
APPENDIX D: Examples of EO Specifications and EO Rank Specifications Using Templates

D1 Species Elements

D1.1 Species Having No Location Use Classes

- D1.1.1 *Acipenser brevirostrum*, shortnose sturgeon
- D1.1.2 *Acronicta albarufa*, dagger moth
- D1.1.3 *Amaranthus pumilus*, seabeach amaranth
- D1.1.4 *Aphelocoma coerulescens*, Florida scrub-jay
- D1.1.5 *Bufo boreas*, western toad
- D1.1.6 *Gymnoderma lineare*, rock gnome lichen
- D1.1.7 *Lycaeides melissa samuelis*, Karner blue butterfly
- D1.1.8 *Lysimachia asperulifolia*, rough-leaf loosestrife

D1.2 Migratory Species Having Location Use Classes

- D1.2.1 *Histrionicus histrionicus*, harlequin duck

D2 Community Elements

D2.1 Matrix Communities

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- D2.1.2 *Quercus alba* – *Quercus rubra* – *Quercus macrocarpa* / *Carpinus caroliniana* Forest, white oak – red oak – bur oak / musclewood forest
- D2.1.3 *Tsuga canadensis* – (*Betula alleghaniensis*) Mesic Forest, eastern hemlock – (yellow birch) mesic forest

D2.2 Large Patch Communities

- D2.2.1 *Artemisia tridentata* spp. *tridentata* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation, basin big sagebrush / bluebunch wheatgrass shrub herbaceous vegetation
- D2.2.2 *Thuja occidentalis* – (*Picea mariana* – *Abies balsamea*) / *Alnus incana* Wetland Forest, eastern white cedar – (black spruce – balsam fir) / speckled alder wetland forest

D2.3 Small Patch Communities

- D2.3.1 *Carex lasiocarpa* – *Carex buxbaumii* – *Scirpus cespitosus* Boreal Herbaceous Vegetation, wiregrass sedge – sedge sp. – bulrush sp. boreal herbaceous vegetation

D2.4 Linear Communities

The following examples of specifications utilize templates described in Section 4, EO Specifications and Section 5, EO Ranks and EO Rank Specifications, above. These have been chosen to represent a range of Element groups, life histories, ecological settings, and levels of understanding. Note that for brevity, the citations referenced in these examples are not included in the Bibliography of this document.

D1 Species Elements

D1.1 Species Having No Location Use Classes

D1.1.1 *Acipenser brevirostrum*, shortnose sturgeon

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

An occurrence is defined by any collection or observation of single or multiple individuals. Although this species is migratory, breeding and nonbreeding areas are linked by narrowly defined, continuous corridors (rivers) which must be used for each upstream and downstream migration. Ideally, an occurrence should include the entire portion of a river (from the downstream estuary to the point of furthest upstream passage) utilized by the fish in a specific drainage over the course of an entire breeding cycle. Thus, the occurrence will include areas used for spawning and overwintering as well as the migratory corridor. Specific breeding and nonbreeding areas may be optionally tracked as sub-EOs.

EO Separation

SEPARATION BARRIERS

Barriers that would restrict all, or nearly all, fish passage include anthropogenic barriers (*e.g.*, dam, impoundment) or natural barriers (*e.g.*, high waterfall).

SEPARATION DISTANCE – UNSUITABLE HABITAT

SEPARATION DISTANCE – SUITABLE HABITAT

ALTERNATE SEPARATION PROCEDURE

All observations or collections within the same river drainage will be considered part of the same occurrence unless there is an intervening barrier which restricts fish passage, regardless of the distance between observation or collection points.

SEPARATION JUSTIFICATION

Because these migratory fish move from downstream estuaries to upstream spawning areas over the course of their annual cycle, there is no distance of unsuitable or suitable habitat within a given drainage for differentiating EOs.

FEATURE LABELS

Spawning Area
Nonbreeding Concentration Area

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Novak, P.G.

GSPECS DATE

1997-01-02

GSPECS NOTES

RANKSPECS GROUP

A SPECS

Population estimates of >10,000 adult fish, and positive evidence of reproduction indicated by the collection of females in spawning condition, larvae with yolk sacs, and/or a multiple age/size class distribution within the last 10 years.

B SPECS

Population estimates of 1,000-10,000 adult fish, and positive evidence of reproduction indicated by the collection of females in spawning condition, larvae with yolk sacs, and/or a multiple age/size class distribution within the last 10 years.

C SPECS

Population estimates of 100-999 adult fish, and positive evidence of reproduction indicated by the collection of females in spawning condition, larvae with yolk sacs, and/or a multiple age/size class distribution within the last 10 years.

D SPECS

Population estimates of less than 100 adult fish, or river systems where fish have been observed or collected within the past 10 years, but are not currently known to be breeding (*i.e.*, there are no known active spawning areas, no larval fish with yolk sacs have been taken within the past 10 years, there are no young fish in the age/size class distribution of the individuals which have been captured).

RANKSPECS JUSTIFICATION

“A”-rank threshold: At least two of the best known EOs recently had population estimates in excess of 10,000 adults and have documented spawning areas which are used annually (Dadswell *et al.* 1984).

“C”/“D” threshold: One occurrence with a population estimate in this range has persisted in an essentially landlocked situation for over 100 years, and spawning grounds have been documented (Dadswell *et al.* 1984, Taubert 1980). This indicates that even at this low population level, a viable population may be maintained as long as a spawning site is available.

GRANKSPECS AUTHORSHIP

Novak, P.G.

GRANKSPECS DATE

1997-01-02

GRANKSPECS NOTES

D1.1.2 *Acronicta albarufa*, dagger moth

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

Collections of one or more specimens, unless habitat is obviously inappropriate (see habitat comments in the Element database).

EO Separation

SEPARATION BARRIERS

SEPARATION DISTANCE – UNSUITABLE HABITAT

1 km

SEPARATION DISTANCE – SUITABLE HABITAT

ALTERNATE SEPARATION PROCEDURE

For apparently suitable habitat, the separation distance is 2 km where surveys have failed to find the Element, or 5 km if the habitat is not known to be occupied.

SEPARATION JUSTIFICATION

There is no information to suggest what would be a barrier to dispersal. EO separation distances are based on very limited information; however, strays away from normal habitats are virtually unknown east of MO. The 1 and 2 km distances are best estimates; the 5 km distance reflects the fact that most, if not all, known EOs are substantially larger than 1 square km. All of these figures are based primarily on experience of D.F. Schweitzer with this Element and its habitats.

This species is known to have persisted after large (>4000 hectares [approximately >10,000 acres]), but very infrequent, wildfires in MA, although not all habitat was burned. One current NJ occurrence where adult density appears to be very low is subject to very frequent, patchy, partial, unplanned burns, with some fires occurring in most years.

FEATURE LABELS

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Schweitzer, D.F.

GSPECS DATE

1997-01-16

GSPECS NOTES

RANKSPECS GROUP

A SPECS

Either of the following criteria must be met for an “A”-ranked EO:

- a) >2000 hectares (approximately >5000 acres) of apparently occupied habitat, usually xeric open oak woodland (including barrens) or denser oak forest; or
- b) evidence of occupation based on blacklight samples from a minimum of three sites per 800 hectares (approximately 2000 acres) of presumed habitat, with an average of >1 adults per 15-30 watts of blacklight per night during peak season.

B SPECS

Any one of the following criteria must be met for a "B"-ranked EO:

- a) 800-2000 hectares (approximately 2000-5000 acres) of apparently occupied habitat with capture rate of >1 adult per night per blacklight sample; or
- b) 400-800 hectares (approximately 1000-2000 acres) of apparently occupied habitat where capture rates average 10 adults per blacklight sample in more than one year; or
- c) >2000 hectares (approximately >5000 acres) of apparently occupied habitat where capture rates average 0.1-0.9 adults per blacklight sample.

C SPECS

Any one of the following criteria must be met for a "C"-ranked EO:

- a) 200-400 hectares (approximately 500-1000 acres) of apparently occupied habitat where average capture frequency is ≥ 1 adult per 10 blacklight samples at peak season; or
- b) 40-200 hectares (approximately 100-500 acres) of apparently occupied habitat with evidence that the species has persisted for more than 10 years, and is not declining; or
- c) 800-2000 hectares (approximately 2000-5000 acres) of apparently occupied habitat where average capture frequency is 0.1-0.9 adult per blacklight sample; or
- d) >2000 hectares (approximately >5000 acres) of apparently occupied habitat, but trap catches consistently average <1 adult per 10 blacklight samples.

D SPECS

Sites <200 hectares (approximately <500 acres) where the species is present, and not meeting "C"-rank specifications.

RANK SPECS JUSTIFICATION

"A"-rank threshold: A capture rate of >1 adult per night with blacklight traps would suggest adult densities of several per acre. Since this species has a long flight season and apparently short adult life (*ca.* 1 week in captivity - Schweitzer), most individuals of a given brood will not be present on a given night.

