Element occurrence review and update for five rare plant species

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ABSTRACT

Indian Valley sedge (*Carex aboriginum*), MacFarlane's four o-clock (*Mirabilis macfarlanei*), Mulford's milkvetch (*Astragalus mulfordiae*), Spalding's silene (*Silene spaldingii*), and Ute ladies'-tresses (*Spiranthes diluvialis*) are all rare plants of conservation concern that occur in Idaho. The Idaho Conservation Data Center (IDCDC) manages spatial and tabular data pertaining to rare plant species using element occurrences (EOs). Federal and state agencies rely on the IDCDC Biotics Database (2005) for information to help plan rare plant conservation efforts. The objectives of this project were to apply the following tasks in the IDCDC Biotics Database for Indian Valley sedge, MacFarlane's four o-clock, Mulford's milkvetch, Spalding's silene, and Ute ladies'-tresses: 1) update and review EO specifications and EO rank specifications; 2) update spatial data; 3) delineate EOs using EO specifications; 4) update and review tabular data; and 5) apply EO ranks based on EO rank specifications. Changes to EOs and EO ranks are summarized. Coordination with state and province programs within the NatureServe Network was essential in developing the EO specifications and EO rank specifications. After application of the EO specification and EO rank specifications, the five rare plant species had the following number of EOs and breakdown of EO ranks within Idaho: 1) seven Indian Valley sedge EOs with the following ranks: B=2, C=4, and D=1; 2) nine MacFarlane's four o'clock EOs with the following ranks: B=3, BC=1, C=4, and D=1; 3) 32 Mulford's milkvetch EOs with the following ranks: A=2, B=7, B?=7, BC=2, C=6, C?=4, X=1, and X?=3; 4) 19 Spalding's silene EOs with the following ranks: B=4, BC=1, C=9, C?=1, D=2, F=1, and not ranked=1; and 5) eight Ute ladies'-tresses EOs with the following ranks: A=1, B=2, C=4, and CD=1. Continued coordination with other programs is essential for providing accurate and seamless data about multi-jurisdictional rare plant species. This report establishes a standard for Indian Valley sedge, MacFarlane's four o-clock, Mulford's milkvetch, Spalding's silene, and Ute ladies'-tresses EOs and EO ranks.

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The objectives of this project were to apply the following tasks in the IDCDC Biotics Database for Indian Valley sedge, MacFarlane's four o-clock, Mulford's milkvetch, Spalding's silene, and Ute ladies'-tresses: 1) update and review EO specifications and EO rank specifications; 2) update spatial data; 3) delineate EOs using EO specifications; 4) update and review tabular data; and 5) apply EO ranks based on EO rank specifications. This report establishes a rangewide standard for Indian Valley sedge, MacFarlane's four o-clock, Mulford's milkvetch, Spalding's silene, and Ute ladies'-tresses EOs and EO ranks. Changes to EOs and EO ranks are summarized.

METHODS

EO specifications for delineating EOs were developed using habitat-based delimitation guidance developed by NatureServe (2004; Appendix B). EO rank specifications were developed based on evaluating existing EOs in the IDCDC Biotics Database (2005; 2006) and NatureServe Rangewide Database (2006); corresponding with Natural Heritage Program staff in other states where the species occurs (if applicable) and other knowledgeable individuals; and the "Element occurrence data standard" (NatureServe 2002).

New spatial and tabular data submissions were added to the IDCDC database, if available. Whenever possible, GPS points replaced or were added to EOs for greater spatial accuracy. The uncertainty buffer for EO features based on GPS points remained a 25-m radius. The uncertainty buffer for all EO features that had been digitized with 1:24,000 quad maps was reduced from a 100-m to 50-m radius. EO features were then measured pairwise and edge-to edge from the uncertainty buffer using the species-specific EO specifications. EO numbers that were deleted were not reused, resulting in skips in EO numbers. After ensuring the EOs were spatially delimited in accordance with the updated EO specifications, the associated tabular data were updated. Data on condition, size, and landscape context were summarized and reviewed to ensure that the rank was consistent with the EO rank specifications. All plant nomenclature is based on the U.S. Department of Agriculture Plants Database (2006).

EO Data Standard: Indian Valley sedge (*Carex aboriginum)*

Status: G1S1 (ID)

Demographic Patterns: Indian Valley sedge is a perennial species and its transplants have survived for > 3 years in garden settings (Murphy and Cooke 2003, Murphy and Hahn 2005). Additional demographic information is not well known.

Dispersal Capabilities: Indian Valley sedge reproduces from seed and vegetatively by rhizomes and rootstock (Hitchcock et al. 1969, Herman 1970). Seed is wind-pollinated and dispersal is most likely by wind, gravity, and seasonal flooding (Moseley 1990).

Habitat: Indian Valley sedge occurs in riparian and wetland settings within the sagebrush-steppe zone. Soils are ephemerally moist alluvial clay-rich soils underlain by basalt (Murphy 2002, Murphy and Cooke 2003, Murphy and Hahn 2005). Indian Valley sedge occurs at elevations ranging from 875 to 1355 m in narrow canyons on low alluvial terraces of intermittent creeks, seeps, mesic graminoid meadows, grass dominated gaps within scrub-shrub riparian areas, and occasionally along moist ditches. In general, characteristic habitat is the transitional zone between wet, flooded sites and dry upland areas. Frequently encountered species growing with Indian Valley sedge *ar*e black hawthorn *(Crataegus douglasii*), syringa *(Philadelphus lewisii*), Woods' rose *(Rosa woodsii*), arroyo willow *(Salix lasiolepis*), snowberry *(Symphoricarpos albus*), small camas *(Camassia quamash*), sedge spp. (*Carex* spp.), California oatgrass *(Danthonia californica*), spikerush spp. (*Eleocharis* spp.), Carolina geranium *(Geranium carolinianum*), meadow barley *(Hordeum brachyantherum*), rush spp. (*Juncus* spp.), bulbous bluegrass *(Poa bulbosa*), and Kentucky bluegrass *(Poa pratensis*; Murphy and Cooke 2003, Murphy and Hahn 2005).

Threats: Introduced weed invasion, highway construction, hydrologic and soil alteration, off-highway vehicle (OHV) use, residential development, and livestock grazing are threats to known occurrences. Habitat potentially capable of supporting Indian Valley sedge has likely been fragmented, degraded, and/or destroyed in the past, largely because of agricultural conversion, introduced weed invasion, hydrologic and soil alteration, residential and commercial development, and livestock grazing (Moseley 1990, Murphy and Hahn 2005).

Global Distribution: Indian Valley sedge is endemic to Adams and Washington counties in west-central Idaho. Its distribution extends approximately 16 km wide by 40 km long.

EO SPECIFICATIONS

MINIMUM EO CRITERIA

Element occurrence (EO) features constitute one EO if they are <3 km apart and share linear water-current flow in the same riparian system. The minimum separation distance is reduced to 1 km if the EO features do not share linear water-current flow in the same riparian system. Separation distances between EO features are measured pairwise and edge-to-edge after accounting for locational uncertainty.

EO Separation

SEPARATION DISTANCE – SUITABLE/UNSUITABLE HABITAT
Habitats supporting Indian Valley sedge are characterized by ephemerally moist clay rich soils derived from basalt (Murphy 2002, Murphy and Cooke 2003, Murphy and Hahn 2005). Unsuitable habitat is characterized by sites that are well drained or flooded throughout the growing season (Murphy, pers. comm. 2005). All Indian Valley sedge EO features were separate EOs if they were ≥ 3 km apart sharing linear water-current flow or ≥ 1 km apart not sharing linear water-current flow because habitat suitability was unknown or undocumented. The separation distance may be extended to 10 km (sharing linear water-current flow) or 2 km (not sharing linear water-current flow) if more information is known about habitat suitability between the EO features in the future.

ALTERNATE SEPARATION PROCEDURES
No alternate separation procedures were used.

SEPARATION JUSTIFCIATION
Separation justification for delineating Indian Valley sedge is based on Tier 3 implementation using habitat-based delimination guidance (see Fig. 1 in Nature Serve 2004:14). The riparian/shore system criteria are applicable and the dynamic landscape mosaic criteria are not applicable.

EO RANK SPECIFICATIONS

EO Rank Specs

A SPECS
SIZE: >300 clusters or >400 flowering stems. CONDITION: Native plant community is intact with zero to low introduced plant species cover and/or minimal anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is unfragmented and ecological and hydrological processes are intact.

B SPECS
SIZE: 75-300 clusters or 200-400 flowering stems. CONDITION: Native plant community is intact with low to moderate introduced plant species cover and/or low to moderate anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be partially fragmented, but ecological and hydrological processes are intact.

C SPECS
SIZE: 10-75 clusters or 50-200 flowering stems. CONDITION: Native plant community is partially intact with moderate to high introduced plant species cover and/or moderate

to high anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be moderately fragmented, but ecological and hydrological processes are intact.

D SPECS
SIZE: <10 clusters or <50 flowering stems. CONDITION: Few components of the native plant community remain and introduced plant species cover and/or anthropogenic disturbance is high. LANDSCAPE CONTEXT: Surrounding landscape is fragmented with many ecological and hydrological processes no longer intact.

E SPECS
Extant: EO has been verified extant, but population size, condition, and landscape context have not been assessed.

F SPECS
Failed to find: EO has been surveyed by experienced individuals who failed to find any Indian Valley sedge individuals, despite searching under conditions appropriate for the element at a location where it was previously recorded. Only one visit is required for this rank designation, but the survey should cover the entire extent of the EO. The F-rank was first standardized by NatureServe (2002) and was not implemented before this project.

H SPECS
Historical: Historical EO indicating where Indian Valley sedge was previously found, often based on older herbarium records (pre-1970). Location records are typically geographically vague and may be simply indicated by the name of a town.

X SPECS
Extirpated: EO has been extirpated. Extirpation is based on: 1) agricultural conversion, commercial or residential development, or other documented habitat destruction where Indian Valley sedge has been previously recorded, or 2) when an EO has consistently received an F-rank based on at least five visits over a 10-year time period.

RANK SPECS JUSTIFICATION
EO rank specifications were developed by evaluation of existing EOs (Idaho Conservation Data Center 2005) and the “Element occurrence data standard” (NatureServe 2002). Rank factors were weighted so that: condition=33%; size=33%; and landscape context=33%. Changes in the number of plants should not be used solely to justify a rank change unless condition and/or landscape context has concurrently changed; and/or if the known EO area has been expanded. The rank factors are calculated to verify the most appropriate rank, where A=4, B=3, C=2, and D=1. The output calculation is used to designate the following ranks: A=3.6-4.0; B=2.6-3.4; C=1.6-2.4; and D=0.0-1.4. A range rank (i.e. BC) is used when the output calculation is 1.5, 2.5, or 3.5. Range ranks can also be used if the EO or rank factors share qualities of multiple ranks. If there is incomplete information about size, condition, and/or landscape context factors, the “?” qualifier can be used with the most appropriate rank (i.e. B?). E-, F-, H-, and X-ranks should be used when appropriate.

SUMMARY OF CHANGES

After application of the EO specification and EO rank specifications, there are seven Indian Valley sedge EOs with the following ranks: B=2, C=4, and D=1. Previously, there were nine EOs with the following ranks: A=1, B=1, C=2, E=4, and X=1 (Idaho Conservation Data Center 2006). EO 9 was deleted and added to EO 4 because they were <3 km apart and share linear water-current flow in the same riparian system (Fig. 1). Several subpopulations discovered in 2005 were also added to EO 4. The new EO 4 was given a B-rank, as a result of both the updated EO specifications and EO rank specifications. EO 1 was deleted because it is based on an 1899 herbarium record with high locational uncertainty (e.g., "Indian Valley"); and the associated herbarium record was incorporated into EO 7 in the Indian Valley area. EOs 5-8 all had E-ranks before application of the EO rank specifications. After application of the EO rank specifications, EOs 5, 6, and 8 were all given C-ranks and EO 7 a D-rank. All Indian Valley sedge EOs on federal lands is managed by BLM. EO 7 occurs entirely on BLM land, and EOs 3 and 4 occur partially on BLM land (Table 1).

RANGEWIDE COMPARISON

Indian Valley sedge only occurs in Idaho, so the updated EO specifications and EO rank specifications are representative across its rangewide distribution.

Table 1. Indian Valley sedge (*Carex aboriginum*) EO and EO rank changes.

EO#	2	3	4	5	6	7	8
Land ownership[1]	P	F,P	F,P,S	P	F	S	P
First observation date	1999	2001	2001	2000	2002	1899 (1); 2002 (7)	2002
New EO changes	-	-	Deleted EO 9 (subpopulations 1-3) and lumped it with EO 4 (subpopulations 8-11). In 2005, subpopulations 4-7 were also added.	-	-	Deleted vague herbarium record representing EO 1; and added it to herbarium records associated with EO 7 (closest EO).	-
Original EO rank	C	B	C (4); A (9)	E	E	E (7); X (1)	E
Date	unknown	unknown	unknown (4); 2003 (9)	unknown	unknown	unknown (7); 1989 (1)	unknown
Previous EO rank	-	-	-	-	-	-	-
Date	-	-	-	-	-	-	-
New EO rank	C	B	B	C	C	D	C
Rank factor ratings[2]	C-B-C?	B-C-A	B-A-B	B-C-C	B-D-B?	C-D-D	C-A?-D
Rank factor change[3]	-	-	size (+)	-	-	-	-
EO rank change influenced by EO specifications	-	-	yes	-	-	-	-
EO rank change influenced by EO rank specifications	-	-	yes	-	-	-	-
New EO rank changes	-	-	Changed rank primarily based on the updated EO specifications and EO rank specifications. Additional subpopulations also increased extent of EO.	Baseline EO rank based on moderately-sized EO occurring in mostly native community located along roadside and near developed areas.	Baseline EO rank based on small-sized EO occurring in mixed native and introduced community with possibly few major landscape disturbances.	Baseline EO rank based on small-sized EO occurring in mostly introduced community; and noxious weeds occur commonly in surrounding landscape.	Baseline EO rank based on large-sized EO occurring in mixed native and introduced community located along roadside; and noxious weeds occur commonly in surrounding landscape.

