NatureServe
A Network Connecting Science With Conservation

EO Specs: Separation Distance for Animals

Version 1.0 (29 October 2004)

1. Movement Data and Determination of Separation Distance

Ideally, separation distances should yield occurrences that are, for all practical purposes, demographically independent. Thus separation distances should be based on information on the dispersion patterns and dispersal characteristics of a species or group of related species ("EO Specs Group"). Unfortunately, adequate information on these characteristics does not exist for most species. However, even when data are available, there is no single, strictly correct measure for identifying "independent" populations or metapopulations. Demographic and genetic connections among populations form a continuum rather than discrete categories. Additionally, due to often substantial ecogeographic and temporal variation in average or modal movement characteristics of a species, and variations resulting from differences in study methods, any particular data set is not necessarily the best reflection of a species' or group's movement characteristics or an ideal basis for separation distance determination. So separation distance generally must reflect dispersion patterns and movement characteristics in a general way rather than as a precise mathematical outcome of specific data. Consequently, in element occurrence specifications, certain somewhat standardized separation distances (e.g., 5, 10, 15, 20 km) have been adopted. Although separation distances are necessarily fairly arbitrary, they do generally attempt to reflect mobility similarities and differences among species or groups of species, except in the case of birds and other highly mobile species for which separation distances must be much smaller than movements would indicate such that occurrences are of practical size for conservation purposes (such occurrences do not attempt to represent populations or metapopulations).

2. Minimum Suitable-Habitat Separation Distance

For most species, occupied locations separated by short distances of suitable habitat not known to be occupied generally do not represent discrete populations; usually the intervening area is occupied (if not in the short-term then usually over a period of several years), or at least it is not a significant discontinuity between populations. Thus the minimum suitable-habitat separation distance should not be too small. Accordingly, the minimum suitable-habitat separation distance is 3-5 kilometers for most species and groups, and 1 or 2 kilometers for only the most sedentary ones. (The standardized minimum separation distance for suitable and unsuitable habitat is 1 kilometer; see EO Data Standard.) These values, though necessarily arbitrary, are intended to reduce the incidence of inadvertent splitting of populations and metapopulations into multiple occurrences.

3. Habitat Suitability and Occurrence Separation

The following definitions have been adopted for distinguishing suitable and unsuitable habitat:

Suitable: habitat capable of supporting reproduction or used regularly for feeding or other essential life history functions; a habitat in which you would expect to find the species (assuming appropriate season and conditions); includes marginally suitable habitat that is contiguous with clearly suitable habitat.

Unsuitable: habitat through which the species may successfully disperse but that cannot support reproduction or long-term survival.

Use the following guidelines to determine whether to use the separation distance for suitable habitat or unsuitable habitat when circumscribing occurrences:

	Habitat thoroughly surveyed	**Habitat inadequately surveyed**
Apparently suitable	Suitable	Suitable
Suitability uncertain	Unsuitable	Suitable
Apparently unsuitable	Unsuitable	Unsuitable

Note that treatment of inadequately surveyed habitat as suitable or unsuitable depends on a subjective assessment of whether or not the habitat is likely to be suitable. If the habitat seems to be more likely to be suitable than unsuitable, or if suitability is completely unknown, treat it as suitable.[1]

4. Overriding the Separation Distance Criteria

Circumstances occasionally indicate that patches of occupied habitat (i.e., source features) that are farther apart than the nominal separation distance should be joined as parts of a single occurrence. For example, if the separation distance for a riverine species is 10 km and patches of occupied habitat along a river are known to be sequentially separated by distances of 5, 8, 7, 9, 2, 4, 12, 6, 3, 5, and 8 km, and there are no barriers present and no reason to believe that more than one population is involved, then it makes biological sense to include all of the patches along the river in a single occurrence despite the existence of a gap that is in excess of the separation distance. Similarly, with arid country taxa especially, but also others, it is reasonable to cluster all populations in an obvious landscape feature such as a canyon or along a stream as one occurrence even if the separation distances are somewhat violated. Joining as a single occurrence patches that are beyond the separation distance is particularly appropriate when the apparent gap that exceeds the separation distance has not been adequately surveyed.