Some habitats are known to be 2000 hectares (approximately 5000 acres), but most are smaller. This species seldom turns up in small habitat patches (see "C"-rank specifications) so "A"-rank specifications need to be high to identify exceptional EOs.

"C"/"D" threshold: This species seldom, if ever, occurs in small (<400 hectare [approximately <1000 acre]) habitats, and is absent from most apparently suitable larger habitats east of MO. Schweitzer believes these specifications will probably define a potentially viable population. The area criteria may be slightly low, but Schweitzer feels it is best to leave some margin for error.

The likely high (but rarely 100%) mortality during fires should be considered in rank specifications. In many cases (*e.g.*, all but the coolest dormant season fires; or in some habitats any summer fire), burned areas should not be considered currently occupied, but will almost certainly be recolonized. Thus, occupied habitat should exclude the average percentage subject to such burns each year. Schweitzer suggests fire should not be considered if:

- a) individual burns seldom affect >10% of any size habitat in any given year; or
- b) fires affect less than 75% of a >800 hectare (approximately >2000 acre) habitat at intervals of 25 years or longer; or
- c) the unburned refugia will be ≥ 2000 hectares (approximately ≥ 5000 acres) in all years.

GRANKSPECS AUTHORSHIP

Schweitzer, D.F.

GRANKSPECS DATE

1997-01-16

GRANKSPECS NOTES

D1.1.3 *Amaranthus pumilus*, seabeach amaranth

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

Any occurrence of one or more plants. This is a fugitive annual species that occurs in an unstable and shifting habitat. In addition, populations may be present even though plants are not visible for one or more years. This species seed-banks, and may not appear in a given year if seeds are covered over too deeply.

EO Separation

SEPARATION BARRIERS

A barrier to dispersal of the species would be any distance of estuarine water >100 m at low tide (*i.e.*, populations on separate islands are separate EOs).

SEPARATION DISTANCE – UNSUITABLE HABITAT

1 km

SEPARATION DISTANCE – SUITABLE HABITAT

5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

The distance for unoccupied but suitable habitat is set at such a great distance because of the fugitive nature of *Amaranthus pumilus*, and the likelihood that intervening "suitable but unoccupied" habitat will likely be occupied at some time in the near future (*i.e.*, two apparently separate EOs will become connected, leading to instability of EOs). Unsuitable habitat is categorized on the basis of unsuitability for the foreseeable future, such as riprap, sea walls, or barren beach areas (with beach-grooming or extremely heavy recreational use). Note that scarped and eroding foredunes should not be considered unsuitable for the foreseeable future, as new deposition of sand may quickly change its suitability. EO specifications (*e.g.*, separation distances) should be determined as much as possible by the spatial distribution of plants. Plant distribution should be based on recent (*i.e.*, within the past 5 years) repeat surveys performed subsequent to any major catastrophic change in habitat occurring during that period.

FEATURE LABELS

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Weakley, A.

GSPECS DATE

1997-01-02

GSPECS NOTES

RANKSPECS GROUP

A SPECS

1000 or more individuals on average, based on all censuses in the last 5 years and subsequent to any major catastrophic change in the habitat.

B SPECS

100-999 individuals on average, as above.

C SPECS

10-99 individuals on average, as above.

D SPECS

1-9 individuals on average, as above.

RANK SPECS JUSTIFICATION

“A” rank threshold: It is not anticipated that future occurrences will exceed the best that currently exist. Thus, “A”-rank criteria are set such that the largest, most stable, and most viable occurrences currently in existence are so designated.

“C”/“D” threshold: Populations with fewer than 10 individuals average (based on repeat census) may be temporarily small but viable populations; they are re-ranked upwards (by specifications above) if they produce more individuals. In contrast, such populations may represent temporary waifs in generally unsuitable situations.

GRANKSPECS AUTHORSHIP

Weakley, A.

GRANKSPECS DATE

1997-01-02

GRANKSPECS NOTES

D1.1.4 *Aphelocoma coerulescens*, Florida scrub-jay

SPECS GROUP**LOCATION USE CLASSES****MINIMUM EO CRITERIA**

Occurrences of the Florida scrub-jay are defined by one or more territorial pairs.

EO Separation**SEPARATION BARRIERS**

A barrier to dispersal of the species would include open water, especially with forested margins, and closed-canopy forest.

SEPARATION DISTANCE – UNSUITABLE HABITAT

3.5 km

SEPARATION DISTANCE – SUITABLE HABITAT

3.5 km

ALTERNATE SEPARATION PROCEDURE

Note that separation distances are assessed between territorial borders.

SEPARATION JUSTIFICATION

This relatively sedentary species is described as occurring in metapopulations, which Stith *et al.* (1996) delineated by buffering all territories with a 12 km buffer, a distance beyond which dispersal is negligible. The researchers also selected 3.5 km as a dispersal buffer to delineate subpopulations after they found that 80% of documented dispersals are 1.7 km or less, and 85% are within 3.5 km.

Subpopulations, rather than metapopulations, are principal EOs for this species. In part this derives from a recommendation that the highest conservation priority is to preserve the large subpopulations (Stith *et al.* 1996). Also, some of the metapopulations appear to be impractically large conservation targets (*e.g.*, 200 km of coastal central Florida). The metapopulation context of a subpopulation is taken into account in the “B” and “C” EO ranks below, and should be taken into account in site selection and design.

Only one distance is used for both suitable and unsuitable habitat, in part because Stith *et al.* (1996) did not distinguish dispersal across unsuitable (other than the “barriers” listed above) versus suitable habitat, and in part because dispersing jays appeared to cue on other resident jays more strongly than on habitat.

FEATURE LABELS***Inferred Extent*****IE DISTANCE****IE NOTES****GSPECS AUTHORSHIP**

Master, L.L.

GSPECS DATE

1997-01-06

GSPECS NOTES**RANKSPECS GROUP****A SPECS**

>=400 pairs.

B SPECS

Either 100-399 pairs; or 50-99 pairs that are part of a metapopulation of ≥ 100 pairs (all within 12 km of each other).

C SPECS

Either 10-99 pairs; or < 10 pairs that are part of a metapopulation of ≥ 50 pairs (all within 12 km of each other). The key ecological process, fire, must be reasonably intact or restorable.

D SPECS

1-9 pairs or not otherwise meeting "C" rank specifications.

RANK SPECS JUSTIFICATION

"A" rank threshold: This number is considered to convey a very low probability of extinction (Fitzpatrick *et al.* in prep). Although historical populations were likely much larger, three geographically separate subpopulations met this criterion in 1993 (Stith *et al.* 1996). Given continued development pressures and fire suppression, the present large populations are possibly the best achievable. Condition and landscape factors are considered to be partially intact, at least temporarily, if this size criterion is met. Stith *et al.* (1996) discussed the need to maintain fire as a key ecological process, and landscape connectivity so that large populations do not become fragmented.

"C"/"D" threshold: The results of the model by Stith *et al.* (1996) indicate that a population of 10 pairs has approximately a 50% probability of extinction within 100 years.

GRANKSPECS AUTHORSHIP

Master, L.L.

GRANKSPECS DATE

1997-01-06

GRANKSPECS NOTES

D1.1.5 *Bufo boreas*, western toad

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

Occurrences are defined by any collection or observation of one or more individuals. When a breeding site is known, the EO minimally includes breeding site(s) and the surrounding area of suitable upland habitat extending 500 m from breeding sites.

EO Separation

SEPARATION BARRIERS

A major barrier to dispersal would be a busy interstate highway without culverts.

SEPARATION DISTANCE – UNSUITABLE HABITAT

SEPARATION DISTANCE – SUITABLE HABITAT

ALTERNATE SEPARATION PROCEDURE

EOs should be evaluated using a 5 km separation distance between drainages in mountainous terrain, or a 10 km separation distance in low elevation areas or within a drainage in mountainous terrain.

SEPARATION JUSTIFICATION

Recent radiotelemetry evidence strongly suggests that movements away from breeding sites of up to 2 km are common (C.R. Peterson, pers. comm.). S. Corn (pers. comm.) found that several males and females per generation moved between two breeding sites 10 km apart, and many moved between breeding sites 2 km apart, even within the same season. These movements were within a drainage in mountainous terrain, but movements between drainages may be less common (S. Corn, pers. comm.). Additionally, radiotelemetry and mark-recapture data for western toads and *Rana pretiosa* complex frogs suggest they readily move across seemingly inhospitable habitat (*e.g.*, Nevada desert, high elevation granite slabs), apparently during wet weather (various papers presented at the Conference on Declining and Sensitive Amphibians in the northern Rocky Mountains and the Pacific Northwest held 7-8 Nov. 1996, in Boise, Idaho, by researchers including D.A. Patla, C.R. Peterson, D. Pilliod, J. Reiser, and P. Ritson).

What constitutes a major barrier remains poorly known. In Yellowstone National Park, a major highway effectively eliminated regular use of one part of a *Rana pretiosa* occurrence that had been regularly used historically (C.R. Peterson and D.A. Patla, pers. comm.).