[1]Land ownership is federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

<u>EO Data Standard: MacFarlane's four o'clock (M*irabilis macfarlanei)*</u>

Status: G2S1 (OR); G2S2 (ID)

Demographic Patterns: MacFarlane's four o'clock is a long-lived, deep-rooted perennial forb that reproduces sexually by seed and asexually through long spreading rhizomes (U.S. Fish and Wildlife Service 2000). Individuals may comprise several hundred stems ranging up to approximately 9 m^2, making it difficult to ascertain changes in the number of plants at a given site (Callihan 1988, Kaye 1995). In one demographic study, Kaye (1995) found that the number of plants remained relatively stable over a five-year time period at occurrences in the Hells Canyon area. Clonal spread may contribute more to population stability compared to seedling recruitment (Kaye 1995, Barnes et al. 1997), although both are important to long-term genetic stability (U.S. Fish and Wildlife Service 2000). Some studies have found low rates of seedling recruitment (Kaye et al. 1990, Kaye 1995), while others have found that seedling recruitment is a rare event (Barnes et al. 1994, Johnson 1995, Barnes et al. 1997, U.S. Fish and Wildlife Service 2000).

Dispersal Capabilities: MacFarlane's four o'clock produces seeds via cross-pollination, but is also capable of self-pollination. The most common pollinators are bees of several genera, including *Anthophora, Bombus, Ceratina, Melecta, Synhalonia, Halictus,* and *Lasioglossum* (Barnes 1996). Seed dispersal likely occurs via gravity and rain (Kaye 1992). Research indicates that genetic diversity in MacFarlane's four o'clock is lower than for plant species with a similar life history. Gene flow was greatest between sites <0.5 km apart and decreased as distances increased (Barnes et al. 1994).

Habitat: MacFarlane's four o'clock occurs in river canyon habitats in sandy to rocky soils. Talus rock often underlies the soils and several sites are unstable and prone to erosion. The climate is characterized by warm and dry conditions and most precipitation occurs during winter and spring rains. Plants are most commonly found on steep slopes with southwest to western aspects, although they may be found at any aspect or slope position. MacFarlane's four o'clock typically occurs in bunchgrass communities dominated by bluebunch wheatgrass *(Pseudoroegnaria spicata*). Other native graminoid associates include sand dropseed *(Sporobolus cryptandrus*), red threeawn *(Aristida longiseta*), Sandberg bluegrass *(Poa secunda*), needle and thread *(Hesperostipa comata*), annual fescue *(Festuca* spp.), and Idaho fescue *(Festuca idahoensis*). Native shrub and tree associates include: gray rabbitbrush *(Chrysothamnus nauseosus*), Saskatoon serviceberry *(Amelanchier alnifolia*), netleaf hackberry *(Celtis reticulata*), smooth sumac *(Rhus glabra*), and spiny greasebush *(Glossopetalon nevadense*). Some native forb associates include: pallid milkweed *(Asclepias cryptoceras*), buckwheat *(Eriogonum spp.*), penstemon *(Penstemon* spp.), western poison ivy *(Toxicodendron rydbergii*), western yarrow *(Achillea millefolium*), Snake River phlox *(Phlox colubrina*), arrowleaf balsamroot *(Balsamorhiza sagittata*), phacelia *(Phacelia* spp.), biscuitroot *(Lomatium* spp.), and milkvetch *(Astragalus* spp.). Non-native species include cheatgrass *(Bromus tectorum*), moth mullein *(Verbascum* *blattaria*), Japanese brome *(Bromus japonicus*), tall tumblemustard *(Sisymbrium altissimum*), pale madwort *(Alyssum alyssoides*), rattlesnake brome *(Bromus brizaeformis*), yellow starthistle *(Centaurea solstitialis*), redstem stork's bill *(Erodium cicutarium*), St. Johnswort *(Hypericum perforatum*), Kentucky bluegrass *(Poa pratensis*), bull thistle *(Cirsium vulgare*), Fuller's teasel *(Dipsacus sylvestris*), and flixweed *(Descurainia* spp.; Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005).

Threats: Non-native plant species and uncharacteristically large or frequent wildfires are likely the greatest threats to MacFarlane's four o'clock (U.S. Fish and Wildlife Service 2000). The deep, thick roots of MacFarlane's four o'clock can probably survive most fires, especially because they generally occur later in the summer when the plant is dormant (Mancuso 1996). However, the subsequent increases in non-native plant species associated with these fires may compete for resources. Herbicide and pesticide spraying, landslides and flood damage, and road and trail construction and maintenance are also threats to MacFarlane's four o'clock, especially to one occurrence that is located adjacent to a major highway. Livestock grazing and trampling may indirectly affect MacFarlane's four o'clock through soil erosion, soil compaction, non-native plant species introduction and seed establishment, and forage selection and avoidance that could alter community composition. Insect damage and disease, wildlife grazing and trampling, recreation (i.e. hiking), off-highway vehicle (OHV) use, plant collecting, mining, pollinator competition with other species, and inbreeding depression are additional threats that may potentially occur or have been documented (Kaye 1995, U.S. Fish and Wildlife Service 2000).

Global Distribution: Idaho County, Idaho; Wallowa County, Oregon. MacFarlane's four o'clock is narrowly endemic to portions of the Snake, Salmon, and Imnaha river canyons in northeastern Oregon and adjacent west-central Idaho. The species global range is approximately 46 by 29 km (Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005).

EO SPECIFICATIONS

MINIMUM EO CRITERIA
Element occurrence (EO) features are separate EOs if they are ≥ 1 km apart. Separation distances between EO features are measured pairwise and edge-to-edge after accounting for locational uncertainty.

EO Separation

SEPARATION DISTANCE – SUITABLE/UNSUITABLE HABITAT
Habitats supporting MacFarlane's four o'clock are characterized by bunchgrass communities in sandy or rocky soils, typically located on steep slopes with southwestern to western aspects (Idaho Conservation Data Center 2006, Oregon Natural Heritage Information Center 2005). Unsuitable habitat is characterized by habitat that does not meet these criteria. All MacFarlane's four o'clock EO features were separate EOs if

they were $\geq$ 1 km apart because habitat suitability was generally unknown or undocumented. The separation distance may be extended to 2 km if more information is known about habitat suitability between the EO features in the future.

ALTERNATE SEPARATION PROCEDURES
No alternate separation procedures were used.

SEPARATION JUSTIFICATION
Separation justification for delineating MacFarlane's four o'clock EOs is based on Tier 3 implementation using habitat-based delimitation guidance (see Fig. 1 *in* NatureServe 2004:14). The dynamic landscape mosaic and riparian/shore system criteria are not applicable.

EO RANK SPECIFICATIONS

EO Rank Specs

A SPECS
SIZE: >1000 ramets or >100 genets. CONDITION: Native plant community is intact with zero to trace introduced plant species cover and/or no significant anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is unfragmented and ecological processes are intact.

B SPECS
SIZE: 500-999 ramets or 50-99 genets. CONDITION: Native plant community is intact with trace to low introduced plant species cover and minimal anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be partially fragmented, but ecological processes are intact.

C SPECS
SIZE: 100-499 ramets or 10-50 genets. CONDITION: Native plant community is partially intact with low to moderate introduced plant species cover and/or moderate anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be moderately fragmented, but ecological processes are intact.

D SPECS
SIZE: <100 ramets or <10 genets. CONDITION: Few components of the native plant community remain. Introduced plant species cover is moderate to high and/or there is significant anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is fragmented with many ecological processes no longer intact.

E SPECS
Extant: EO has been verified extant, but population size, condition, and landscape context have not been assessed.

F SPECS
Failed to find: EO has been surveyed by experienced individuals who failed to find any MacFarlane's four o'clock individuals, despite searching under conditions appropriate for the element at a location where it was previously recorded. Only one visit is required for this rank designation, but the survey should cover the entire extent of the EO.

H SPECS
Historical: An EO that has not been observed since 1970. These are historical EOs indicating where MacFarlane's four o'clock was reported, often based on older herbarium records. Location records are typically geographically vague and may be simply indicated by the name of a town.

X SPECS
Extirpated: EO has been extirpated. Extirpation is based on: 1) road construction, commercial or residential development, or other documented habitat destruction where MacFarlane's four o'clock has been previously recorded, or 2) when an EO has consistently has received an F-rank based on at least five visits over a 10-year time period.

RANK SPECS JUSTIFICATION
Rank factors were developed based on evaluation of extant EOs in Idaho and Oregon (Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005) and the "Element occurrence data standard" (NatureServe 2002). Rank factors were weighted based on NatureServe EO data standards for a large patch community pattern type (NatureServe 2002). Rank factors were weighted in the following manner: condition=45%; size=33%; and landscape context=22%. Changes in the number of plants should not be used solely to justify a rank change unless condition and/or landscape context has concurrently changed; and/or if the known EO area has been expanded. The rank factors are calculated to verify the most appropriate rank, where A=4, B=3, C=2, and D=1. The output calculation is used to designate the following ranks: A=3.6-4.0; B=2.6-3.4; C=1.6-2.4; and D=0.0-1.4. A range rank (i.e. BC) is used when the output calculation is 1.5, 2.5, or 3.5. Range ranks can also be used if the EO or rank factors share qualities of multiple ranks. If there is incomplete information about size, condition, and/or landscape context factors, the "?" qualifier can be used with the most appropriate rank (i.e. B?). E-, F-, H-, and X-ranks should be used when appropriate.

SUMMARY OF CHANGES

After application of the EO specification and EO rank specifications, there are nine MacFarlane's four o'clock EOs with the following ranks: B=3, BC=1, C=4, and D=1. Previously, there were eight EOs with the following ranks: A=1, B=3, BC=1, and C=4 (Idaho Conservation Data Center 2006). EO 2 was split into two EOs because its northernmost EO feature was >1 km from the rest of the EO (Fig. 2). This EO feature was turned into new EO 9 and given a B-rank. EO 2 remained a C-rank. EO 1 changed from a B- to a D-rank, and EO 6 changed from an A- to a B-rank. Both EOs 1 and 6 changed rank solely because of the addition of condition and landscape context to the EO rank specifications. All EOs occurring on federal land are managed by BLM, except EO 6 (USFS). EOs 1, 2, 3, 7, 8, and 9 all occur partially or wholly on BLM land (Table 2).

RANGEWIDE COMPARISON

Based on EO specifications with a 1 km separation distance, there are currently 13 MacFarlane's four o'clock EOs rangewide (Oregon Natural Heritage Information Center 2005, Idaho Conservation Data Center 2006). The Oregon Natural Heritage Information Center primarily uses number of plants for ranking MacFarlane's four o'clock EOs (S. Vrilakas, pers. comm. 2006). Taking in account the different EO rank specifications used in Idaho and Oregon, the 13 EOs have the following ranks: A=1, B=3, BC=1, C=6, C?=1, and D=1. Continued coordination between the Idaho Conservation Data Center and Oregon Natural Heritage Information Center will improve the consistency of MacFarlane's four o'clock EOs throughout its range.

Table 2. MacFarlane's four o'clock (*Mirabilis macfarlanei*) EO and EO rank changes.

EO#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Land ownership[1]	F	F,P	F	P	P	F,P	F	F	F
First observation date	1947	1980	1994	1980	1980's	1988	1988	2001	1994
New EO changes	-	Deleted northernmost feature of EO 2 and turned it into new EO 9.	-	-	-	-	-	-	Deleted northernmost feature of EO 2 and turned it into new EO 9
Original EO rank	B	BC	C	C	B	A	C	C	BC (2)
Date	1991	unknown	unknown	unknown	1993	1991	1991	2001	unknown
Previous EO rank	-	-	-	-	-	-	-	-	-
Date	-	-	-	-	-	-	-	-	-
New EO rank	**D**	**BC**	**C**	**C**	**B**	**B**	**C**	**C**	**B**
Rank factor ratings[2]	D-D-D	C-AB?-C	C-C-B	C-C-BC?	B-B-B?	C-A-C	C?-C?-C?	CD-A-C	B-A-B?
Rank factor change[3]	-	-	-	-	-	-	condition (-)	-	-
EO rank change influenced by EO specifications	-	-	-	-	-	-	-	-	yes
EO rank change influenced by EO rank specifications	yes	-	-	-	-	yes	-	-	yes
New EO rank changes	EO rank changed because small-sized EO occurs in very weedy, burned site surrounded by introduced weeds.	-	-	-	-	EO rank changed because large-sized EO occurs in degraded native perennial grasslands with weed invasions.	-	-	EO rank changed because large-sized EO occurs in native perennial grasslands mixed with introduced species. Surrounding landscape has little anthropogenic disturbance, but may be affected by introduced weeds.

[1]Land ownership is federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

EO Data Standard: Mulford's milkvetch *(Astragalus mulfordiae)*

Status: G2S1 (OR); G2S2 (ID)

Demographic Patterns: Mulford's milkvetch is generally a short-lived perennial, although some older individuals have been observed. The number of plants may greatly fluctuate over time at a given EO (Findley 1998, Mancuso 1999). Findley (1998) has suggested that failed reproductive mechanisms (seed production and seedling establishment) may result in site extirpation in 10-15 years.

Dispersal Capabilities: Mulford's milkvetch only reproduces by seed. Seed dispersal likely occurs by gravity and wind (U.S. Fish and Wildlife Service 1995, Mancuso 1999). Insects observed visiting plants include three butterfly species (*Hesperia juba*, *Icaricia icaroides*, and *Lycaeides melissa*), five bee species (*Andrena nigerrima*, *Hoplitis hypocrita*, *Osmia cynapoda*, *Osmia integra*, and *Synhalonia edwardsia*), and one beetle species (*Acmaeodera bishopiana*; Stephens 2001).