[1] In contrast, botanists in the heritage network treat habitat of unknown suitability as unsuitable [explanation to be added]

Separation distances should be overridden only when professional consensus indicates that it is more biologically appropriate to do so than to establish multiple occurrences. Additionally, as a general rule, patches of occupied suitable habitat that are more than approximately 1.5 times the separation distance from the nearest occupied patch should not be recorded as parts of the same occurrence. However, in vast, relatively uniform landscape units for which survey data are sparse, the nominal separation distance may be increased even further, if it is more biologically reasonable to do so than to establish multiple occurrences.

If it appears that overriding the separation distance seems to be appropriate on a regular basis, please contact the responsible NatureServe staff in order to discuss the possibility of increasing the separation distance. Changing a separation distance may affect occurrences and data management in multiple states/provinces, so changes are made only if deemed appropriate by consensus of responsible NatureServe staff and affected subnational jurisdictions.

5. Alternative Separation Procedures

For some species (or EO specs groups), occurrence separations may be based on an alternative procedure rather than the two usual distance values (for suitable and unsuitable habitat). For example, occurrence specifications may provide separation distance values for more than two categories of habitat, or they may employ a qualitative method (e.g., based on hydrographic units or population migration patterns) rather than numerical distances for distinguishing occurrences. For some highly mobile, occurrence-tracked species for which locational data are typically recorded as points or tiny polygons (e.g., bald eagle nests), EO specifications may indicate that every location or territory qualifies as an occurrence. This simplified procedure may be particularly appropriate for species characterized by a large number of locations over a wide area. For these, appropriate numerical separation distances would be very large and occurrences would be impracticably large for all but the most esoteric uses. Using a small separation distance would yield smaller but completely arbitrary occurrences, and ranking these would be meaningless.

6. Separation Distance and Occurrence Mapping

Separation distance does not affect how occupied patches of habitat (source features) are mapped, but it does alter how these patches are allocated among occurrences. For example, two distinct occupied patches that are separated by a gap of 4 kilometers are mapped as two polygons regardless of whether the separation distance is 3 kilometers or 5 kilometers. With a 3-kilometer separation distance, they would represent two occurrences, whereas a 5-kilometer separation distance would yield one occurrence with multiple polygons. Occurrence boundary delineation is a process that is independent of separation distance; see “Mapping Guidelines.”

EO Specs: Mapping Guidelines for Animals

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1. Mapping Occurrences

Occurrence mapping usually involves the translation of point locations (e.g., collection sites, locations of brief observations) into one or more polygonal source features. A basic guideline for occurrence mapping is that mapped features should be based on what we know rather than what we suspect about the distribution of a species in an area. Documented observation locations are the primary basis for mapping an occurrence. Interpolation (mapping of habitat between adjacent known points or locations) usually is appropriate, whereas extrapolation (mapping of areas outside the known locations) should be limited. Thus mapped occurrences generally are conservative representations of occupied (or formerly occupied) habitat (contrast with Inferred Extent; see section 2).

Occurrence mapping often is not as straightforward as it may sound. Over the years, biologists in the heritage network have adopted a wide range of protocols to address ambiguous mapping situations. Some highly conservative approaches map only points that represent known collection or observation locations. Others regard one or a few observations as an appropriate basis for mapping a large patch of suitable habitat as the occurrence. Given identical information, different biologists may produce dramatically different mapped occurrences. Such inconsistencies confound multijurisdictional status assessments and inhibit effective range-wide conservation planning. To increase mapping consistency across the network, we here recommend some standardized mapping policies. These recommendations cover some frequently encountered mapping situations, but the wide range of potential circumstances makes it impossible to cover all mapping situations. We anticipate that ad hoc mapping decisions will remain a common practice, but we encourage those who have adopted policies for situations not covered by this document to share their experiences with other programs (e.g., via the zoology listserve).