EO rank depends mainly on population attributes enumerated in the following rank specifications. For all ranks, the EO may be either one polygon, or multiple polygons if separated by distances no larger than specified above. Population estimates may be based on careful judgment if adequate data is unavailable; use recent median population size if data is available from multiple years.

FEATURE LABELS

Breeding Site
Hibernation Site

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Reichel, J.D. and G.A. Hammerson

GSPECS DATE

1997-01-31

GSPECS NOTES

RANKSPECS GROUP

A SPECS

EO includes >500 breeding females.

B SPECS

EO includes 50-500 breeding females.

C SPECS

EO includes 5-49 breeding females.

D SPECS

EO includes <5 breeding females.

RANK SPECS JUSTIFICATION

“A” rank threshold: Single breeding pond/lake populations of 200-400 females have been reported in the literature (Nussbaum *et al.* 1983, Olson 1989, Blaustein *et al.* 1994). It seems likely that by combining adjacent (<10 km apart) breeding populations into a single occurrence, some occurrences would qualify for “A”-rank status. These numbers may be revised upward if:

- a) it is found that many EOs are larger when applying the current EO specifications across the range of the toad; or
- b) PVA models show that substantially larger numbers are needed to maintain EOs (thereby increasing the numbers needed for “C”-rank status).

“C”/“D” threshold: While western toads are relatively long-lived (up to 9 years; Campbell 1976), it seems unlikely that isolated populations of less than 5 breeding females could survive for 100 years. However, S. Corn (pers. comm.) has seen small populations (2-5) females lasting at least 10 years. PVA modeling should be used to better determine this number.

GRANKSPECS AUTHORSHIP

Reichel, J.D. and G.A. Hammerson

GRANKSPECS DATE

1997-01-31

GRANKSPECS NOTES

D1.1.6 *Gymnoderma lineare*, rock gnome lichen

SPECS GROUP**LOCATION USE CLASSES****MINIMUM EO CRITERIA**

Any naturally occurring population. This species occurs in several different habitats:

- a) exposed or semi-exposed high-elevation cliff faces;
- b) small to medium rock outcrops under full canopy in high elevation forests, or at low to moderate elevations in forests in extremely humid gorges, especially near waterfalls; or
- c) rock outcrops and boulders in high to moderate elevation streams.

EO Separation**SEPARATION BARRIERS****SEPARATION DISTANCE – UNSUITABLE HABITAT****SEPARATION DISTANCE – SUITABLE HABITAT****ALTERNATE SEPARATION PROCEDURE**

The separation distance for occurrences in different habitats (see above) is 1 km, or between occurrences in the same habitat is 2 km. Patches located closer than these distances can be recorded as sub-EOs.

SEPARATION JUSTIFICATION

It is difficult to survey this species (and its rock outcrop habitat) reliably. EO separation distances are, therefore, relatively long. Occurrences in different habitats have very different dynamics. Thus, it is desirable to keep these separate unless in closer proximity (<1 km separation distance).

FEATURE LABELS***Inferred Extent*****IE DISTANCE****IE NOTES****GSPECS AUTHORSHIP**

Weakley, A.

GSPECS DATE

1997-01-25

GSPECS NOTES**RANKSPECS GROUP****A SPECS**

>50 square meters cover and <10% showing necrosis.

B SPECS

10-50 square meters cover and <10% showing necrosis; or >50 square meters with 10-30% showing necrosis.

C SPECS

2-10 square meters cover and <10% showing necrosis; or 10-50 square meters and >10% showing necrosis; or >50 square meters and >30% showing necrosis.

D SPECS

Less than 2 square meters cover; or <10 square meters and 10-90% necrosis.

RANK SPECS JUSTIFICATION

“A” rank threshold: The “A” rank criteria emphasize substantial cover and apparent vitality.

“C”/“D” threshold: EOs not meeting “C” rank specifications have considerable probability of extirpation, either from intrinsic low size and susceptibility to accident, or from moderate to small size in combination with obvious decline.

GRANKSPECS AUTHORSHIP

Weakley, A.

GRANKSPECS DATE

1997-01-25

GRANKSPECS NOTES

D1.1.7 *Lycæides melissa samuelis*, Karner blue butterfly

[The following specifications are based on a U.S. Fish and Wildlife Service Draft Recovery Plan, and may need revision depending upon criteria adopted in the final, published Recovery Plan.]

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

Any collection or observation of one or more individuals. EO boundaries will often approximate natural community boundaries and must contain adequate resources to sustain all life stages.

EO Separation

SEPARATION BARRIERS

Dispersal of the species would be inhibited by a barrier ≥ 100 m that extends beyond the boundaries of the occurrence.

SEPARATION DISTANCE – UNSUITABLE HABITAT

1 km

SEPARATION DISTANCE – SUITABLE HABITAT

2 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

Evidence suggests that long term viable populations of this species occur as metapopulations (*e.g.*, Givnish *et al.* 1988; Schweitzer 1994; U.S. Fish and Wildlife Service Draft Recovery Plan). Demes are typically separated by 50-100 m of unsuitable habitat, and may also be defined on the basis of mark-recapture (MRR) data. Where applicable, the metapopulation, rather than the subpopulation or deme, is the principal EO for this species. Principal EO boundaries usually approximate those of the associated barrens or savanna community, even though these communities may contain some habitat that is unsuitable for the Element.

What constitutes a major barrier remains poorly known. Any habitat discontinuity may deter movement of adults, but dispersers are known to cross busy two-lane highways, lawns, forest, parking lots, *etc.* A possible barrier should be considered only if there is evidence that it actually deters the movement of individuals.

EO separation distances are based on data from unpublished reports reviewed in the Draft Recovery Plan, and in Givnish *et al.* (1988) and Schweitzer (1994). Typically, few adults leave their original habitat patch; however, dispersal ≥ 1 km has been documented repeatedly, and a few longer dispersal events are known. Generally, if substantial suitable contiguous habitat occurs between two known occupied habitat patches < 2 km apart, it is very likely the intervening habitat will prove to be occupied.

In developing EO rank specifications, numbers can be accurately estimated only through use of MRR data (see Gall 1985); non-MRR estimates are likely to be somewhat low. It is known empirically that the total brood size will normally be approximately triple the census on a given day during peak season. Use of this tripling method is based on the assumption that the majority of adults are observed, which seldom occurs. Thus, the tripling method is usually inaccurate for determining brood size, particularly for large dispersed populations (consult Schweitzer [1994] or Recovery Plan to determine if tripling method might be adequate). Numbers used in these specifications represent true brood size numbers (*i.e.*, determined from MRR data rather than census numbers).

For EO rank specification purposes, habitat burned subsequent to the preceding July 10th should be assumed to have been unoccupied for at least one year. This may affect estimation of numbers for "normal" or "worst" years.

FEATURE LABELS

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Schweitzer, D.F.

GSPECS DATE

1997-01-16

GSPECS NOTES

RANKSPECS GROUP

A SPECS

Each of the following criteria must be met for an "A"-ranked EO:

- a) >20,000 adults in the larger annual brood (usually July), and >5,000 adults in the smaller brood (usually late May-June); and
- b) >=5 demes meeting "C"-rank specifications, or >=4 meeting "B"-rank specifications, in normal years; and
- c) occupying >800 hectares (approximately >2,000 acres) of appropriately managed habitat including lupine occurring in microhabitats having 0-60% shade or diverse topographic aspect.

In addition, the metapopulation must have >=1,000 adults in the smaller brood, and approximately 4,000 in the larger brood, in the worst possible year (*e.g.*, immediately after a wildfire, in a severe drought). There must be some gene flow between each of the demes described in (b) above and another deme. In addition, between some of the demes there should be lupine that is occasionally occupied by either adults or larvae.

B SPECS

Each of the following criteria must be met for a "B"-ranked EO:

- a) >=10,000 adults in the larger brood, or >=2,500 smaller brood, of a normal year, but otherwise not meeting some of the "A" rank specifications; and
- b) >=4 demes, 3 of which individually would meet "C"-rank specifications, and have gene flow with another deme; and
- c) if there are no demes meeting "C"-rank specifications, there must be >=50 occupied habitat patches in most years, and >=20 in worst years, well distributed throughout the associated community or potential habitat.

In addition, the total associated community or potential habitat must be >400 hectares (approximately >1,000 acres), and the total metapopulation must be >=500 adults in smaller brood of the worst possible year.

C SPECS

The first criterion (a), and either one of the following two criteria (b or c), must be met for a "C"-ranked EO:

- a) >3,000 adults in the larger annual brood in normal year, and >=100 adults in the smaller brood in the worst years; and
- b) >=2 demes, with >=20% (or 1,000 adults in larger brood) of total population not being in the largest deme; or
- c) population consisting of a single deme must occupy >=80 hectares (approximately >=200 acres), consist of >5000 adults in larger brood of a normal year, and >200 adults in smaller brood of worst year.