Habitat: Mulford's milkvetch occurs in loose sand derived from lacustrine and alluvial sediments on sandy bluffs and dunelike river-terraces. It occurs on southerly and westerly aspects at elevations of 650-1100 m (Barneby 1989, Mancuso 1999, Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005). Mulford's milkvetch is generally found in or near shrub-steppe communities with big sagebrush *(Artemisia tridentata*), antelope bitterbrush *(Purshia tridentata*), needle and thread *(Hesperostipa comata*), Indian ricegrass *(Achnatherum hymenoides*), bluebunch wheatgrass *(Pseudoroegneria spicata*), and Fendler threeawn *(Aristida purpurea* var. *longiseta*). In Owyhee County, Mulford's milkvetch is more often found where there is an open mix of desert shrub species, such as fourwing saltbush *(Atriplex canescens*), horsebrush species *(Tetradymia species*), and gray rabbitbrush *(Ericameria nauseosa*). In Oregon, Mulford's milkvetch is nearly constantly associated with green rabbitbrush *(Chrysothamnus viscidiflorus*), arrowleaf balsamroot *(Balsamorhiza sagittata*), and sand dune penstemon *(Penstemon acuminatus*). Other associated species include Douglas' brodiaea *(Brodiaea douglasii*), prickly phlox *(Leptodactylon pungens*), Douglas' dustymaiden *(Chaenactis douglasii*), hoary aster *(Machaeranthera canescens*), and pale evening primrose *(Oenothera pallida*; Mancuso 1999, Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005).

Threats: Habitat degradation and loss have been attributed to off-highway vehicle use, introduced weed invasion, livestock grazing and trampling, mining, wildfires, residential and commercial development, rangeland reseeding projects, and non-motorized recreational activities (U.S. Fish and Wildlife Service 1995, Findley 1998, Mancuso 1999, Mancuso and Colket 2005). Many of these factors have cumulatively contributed to further habitat degradation and fragmentation of Mulford's milkvetch EOs. Insect pollinators may also be negatively affected by these factors and from the application of herbicides and insecticide for noxious weed and grasshopper control on the rangelands (U.S. Fish and Wildlife Service 1995).

Global Distribution: Ada, Owyhee, Payette, and Washington Counties, Idaho; Malheur County, Oregon. Mulford's milkvetch is endemic to the western Snake River Plain and its associated tributaries (Barneby 1989, Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005).

EO SPECIFICATIONS

MINIMUM EO CRITERIA
Element occurrence (EO) features are separate EOs if they are ≥ 1 km apart. Separation distances between EO features are measured pairwise and edge-to-edge after accounting for locational uncertainty.

EO Separation

SEPARATION DISTANCE – SUITABLE/UNSUITABLE HABITAT
Habitats supporting Mulford's milkvetch are characterized by dry, sandy slopes (Mancuso 1999, Mancuso and Colket 2005). Unsuitable habitat is characterized by habitat that does not meet these criteria. All Mulford's milkvetch EO features were separate EOs if they were ≥ 1 km apart because habitat suitability was generally unknown or undocumented. The separation distance may be extended to 2 km if more information is known about habitat suitability between the EO features in the future.

ALTERNATE SEPARATION PROCEDURES
There are no alternate separation procedures.

SEPARATION JUSTIFICATION
Separation justification for delineating Mulford's milkvetch EOs is based on Tier 3 implementation using habitat-based delimitation guidance (see Fig. 1 *in* Appendix B).

EO RANK SPECIFICATIONS

EO Rank Specs

A SPECS
SIZE: >400 genets. CONDITION: Native plant community is intact with zero to trace introduced plant species cover and/or no significant anthropogenic disturbance. EO is unburned. LANDSCAPE CONTEXT: Surrounding landscape is unfragmented and ecological processes are intact.

B SPECS
SIZE: 100-400 genets. CONDITION: Native plant community is intact with trace to low introduced plant species cover and minimal anthropogenic disturbance. EO is predominantly unburned. LANDSCAPE CONTEXT: Surrounding landscape may be partially fragmented, but ecological processes are intact.

C SPECS
SIZE: 25-100 genets. CONDITION: Native plant community is partially intact with low to moderate introduced plant species cover and/or moderate anthropogenic disturbance. EO has partially burned. LANDSCAPE CONTEXT: Surrounding landscape may be moderately fragmented, but ecological processes are intact.

D SPECS
SIZE: <25 genets. CONDITION: Few components of the native plant community remain. Introduced plant species cover is moderate to high and/or there is significant anthropogenic disturbance. EO has been predominantly to completely burned. LANDSCAPE CONTEXT: Surrounding landscape is fragmented with many ecological processes no longer intact.

E SPECS
Extirpated: EO has been verified extant, but population size, condition, and landscape context have not been assessed.

F SPECS
Failed to find: EO has been surveyed by experienced individuals who failed to find any Mulford's milkvetch individuals, despite searching under conditions appropriate for the element at a location where it was previously recorded. Only one visit is required for this rank designation, but the survey should cover the entire extent of the EO. The F-rank was first standardized by NatureServe (2002) and was not implemented before this project.

H SPECS
Historical: Historical EO indicating where Mulford's milkvetch was reported, often based on older herbarium records (pre-1970). Location records are typically geographically vague and may be simply indicated by the name of a town.

X SPECS
Extirpated: EO has been extirpated. Extirpation is based on: 1) agricultural conversion, commercial or residential development, or other documented habitat destruction where Mulford's milkvetch has been previously recorded, or 2) when an EO has consistently has received an F-rank based on at least five visits over a 10-year time period.

RANK SPECS JUSTIFICATION
EO rank specifications were developed by evaluation of existing EOs in Idaho and Oregon (US Fish and Wildlife Service 1995, Idaho Conservation Data Center 2005, Oregon Natural Heritage Information Center 2005) and the "Element occurrence data standard" (NatureServe 2002). Rank factors were weighted based on NatureServe EO data standards for a large patch community pattern type (NatureServe 2002). Rank factors were weighted in the following manner: condition=45%; size=33%; and landscape context=22%. Changes in the number of plants should not be used solely to justify a rank change unless condition and/or landscape context has concurrently changed; and/or if the known occurrence area has been expanded. The rank factors

are calculated to verify the most appropriate rank, where A=4, B=3, C=2, and D=1. The output calculation is used to designate the following ranks: A=3.6-4.0; B=2.6-3.4; C=1.6-2.4; and D=0.0-1.4. A range rank (i.e. BC) is used when the output calculation is 1.5, 2.5, or 3.5. Range ranks can also be used if the EO or rank factors share qualities of multiple ranks. If there is incomplete information about size, condition, and/or landscape context factors, the "?" qualifier can be used with the most appropriate rank (i.e. B?). E-, F-, H-, and X-ranks should be used when appropriate.

SUMMARY OF CHANGES

After application of the EO specification and EO rank specifications in Idaho, there are 32 Mulford's milkvetch EOs with the following ranks: A=2, B=7, B?=7, BC=2, C=6, C?=4, X=1, and X?=3. Previously, there were 26 EOs with the following ranks: A=7, B=6, C=4, AD=2, E=3, and X=4 (Idaho Conservation Data Center 2006).

EO 8 was split and its three northernmost EO features became new EO 31 (Fig. 3). EO 8 changed from an A- to B-rank, but EO 31 continued to have an A-rank. EO 9 was split into three EOs so that its westernmost EO features turned into new EO 27 and its easternmost EO feature turned into new EO 28 (Fig. 4). EO 9 changed from a B- to B?-rank. EO 27 was given a BC-rank. EO 28 was given an X-rank because was already considered extirpated due to habitat loss. EO 14 was split and its southernmost EO feature was new EO 29 (Fig. 5). EO 14 changed from a C- to B?-rank and EO 29 was given a C?-rank. EO 15 was split and its three westernmost EO features were turned into new EO 30 (Fig. 6). EO 15 changed from a C- to C?-rank and EO 30 was given a C-rank. EO 20 was split and its seven easternmost EO features were turned into new EO 32 (Fig. 7). EO 20 did not change from a B-rank, but EO 32 was given a C?-rank.

Parent EO 1, EO 19, and sub-EOs 700-718 were deleted and are currently represented by EOs 33 and 34. Parent EO 1 was split so that sub-EOs 700-710, 712-713, 715-716, and 718 were deleted, along with EO 19, and turned into new EO 33 (Fig. 8). The rest of parent EO 1, including sub-EOs 711, 714, and 717, was turned into new EO 34 (Fig. 9). EO 33 was given a BC-rank and EO 34 was given a B-rank.

The following paragraph describes all EO ranks changes for EOs not affected by the updated EO specifications. EOs 10, 11 and 16 changed from A- to B-ranks. EOs 3, 12, and 18 changed from A- to B?-ranks. EO 2 changed from a B- to an A-rank. EOs 13 and 17 changed from a B- to a B?-rank. EO 4 changed from a C- to a C?-rank. EOs 22, 23, and 24 all changed from an E- to a C-rank. EOs 6 and 7 changed from X- to X?-ranks.

All previously ranked EOs (all EOs except E-ranked EOs; n=29) had EO ranks that were partially or completely affected by the application of the updated EO specifications and/or EO rank specifications. Thirty-eight percent of all EOs (n=32) had a documented negative change in condition and/or landscape context since first observed. Six percent of all EOs (n=32) experienced a lower EO rank that was partially influenced by a documented negative change in condition and/or landscape context since the most recent EO rank date (EOs 9 and 11). Most of the negative changes in condition and landscape condition were due to OHV use. All Mulford's milkvetch EOs occurring on federal lands is attributed to BLM. EOs 2-5, 8-14, 16, 18, 20-26, 29, and 32 all occur partially or wholly on BLM land (Table 3).

RANGEWIDE COMPARISON

Based on the updated EO specifications with a 1 km separation distance, there are currently 45 Mulford's milkvetch EOs rangewide (Oregon Natural Heritage Information Center 2005, Idaho Conservation Data Center 2006). The Oregon Natural Heritage Information Center primarily uses number of plants for ranking Mulford's milkvetch EOs (S. Vrilakas, pers. comm. 2006). Taking in account the different EO rank specifications used in Idaho and Oregon, the 45 EOs have the following ranks: A=8, B=9, B?=7, BC=2, C=7, C?=4, D=1, H?=1, unrankable(U)=1, X=1, X?=3; and not ranked(NR)=1. Continued coordination between the Idaho Conservation Data Center and Oregon Natural Heritage Information Center will improve the consistency of delineating and ranking Mulford's milkvetch EOs throughout its range.

Table 3. Mulford's milkvetch (*Astragalus mulfordiae*) EO and EO rank changes.

EO#	**2**	**3**	**4**	**5**	**6**	**7**
Land ownership[1]	F	F,P	F	F	P	P
First observation date	1997	1944	1997	1971	1946	1938
New EO changes	-	-	-	-	-	-
Original EO rank	B	A	C	B	X	X
Date	unknown	1996	unknown	1997	1998	unknown
Previous EO rank	-	-	-	-	-	-
Date	-	-	-	-	-	-
New EO rank	**A**	**B?**	**C?**	**B**	**X?**	**X?**
Rank factor ratings[2]	A-B-AB?	B-A-B?	BC?-C?-?	B-B-B	-	-
Rank factor change[3]	-	-	-	-	-	-
EO rank change influenced by EO specifications	-	-	-	-	-	-
EO rank change influenced by EO rank specifications	yes	yes	yes	-	yes	yes
New EO rank changes	EO rank changed because moderately-sized EO occurs in and is probably surrounded by native community associates, with no mention of introduced species.	EO rank changed because large-sized EO occurs in native community with variable cheatgrass cover (high in places). Landscape context data is absent, but overall EO rank is probably B if landscape context is consistent with condition.	EO rank changed because moderately small-sized EO occurs in native community with unknown abundance of cheatgrass. Landscape context data is absent, but overall EO rank is probably C if landscape context is consistent with condition.	-	EO rank changed because of uncertainty of extirpation noted in EO record.	EO rank changed because of uncertainty of extirpation noted in EO record.

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 3. (Continued)

EO#	8	9	10	11	12
Land ownership[1]	F,P	F	F	F	F
First observation date	1984	pre-1982	1999	1999	1996
New EO changes	Deleted northernmost three features of EO 8 and turned them into new EO 31.	Deleted westernmost feature of EO 9 and turned it into new EO 27; and deleted easternmost feature of EO 9 and turned it into new EO 28.	-	-	-
Original EO rank	A	B	A	A	A
Date	1995	unknown	1999	1999	1996
Previous EO rank	-	-	-	-	-
Date	-	-	-	-	-
New EO rank	**B**	**B?**	**B**	**B**	**B?**
Rank factor ratings[2]	B-A-D	B-B-BD?	B-A-C	B-B-B	BC-A-?
Rank factor change[3]	condition(-), landscape(-)	condition(-)	-	landscape(-)	-
EO rank change influenced by EO specifications	-	-	-	-	-
EO rank change influenced by EO rank specifications	yes	yes	yes	yes	yes
New EO rank changes	EO rank changed because large-sized EO occurs in native community with introduced weed invasions that burned (early-1990s?). Surrounding landscape is described as poor, and is surrounded by major weed invasions and agricultural lands.	EO rank changed because landscape context data is absent.	EO rank changed because large-sized EO occurs in native community with low cheatgrass cover, and cheatgrass-dominated and seeded burned areas occur nearby.	EO rank changed because moderately large-sized EO occurs in and is surrounded by native community with low cheatgrass cover; and heavy OHV use occurs nearby.	EO rank changed because large-sized EO occurs in native community with abundant cheatgrass, but landscape context data is absent.