A. Map the whole patch or not?

A single location in a small patch of suitable habitat may be sufficient to justify mapping the entire patch as the occurrence. For any patch that is not larger than a typical or average home range size or (for species with limited mobility) not longer than an ordinary dispersal distance, the entire patch should be mapped as the occurrence. Information on home range size or dispersal characteristics (if available) can be found in the EO Specifications or Characterization files for each species or EO Specs group.

The appropriate size of the mapped occurrence becomes ambiguous in situations characterized by just one or a few locations in a small portion of a large patch of contiguous suitable habitat (larger than the typical or average home range size). In such cases, we recommend that the occurrence be mapped as a polygon that minimally includes all locations that are not separated by a gap larger than the separation distance. In addition, depending on locational uncertainty, this polygon may also include a variable amount of suitable habitat outside a minimum convex

polygon defined by available observation locations. However, if the area of the mapped feature includes more than 70 percent of the total contiguous area of suitable habitat, then include the entire patch of suitable habitat in the occurrence, using unsuitable habitat to define the boundary. *Note*: The value of 70 percent serves as an arbitrary threshold deemed appropriate as an indicator that, for all practical purposes, the entire patch likely is occupied.

The boundaries of patches of occupied suitable habitat sometimes can be readily identified by their abrupt transitions into adjacent areas of unsuitable habitat (e.g., wetland/upland edge, or a forest/grassland edge). In other situations, suitable habitat may grade gradually into unsuitable habitat. In these latter circumstances, occurrences should include only suitable habitat and contiguous marginally suitable habitat.

Suitable habitat may be interrupted by narrow or wide areas of unsuitable habitat that are smaller than the separation distance. How do these areas affect what is mapped as part of an occurrence? Basically, this is a subjective determination that should take into consideration the relative size and nature of the suitable and unsuitable habitats and the behavioral characteristics of the species. Narrow habitat interruptions should be ignored if those areas are relatively inconsequential discontinuities in an otherwise continuous tract of suitable habitat.

B. Map it as part of the occurrence, or treat it as inferred extent?

Frequently there is an substantial gray area between what we know for certain and what may be inferred about the extent of occupied habitat. For example, we often have data on the breeding locations of pool-breeding but otherwise terrestrial amphibians, or the lek sites of grouse, but usually we lack adequate site-specific information on the occupied upland habitat of the amphibians or the nesting and feeding sites of the grouse. Nevertheless, these other habitats adjacent to breeding pools and lek sites are absolutely required and necessarily occupied, so we "know" that they are part of the occurrence even if we lack specific information on the full extent and precise occupancy of that adjacent occupied habitat. Therefore, based on available data for these examples, suitable habitat extending several kilometers around a sage grouse lek site, or at least a few hundred meters around a wood frog breeding site, should be included in the mapped representation of the occurrence. This area, regarded as a biologically appropriate extrapolation, may be defined, and its biological basis is described, in the mapping guidance section of the occurrence specifications for the species or group. Beyond this area, additional habitat that is thought to be part of the occurrence but for which there is greater uncertainty, may be represented in an Inferred Extent polygon or in a predicted distribution layer for the species.

2. Inferred Extent

An inferred extent (IE) polygon and a mapped occurrence (represented by a point, line, or polygon) are independent but related spatial representations. An occurrence represents known occupied habitat. An inferred extent polygon is a representation of the known occupied habitat plus additional habitat surrounding that area. Conceptually, inferred extent for an occurrence consists of one or more polygons that represent the area likely encompassed by the occurrence, as inferred from mapped source features (known occupied habitat) and knowledge of the biology of the species. For example, the IE polygon for an occurrence based on a single bog turtle

observation in a fen could encompass the entire fen and any closely adjacent fens, as well as presumed migration/dispersal corridors. The outer extent of the IE polygon should be kept within a reasonable distance of the known occupied habitat (i.e., the occurrence itself), generally not more than the maximum known single-year migration distance for the species (assumes species is nonvolant), and certainly not more than the separation distance. It should exclude areas not likely to be regularly occupied. The extent of the IE polygon should be determined by a biologist experienced with species and its habitat. As a projection of an occurrence's probable extent, the IE polygon is useful for environmental review, especially when data limitations result in excessively conservative approximations of occurrence dimensions.