D SPECS

Any occurrence meeting minimum specifications for an EO but not meeting "C"-rank specifications.

RANK SPECS JUSTIFICATION

"A" rank threshold: All major references indicate a need for multiple demes and/or substantial habitat size to buffer the impact of catastrophic events (*e.g.*, uncontrolled fire). Variable aspect and shade conditions provide some protection from weather extremes such as drought and late spring freezes. Large population size also provides a buffer against population fluctuations caused by weather and other factors. The "A"-rank specifications should be set above the Large Viable Population criteria of the Recovery Plan.

"C"/"D" threshold: Several studies (*e.g.*, see Recovery Plan or Schweitzer 1994) show low survival rates over a period of 10-20 years, and even less for populations with >=1,000 July brood adults. Individual habitat patches are subject to

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catastrophic events (*e.g.*, weather) that can cause numbers to crash at least an order of magnitude. All extant EOs are likely to have been much larger historically.

The "C"-rank specifications should meet the Minimum Viable Population (MVP) criteria of the Recovery Plan. The Recovery Team believes a viable population generally must be >1,000, and may determine that 3,000 in a normal year is minimal. Single demes will probably not be considered viable in the Recovery Plan, but Schweitzer disagrees and considers such an EO to be potentially viable with careful management. The most stable documented population (with >20 years of observation) exists at the Saratoga Airport (NY) and seems to fit these criteria, with probably >10,000 in only one deme. Schweitzer has studied it in detail and believes that the habitat is large enough so that loss to catastrophic events (other than cessation of management) is unlikely.

GRANKSPECS AUTHORSHIP

Schweitzer, D.F.

GRANKSPECS DATE

1997-01-16

GRANKSPECS NOTES

D1.1.8 *Lysimachia asperulifolia*, rough-leaf loosestrife

SPECS GROUP

LOCATION USE CLASSES

MINIMUM EO CRITERIA

Any naturally occurring population.

EO Separation

SEPARATION BARRIERS

SEPARATION DISTANCE – UNSUITABLE HABITAT

SEPARATION DISTANCE – SUITABLE HABITAT

2 km

ALTERNATE SEPARATION PROCEDURE

The separation distance for EOs across unsuitable habitat (*e.g.*, upland pinelands) or altered and unsuitable areas is 1 km. However, in sandhills the separation distance may be as little as 0.5 km across a watershed break (in order to make watershed EO separations practical).

SEPARATION JUSTIFICATION

The rationale for this large a separation distance across suitable but apparently unoccupied habitat is to maintain stability of EOs. This species often occurs as apparently small and isolated populations in linear pocosins along sandhill streams, or in ecotones along peat dome pocosins. Owing to the difficulty of surveying for this species in fire-suppressed pocosin habitats, it can often be assumed that apparently unconnected populations will eventually be found to be more closely connected; these are best regarded as subpopulations. These subpopulations may be recognized, if desired, as sub-EOs.

FEATURE LABELS

Inferred Extent

IE DISTANCE

IE NOTES

GSPECS AUTHORSHIP

Weakley, A.

GSPECS DATE

1997-01-02

GSPECS NOTES

RANKSPECS GROUP

A SPECS

>=1000 stems (ramets); populations with all of the following: many genets flowering vigorously, in natural site, with natural processes (primarily fire and hydrology) approximating natural conditions. To receive an "A" rank, deep peat pocosin populations require infrequent fire, and intact or minimally affected site hydrology. To receive an "A" rank, ecotonal populations (sandhill/pocosin, flatwoods/pocosin, and savanna/pocosin) require frequent prescribed or natural (at least once per decade and preferably more frequent) fire, and minimal ground disturbance of the ecotone (as by fire plows).

B SPECS

300-1000 stems (ramets); populations with at least two of the following: many genets flowering vigorously, in natural site (fire regime natural, hydrology intact, ground disturbance minimal).

C SPECS

50-300 stems (ramets); populations lacking most of the following: many genets flowering vigorously, in natural site (fire regime natural, hydrology intact, ground disturbance minimal). Minimum criteria for "C" rank should state that the population is likely to be viable, with emphasis on the likelihood that processes necessary for *Lysimachia* will continue.

D SPECS

Less than 50 stems (ramets); populations with few genets flowering poorly, in site maintained by unnatural means (*e.g.*, mowing). Populations with >50 ramets may still be ranked "D" if in an unnaturally created and maintained situation (*e.g.*, a road ditch) with little likelihood of long-term viability.

RANK SPECS JUSTIFICATION

"A" rank threshold: It is not anticipated that future occurrences will exceed the best that currently exist. Thus, "A"-rank criteria are set such that the larger and more viable occurrences currently in existence are so designated. Habitat features (fire, hydrology, ground disturbance) are as important as documented population size.

"C"/"D" threshold: EOs not meeting "C"-rank criteria are likely to: be susceptible to extirpation through accident; have low population viability; and occur in degraded habitats with low long-term potential for survival.

GRANKSPECS AUTHORSHIP

Weakley, A.

GRANKSPECS DATE

1997-01-02

GRANKSPECS NOTES

D1.2 Migratory Species Having Location Use Classes

D1.2.1 *Histrionicus histrionicus*, harlequin duck

SPECS GROUP

LOCATION USE CLASSES

Breeding
Nonbreeding

BREEDING LOCATION USE CLASS:

MINIMUM EO CRITERIA

EOs are defined by a drainage, or portion of a drainage, where breeding is known or highly suspected. Minimally, this should be based on three or more independent observations of females or pairs (*e.g.*, one pair in three different years, three different pairs in one year).

EO Separation

SEPARATION BARRIERS

A barrier to dispersal of the species in the BREEDING class would include >2 km over a major divide.

SEPARATION DISTANCE – UNSUITABLE HABITAT

10 km

SEPARATION DISTANCE – SUITABLE HABITAT

ALTERNATE SEPARATION PROCEDURE

The separation distance (measured along watercourses) for both rarely used habitat (*e.g.*, lakes, <1% gradient rivers) and for apparently suitable habitat not known to be occupied is 20 km.

SEPARATION JUSTIFICATION

The barrier is based on lack of movements between streams separated by a 4-km (2.5-mile) rise over a major divide (Reichel and Genter 1997). Unsuitable habitat (*i.e.*, across land) separation is based on movements of up to 7 km over a low divide (Cassirer and Groves 1994). Movements along watercourses include a 21-km movement across a reservoir (Reichel and Genter 1995), while a few movements up to 31 km have occurred across mixed suitable and unsuitable habitat (Reichel and Genter 1996); all have either occurred between years or following a substantial disturbance. Home ranges average 7-10 km of stream length (Kuchel 1977, Cassirer and Groves 1992).

FEATURE LABELS

Inferred Extent

IE DISTANCE

IE NOTES

RANKSPECS GROUP

A SPECS

>=100 pairs within a single EO.

B SPECS

40-99 pairs within the EO.

C SPECS

3-39 pairs within the EO.

D SPECS

A yearly average of 1-2 pairs within the EO.

RANK SPECS JUSTIFICATION

“A” rank threshold: The largest currently known breeding class EO was calculated to include 215 adults on the Bow River, Alberta (Smith 1996). “A” rank specifications may need to be increased if data from Alaska shows substantially larger numbers within single EOs.

“C”/“D” threshold: Given the low productivity and high site fidelity, less than 3 pairs are not likely to be viable over a 100-year period. However, little data is available on numbers of ducks present versus the length of time an occurrence is maintained.

NONBREEDING LOCATION USE CLASS:

MINIMUM EO CRITERIA

EOs are defined by the presence of ≥ 25 individuals using an area >1 week in most years on coastal waters, or ≥ 5 individuals for interior staging areas.

EO Separation

SEPARATION BARRIERS

SEPARATION DISTANCE – UNSUITABLE HABITAT

20 km

SEPARATION DISTANCE – SUITABLE HABITAT

20 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

Of 89 females marked during late summer molt in coastal Alaska, 92% stayed within approximately 20 km of where they were marked through mid-February (Esler 1996).

FEATURE LABELS

Coastal Aggregation
Staging Area

Inferred Extent

IE DISTANCE

IE NOTES

RANKSPECS GROUP

A SPECS

≥ 3000 birds using an area >1 month yearly.

B SPECS

1000-2999 birds using an area >1 month yearly.

C SPECS

100-999 birds using an area >1 week in most years.

D SPECS

25-99 birds using an area >1 week in most years for coastal staging, wintering, and summer nonbreeding areas. 5-99 birds for interior staging areas.

RANK SPECS JUSTIFICATION

“A” rank threshold: Reports during the nonbreeding season of up to 5300 are known from Hornby Island, B.C. (Goudie 1996), however “A” rank specifications may need to be increased if data from Alaska shows substantially larger numbers.

“C”/“D” threshold: Given the low productivity and high site fidelity, less than 3 pairs are not likely to be viable over a 100-year period. However, little data is available on numbers of ducks present versus the length of time an occurrence is maintained.