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 3. (Continued)

EO#	**13**	**14**	**15**	**16**	**17**	**18**
Land ownership[1]	F	F,P	CO,P	F,P	P	F,P
First observation date	1980	1994	1992	1899	1990	1985
New EO changes	-	Deleted southernmost feature of EO 14 and turned it into new EO 29.	Deleted three westernmost features of EO 15 and turned them into new EO 30.	-	-	-
Original EO rank	B	AD	C	A	B	A
Date	1996	unknown	unknown	unknown	1996	1995
Previous EO rank	-	C	-	-	-	-
Date	-	1999	-	-	-	-
New EO rank	**B?**	**B?**	**C?**	**B**	**B?**	**B?**
Rank factor ratings[2]	C-AB-BC?	C-A-C?	C-C-BC?	B-A-D	B?-B-?	B-A-BD?
Rank factor change[3]	condition(-), landscape(-)	condition(-), landscape(-)	-	size(+)	-	-
EO rank change influenced by EO specifications	-	-	-	-	-	-
EO rank change influenced by EO rank specifications	yes	yes	yes	yes	yes	yes
New EO rank changes	EO rank changed because landscape context data is absent.	EO rank changed because large-sized EO occurs in native community with abundant cheatgrass, but landscape context data is absent. Large size weighted overall EO rank upward.	EO rank changed because landscape context data is absent.	EO rank changed because large-sized EO occurs in native community with high introduced weed cover in places; and is surrounded by predominantly agricultural lands and introduced annual grasslands.	EO rank changed because landscape context data is absent.	EO rank changed because large-sized EO occurs in native community with OHV trails. Landscape context data is largely absent, but EO is threatened by development and OHV use.

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 3. (Continued)

EO#	20	21	22	23	24	25	26
Land ownership[1]	F	F,P	F	F	F	F	F
First observation date	1995	1979	2001	2002	2002	2002	2002
New EO changes	Deleted seven easternmost features of EO 20 and turned them into new EO 32.	-	-	-	-	-	-
Original EO rank	B	X	E	E	E	C	C
Date	1995	1995	unknown	unknown	unknown	2002	2002
Previous EO rank	-	-	-	-	-	-	-
Date	-	-	-	-	-	-	-
New EO rank	**B**	**X?**	**C**	**C**	**C**	**C**	**C**
Rank factor ratings[2]	B-AB-D	-	C-C-C	B-D-D	C-D-C	BC-C-CD	B-D-B
Rank factor change[3]	-	-	-	-	-	-	-
EO rank change influenced by EO specifications	-	-	-	-	-	-	-
EO rank change influenced by EO rank specifications	-	yes	-	-	-	-	-
New EO rank changes	-	EO rank changed because uncertainty of extirpation was noted in EO record.	Baseline EO rank based on moderately small-sized EO occurring within mixed native and introduced community that burned in 2002; and is surrounded by introduced annual grasslands.	Baseline EO rank based on small-sized EO occurring within mixed native and introduced community that is surrounded by introduced annual grasslands. In addition, OHV use occurs within EO and general area.	Baseline EO rank based on small-sized EO occurring within mostly native community with low cheatgrass cover, but OHV use occurs in occupied habitat. In addition, heavy use OHV trails occur in general area and cheatgrass is dominant in some parts of surrounding landscape.	-	-

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 3. (Continued)

EO#	27	28	29	30	31
Land ownership[1]	P	P	F	CO,P	F,P
First observation date	1997	pre-1982	1994	1992	1984
New EO changes	Deleted westernmost feature of EO 9 and turned it into new EO 27.	Deleted easternmost feature of EO 9 and turned it into new EO 28.	Deleted southernmost feature of EO 14 and turned it into new EO 29.	Deleted three westernmost features of EO 15 and turned them into new EO 30.	Deleted northernmost three features of EO 8 and turned them into new EO 31.
Original EO rank	B (9)	X	AD (14)	C (15)	A (8)
Date	unknown	1997	unknown	1995	1995
Previous EO rank	-	B (9)	C (14)	-	-
Date	-	unknown	1999	-	-
New EO rank	**BC**	**X**	**C?**	**C**	**A**
Rank factor ratings[2]	B-C-?	-	C-C-?	C-D-C	A-A-AB
Rank factor change[3]	-	condition(-), size(-)	condition(-)	condition(-), landscape(-)	condition(-), landscape(-)
EO rank change influenced by EO specifications	yes	yes	-	-	-
EO rank change influenced by EO rank specifications	yes	-	yes	-	-
New EO rank changes	Newly defined EO given BC rank until more specific information is provided. EO rank based on moderately small-sized EO occurring within native community, with little additional information about condition or landscape context.	Newly defined EO was ranked based on its EO rank (X) before it was lumped with EO 9 in 1997. Former EO 9 subpopulation was still considered extirpated, but was a B-rank overall. Extirpation is based on observation of bulldozed site where plants used to occur.	Newly defined EO was ranked based on moderately small-sized EO occurring within native community with cheatgrass and high use OHV trails. Landscape context data is absent, contributing to rank uncertainty.	-	No rank change, but there have been no new observations since 1999.

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 3. (Continued)

EO#	32	33	34
Land ownership[1]	F	CI, P	P
First observation date	1995	1892	1988
New EO changes	Deleted seven easternmost features of EO 20 and turned them into new EO 32.	Deleted sub-EOs 700-710, 712-713, 715-716, and 718 from parent EO 1 and also deleted EO 19, and lumped them together into new EO 33. Deleted sub-EOs 711, 714, and 717 from parent EO 1, and turned them into new EO 34.	
Original EO rank	C	AD (1); X (19)	AD (1)
Date	unknown	1992 (1); unknown (19)	1995
Previous EO rank	B (20)	-	-
Date	1995	-	-
New EO rank	**C?**	**BC**	**B**
Rank factor ratings[2]	C-B-?	BD-A-CD	BC-A-C
Rank factor change[3]	-	condition(-), size(-), landscape(-)	landscape(-)
EO rank change influenced by EO specifications	-	yes	yes
EO rank change influenced by EO rank specifications	yes	yes	yes
New EO rank changes	Newly defined EO was ranked based on its EO rank (C) before it was lumped with EO 20 in 1995. Newly defined EO was ranked based on moderately large-sized EO occurring within native community with cheatgrass and heavy livestock disturbance. Landscape context data is absent, contributing to rank uncertainty.	Newly defined EO encompasses most sub-EOs that were formerly part of EO 1. EO was ranked based on its large size, variably poor to good condition, and fair to poor landscape context.	Newly defined EO encompasses three sub-EOs that were formerly part of EO 1. EO was ranked based on its large size in a mostly native community with low to moderate cheatgrass cover; and surrounding landscape is threatened by development and has a golf course. EO hasn't been visited in 7-14 years.

[1]Land ownership is City of Boise (CI), Ada County (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

EO Data Standard: Spalding's silene (*Silene spaldingii*)

Status: Federally threatened; G2S1 (BC, ID, MT, and OR); G2S2 (WA)

Demographic Patterns: Spalding's silene is a deep-rooted, simple or multi-stemmed perennial forb that reproduces by seed (Hill and Gray 2004). Spalding's silene can live for at least five years. It may survive dormant underground for many years (Lesica 1997, Mincemoyer 2005). In Montana, Lesica (1997) found that the number of Spalding silene plants remained stable over a five-year time period. He also found that the proportion of plants in the prolonged dormancy life stage had a strong biennial periodicity. Hill and Gray (2005) found that the prolonged dormancy life stage may last for one or several years before returning aboveground. In Idaho, Hill and Gray (2005) found that rodent activity appeared to be related to the mortality of Spalding's silene plants. In Montana, Lesica (1999) found that fire did not appear to affect recruits or adults in some years, but Hill and Gray (2005) observed that it may indirectly affect Spalding's silene by increasing introduced weed species.

Dispersal Capabilities: Spalding's silene seeds are probably dispersed by animals that digest the seeds and/or seedheads (deer, elk, and possibly birds and rodents; Hill and Gray 2004). The golden northern bumblebee (*Bombus fervidus*), a ground-dwelling bumblebee species, is an important pollinator rangewide. The golden northern bumblebee may be detrimentally affected by agricultural conversion, pesticide application, livestock grazing, and fires (Lesica and Heidel 1996, Hill and Gray 2004). Noctuid moths may also be important pollinator for Spalding's silene.

Habitat: Spalding's silene occurs at elevations of 400-1585 m rangewide and is associated with northerly aspects (Hill and Gray 2004). Spalding's silene occurs in grassland, shrub, and forest communities in five major physiographic areas: Palouse grasslands (WA/ID), canyon grasslands (WA/ID/OR), channeled scablands (WA), Wallowa Plateau (OR), and intermontane valleys (MT/BC; Hill and Gray 2004). Spalding's silene occurs in the following communities within its rangewide distribution: big sagebrush-Idaho fescue (WA); bluebunch wheatgrass-Idaho fescue (WA/ID); Idaho fescue-bluebunch wheatgrass (ID/WA); Idaho fescue-prairie junegrass (ID/OR/WA); Idaho fescue-rose (ID/OR/WA); Idaho fescue-snowberry (ID/OR/WA); ponderosa pine-Idaho fescue (WA); ponderosa pine-snowberry (WA); rough fescue-Idaho fescue (MT/BC); rough fescue-bluebunch wheatgrass-needle and thread (MT/BC); threetip sagebrush-Idaho fescue (WA); and white sagebrush-Idaho fescue (OR). Associated species include: Idaho fescue (*Festuca idahoensis*), common snowberry (*Symphoricarpos albus*), rose (*Rosa* spp.), bluebunch wheatgrass (*Pseudoroegnaria spicata*), prairie junegrass (*Koeleria macrantha*), needle and thread (*Hesperostipa comata*), big sagebrush (*Artemisia tridentata*), threetip sagebrush (*Artemisia tripartita*), ponderosa pine (*Pinus ponderosa*), white sagebrush (*Artemisia ludoviciana*), rough fescue (*Festuca scabrella*), and needle and thread. Common introduced weed species include: Japanese brome (*Bromus japonicus*), cheat (*B. secalinus*), cheatgrass (*B. tectorum*), yellow starthistle (*Centaurea solstitialis*), diffuse knapweed (*C. diffusa*), spotted knapweed (*C. maculosa*), rush skeletonweed (*Chondrilla juncea*), Canada thistle (*Cirsium arvense*), teasel (*Dipsacus sylvestris*), leafy spurge (*Euphorbia esula*), St. Johnswort (*Hypericum perforatum*), dalmation toadflax (*Linaria dalmatica*), Kentucky bluegrass (*Poa pratensis*), sulfur cinquefoil (*Potentilla recta*), tall tumblemustard (*Sisymbrium altissimum*), and ventenata (*Ventenata dubia*; Hill and Gray 2004).

Threats: Threats to Spalding's silene include introduced weed invasion, agricultural conversion, wildfires, inbreeding depression, herbivore predation, and herbicide application and drift from herbicide application (Hill and Gray 2004).

Global Distribution: Endemic to north-central Idaho (Idaho, Lewis, and Nez Perce Counties); western Montana (Flathead, Lake, Lincoln, and Sanders Counties); northeastern Oregon (Wallowa County); and eastern Washington (Adams, Asotin, Lincoln, Spokane and Whitman Counties). One western Montana EO extends into British Columbia, Canada (East Kootenay County; Hill and Gray 2004; NatureServe Rangewide Database 2006).

EO SPECIFICATIONS

MINIMUM EO CRITERIA
Element occurrence (EO) features are separate EOs if they are ≥ 1 km apart. Separation distances between EO features are measured pairwise and edge-to-edge after accounting for locational uncertainty.

EO Separation

SEPARATION DISTANCE – SUITABLE/UNSUITABLE HABITAT
Habitats supporting Spalding's silene are characterized by: 1) the presence of Idaho fescue or rough fescue; 2) elevations of 400-1585 m; and 3) northerly aspects, especially within drier portions of its range (Hill and Gray 2004, Idaho Conservation Data Center 2006). Unsuitable habitat is characterized by habitat that does not meet these criteria. All Spalding's silene EO features were separate EOs if they were ≥ 1 km apart because habitat suitability was unknown or undocumented. The separation distance may be extended to 2 km if more information is known about habitat suitability between the EO features in the future.

ALTERNATE SEPARATION PROCEDURES
No alternate separation procedures were used.

SEPARATION JUSTIFICATION
Separation justification for delineating Spalding's silene EOs is based on Tier 3 implementation using habitat-based delimitation guidance (see Fig. 1 *in* NatureServe 2004:14). The dynamic landscape mosaic and riparian/shore system criteria are not applicable.

EO RANK SPECIFICATIONS

EO Rank Specs

A SPECS
SIZE: >500 genets. CONDITION: Native plant community is intact with zero to trace introduced plant species cover and/or no significant anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is unfragmented and ecological processes are intact.

B SPECS
SIZE: 200-500 genets. CONDITION: Native plant community is intact with trace to low introduced plant species cover and minimal anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be partially fragmented, but ecological processes are intact.

C SPECS
SIZE: 100-200 genets. CONDITION: Native plant community is partially intact with low to moderate introduced plant species cover and/or moderate anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be moderately fragmented, but ecological processes are intact.

D SPECS
SIZE: <100 genets. CONDITION: Few components of the native plant community remain. Introduced plant species cover is moderate to high and/or there is significant anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is fragmented with many ecological and hydrological processes no longer intact.

E SPECS
Extant: EO has been verified extant, but population size, condition, and landscape context have not been assessed.

F SPECS
Failed to find: EO has been surveyed by experienced individuals who failed to find any Spalding's silene individuals, despite searching under conditions appropriate for the element at a location where it was previously recorded. Only one visit is required for this rank designation, but the survey should cover the entire extent of the EO.

H SPECS
Historical: Historical EO indicating where Spalding's silene was reported, often based on older herbarium records (pre-1970). Location records are typically geographically vague and may be simply indicated by the name of a town.

X SPECS
Extirpated: EO has been extirpated. Extirpation is based on: 1) agricultural conversion, commercial or residential development, or other documented habitat destruction where

Spalding's silene has been previously recorded, or 2) when an EO has consistently has received an F-rank based on at least five visits over a 10-year time period.

