounding the observation______________________________

____
____

LANDSCAPE CONTEXT (continued)

Comment on stability/old growth of communities in area surrounding the observation ______________________________

____

Comment on evenness of species distribution in area surrounding the observation ______________________________

____

Comment on evidence of existing disturbance (either natural or caused by humans) and changes to ecological processes (e.g., hydrologic and fire regimes) in area surrounding the observation

____

____

Comment on exotics present in area surrounding the observation and describe resulting impacts ______________________________

____

____

General Habitat: Describe abiotic factors in area surrounding the observation, such as slope, aspect, topographic position, geology, soils/substrates, hydrologic regime, groundcover, light, Cowardin system, land forms, aquatic features, soils/substrate, geological formations, and water quality.

____

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MISCELLANEOUS DATA

PAST IMPACTS on the Element, both within and surrounding the observed area (e.g., grazing, logging, mining, agriculture, ORVs, dumping)

____

____

____

____

MANAGEMENT, MONITORING and RESEARCH NEEDS for the Element at this location (e.g., burn periodically, open the canopy, ensure water quality, control exotics, ban ORVs, study effects of browsing)

____

____

____

____

PROTECTION NEEDS for the Element at this location (e.g., protect the entire marsh, the slope and crest of slope) ______________________________

____

____

____

ADDITIONAL COMMENTS: ______________________________

____

____

____

Data sensitive? Y N Sourcecode ______________________________ Best reference ______________________________

SPECIES COMPOSITION AND COVER/ABUNDANCE CLASS BY STRATUM (enter values for each stratum AND for Total Cover)

SPECIES	C	Total	T2	T3	S1	S2	H	N	V	E

Column "C" is a checkoff indicating that the plant was collected

"Total" is the cover value for the species in all strata combined

Strata

- T2 = canopy
- T3 = subcanopy
- S1 = tall shrub
- S2 = low shrub
- H = herb
- V = vine
- E = epiphyte

Cover Class *

1	trace	6	10 – 25%
2	0.1 – 1%	7	25 – 50%
3	1 – 2%	8	50 – 75%
4	2 – 5%	9	75 – 95%
5	5 – 10%	10	>95%

* this is a widely-used scale included as a guideline

Use additional pages if necessary.