GSPECS AUTHORSHIP

Reichel, J.D. and E.F. Cassirer

GSPECS DATE

1996-11-26

GSPECS NOTES

GRANKSPECS AUTHORSHIP

Reichel, J.D. and E.F. Cassirer

GRANKSPECS DATE

1996-11-26

GRANKSPECS NOTES

D2 Community Elements

D2.1 Matrix Communities

D2.1.1 *Pinus ponderosa* / *Physocarpus monogynus* Forest, ponderosa pine / mountain ninebark forest

SPECS GROUP

Ponderosa Pine Forest and Woodland Alliances, Black Hills Group

MINIMUM SIZE

2 ha

EO Separation

SEPARATION BARRIERS

Barriers that would separate patches of this community include a major two-lane paved highway, urban development, and an open body of water.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

2 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on ponderosa pine or shrub and herb seed dispersal. Seeds of ponderosa pine are reported to travel as far as 120 m from the parent tree (Barret 1978 in Oliver and Ryker 1990). The separation distance for intervening natural or semi-natural communities seems to be a pragmatically useful distance.

FEATURE LABELS

GSPECS AUTHORSHIP

McAdams, A. and D. Faber-Langendoen

GSPECS DATE

1998-06-29

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Condition, size, and landscape context are weighted equally for this type because, although it is a matrix type, it occurs within a mosaic of other ponderosa pine community types that together comprise the matrix.

EO RANK FACTOR *1st*

Condition

A SPECS

- a) Overstorey structure intact (*i.e.*, average of 25 trees per hectare greater than 40 cm dbh and/or more than 160 years old have not been cut [Mehl 1992]); crown shape mature, flattened; bark yellowish in character;
- b) understory vegetation composed of native species;
- c) shrub layer may or may not be present;

- d) there is evidence of fire as a natural process, including potentially long intervals without fire (>45 years). Such evidence might include fire scars and scorching. Evidence of lack of natural fire patterns might include increased densities of small diameter trees, increased litter depth, and/or decreased herbaceous production;
- e) stands may have been thinned with minimal disruption of understory (>20 years ago), but little or no exotics are present.

B SPECS

- a) Old growth trees present over greater than 75% of occurrence (i.e. average of 25 trees per hectare greater than 40 cm dbh and/or more than 160 years old have not been cut (Mehl 1992) over most of the area;
- b) if thinning of small diameter trees has occurred, there is little evidence of minimal disruption of understory vegetation;
- c) some light grazing by livestock may have occurred;
- d) exotic species may be present at low densities.

C SPECS

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing);
- b) heavy grazing by livestock has severely altered ground layer composition;
- c) some exotic species present (including such species as *Cirsium arvense* [Canada thistle] and/or *Euphorbia esula* [leafy spurge]).

D SPECS

- a) Heavily logged and thinned, perhaps to the point of a clear-cut;
- b) ground very disturbed with major disruptions to vegetation;
- c) large proportion of exotic species, including *Cirsium arvense* (Canada thistle) and/or *Euphorbia esula* (leafy spurge).

RANK SPECS JUSTIFICATION

“A” rating threshold: Old growth criteria are based on those of Mehl (1992), who reviewed these criteria for ponderosa pine forests and other types throughout the Rocky Mountain region. Ponderosa pine forest systems generally depend on some form of fire to maintain overstory and understory composition. Brown and Sieg (1996) show that the range of fire in the Black Hills was between 1-45 years. Lack of fires within this time frame leads to structural changes in ponderosa pine, and alters ground layer composition and diversity. Fire intervals may be even longer in the northern Black Hills.

“C”/“D” threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of ponderosa pine old-growth structure would take greater than 100 years.

EO RANK FACTOR [2nd]

Size

A SPECS

Very large (≥ 200 ha)

B SPECS

Large (50-199 ha)

C SPECS

Moderate (15-49 ha)

D SPECS

Small (<15 ha)

RANK SPECS JUSTIFICATION

“A” rating threshold: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to be representative of the type.

“C”/“D” threshold: Stands lack variability, and often are confined to specific aspects or slopes.

The minimum size, even for “D”-ranked occurrences, will rarely fall below 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects.

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – area around the EO is largely intact natural vegetation, with species interactions and natural processes occurring across communities (>2000 ha).

B SPECS

Moderately connected – area around the EO is moderately intact natural vegetation, with species interactions and natural processes occurring across many communities; landscape includes partially disturbed natural or semi-natural communities, some of it not high quality due to overgrazing or recent logging (>2000 ha).

C SPECS

Moderately fragmented – area around the EO is largely a combination of cultural and natural vegetation, with barriers between species interactions and natural processes across natural communities; EO is surrounded by a mix of intensive agriculture and adjacent forest lots.

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities.

RANK SPECS JUSTIFICATION

“A” rating threshold: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (*i.e.*, the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) proposed by Shugart (1984) – fifty times the average disturbance size, or Johnson and Van Wagner (1985) – two times the maximum disturbance size (see also Frelich 1995), can be used as a rough guide to landscape size. If disturbance regimes are virtually unknown, the minimum “C”-rated size (15-49 ha) can be used as a starting point and multiplied by fifty. Thus, “A”-rated ponderosa pine landscapes may need to be 750-2500 ha in size.

“C”/“D” threshold: Processes such as natural disturbances are essentially irretrievable.

GRANKSPECS AUTHORSHIP

McAdams, A. and D. Faber-Langendoen

GRANKSPECS DATE

1998-06-29

GRANKSPECS NOTES

**D2.1.2 *Quercus alba* – *Quercus rubra* – *Quercus macrocarpa* / *Carpinus caroliniana*
Forest,
white oak – red oak – bur oak / musclewood forest**

SPECS GROUP

Quercus alba – (*Quercus rubra*, *Carya* spp.) Forest Alliance

MINIMUM SIZE

2 ha

EO Separation

SEPARATION BARRIERS

Barriers that would separate patches of this community include a four-lane highway, urban development, and an open body of water.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

4 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

The separation factors are based on seed dispersal of *Quercus* and *Carya* spp., which are dependent on squirrels and jays. These dispersers can move considerable distances between patches in intact or fragmented landscapes, from several hundred meters to 4 or 5 km (Harrison and Werner 1984, Crow 1988, Johnson and Webb 1989).

FEATURE LABELS

GSPECS AUTHORSHIP

Dunevitz, H. and D. Faber-Langendoen

GSPECS DATE

1998-06-29

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Condition, size and landscape context are weighted equally for this type. Although matrix types typically consider condition to be of less importance than size and landscape context, this community type has been extensively cleared throughout its range, and choosing among remaining examples requires a greater consideration of condition because of the potential for extensive alteration of the groundlayer.

EO RANK FACTOR [1st]

Condition

A SPECS

For types that attain old-growth status:

- a) age of forest is typically old growth (120 years old or more);
- b) human-induced disturbance is minimal, including light selective logging that occurred in the past (>80 years ago);
- c) structure is all-aged with multi-layered canopies and some mesophytic species, such as *Acer saccharum* or *Fraxinus americana*, which may only be in the subcanopy or understory;
- d) a proportion of the *Quercus* spp. exceed 70 cm diameter at breast height, depending on site condition;

- e) few or no exotic species occur in the overstory or understory, with little evidence of livestock grazing within the last 80 years.

For types that do not attain old-growth status and require disturbance for regeneration:

- a) forest is typically older (>100 years old or more) and of natural origin (regenerating following natural disturbance such as fire or wind-storm);
- b) there is little or no human-induced disturbance, except natural area management such as prescribed burning or light selective logging that occurred in the past (>80 years ago);
- c) structure is even or all-aged, with single or multi-layered canopies;
- d) shrub layer is not composed predominantly of species that follow livestock grazing, but instead is composed of *Corylus americana* (hazel), *Prunus virginiana* (chokecherry), *Cornus* spp. (dogwood, including *C. florida*) and/or *Vaccinium* spp. (blueberry);
- e) ground layer is composed of native species typical of oak forests;
- f) there is evidence of fire in the last fifty years.

B SPECS

- a) Typically a mature or nearly mature forest, younger than old-growth, but with intact canopy;
- b) if logging occurred, it was either long ago (>60 years ago), very light selective cutting, or was done as a deliberate management strategy to approximate natural disturbance such as fire;
- c) at most, very light livestock grazing occurred within the last 60 years.

C SPECS

- a) EO may have been grazed by livestock, but not heavily enough to destroy groundlayer or result in dominance by armed shrubs that characteristically follow grazing;
- b) selective logging may have recently occurred (20- 60 years ago), but community composition has remained intact and some tree regeneration (including *Quercus* spp.) is occurring;
- c) also includes young second-growth (20-60 year old) stands that originated with good regeneration following clearcutting or burning.