RANK SPECS JUSTIFICATION
EO rank specifications were developed by rangewide evaluation of existing EOs (Idaho Conservation Data Center 2006, Rangewide Database 2006) and the "Element occurrence data standard" (NatureServe 2002). Rangewide size criteria were also developed through communication with knowledgeable individuals (M. Fairbarns, K. Gray, J. Hill, P. Lesica, pers. comm. 2006) and review of the Spalding's silene EOs in the NatureServe Rangewide Database (2006). Rank factors were weighted based on NatureServe EO data standards for a large patch community pattern type (NatureServe 2002). Rank factors were weighted in the following manner: condition=45%; size=33%; and landscape context=22%. Changes in the number of plants should not be used solely to justify a rank change unless condition and/or landscape context has concurrently changed; and/or if the known occurrence area has been expanded. The rank factors are calculated to verify the most appropriate rank, where A=4, B=3, C=2, and D=1. The output calculation is used to designate the following ranks: A=3.6-4.0; B=2.6-3.4; C=1.6-2.4; and D=0.0-1.4. A range rank (i.e. BC) is used when the output calculation is 1.5, 2.5, or 3.5. Range ranks can also be used if the EO or rank factors share qualities of multiple ranks. If there is incomplete information about size, condition, and/or landscape context factors, the "?" qualifier can be used with the most appropriate rank (i.e. B?). E-, F-, H-, and X-ranks should be used when appropriate.

SUMMARY OF CHANGES

After application of the EO specification and EO rank specifications, there are 19 Spalding's silene EOs with the following ranks: B=4, BC=1, C=9, C?=1, D=2, F=1, and not ranked=1. Two of these 19 EOs were first entered into the IDCDC Database in 2006 (EOs 20 and 21). EO 20 was discovered in 2004 and EO 21 was discovered in 2005. Previously, there were 21 EOs with the following ranks: A=2, B=4, C=1, C?=1, D=6, E=3, and not ranked=4 (Idaho Conservation Data Center 2006).

EOs 15 and 17 were deleted and added to EO 16, and given a B-rank (Fig. 10). No other EOs changed as a result of the updated EO specifications. EOs 3 and 6 changed from an A- to B-rank. EOs 8, 9, and 19 changed from a B- to C-rank. EOs 1 and 2 changed from a D- to C-rank; and EO 12 changed from a D- to C?-rank. EO 18 changed from a C?- to a C-rank. EO 4 changed from a D- to an F-rank because no plants were observed during the last visit. EOs 10 and 21 changed from an E-rank to a C- and B-rank, respectively. EOs 13 and 14 had not yet been ranked, and were given BC- and C-ranks, respectively. The addition of condition and landscape context in the updated EO rank specifications was the primary reason all previously ranked EOs underwent EO rank changes. All EOs occurring on federal lands are managed by the BLM, except EO 21, which is managed by the USFS (Table 4).

RANGEWIDE COMPARISON

EO Specifications

The Montana Natural Heritage Program (MTNHP) and Washington Natural Heritage Program (WANHP) are using habitat-based plant EO delimitation guidance (NatureServe 2004) for Spalding's silene EO specifications, as is presented in this report for IDCDC. The WANHP is interpreting the habitat-based plant EO delimitation guidance so that the separation distance is 2 km (J. Arnett, pers. comm. 2006). The habitat-based plant EO delimitation guidance states that 1 km should be the minimum separation distance, over unknown and/or unsuitable habitat; and 2 km is the maximum separation distance when separated by more than 1 km of suitable habitat (NatureServe 2004). WANHP also uses alternate separation distances of up to 3 km to include outliers (J. Arnett, pers. comm. 2006). The Oregon Natural Heritage Information Center (ORNHIC) uses a 0.5 km separation distance, but will consider using a 1 km separation distance (S. Vrilakas, pers. comm. 2006). The British Columbia Conservation Data Center (BCCDC) currently has only one EO (shared with MTNHP), but may have additional EOs in their data backlog (J. Penny, pers. comm. 2006).

The large number of states within the distribution of Spalding's silene has resulted in the implementation of not only multiple EO specifications, but also multiple interpretations of the habitat-based plant EO delimitation guidance. There are currently 131 Spalding's silene EOs reported in the NatureServe Rangewide Database (2006) and in this report, although this number is based on the variable application of EO specifications. Of these, one occurs in British Columbia which extends from Montana, 11 in Montana, 19 in Idaho, 25 in Oregon, and 76 in Washington.

EO Rank Specifications

Rangewide, Spalding's silene EOs are generally based on the number of plants (size; MTNHP, ORNHIC), although land ownership is also sometimes considered (ORNHIC). MTNHP uses general ranking guidelines for most plant species, where an A=>1,000 genets, B=100-1,000 genets, C=10-50 genets, and D=<10 genets (S. Mincemoyer, pers. comm. 2006). ORHNIC uses the following size standards for ranking Spalding's silene: A=>500 genets, B=200-500 genets, C=50-200 genets, and D=<50 genets (S. Vrilakas, pers. comm. 2006). It is unknown whether the BCCDC or WANHP use standardized EO specifications for ranking Ute ladies'-tresses EOs.

EO rank specifications were developed by rangewide evaluation of existing EOs (Idaho Conservation Data Center 2006, Rangewide Database 2006) and the "Element occurrence data standard" (NatureServe 2002). Rangewide size criteria were also developed through communication with knowledgeable individuals (M. Fairbarns, K. Gray, J. Hill, P. Lesica, pers. comm. 2006) and review of the Spalding's silene EOs in the NatureServe Rangewide Database (2006). Size criteria used in this report are the same as size criteria used by ORNHIC, but contribute to 33% of the EO rank instead of the entire rank. Keeping in mind that Spalding's silene EOs are ranked differently throughout its range, the 131 EOs have the following EO ranks: 3 A-, 5 AB-, 13 B-, 6 BC-, 22 C-, 3 C?-, 4 CD-, 21 D-, 5 E-, 1 F-, 6 H-, 1 X-, and 37 U-ranked EOs (NatureServe Rangewide Database 2006).

Overview

One of the most important aspects of applying the habitat-based plant EO delimitation guidance (2004) will be in the consistent interpretation of suitable habitat. It will also be important to develop realistic and meaningful EO rank specifications that can be used to rank Spalding's silene EOs throughout its range. Coordinated review of EO specifications and EO rank specifications between the state and province NatureServe programs will be required to ensure the consistent rangewide representation of Spalding's silene EOs and EO ranks.

Table 4. Spalding's silene (*Silene spaldingii*) EO and EO rank changes.

EO#	**1**	**2**	**3**	**4**	**5**	**6**
Land ownership[1]	P	P	P	P	P	P,F
First observation date	1996	1996	1996	1980	1996	1993
New EO changes	-	-	-	-	-	-
Original EO rank	D	D	A	D	D	A
Date	1996	2003	2003	1980	1996	2002
Previous EO rank	-	-	-	-	-	-
Date	-	-	-	-	-	-
New EO rank	**C**	**C**	**B**	**F**	**D**	**B**
Rank factor ratings[2]	B-D-C	B-D-D	A-D-A?	B?-F-C?	C-D-D	BC-B-C
Rank factor change[3]	-	-	-	-	-	landscape context(-)
EO rank change influenced by EO specifications	-	-	-	-	-	-
EO rank change influenced by EO rank specifications	yes	yes	yes	yes	-	yes
New EO rank changes	EO rank changed because small-sized EO occurs in native community in good condition, but is surrounded by ranchettes and bulldozed home sites. However, EO rank should be verified because no updates have been submitted for 10 years.	EO rank changed because small-sized EO occurs in native community in good condition, but is surrounded agricultural lands and mining activities.	EO rank changed because small-sized EO occurs in native community and landscape in excellent condition, but rank should be verified because no updates have been submitted for 10 years.	Changed to F-rank because no plants were observed when last surveyed by qualified individuals in 2001.	No rank change, but rank should be verified because no updates have been submitted for 10 years.	EO rank changed because moderately large-sized EO occurs in mixed introduced and native community in poor to excellent condition, and is surrounded by major weed invasions.

[1]Land ownership is federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 4. (Continued)

EO#	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Land ownership[1]	P	P	S	S	P	P	P
First observation date	1964	1993	2001	2001	2001	2001	2001
New EO changes	-	-	-	-	-	-	-
Original EO rank	C	B	B	E	D	D	-
Date	1996	1993	2002	unknown	2005	unknown	-
Previous EO rank	-	-	-	-	-	-	-
Date	-	-	-	-	-	-	-
New EO rank	**C**	**C**	**C**	**C**	**D**	**C?**	**BC**
Rank factor ratings[2]	B-D-C	B-D-B?	BC-C-C	BC-D-C?	D-D-D	C-D-CD?	A-D-?
Rank factor change[3]	landscape context(-)	-	-	-	-	-	-
EO rank change influenced by EO specifications	-	-	-	-	-	-	-
EO rank change influenced by EO rank specifications	-	yes	yes	-	-	yes	-
New EO rank changes	-	EO rank changed because small-sized EO occurs in native community and landscape in good condition	EO rank changed because moderately small-sized EO occurs in mixed native and introduced community, with introduced weeds present at EO and surrounding landscape.	Baseline EO rank based on small-sized EO occurring in mixed native and introduced community, with introduced weeds present at EO and surrounding landscape.	-	EO rank changed because small-sized EO occurs in mixed introduced and native community, but with little abundance information to accurately determine condition and landscape context.	Baseline EO BC-rank based on small-sized EO occurring in native community, but with no landscape context information.

[1]Land ownership is federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 4. (Continued)

EO#	14	16	18	19	20	21
Land ownership[1]	F	F, S	F	S	P	F
First observation date	2001	2001	2003	2003	2004	2005
New EO changes	-	Deleted EOs 15 and 17 and added them to EO 16.	-	-	-	-
Original EO rank	-	B (16); E (17)	C?	B	-	E
Date	-	2002 (16); unknown (17)	2003	2005	-	2006
Previous EO rank	-	-	-	-	-	-
Date	-	-	-	-	-	-
New EO rank	**C**	**B**	**C**	**C**	**-**	**B**
Rank factor ratings[2]	C-D-C	B-B-C	C-D-CD	BC-D-BC	-	AB-C-A
Rank factor change[3]	-	-	-	-	-	-
EO rank influenced by EO specifications	-	yes	-	-	-	-
EO rank influenced by EO rank specifications	-	-	-	yes	-	yes
New EO rank changes	Baseline EO rank based on small-sized EO occurring in native community, but overgrown with introduced weeds.	-	EO rank changed because small-sized EO occurs in mixed native and introduced community; many introduced weeds are present in EO and are widespread in surrounding landscape.	EO rank changed because small-sized EO occurs in mixed native and introduced community; introduced weeds are present in EO and surrounding landscape.	-	Baseline EO rank based on moderately-sized EO occurring in native community, with light weed cover in surrounding area.

[1]Land ownership is federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

<u>EO Data Standard: Ute ladies'-tresses (*Spiranthes diluvialis*)</u>

Status: Federally threatened; G2S1 (ID, NE, UT, WA, and WY); G2S2 (CO and MT); G2SH (NV). Note that Ute ladies'-tresses was rediscovered in Nevada in July 2005, and will likely be changed from a G2SH to a G2S1 (Fertig et al. 2005).

Demographic Patterns: Ute ladies'-tresses is a long-lived simple or multi-stemmed perennial forb that reproduces by seed and possibly by asexual reproduction (Fertig et al. 2005). Flowering occurs from early July through late October. The primary life stages exhibited are seedling, subterranean dormant, above-ground vegetative, and reproductive. The subterranean dormant stage may persist for as long as four or more years before transitioning above-ground stages (Fertig et al. 2005). Counts based only on the number of flowering stems have been documented to fluctuate as much as 79% between years. However, counts tend to be relatively stable if vegetative and fruiting stems are tallied in addition to flowering stems. Timing and surveyor effort also likely influence the number of plants counted (Fertig et al. 2005).

Dispersal Capabilities: Ute ladies'-tresses produce microscopic seeds that are dispersed via wind and water (Sipes and Tepidino 1995, Fertig et al. 2005). These tiny seeds are likely short-lived and their successful germination depends upon the presence of certain mycorrhizal soil fungi (Hildebrand 1998, McGonigle and Sheridan 2004, Fertig et al. 2005). Past research indicates that bumblebees (*Bombus* spp.) are the most important pollinators of Ute ladies'-tresses. Solitary bees (*Anthophora* spp.) and introduced honeybees (*Apis mellifera*) also serve as pollination vectors (Sipes and Tepedino 1995, Pierson et al. 2001, Fertig et al. 2005).

Habitat: Ute ladies'-tresses occurs in moist meadow habitats associated with floodplains, oxbows, and stream and river terraces (CO, ID, MT, NE, UT, WY); subirrigated or spring-fed abandoned stream channels and valleys (CO, ID, MT, NV, UT); lakeshores (WA); and human-modified riparian and lacustrine habitats (Fertig et al. 2005). It has been found at elevations varying from 220 to 2134 m. Rangewide, many EOs occurring in riparian habitats are found in wide valley floodplains at the base of mountains where narrow stream reaches become unconfined (Fertig et al. 2005). Ute ladies'-tresses is associated with silty to loamy calcic soils, and shallow clayey-silt to sandy-loam alluvial soils overlying permeable cobbles, gravels, and sediments. Dominant species associatd with Ute ladies'-tresses include: box elder (*Acer negundo*), creeping bentgrass (*Agrostis stolonifera*), water birch (*Betula occidentalis*), woolly sedge (*Carex pellita*), analogue sedge (*Carex simulata*), little green sedge (*Carex viridula*), meadow thistle (*Cirsium scariosum*), redosier dogwood (*Cornus sericea*), tapered rosette grass (*Dichanthelium acuminatum*), inland saltgrass (*Distichlis stricta*), silverberry (*Elaeagnus commutata*), fewflower spikerush (*Eleocharis pauciflora*), beaked spikerush (*Eleocharis rostellata*), quackgrass (*Elymus repens*), smooth horsetail (*Equisetum laevigatum*), Baltic rush (*Juncus balticus*), Torrey's rush (*Juncus torreyi*), scratchgrass (*Muhlenbergia asperifolia*), mat muhly (*Muhlenbergia richardsonis*), witchgrass (*Panicum capillare*), reed canarygrass (*Phalaris arundinacea*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), narrowleaf cottonwood (*Populus angustifolia*), narrowleaf willow (*Salix exigua*), greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), and seaside arrowgrass (*Triglochin maritimum*; Fertig et al. 2005).

Threats: Current and potential threats to Ute ladies'-tresses include: urbanization, road and infrastructure construction, hydrologic development, agricultural conversion of wetlands, introduced weed invasion, pesticide application, pollinator loss, overcollection, livestock and native herbivore grazing, recreation, drought, vegetation succession, fire suppression, and intrinsic rarity of Ute ladies'-tresses and associated mycorrhizae (U.S. Fish and Wildlife Service 1992, Fertig et al. 2005).

Global Distribution: Ute ladies'-tresses occurs in northern Colorado (Boulder, El Paso, Jefferson, Larimer, Moffat, Morgan, and Weld Counties); southeastern Idaho (Bingham, Bonneville, Fremont, Jefferson, and Madison Counties); southwestern Montana (Beaverhead, Broadwater, Gallatin, Jefferson, and Madison Counties); western Nebraska (Sioux County); southeastern Nevada (Lincoln County); northern and south-central Utah Daggett, Duchesne, Garfield, Salt Lake, Tooele, Uintah, Utah, Wasatch, Wayne, and Weber Counties); north-central Washington (Chelan and Okanogon Counties); and eastern Wyoming (Converse, Goshen, Laramie, and Niobrara Counties). The greatest proportion of Ute ladies'-tresses EOs are in Utah and Colorado. The distribution of Ute ladies'-tresses is discontinuous within its eight state range (NatureServe Rangewide Database 2006, Fertig et al. 2005).

EO SPECIFICATIONS

MINIMUM EO CRITERIA

Element occurrence (EO) features constitute one EO if they are <3 km apart and share linear water-current flow in the same riparian system. The minimum separation distance is reduced to 1 km if the EO features do not share linear water-current flow in the same riparian system. Separation distances between EO features are measured pairwise and edge-to-edge after accounting for locational uncertainty.

EO Separation

SEPARATION DISTANCE – SUITABLE/UNSUITABLE HABITAT

Habitats supporting Ute ladies'-tresses are characterized by moist meadow habitats associated with floodplains, oxbows, and stream and river terraces; subirrigated or spring-fed abandoned stream channels and valleys; and lakeshores (Fertig et al. 2005). Unsuitable habitat is characterized by sites that do not meet these criteria. All Ute ladies'-tresses EO features were separate EOs if they were ≥ 3 km apart sharing linear water-current flow or ≥ 1 km apart not sharing linear water-current flow if habitat suitability was unknown or unsuitable. The separation distance may be extended to 10 km (sharing linear water-current flow) or 2 km (not sharing linear water-current flow) if more information is known about habitat suitability between the EO features.

ALTERNATE SEPARATION PROCEDURES
No alternate separation procedures were used.

SEPARATION JUSTIFCIATION
Separation justification for delineating Ute ladies'-tresses is based on Tier 3 implementation using habitat-based delimitation guidance (see Fig. 1 in Nature Serve 2004:14). The riparian/shore system criteria are applicable and the dynamic landscape mosaic criteria are not applicable.

EO RANK SPECIFICATIONS

EO Rank Specs

A SPECS
SIZE: >100 genets. CONDITION: Native plant community is intact with zero to low introduced plant species cover and/or minimal anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape is unfragmented and ecological and hydrological processes are intact.

B SPECS
SIZE: 50-99 genets. CONDITION: Native plant community is intact with low to moderate introduced plant species cover and/or low to moderate anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be partially fragmented, but ecological and hydrological processes are intact.

C SPECS
SIZE: 20-49 genets. CONDITION: Native plant community is partially intact with moderate to high introduced plant species cover and/or moderate to high anthropogenic disturbance. LANDSCAPE CONTEXT: Surrounding landscape may be moderately fragmented, but ecological and hydrological processes are intact.

D SPECS
SIZE: <20 genets. CONDITION: Few components of the native plant community remain and introduced plant species cover and/or anthropogenic disturbance is high. LANDSCAPE CONTEXT: Surrounding landscape is fragmented with many ecological and hydrological processes no longer intact.

E SPECS
Extant: EO has been verified extant, but population size, condition, and landscape context have not been assessed.

F SPECS
Failed to find: EO has been surveyed by experienced individuals who failed to find any Ute ladies'-tresses individuals, despite searching under conditions appropriate for the element at a location where it was previously recorded. Only one visit is required for this rank designation, but the survey should cover the entire extent of the EO.

H SPECS
Historical: An EO that has not been observed since 1970. These are historical EOs indicating where Ute ladies'-tresses was reported, often based on older herbarium records. Location records are typically geographically vague and may be simply indicated by the name of a town.

X SPECS
Extirpated: EO has been extirpated. Extirpation is based on: 1) documented habitat destruction where Ute ladies'-tresses has been previously recorded, or 2) 2) when an EO has consistently has received an F-rank based on at least five visits over a 10-year time period.

RANK SPECS JUSTIFICATION
EO rank specifications were based on the Colorado Natural Heritage Program (2000) EO rank specifications for Ute ladies'-tresses and the "Element occurrence data standard" (NatureServe 2002). Rank factors were weighted based on the linear community pattern type so that: landscape context=45%; condition=33%; and size=22% (NatureServe 2002). Changes in the number of plants should not be used solely to justify a rank change unless condition and/or landscape context has concurrently changed; and/or if the known EO area has been expanded. The rank factors are calculated to verify the most appropriate rank, where A=4, B=3, C=2, and D=1. The output calculation is used to designate the following ranks: A=3.6-4.0; B=2.6-3.4; C=1.6-2.4; and D=0.0-1.4. A range rank (i.e. BC) is used when the output calculation is 1.5, 2.5, or 3.5. Range ranks can also be used if the EO or rank factors share qualities of multiple ranks. If there is incomplete information about size, condition, and/or landscape context factors, the "?" qualifier can be used with the most appropriate rank (i.e. B?). E-, F-, H-, and X-ranks should be used when appropriate.

SUMMARY OF CHANGES

After application of the EO specification and EO rank specifications for Idaho, there are eight Ute ladies'-tresses EOs with the following ranks: A=1, B=2, C=4, and CD=1. Previously, there were 24 EOs with the following ranks: A=4, AB=1, B=8, BC=4, C=4, CD=1, D=1, and E=1 (Idaho Conservation Data Center 2006). In 2005, an additional EO was discovered on Fort Hall Indian Reservation in Bingham County, Idaho, but is not included in these results (C. Davis, pers. comm.).

EOs 3, 9, 10, 11, 12, 13, 21, and 22 were deleted and added to EO 2, and given an A-rank (Fig. 11). EOs 19 and 20 were deleted and added to EO 4, and given a C-rank (Fig. 12). EO 8 was deleted and added to EO 6, and given a B-rank (Fig. 13). EOs 5 and 15 were deleted and added to EO 7, and given a C-rank (Fig. 14). EOs 16, 17, and 18 were deleted and added to EO 14, and given a B-rank (Fig. 15). EOs 1, 24, and 25 were the only EOs that did not change with the updated EO specifications, and EO 25 was the only EO that did not also change EO rank. EOs 1 and 24 both changed from a BC- to a C-rank.

RANGEWIDE COMPARISON

EO Specifications

Both the Colorado Natural Heritage Program (CONHP) and Wyoming Natural Diversity Database (WYNDD) currently use EO specifications defining separation distance across suitable habitat as 8.1 km, and separation distance across unsuitable habitat as 1.6 km (Colorado Natural Heritage Program 2000, B. Heidel, pers. comm. 2006). However, the WYNDD is planning on updating its EO specifications in accordance with habitat-based plant EO delimitation guidance (NatureServe 2004). The Montana Natural Heritage Program (MTNHP) is also planning on using the habitat-based plant EO delimitation guidance, using a conservative interpretation of habitat suitability that results in a 3 km separation distance unless habitat suitability is known (S. Mincemoyer, pers. comm. 2006). The Utah Conservation Data Center (UTCDC) and Washington Natural Heritage Program (WANHP) also plan on updating its EO specifications in accordance with habitat-based plant EO delimitation guidance, although the UTCDC is using only the 10 km separation distance (R. Fitts, pers. comm. 2006, J. Arnett, pers. comm. 2006). It is unknown which EO specifications are used by the Nebraska Nongame and Endangered Species Program (NBNESP) or Nevada Natural Heritage Program (NVNHP) .Both programs have few EOs. The EO specifications presented in this report are most consistent with the MTNHP interpretation of the habitat-based plant EO delimitation guidance.

The large number of states that occur within the distribution of Ute ladies'-tresses has resulted in the implementation of multiple EO specifications, and multiple interpretations of the habitat-based plant EO delimitation guidance (2004). Application of the EO specifications using the 3 km separation distance resulted in eight Ute ladies'-tresses EOs in Idaho. If there were sufficient known habitat suitability for the 10 km separation distance, there would be only five Ute ladies'-tresses EOs in Idaho. Based on the 8.1 km separation distance, there would be seven Ute ladies'-tresses EOs (Idaho Conservation Data Center 2006). Rangewide, there are 61 Ute ladies'-tresses EOs based on the 8.1 km separation distance criteria, including nine which are not considered extant (Fertig et al. 2005). There are currently 112 Ute ladies'-tresses EOs reported in the NatureServe Rangewide Database (2006) and in this report, although this number is based on the variable application of EO specifications. Of these, 40 EOs occur in Colorado, 8 in Idaho, 12 in Montana, 2 in Nebraska, 1 in Nevada, 41 in Utah, 4 in Washington, and 4 in Wyoming.

EO Rank Specifications

Both the CONHP and WYNDD currently use the same EO rank specifications. These EO rank specifications use condition, size, and landscape context for the overall EO rank, but size is weighted greater than the other rank factors (Colorado Natural Heritage Program 2000, B. Heidel, pers. comm. 2006). However, Bonnie Heidel (WYNDD) expressed concern about using size because the proportion of subterranean dormant, above-ground vegetative, and reproductive Ute ladies'-tresses plants can shift between years, independent of mortality and recruitment. Reproductive plant are generally the only life stage tallied, resulting in fluctuations in the number of plants reported that could unduly affect the EO rank.

The UTCDC does not currently have standardized EO specifications for ranking Ute ladies'-tresses EOs, instead relying on "intuitively-based ranking" (R. Fitts, pers. comm. 2006). MTNHP uses general ranking guidelines for all plant species, where an A=>1,000 genets, B=100-1,000 genets, C=10-50 genets, and D=<10 genets (S. Mincemoyer, pers. comm. 2006). It is unknown whether the NBNESP, NVHHP, or WANHP use standardized EO specifications for ranking Ute ladies'-tresses EOs.

EO rank specifications developed for IDCDC were primarily based on EO rank specifications used by the CONHP and WYNDD (Colorado Natural Heritage Program 2000) and the "Element occurrence data standard" (NatureServe 2002). The main differences between the EO specifications used by the CONHP and WYNDD and the EO specifications developed for the IDCDC were the following: 1) omitting "presence of multiple age classes and flowering and fruiting" in assessing condition; 2) using qualifiers such as "trace", "low", "moderate", and "high" instead of "<1%", "<10%", "10-50%", and ">50%" to describe introduced plant species cover; and 3) weighting rank factors based on a linear community pattern so that landscape context=45%; condition=33%; and size=22% (NatureServe 2002), instead of weighting size more than the other rank factors (Colorado Natural Heritage Program 2000).

Essentially, the IDCDC EO rank specifications are based on updating the EO rank specifications used by the CONHP and WYNDD (Colorado Natural Heritage Program 2000) to meet standards recommended in the "Element occurrence data standard" (NatureServe 2002). Keeping in mind that Ute ladies'-tresses EOs are ranked differently throughout its range, the 112 EOs have the following EO ranks: 3 A-, 3 AB-, 16 B-, 18 C-, 4 CD-, 5 D-, 2 E-, 6 H-, 1 X-, and 2 X?- ranked EOs, in addition to 51 EOs that are currently not ranked (NatureServe Rangewide Database 2006). All EOs occurring on federal land are managed by BLM, with two exceptions. EOs 2 and 4 are both managed by the BLM and USFS.

Overview

One of the most important aspects of applying the habitat-based plant EO delimitation guidance (2004) will be in the consistent interpretation of suitable habitat. It will also be important to develop realistic and meaningful EO rank specifications that can be used to rank Ute ladies'-tresses EOs. EO ranks predominantly or completely weighted on the number of reproductive plants may not be representative of population trends (Fertig et al. 2006, B. Heidel, pers. comm. 2006). The IDCDC EO rank specifications were designed to integrate condition and landscape context with size. Weighting landscape context and condition more than size is likely more representative of a riparian species' requirements. Coordinated review of EO specifications and EO rank specifications between the state NatureServe programs will be required to ensure the consistent rangewide representation of Ute ladies'-tresses EOs and EO ranks.

Table 5. Ute ladies'-tresses (*Spiranthes diluvialis)* EO and EO rank changes.