D SPECS

Heavily cut or heavily grazed forest with a dense shrub layer of *Xanthoxylum americanum* (prickly ash), *Ribes* spp. (gooseberries), or *Rhamnus cathartica* (buckthorn), with a ground layer generally containing low diversity, either packed or very loose soil with few herbaceous plants, or dominated by weedy grasses and sedges or by exotic species, such as *Alliaria petiolata* (garlic mustard).

RANK SPECS JUSTIFICATION

“A” rating threshold: Parker (1989) required that old-growth conditions for central hardwoods, including oak forests, was >150 years, but noted that distinctions between old forest (100-150 years) and old-growth forests have not been developed. Frelich (1995) used 120 years to define old growth oak-hickory forests in the Lake States of Michigan, Minnesota, and Wisconsin. Parker (1989) also restricted old growth to stands with >80 years with no livestock grazing. The role of fire in oak forests is not clear, but some type of ground fire with occasional catastrophic disturbances has been noted (Guntenspergen 1983, Parker 1989, Abrams 1992, Olson 1996). Ground-layer characteristics of fire-maintained oak forests are poorly understood, but *Quercus* spp. regeneration may be enhanced through fires.

“C”/“D” threshold: *Quercus* spp. regeneration is unlikely, and exotics will have altered the ground-layer, preventing re-establishment of native species. *Alliaria petiolata* is difficult to eradicate (Nuzzo 1991, Schwartz and Heim 1996).

EO RANK FACTOR [2nd]
Size

A SPECS

Very large (≥ 100 ha)

B SPECS

Large (40-99 ha).

C SPECS

Moderate (10-39 ha).

D SPECS

Small (<10 ha)

RANK SPECS JUSTIFICATION

“A” rating threshold: In a study of one township in southeastern Wisconsin, Guntenspergen (1983), reported that nineteenth century stands of forest rarely exceeded 200 ha, and averaged 40 ha. Currently few stands exceed 30 ha throughout the central hardwoods of the United States (Parker 1989).

“C”/“D” threshold: Guntenspergen (1983) found that below the 10 ha limit, edge effects became pronounced. Brothers (1992, 1993) reported that stands at or above 10 ha in size were fairly resistant to invasion by shade-intolerant exotics (e.g., *Taraxacum officinale* [dandelion], *Rosa multiflora* [multiflora rose], and *Chenopodium album* [goosefoot]). However shade-tolerant exotics (e.g., *Alliaria petiolata* [garlic mustard], *Lonicera japonica* and *L. tatarica* [honeysuckles]), may be able to spread into small fragments far more easily.

The minimum size, even for “D”-ranked occurrences, is not likely to fall below 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects, which can extend 50 m from the edge (Guntenspergen 1983, Brothers 1992).

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – area around the EO is largely intact natural vegetation, with species interactions and natural processes occurring across communities (>500 ha).

B SPECS

Moderately connected – area around the EO is moderately intact natural vegetation, with species interactions and natural processes occurring across many communities; landscape includes partially disturbed natural or semi-natural communities, some of it not high quality due to overgrazing or recent logging (>500 ha).

C SPECS

Moderately fragmented – area around the EO is largely a combination of cultural and natural vegetation, with barriers between species interactions and natural processes across natural communities; EO is surrounded by a mix of intensive agriculture and adjacent forest lots (total area no smaller than ten times the minimum “C”-rated size [>100 ha]).

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities.

RANK SPECS JUSTIFICATION

“A” rating threshold: Definitions for minimum dynamic area (i.e., the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) proposed by Shugart (1984) – fifty times the average disturbance size, or by Johnson and Van Wagner (1985) – two times the maximum disturbance size (see also Frelich 1995), can be used as a rough guide to landscape size. If disturbance regimes are virtually unknown, as they are for oak forests, the minimum “C”-rated size (10-39 ha) can be used as a starting point and multiplied by fifty. Thus, “A”-rated oak forest landscapes may need to be about 500-2000 ha in size.

“C”/“D” threshold: “C”-rated landscapes still provide a buffer against some edge effects on an EO and provide some connectivity to other natural communities.

GRANKSPECS AUTHORSHIP

Dunevitz, H. and D. Faber-Langendoen

GRANKSPECS DATE
1998-06-29

GRANKSPECS NOTES

**D2.1.3 *Tsuga canadensis* – (*Betula alleghaniensis*) Mesic Forest,
eastern hemlock – (yellow birch) mesic forest**

SPECS GROUP

Tsuga canadensis Forest Alliance Group

MINIMUM SIZE

2 ha

EO Separation

SEPARATION BARRIERS

Barriers that would separate patches of this community include a four-lane highway, urban development, and an open body of water.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

2 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

The separation distance for cultural vegetation is based on the suggested minimum value, since little is known about limitations on seed dispersal. The separation distance of 2 km for intervening natural or semi-natural communities seems to be a pragmatically useful distance.

FEATURE LABELS

GSPECS AUTHORSHIP

Faber-Langendoen, D.

GSPECS DATE

1998-06-29

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Size is the primary factor, landscape context is the secondary factor, and condition is the tertiary factor. The primary and secondary factors are weighted equally, and weighted more heavily than the tertiary factor. The rationale for the sequence is that this is a matrix type, less affected by condition than size and landscape context. Note however, that size can be naturally very variable in this type (Mladenoff et al. 1993).

EO RANK RACTOR [1st]

Condition

A SPECS

- a) Overstory structure intact (*i.e.*, old-growth has not been cut), generally 150 years old or more;
- b) understory vegetation composed of native species;
- c) stands may have been thinned with minimal disruption of understory (>20 years ago), but little or no exotics are present.

B SPECS

- a) Overstory structure intact, with perhaps some selective logging. Stand age may range from 80-150 years;

- b) if thinning of small diameter trees has occurred, there is little evidence of disruption of understory vegetation;
- c) some light grazing by livestock may have occurred;
- d) exotic species may be present at low densities.

C SPECS

- a) Heavily logged with only small diameter trees remaining and disturbance to understory vegetation (due to logging activities or grazing); stand age may range from 50-80 years;
- b) heavy grazing by livestock or by deer has severely altered ground layer composition;
- c) some exotic species present.

D SPECS

- a) Heavily logged and thinned, perhaps to the point of a clear-cut; stand age less than 50 years;
- b) ground very disturbed with major disruptions to vegetation;
- c) large proportion of exotic species.

RANK SPECS JUSTIFICATION

“A” rating threshold: Hemlock forest systems begin to take on old-growth characteristics only after 150 years, and may even go through a series of old-growth changes between 180 and 400 years (Tyrrell and Crow 1994). Forest stands of this type experience relatively low disturbance rates, so under natural disturbance regimes most of the stands should be in old-growth.

“C”/“D” threshold: Native ground layer composition is severely altered and unlikely to replace exotics. Recovery of hemlock old-growth structure would take greater than 100 years. Overgrazing by deer could prevent hemlock regeneration (Mladenoff and Stearns 1993).

EO RANK FACTOR [2nd]
Size

A SPECS

Very large (≥ 400 ha)

B SPECS

Large (40-399 ha)

C SPECS

Moderate (4-39 ha)

D SPECS

Small (< 4 ha)

RANK SPECS JUSTIFICATION

“A” rating threshold: Stands this size would be able to support natural disturbance processes such as wind blowdowns, and would contain sufficient internal variability to be representative of the type. Studies of old-growth landscapes in the Great Lakes region show that stands can attain this size (Mladenoff *et al.* 1993).

“C”/“D” threshold: Studies by Mladenoff *et al.* (1993) found that in one old-growth landscape, patches of hemlock stands ranged in size from 2 ha to over 1,000 ha, and that the average stand was 21 ha. Stands much below this average (*i.e.*, less than 4 ha) will be dominated by edge effects throughout the stand.

The minimum size, even for “D”-ranked occurrences, will rarely fall below 2 ha. Stands below 2 ha become difficult to judge in terms of stand homogeneity, and become heavily influenced by edge effects. Note, however, that size can be naturally quite variable in this type (Mladenoff *et al.* 1993).

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – area around the EO is largely intact natural vegetation, with species interactions and natural processes occurring across communities (>5000 ha).

B SPECS

Moderately connected – area around the EO is moderately intact natural vegetation, with species interactions and natural processes occurring across many communities; landscape includes partially disturbed natural or semi-natural communities, some of it not high quality due to overgrazing or recent logging (>5000 ha).

C SPECS

Moderately fragmented – area around the EO is largely a combination of cultural and natural vegetation, with barriers between species interactions and natural processes across natural communities; EO is surrounded by a mix of intensive agriculture and adjacent forest lots.

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities.

RANK SPECS JUSTIFICATION

“A” rating threshold: Landscapes could sustain natural disturbance regimes. Definitions for minimum dynamic area (*i.e.*, the area of land necessary so that the proportion of the landscape in early, middle and late successional stages will remain constant over time, given the occurrence of windstorms and fires) proposed by Shugart (1984) – fifty times the average disturbance size, or Johnson and Van Wagner (1985) – two times the maximum disturbance size (see also Frelich 1995), can be used as a rough guide to landscape size. Frelich and Lorimer (1991) showed that the average disturbance size in these hemlock-hardwood forests was about 100 ha, so that landscapes of over 5,000 ha would be needed to sustain old-growth characteristics.