EO#	**1**	**2**	**4**	**6**	**7**
Land ownership[1]	F	F,P	F,P	F,P	CO, F,P
First observation date	1996	1996	1996	1997	1997
New EO changes	-	Deleted EOs 3, 9, 10, 11, 12, 13, 21, and 22 and added them to EO 2.	Deleted EOs 19 and 20 and added them to EO 4.	Deleted EO 8 and added it to EO 6.	Deleted EOs 5 and 15 and added them to EO 7.
Original EO rank	A	A (3,9,10,13,21,22), B (2,11), C (12)	B (19), C (4)	A (6), B (8)	B (7,15), C (5)
Date	1996	1997 (3,9,10,11,13,21), 1998 (2), 1999 (10,12,22)	1999 (4,19)	1997 (8), 1999 (6)	1997 (5,15), 1999 (7)
Previous EO rank	BC	BC (2,13), C (9,10), D (12)	-	-	-
Date	2001	2001 (2, 9,10,13)	-	-	-
New EO rank	**C**	**A**	**C**	**B**	**C**
Rank factor ratings[2]	C-D-C	B-A-A	C-C-C	B-A-C	C-D-B
Rank factor change[3]	condition(-)	-	-	condition(-)	condition(-)
EO rank change influenced by EO specifications	-	yes	yes	yes	yes
EO rank change influenced by EO rank specifications	yes	yes	yes	yes	yes
New EO rank changes	EO rank changed because small-sized EO occurs in mixed native and introduced community near popular campground and dredging activities.	Newly defined EO was ranked based on large-sized EO occurring within mostly native community with anthropogenic disturbances and variable introduced weed cover; and with appropriate ecological and hydrological processes for species.	Newly defined EO was ranked based on moderately small-sized EO occurring within mixed native and introduced community with anthropogenic disturbances. Occupied habitat has been drier since 1997 flood, indicating altered hydrological processes.	Newly defined EO was ranked based on large-sized EO occurring within mostly native community with noxious weed and OHV use issues. Many subpopulations are completely surrounded by levees and apparently no longer experience spring floods.	Newly defined EO was ranked based on small-sized EO occurring within mixed native and introduced community with several anthropogenic disturbances.

[1]Land ownership is county (CO), federal (F), private (P), and state (S). [2]Rank factor rating shows the individual ratings for condition (C), size (S), and landscape context (LC) that were used to develop the overall EO rank. Rank factor ratings are showing in the format C-S-LC. A "?" is used to indicate if not enough data is available to make a rank factor rating. [3]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

Table 5. (Continued)

EO#	14	24	25
Land ownership[1]	F	S	P
First observation date	1997	2002	2003
New EO changes	Deleted EOs 16, 17, and 18 and added them to EO 14.	-	-
Original EO rank	A (16,17,18), B (14)	BC	CD
Date	1997 (14,17), 1999 (16)	unknown	2003
Previous EO rank	AB (16), B (17,18)	-	-
Date	2001 (16,17,18)	-	-
New EO rank	**B**	**C**	**CD**
Rank factor ratings[2]	B-A-B	C-A-C	BC-D-D
Rank factor change[3]	-	-	-
EO rank change influenced by EO specifications	yes	-	-
EO rank change influenced by EO rank specifications	yes	yes	-
New EO rank changes	Newly defined EO was ranked based on large-sized EO occurring within mostly native community with introduced weeds. Anthropogenic disturbances occur near EO, especially campsites, trails, fire rings, etc.	EO rank changed because large-sized EO occurs in mixed native and introduced community that is predominantly surrounded by agricultural lands.	-

[1]Land ownership is county (CO), federal (F), private (P), and state (S). [2]Rank factor change states whether EO had a documented positive (+) or negative (-) change in condition, size, and/or landscape context since first observed.

DISCUSSION

The EO specifications developed for this project were based on habitat-based delimitation guidance developed by NatureServe (2004; Appendix B), and ensure consistency between EOs, at least within Idaho. Most states and provinces are planning on applying the habitat-based delimitation guidance for delimiting EOs within their jurisdiction. Past EO delimitation guidelines were intuitively-based and inconsistently applied, often using perceived geographic barriers to separate EOs. The one new MacFarlane's EO and six new Mulford's milkvetch EOs created as a consequence of applying the EO specifications do not represent any additional expansion to their ranges within Idaho. Likewise, the loss of two Indian Valley sedge EOs, two Spalding's silene EOs, and 16 Ute ladies'-tresses EOs do not represent any reduction to their ranges within Idaho.

Earlier EO rank specifications were probably primarily based on size (number of plants), with little consideration given to habitat and landscape context, but this is not necessarily the best descriptor of EO health. The updated EO rank specifications were designed to integrate condition and landscape context with the size standards used in the past. Condition and landscape context are indirect measures of ecological integrity, flow, and pollinator availability. As a result of applying the EO rank specifications, some EOs underwent rank changes that may not have occurred if the size was the only rank criteria. The F-rank was also newly applied and useful for indicating absence of plants without designating an X-rank. The F-rank indicates which EOs are most susceptible to extirpation, when combined with habitat and/or landscape decline. The F-rank will be modified if plants are observed at a later date.

One of the pitfalls in using condition, size, and landscape context data is that all these factors are not necessarily provided in the EO record (particularly landscape context). While an EO rank can still be applied based on partially complete information, it reflects the need to make sure that data are collected so that the most accurate EO rank can be assigned. These needs should be communicated to our data providers so they understand our needs and how it will improve the usefulness of the EO data.

The EO rank is most useful for assessing the status of EOs if used in conjunction with details provided in the EO record. The EO rank reflects the overall condition, size, and landscape context of an EO, but is not necessarily influenced by land area (especially if a large number of plants are concentrated over a small land area). Many EOs do not have enough detailed land area information to precisely assess the land area of occupied habitat. Detailed land area information and/or the number of subpopulations can also be used to indicate which EOs should be given greater conservation priority. Evaluation of the EO record in conjunction with the EO rank should be done by land management agencies to prioritize conservation efforts.

Continued coordination with other programs is essential for providing accurate and seamless data about rare plant species. This report represents an initial step in the process of applying consistent EO specifications and EO rank specifications across the ranges of Indian Valley sedge, MacFarlane's four o'clock, Mulford's milkvetch, Spalding's silene, and Ute ladies'-tresses. Completion of this project increases the usefulness of the IDCDC database for rare plant conservation efforts.

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APPENDIX A. Figures 1-15

APPENDIX B. A Habitat-based Strategy for Delimiting Plant Element Occurrences: Guidance from the 2004 Working Group (NatureServe 2004)

A Habitat-based Strategy for Delimiting Plant Element Occurrences:

Guidance from the 2004 Working Group (NatureServe 2004)

The "Element Occurrence" (EO) is a fundamental unit of information in the NatureServe Natural Heritage methodology. NatureServe's Element Occurrence Data Standard[1] (hereafter, EO Data Standard) defines an Element Occurrence (EO) as "an area of land and/or water in which a species or natural community is, or was present." *SubEOs* can be used for tracking information on more localized areas that are part of a single EO.

While EOs are often self-evident for vascular plants, two fundamental questions regularly arise in developing botanical EO data:

a. *Minimum criteria* for an EO – whether an observation, collection, or other report of a plant at a particular place can be considered to be sufficient basis for an EO record.

b. *Separation distances* for nearby EOs – whether two (or more) observations in different but nearby places should be considered different EOs, or combined into a single EO.

The EO Data Standard provides for use of Element Occurrence Specifications ("EO specs") to delineate and differentiate EOs, including both minimum criteria and separation distances. Individually written ("custom") EO specs are of two general kinds. *Element-specific EO Specs* are written for a particular, generally well-known element, drawing on element-specific information on ecology, species biology, threats/vulnerabilities, management needs, etc. *Group EO Specs* are written for a group of related or ecologically similar elements (specified by a list or by a scoping definition), drawing on various considerations broadly applicable to the particular group. Custom EO specs may also be developed to address unusual population structures or dispersal dynamics. Note that custom EO specs may specify shorter as well as longer separation distances when considered appropriate in particular cases.

Minimum EO criteria usually follow generally accepted (although not well-documented) criteria, considering such evidence as successful or potentially successful establishment, presumed naturalness (including deliberate restorations and reintroductions within the element's historical range), and review of reliability of identification and locality information. A single well-established individual plant is often considered to meet the minimum criteria for an EO. The issue of minimum EO criteria is addressed more extensively in the EO Data Standard, and is not further considered here. When necessary, custom EO specifications can be written to identify minimum EO criteria for a particular taxon.

I. The 2004 Plant EO Specs Working Group

For the many thousands of vascular plant species with Element Occurrences tracked by Heritage Programs or Conservation Data Centers, relatively few have individual or group element-occurrence specifications (custom EO specs). However, the default 1 km minimum

[1]NatureServe. 2002. Element Occurrence Data Standard, 6 February 2002. NatureServe, Arlington, Virginia. Accessed at http://whiteoak.natureserve.org/eodraft/index.htm, September 2004.

separation distance provided by the EO Data Standard has often been considered inappropriately small, particularly for riparian plants, plants found in dynamic landscape mosaics such as fire systems or sand dunes, and plants scattered in large areas of apparently suitable habitat. Indeed, the EO Data Standard encourages the use of larger separation distances in such cases.

A working group of Heritage and NatureServe botanists[2] convened in March 2004 to help advance production of EO Specifications (EO specs) for plants. They developed the general strategy presented here for using commonly encountered habitat and landscape situations for delimiting EOs of vascular plants that lack custom EO specs. In this novel strategy, pairs or groups of observations of the element are reviewed to determine whether they are better treated within the same EO or as separate EOs. Since plant taxa may show different habitat relations or distribution patterns in different portions of their geographical ranges, this method can result in different separation distances being applied in different places for the same taxon, and perhaps even within the same EO.

In effect, the group's strategy provides a single, interim alternative separation procedure available for use for any plant element for which more focused individual or group EO specs have not been developed. The group's guidelines should promote standardization across the NatureServe network in the process of thinking through the appropriate occurrence delimitation for particular EOs, as an alternative to use of individually specified range-wide separation distances for elements or groups of elements (as usually provided in custom EO specs) or rigid use of the default 1 km minimum EO separation distance specified in the EO Data Standard.

The group's strategy was developed primarily to provide general guidance for EO separation distances for native North American vascular plants, but can be applied to other plants or regions as well. Of course, element-specific or group specs may always be developed for elements for which these recommendations clearly do not apply, or for which other separation distances based on particular circumstances are more appropriate. Given the group members' limited familiarity with tropical, polar, ocean-island, and marine systems, these guidelines should be used with caution in such circumstances, and more appropriate EO separation distances should be applied (and documented) if necessary.

The working group's draft was circulated broadly to Heritage botanists, data managers, and others for review, discussion, and refinement, resulting in the guidance presented here. This report[3] presents the group's strategy as a decision tree (Figure 1), and provides instructions for its use, along with pertinent background material on botanical and ecological considerations and EO methodology.

The group thanks Kat Maybury (NatureServe's Director of Botany) for convening the March meeting, providing ongoing encouragement, promoting Network-wide discussion, and exploring implementation issues; Geoff Hammerson (NatureServe) for his presentation on zoological EO specs; Jennifer Nichols (NatureServe) for guidance on various methodological

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[3] Prepared for the group by Larry Morse, Jim Morefield, and Florence Caplow.

questions; Larry Master for coordinating a needed adjustment to the EO Data Standard; and the numerous reviewers whose questions and suggestions have led to improvements and refinements in this presentation.

II. Methodological Considerations for EOs for Plants

The EO Data Standard notes that "An EO should have *practical conservation value* for the Element." Also, an EO should have *biological merit* and *conservation merit* and be *stable* and *practical.* When feasible, EOs should be actual biological populations, with plants within an EO interacting with each other or being be more closely related to each other than with plants in other EOs. (However, for most plant species, there is relatively little information on actual dispersal rates and distances and other aspects of their population or metapopulation dynamics.) In addition, EO separations should be on scales reasonable for conservation; neither immensely large EOs nor numerous tiny nearby EOs would meet this test. EOs should also involve areas and boundaries that are reasonably stable on the landscape over decades on average, and almost certainly over any given 25-year period, without need for frequent remapping and reallocation of data. Finally, for data comparability, EOs for a particular element should be developed by the same criteria throughout the element's distributional range. The degree of aggregation of observations into EOs particularly affects EO ranks, since larger EOs will often have higher EO ranks. Aggregation also focuses attention on the resulting EOs as overall assemblages in conservation planning, habitat management, or environmental review.

The informal term "EO Feature" is used here for any place (from point locality to large area) where a particular plant element has been observed or otherwise documented as being present (currently or historically) with sufficient evidence of naturalness, persistence, etc., to meet the pertinent minimum EO criteria outlined in the EO Data Standard. As discussed in the EO Data Standard, the areal representation of such a Feature is expanded by an appropriate buffer to address any locational uncertainty in the original information. An Element Occurrence (EO) includes one or more such EO Features. In the EO Data Standard and in this guidance, separation distances are always applied to the Basic Feature of the Biotics EO methodology. Note, however, that the differences between Basic Features and final Procedural Features are negligible for these purposes, so Procedural Features may be considered in EO delimitation if already developed.

EO Features based on historical information, including EOs with a rank of "H" (historical), "F" (failed to find), or "X" (extirpated), especially if they have good locational information, may be used to link extant EO Features that would otherwise be considered to belong to different EOs. Use of such historical information may lead to more appropriate EOs since dispersal patterns, habitat dynamics, and metapopulation phenomena may be better represented. The resulting EO may also be a more appropriate unit for EO ranking and for data use. However, many historical observations have poor locational information (i.e., a very high degree of locational uncertainty), and in that case may be inappropriate for linking otherwise distinct EOs or for combining with a new, more precisely located Feature. Determining whether a new observation is or is not the same as an historical EO is a matter of judgment and generally involves a consideration of the original historical description (often an herbarium specimen label), habitat for the element, and historical and current extent of the habitat within the area of the historical EO, including its estimated locational uncertainty.

Many habitats have experienced fragmentation as a result of human activity (such as clear-cut patches, mined areas, residential development, roads, agricultural development). In general, EO separation distances should not be based on consequences of anthropogenic habitat fragmentation, on differences in ownership or management, or on utility in conservation planning. This is because such factors can differ widely across the range of an element and could lead to very inconsistent EOs; such factors are generally not intrinsic to the element itself. EO specs are intended to result in more consistent EO delimitation despite such spatial variation. For habitat fragmentation in particular (whether new or historical), this should be reflected as a decrease in quality (EO Rank) of one or more formerly less-fragmented EOs, and perhaps also as sub-EOs where management or other conservation factors vary widely between fragments, but not as an increase in the number of EOs.

In many cases, a program may want to maintain EO data at a sub-EO level, based on the individual Features that make up the EO. When previously processed EOs are combined, several sub-EOs may need to be created. Whether or not sub-EOs are used, the original polygons that have been combined into one EO should be maintained.