“C”/“D” threshold: Processes such as natural disturbances are essentially irretrievable.

GRANKSPECS AUTHORSHIP

Faber-Langendoen, D.

GRANKSPECS DATE

1998-06-29

GRANKSPECS NOTES

D2.2 Large Patch Communities

D2.2.1 *Artemisia tridentata* spp. *tridentata* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation, basin big sagebrush / bluebunch wheatgrass shrub herbaceous vegetation

SPECS GROUP

Artemisia tridentata Shrub Herbaceous Alliance, zonal or loamy soil group

MINIMUM SIZE

0.4 ha

EO Separation

SEPARATION BARRIERS

Barriers that would separate patches of this community include a four-lane highway, urban development, and an open body of water.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

2 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

The separation distances for cultural vegetation are based primarily on the suggested minimum value, since little is known about limitations on sagebrush and herb seed dispersal. The separation distance for intervening natural or semi-natural communities seems to be a pragmatically useful distance. Primary criteria considered are the reaction of native species to disturbance, seed dispersal by dominant shrubs, and biology of shrub-steppe passerines.

FEATURE LABELS

GSPECS AUTHORSHIP

Chappell, C., D. Faber-Langendoen, and R. Crawford

GSPECS DATE

1997-07-02

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Condition is the primary factor, size is the secondary factor, and landscape context is the tertiary factor. The primary and secondary factors are weighted equally, and weighted more heavily than the tertiary factor.

EO RANK FACTOR [1st]

Condition

A SPECS

- a) Cryptogamic crust intact, covering >80% of vascular plant interspace; high diversity of lichens and/or mosses in crust;
- b) non-native species and native annual increasers (e.g., *Plantago patagonica*, annual fescues) absent or incidental;

- c) fire-sensitive shrubs mature and recovered from past fires; shrubs well-spaced if present (generally <20-25% cover);
- d) diverse forb layer within expected range for the type; native perennial increasers not particularly prominent. This is now very rare to non-existent and is meant to represent a community that is indistinguishable from a community that has never been grazed and has not burned for some time. Fire was probably part of the "natural" landscape, but fires have increased in frequency unnaturally such that unburned areas are of greater natural value than recently burned areas. Fire frequency has decreased in some parts of the range (e.g., Pacific Northwest).

B SPECS

- a) Cryptogamic crust well-developed, >60% cover of vascular plant interspace; cryptogamic crust little disturbed or may have recovered well from long-past grazing; cryptogamic crust diverse in species composition (at least 3-4 species prominent);
- b) community dominated by natives; non-natives and native annual increasers <10% total cover and <20% relative cover in the herb layer; cheatgrass *not* thick under shrub crowns;
- c) fire-sensitive shrubs prominent, but may not be mature or fully recovered from fire; shrubs well spaced if present; diverse forb layer within expected range for the type; native perennial increasers do not predominate. This is generally the best of what remains in the landscape.

C SPECS

- a) Cryptogamic crust moderately degraded or recovering, >30% cover of vascular plant interspace (although monotypic early-successional moss may be more abundant); species diversity of crust may be relatively low; lichens likely to have low percent cover;
- b) community clearly dominated by natives in the herb layer; non-natives and native annual increasers <20% total cover and <30% relative cover in the herb layer; bunchgrasses >50% relative cover in the herb layer; indicator bunchgrasses (*Pseudoroegneria spicata*, *Festuca idahoensis*) clearly more important than increasers or non-natives; forb diversity may be somewhat lower than expected for the type; native perennial increasers may be relatively prominent but do not dominate. Cheatgrass can often be dense under shrub crowns;
- c) fire-sensitive shrubs may be present or absent; shrubs that increase (e.g., *Artemisia tridentata* spp. *tridentata*) may be somewhat more dense than pre-disturbance, but still <35% cover.

D SPECS

- a) Cryptogamic crust degraded or absent, <30% cover of vascular plant interspace; crust often low diversity;
- b) community may not be clearly dominated by natives; herb layer is a mix of natives and non-natives; native annual increasers or non-native invaders may be >20% cover and >30% relative cover in the herb layer; native indicator bunchgrasses (*Pseudoroegneria spicata*, *Festuca idahoensis* combined) >5-10% cover;
- c) shrubs may be quite dense, with >40% cover.

RANK SPECS JUSTIFICATION

"A"-rating threshold: The "A" rated criteria are based on descriptions of relict communities and reactions of key plant species to anthropogenic disturbances.

"C"/"D" threshold: This threshold is intended to separate "C"-rated occurrences that will naturally improve in condition when released from livestock or other anthropogenic disturbance, from "D"-rated occurrences that will not improve and are prone to irreversible changes in composition.

EO RANK FACTOR [2nd] Size

A SPECS
Very Large (>=200 ha)

B SPECS
Large (80-199 ha)

C SPECS

Moderate: (20-79 ha)

D SPECS

Small (<20 ha)

RANK SPECS JUSTIFICATION

“A”-rating threshold: Stands this size would be able to support natural disturbance processes such as fire, and would contain sufficient internal variability to be representative of the type.

“C”/“D” threshold: Stands lack variability, and are prone to being eliminated by a single disturbance event.

The primary criteria considered are seed dispersal by dominant shrubs, biology of shrub steppe passerines, and the likelihood of an area completely burning in a single event.

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – landscape has been little altered, and the EO is completely surrounded by other high quality communities *and* extensive shrub-steppe (> 400 ha).

B SPECS

Moderately connected – EO is surrounded by moderate to extensive (>400 ha) low quality shrub-steppe, an extensive landscape that is used or has been extensively used for grazing or training.

C SPECS

Moderately fragmented – EO is surrounded by a mix of intensive agriculture and adjacent natural/semi-natural shrub-steppe, or by a relatively small area (total area smaller than twice the minimum EO size) of shrub-steppe in an agriculturally fragmented landscape.

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities. The surrounding landscape is primarily intensive agriculture or suburban development.

RANK SPECS JUSTIFICATION

“A” rating threshold: Natural disturbances, such as fire, can occur on a scale that permits maintenance of patches of the community in a variety of conditions.

“C”/“D” threshold: Processes such as natural disturbances are essentially irretrievable.

The primary criteria considered are seed dispersal by dominant shrubs, biology of shrub steppe passerines, and the likelihood of an area completely burning in a single event.

GRANKSPECS AUTHORSHIP

Chappell, C., D. Faber-Langendoen, and R. Crawford

GRANKSPECS DATE

1997-07-02

GRANKSPECS NOTES

**D2.2.2 *Thuja occidentalis* – (*Picea mariana* – *Abies balsamea*) / *Alnus incana* Wetland Forest,
eastern white cedar – (black spruce – balsam fir) / speckled alder wetland forest**

SPECS GROUP

Thuja occidentalis Saturated Forest Alliance Group

MINIMUM SIZE

0.4 ha

EO Separation

SEPARATION BARRIERS

A substantial barrier that would separate patches of this community is a two-lane highway or larger.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

1 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

Because white cedar swamps are dependent on saturated hydrological processes, the effects of even small roads may create substantial barriers between occurrences.

Boundaries can usually be determined from aerial photos. Difficulties in distinguishing this type from balsam fir, black spruce, or black ash swamps may require mapping as a complex.

FEATURE LABELS

GSPECS AUTHORSHIP

Aaseng, N. and D. Faber-Langendoen

GSPECS DATE

1997-07-02

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Condition is the primary factor, size is the secondary factor, and landscape context is the tertiary factor. The primary and secondary factors are weighted equally, and weighted more heavily than the tertiary factor.

EO RANK FACTOR [1st]

Condition

A SPECS

- a) Site dominated by mature *Thuja occidentalis* generally >150 years old, with lesser cover of *Abies balsamea* and/or *Picea mariana*;
- b) extensive areas (>5 ha) with sufficient tree cover (50-100%) to favor development of typical shade-tolerant flora; species diversity high (>65 species);
- c) no obvious impact on vegetation from flooding or lowering of water table by activities such as road construction, ditching, or mining;
- d) surface disturbance due to winter roads, selective logging, and utility corridors limited to small percentage (<5%) of swamp;

- e) no exotic species present;
- f) absence of overgrazing by deer, as inferred by presence of white cedar reproduction;
- g) Downgrading of rank because of greater disturbance may be offset by significant presence of rare species such as *Cypripedium arietinum*, *Ranunculus lapponicus*, *Geocaulon lividum*, *Arethusa bulbosa*, *Polemonium occidentale*, or important concentrations of several species of orchid.

B SPECS

- a) A stand with the above "A"-rated condition characteristics, but partially degraded by surface activities such as selective logging;
- b) a stand with the above "A"-rated condition characteristics, but impacts due to water table alteration are present (although limited to a narrow band along ditch, road, etc.);
- c) a stand with mature cedar and typical structure, but with depauperate ground flora due to alteration of groundwater by ditching.

C SPECS

- a) Stand has structure and species composition significantly altered from its presettlement character by flooding, lowering of water table, or surface activities;
- b) lowering of water table may result in reduction or near total loss of ground flora;
- c) has more than occasional occurrence of exotic or non-typical cedar-spruce swamp species, but has enough structure and typical species so that the community is still recognizable.

D SPECS

A site where the hydrology has been severely altered or the surface drastically disturbed such that restoration is unlikely to occur.

RANK SPECS JUSTIFICATION

"A"-rating threshold: Maintenance of natural groundwater flow patterns is essential to the condition of this community. Use of rare species is suggested here because of their value as an indicator of natural processes.

"C"/"D" threshold: Groundwater flow has been severely altered such that the community is not likely to persist.

EO RANK FACTOR [2nd]
Size

A SPECS

Very Large (>=40 ha)

B SPECS

Large (20-39 ha)

C SPECS

Moderate (4-19 ha)

D SPECS

Small (<4 ha)

RANK SPECS JUSTIFICATION

"A"-rating threshold: In the United States, white cedar swamps can occur in stands of over 40 ha, and sometimes as large as 200 ha, but this is relatively unusual.

"C"/"D" threshold: White cedar swamps often occur in small, concentrated areas where minerotrophic flows occur. In the New England region, the average occurrence size is 19 ha, and the mode and median sizes are 8 ha. These averages are within the size range specified for "C"-rated occurrences. The minimum viable size of this community is set fairly low at 4 ha.

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – area around the EO is largely intact natural vegetation, with species interactions and natural processes occurring across communities (>1000 ha).

B SPECS

Moderately connected – area around the EO is moderately intact natural vegetation, with species interactions and natural processes occurring across many communities; landscape includes partially disturbed natural or semi-natural communities, some of it not high quality due to overgrazing or recent logging (>1000 ha).

C SPECS

Moderately fragmented – area around the EO is largely a combination of cultural and natural vegetation, with barriers between species interactions and natural processes across natural communities; EO is surrounded by a mix of intensive agriculture and adjacent forest lots.

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities.

RANK SPECS JUSTIFICATION

“A”-rating threshold: Landscape context meeting these criteria provides a buffer against hydrologic changes.

“C”/“D” threshold: EO is subject to direct hydrologic inputs from adjacent land use that will alter the water quality; maintenance of natural hydrologic dynamics will be very difficult.

The landscape context is somewhat small, and partially reflects the small to moderate scale of EO size requirements. Landscape requirements for white cedar swamps need investigation, particularly as they relate to groundwater flows.

GRANKSPECS AUTHORSHIP

Aaseng, N. and D. Faber-Langendoen

GRANKSPECS DATE

1997-07-02

GRANKSPECS NOTES

D2.3 Small Patch Communities

D2.3.1 *Carex lasiocarpa* – *Carex buxbaumii* – *Scirpus cespitosus* Boreal Herbaceous Vegetation, wiregrass sedge – Buxbaum's sedge – tufted club-rush boreal herbaceous vegetation

SPECS GROUP

Carex lasiocarpa Saturated Herbaceous Alliance Group

MINIMUM SIZE

0.05 ha

EO Separation

SEPARATION BARRIERS

A substantial barrier that would separate patches of this community is a two-lane highway or larger.

SEPARATION DISTANCE – DIFFERENT NATURAL/SEMI-NATURAL COMMUNITIES

1 km

SEPARATION DISTANCE – CULTURAL VEGETATION

0.5 km

ALTERNATE SEPARATION PROCEDURE

SEPARATION JUSTIFICATION

Because fens are dependent on hydrological processes, the effects of even small roads may create substantial barriers between occurrences.

Note that occurrences of this community may be difficult to distinguish from other communities. Possible difficulties include:

- a) distinguishing between rich fen and wet meadow on aerial photographs (fens usually appear light blue in color on IR NAP [infra-red national aerial photography] photographs, while wet meadows appear white); and
- b) defining boundaries between rich fen and poor fen. In the absence of field data, these types can often be distinguished on the basis of landform position and inferred surface chemistry and water flow. Poor fens are often distinguished by the abundance of ericaceous shrubs, which appear somewhat orange in color on NHAP (national high altitude photography) photographs.

FEATURE LABELS

GSPECS AUTHORSHIP

Aaseng, N. and D. Faber-Langendoen

GSPECS DATE

1997-07-02

GSPECS NOTES

RANKSPECS GROUP

RANK PROCEDURE

Condition is the primary factor, landscape context is the secondary factor, and size is the tertiary factor. The primary and secondary factors are weighted equally, and weighted more heavily than the tertiary factor.

EO RANK FACTOR [1st]
Condition

A SPECS

- a) No obvious impact on vegetation (determined using aerial photos) resulting from alteration of groundwater by activities such as road construction, ditching, utility corridors, or mining activities. Some minor occurrence of abandoned winter vehicle trails is acceptable;
- b) presence of *Drosera anglica*, and particularly *D. linearis*, is a good indicator of pristine condition. Other rare species may be present, such as *Drosera linearis*, *D. anglica*, *Xyris montana*, *Carex exilis*, *Cladium mariscoides*, and *Rhynchospora fusca* in the boreal section of its range, and *Scirpus cespitosus*, *Cladium maricoides*, *Carex viridula*, and *Eleocharis pauciflora* in the southern part of its range;
- c) high flora diversity because of presence of mud-bottomed pools or flarks and moss-covered ridges (these features can be detected on aerial photos); moss layer is well-developed, consisting of genera such as *Campylium*, *Drepanocladus*, and *Calliergonella*;
- d) no exotic species present.

B SPECS

- a) Sites with "A"-rated condition characteristics, but where surface disturbance over a small to moderate percentage of fen has occurred due to winter roads or utility corridors;
- b) small percentage of fen surface is impacted due to water table alteration (which may be indicated by invasion of *Asclepias incarnata*, *Alnus incana*, or *Cirsium arvense*, or an increase in *Chamaedaphne calyculata*, *Betula glandulifera*, *Larix laricina*, or *Calamagrostis canadensis*);
- c) undisturbed site lacking floristic diversity, fairly monotypic, often with thick thatch; moss layer partially disturbed.

C SPECS

- a) Overall ground water flow intact, but is extensively impacted by ditches and roads; significant portions of fen remain intact;
- b) moss layer may be very patchy.

D SPECS

- a) Hydrology has been severely altered or surface drastically disturbed (*e.g.*, by peat mining) such that restoration is unlikely to occur;
- b) moss layer very sparse; composition may be very simplified.

RANK SPECS JUSTIFICATION

"A"-rating threshold: Maintenance of natural groundwater flow patterns is essential to the condition of this community.

"C"/"D" threshold: Groundwater flow has been severely altered, such that the community is not likely to persist.

Care should be taken not to inflate the rank based on the presence of rare species *per se*; rather, they serve to indicate high quality conditions. Their role as indicators needs further investigation.

EO RANK FACTOR [2nd]
Size

A SPECS

>=20 ha

B SPECS

10-19 ha

C SPECS

4-9 ha

D SPECS

<4 ha

RANK SPECS JUSTIFICATION

“A”-rating threshold: Fens of this size are more likely to have diverse composition.

“C”/“D” threshold: Fens below 4 ha in size are not likely to contain the full range of diversity, and will be easily affected by non-natural processes, should these be occurring nearby.

EO RANK FACTOR [3rd]

Landscape context

A SPECS

Highly connected – area around the EO is largely intact natural vegetation, with species interactions and natural processes occurring across communities (>1000 ha).

B SPECS

Highly connected – area around the EO is moderately intact natural vegetation, with species interactions and natural processes occurring across many communities; landscape includes partially disturbed natural or semi-natural communities, some of it not high quality due to overgrazing or recent logging (>1000 ha).

C SPECS

Moderately fragmented – area around the EO is largely a combination of cultural and natural vegetation, with barriers between species interactions and natural processes across natural communities; EO is surrounded by a mix of intensive agriculture and adjacent forest lots.

D SPECS

Highly fragmented – area around the EO is entirely, or almost entirely, surrounded by agricultural or urban land use; EO is at best buffered on one side by natural communities.

RANK SPECS JUSTIFICATION

“A”-rating threshold: This landscape context provides a buffer against hydrologic changes.

“C”/“D” threshold: EO is subject to direct hydrologic inputs from adjacent land use that will alter the water quality, and maintenance of natural hydrologic dynamics will be very difficult.

Landscape context is fairly small, and partially reflects the smaller scale of EO size requirements. Landscape requirements for fens need investigation.

GRANKSPECS AUTHORSHIP

Aaseng, N. and D. Faber-Langendoen

GRANKSPECS DATE

1997-07-02

GRANKSPECS NOTES