III. Separation Distances for Vascular Plant EOs

Separation distances are a key component to Element Occurrence Specifications (EO specs). The EO Data Standard provides a *Default Separation Distance* of 1 km (~0.62 miles) or greater for plant and animal elements that lack EO specs, noting that situations involving dispersal barriers could involve even shorter distances. When areas (rather than point locations) are known, separations are measured edge-to-edge, not center-to-center, after any locational uncertainty is addressed. While gene flow declines over distance at different rates for different elements, the minimum default EO separation distance of 1 km has been accepted by the Network as the most suitable round-number metric-system approximation broadly applicable to many (but not all) situations.

Some heritage programs use other separation-distance guidance (such as ¼ mile, about 0.4 km) that was developed under a previous EO methodology that did not provide a capability for sub-EOs. These older guidelines tended to encourage use of more numerous but smaller EOs to maintain separate mapped Features and data records for information that can now be tracked at the sub-EO level.

Narrow dispersal barriers are important for many animals, but for vascular plants, there seem to be few cases in which narrow barriers would justify treatment of quite nearby plants in different EOs. Such situations may be addressed in custom EO specs if necessary. However, for most plants, the contrast of suitable and unsuitable habitat is usually more important, with the latter being crossable only in single-generation dispersal events.

While the 1 km default separation distance is generally accepted as a suitable minimum, it has long been recognized by many Network botanists that a standardized 1 km separation distance for all vascular plant EOs lacking custom EO specs seemed inappropriately small in many cases, particularly those in three broad patterns:

- *Riparian corridors,* in which water currents (or at least occasional floods) focus dispersal substantial distances in the water-flow direction. Riparian corridors, seashores, and shores of other large water bodies that have big storm waves often show linear distribution patterns, with a plant species occurring in various places along the water’s edge, or in adjacent habitat affected by floods, storm waves, or other high waters, but not far inland.

- *Dynamic landscape mosaics,* in which particular patches of habitat actively occupied by the element appear and fade on a scale of several years to a few decades, yet the overall habitat area remains relatively fixed in place. Some habitats, for example active sand dunes, fire-dominated systems, and beaver-influenced systems, are mosaic in nature, with the same particular place on the ground unlikely to have the same ecological characteristics over a 50-year period, with recurrent processes continuing to create new habitat patches that subsequently fade.
- *Continuous apparently suitable habitat* in which an irregularly distributed plant is likely to be present (perhaps in a seed bank), or likely to disperse, in places between the currently known observations.

While all such cases could in principle be addressed by custom EO specs, few such specs have been developed to date. Apart from the lack of appropriate information on dispersal and population biology for many elements, custom EO specs can prove difficult to write for wide-ranging plants, since a variety of habitats, dispersal vectors, and population structures may be involved. This is particularly the case for globally common elements that are of conservation concern in only small portions of their range (usually peripheral or disjunct sites).

IV. Novel Strategy: Pairwise Consideration of EO Features Based on Habitat

The working group initially planned to develop various specs groups, based on such factors as habitat characteristics, life history, pollination biology, or seed dispersal strategies. This system would be parallel to the specs groups developed for many animal taxa. However, with discussion, the group encountered three major barriers to the development of specs groups: 1) a lack of knowledge of life history, pollination biology, or seed dispersal strategies for many elements, 2) habitat characteristics that can vary across the elements' ranges, and 3) multiple pollination and dispersal vectors for many elements. For example, seeds of cottonwood *(Populus* spp.) may be mostly wind dispersed, but can also be water dispersed or bird dispersed, and these vectors are going to vary across the range of the element and even among or within populations.

The group soon realized that the practical question at hand instead involves the selection of appropriate separation criteria for nearby observations of the same element, taken as pairs (or groups), not necessarily using a single criterion for an element throughout its entire geographical range. The group’s remaining discussion, and the recommendations presented here, follow that novel track, focusing on the possible role of various familiar habitat and landscape patterns in providing useful guidance on EO delimitation.

This resulting strategy recognizes that while there is need for an objective process in implementing scientifically credible EO separations, there is no real need that the same separation be used throughout the range of a particular element, so long as there is a process for deciding whether any given pair of observations are sufficiently far apart (in their habitat/landscape context) to be treated as separate EOs.

Particular attention was given to the contrast in the EO Data Standard between unsuitable and apparently suitable habitat, and to the special cases of dynamic landscape mosaics and riparian/shore systems. The group identified pertinent combinations and recommended guidance for general EO separation distances for each case, using diverse species with which group members had personal expertise as test cases in refining these recommendations. The overall recommendation is presented as a decision tree (Figure 1), defining cases in which separation distances of 1 km, 2 km, 3 km, and 10 km are suitable for general use in delimiting vascular plant EOs that lack custom individual or group specs.

The group agreed that, if custom EO specs are lacking, EO Features over 10 km apart should be separate (if not bridged by intervening EO Features), and those less than 1 km apart should be combined. While these numbers are somewhat arbitrary, they address an overriding need for consistency in delimiting EOs (EO Data Standard), and are in keeping with informal standards already in use.

The group's recommendation, as revised following review, are:

1. The minimum default separation distance is 1 km, as specified in the EO Data Standard, when no other EO specification or guidance applies.
2. Custom EO specs are needed to justify any separation distances <1 km or >10 km that are not otherwise in compliance with the guidance herein.
3. When custom EO specs are available, they should be used if available information permits.
4. *Additional guidance* is provided here for selected general cases involving nearby pairs/groups of EO Features, with separation distances of 1 km, 2 km, 3 km, or 10 km as appropriate to the situation.
    a. Within **stable, apparently suitable habitat not known to be occupied**, two EO Features separated by up to **2 km** are included in the same EO, unless there is a gap of persistently unsuitable habitat 1 km or more wide.
    b. In **dynamic landscape mosaics**, two EO Features separated by up to **3 km** are included in the same EO, unless there is a gap of persistently unsuitable habitat 1 km or more wide.
    c. In certain **riparian/shore water-dispersal systems,** two EO Features separated by up to **10 km** are included in the same EO, unless there is a gap of persistently unsuitable habitat of 3 km or more, with distances measured along the path of water flow.
5. If EOs exceed 20 km in any direction, they may be broken into two or more EOs for practicality if desired.

For convenience, definitions of key terms, with related notes, are presented together as an appendix. The distinction between suitable and unsuitable habitat, and the three special habitat-based cases, are considered further below.

When necessary in unusual cases, the numerical distances provided here may be adjusted upward by 1.33 (4/3) or downward to 0.75 (3/4) of the specified values, with text explanation. Examples include cases of locational uncertainty, minor outliers, or minor narrowing of otherwise substantial gaps (see Table 1 for ranges). These adjustments should be made only when the EO pattern resulting from application of the general guidelines is unreasonable, and/or when the exact distances on the landscape are uncertain. If more extreme adjustments are needed, element-specific (or group) specs should be written to explain and document the situation.

Table 1. Specified separation distances and acceptable adjustment ranges for habitat-based plant EO delimitation.

Separation (km)	*Range (km)*	*Separation (miles)*	*Range (miles)*
1	0.75–1.33	0.62	0.47–0.83
2	1.50–2.67	1.24	0.93–1.66
3	2.25–4.00	1.86	1.40–2.49
10	7.50–13.33	6.21	4.66–8.28

V. Suitable vs. Unsuitable Habitat

The EO Data Standard’s distinction between “apparently suitable habitat not known to be occupied” and “unsuitable habitat” is fundamental to the guidance provided here, since the extent of any intervening persistently unsuitable habitat is considered in determining whether two EO Features should be included in the same EO or considered separate EOs. Examples of such persistently unsuitable habitats include waters or wetlands separating upland habitats, upland habitats separating riparian habitats or vernal pools, or contrasting bedrock types separating isolated areas of locally unusual bedrock (such as granite, serpentine, limestone, or shale). Note that persistently unsuitable habitat may itself be dynamic, rather than stable, so long as it persistently remains unsuitable for the element.

While areas of persistently unsuitable habitat are not necessarily barriers to single local dispersal events, the difficulty of the species surviving there precludes regular involvement of such areas as gap-bridging stepping-stones for multiple-generation incremental dispersal. Therefore, presence of significant areas of such persistently unsuitable habitat, sufficient to reduce effective dispersal, strengthens isolation between two nearby EO Features within an element's local distribution. Intervening areas of persistently unsuitable habitat, being harder for the element to bridge by dispersal, therefore require shorter separation distances between EO Features than do comparable areas of apparently suitable habitat, in keeping with the EO Data Standard. Of course, discovery of the element in habitat previously thought unsuitable (other than as non-established propagules or as chance seedlings unlikely to survive) suggests that reassessment is needed. Failure to locate the element in the intervening habitat despite intensive searches may of course also suggest that the habitat is unsuitable, not merely unoccupied.

VI. Special Case: Continuous Stable Habitats

Most plants, including many substrate-associated rare species, require particular habitats for establishment and maintenance, as well as possible reproduction and further dispersal. In many instances, the pertinent habitat features (such as bedrock outcrops, topographic settings, hydrographic features, or soil or vegetation types) can be considered stable, being relatively permanent on the landscape, persisting on scales of centuries, millennia, or longer, with a fairly clear (and sometimes remarkably abrupt) boundary between unsuitable and apparently suitable habitat from the perspective of the (presumed) needs of a particular element. Note that habitat here called "stable" nevertheless undergoes many changes, particularly over periods longer than 50 years, and that chance events (such as tree-fall openings) of course occur occasionally within such areas. Seasonal changes and other very frequent disturbance also occur in most "stable" habitats. Examples of species occurring primarily or exclusively in stable habitat include *Trifolium stoloniferum* (running buffalo clover), *Isotria medeoloides* (small whorled pogonia), *Phacelia monoensis* (Mono County phacelia), *Aquilegia barnebyi* (Barneby's columbine), *Trifolium virginicum* (Kate's Mountain clover), *Arabis serotina* (shale-barren rockcress), *Eriogonum anemophilum* (wind-loving buckwheat), *Heuchera alba* (white alumroot), and *Actaea elata* (small bugbane).

The EO Data Standard suggests that stable EOs be delimited using a 25-year timeframe. For purposes of this guidance, habitats are considered stable when, under natural conditions, they are likely to retain their current apparent capacity (or lack of capacity) to support the element in question during any given 50 year period, and certainly so during any given 25 year period. The group accordingly considered habitat or landscape changes recurring every 5–25 years on average, and almost certain to recur within a 50-year period, to indicate the presence of unstable or dynamic habitat (rather than stable habitat) when considering patterns of EO separation distances. However, in distinguishing dynamic habitats, annual or very frequent disturbance should not be considered, nor should disturbance that would be unlikely to occur at a given point in the habitat within a period of 50 years.

For two EO Features separated by 1 km or more, but by less than 3 km (and not in a riparian/shore system), EO delimitation depends first on whether the two EO Features are separated by a substantial area of persistently unsuitable habitat (here specified as being 1 km wide or greater, and expected to lack suitable sites for the element of interest for the next 25 years or more). If the apparently suitable habitat is relatively continuous (without persisting gaps of 1 km or more), EO delimitation next depends on the temporal stability of the habitat. If the habitat is certain (under natural conditions) to remain stable during the next 25 years (for example, mature hardwood, spruce-fir forest, acidic fen, pond or lakes, or highly arid systems), 2 km is the suggested separation distance (see below for a discussion of unstable dynamic systems). This 2 km distance is reasonable because of the need for only one well-centered or two random intervening locations to combine the same element occurrence, as opposed to needing more than one or two patches to bridge a 3 km separation distance.

VII. Special Case: Dynamic Landscape Mosaics

Some plant elements occur in areas of dynamic landscape mosaics, in which patches of disturbed habitat appear and decline cyclically on timescales of several years to several decades. Examples include active sand dune systems, fire-dominated systems, and beaver-influenced systems. In such dynamic habitat mosaics, there are usually particular kinds of plants that thrive in the disturbance patches, but do not thrive as the vegetation matures. Others occur only in mature patches but not in the disturbed patches. Some of these plants can survive in-place between disturbance events as dormant seed (seed banking) or other dormant stages (spore banks, shoot banks, etc.), while other kinds of disturbance-following plants may depend on local dispersal (between different-aged patches within the habitat mosaic) for colonization of freshly opened habitat. In either of these cases, the element is persistent within the general area of the landscape mosaic, even though more transient (at least as obvious, growing plants) at any particular place. Examples of such species include *Platanthera leucophaea* (eastern prairie white-fringed orchid), *Muhlenbergia torreyana* (Torrey's dropseed), and *Astragalus columbianus* (Columbia milk-vetch).

Treating patches of plants that occur in areas of dynamic landscape mosaics as single EOs rather than the continually changing patches is generally not only more practical, reducing need for frequent re-mapping and re-delimitation of EOs, but also usually makes more sense from both an ecological and a conservation perspective. In the EO Data Standard and in this guidance, dynamic landscape mosaics are given special treatment (leading to greater separation distances) because the general area, over a relatively short time, can be expected to include habitat patches suitable for growth of the element, and may even include seed banks or other inconspicuous dormant plants. Therefore, if the element's habitat is part of a dynamic landscape system, 3 km instead of 2 km is the suggested separation distance across such apparently suitable landscape areas, unless persisting unsuitable gaps of 1 km or more intervene.

Many dynamic landscape mosaics have been altered as a result of human activity, such as increase or decrease in fire frequencies, removal of beaver, or dune stabilization. In many cases, the landscape remains dynamic despite a change in the disturbance event frequency, and so can still be considered dynamic within a 5–25 year average cycle for the purpose of EO delimitation. In other cases, the landscape processes have been halted entirely. In general, EO delimitation should be based on historic and/or potential landscape processes. In situations where the natural disturbance cycle is unlikely to ever occur again, or has been replaced by a new disturbance cycle substantially more frequent than every 5 years, however, it may be more appropriate to use the 2 km stable-habitat separation distance instead.

VIII. Special Case: Riparian/Shore Systems with Water-current Dispersal

Flowing water is a uniquely strong, directionally focused dispersal agent, generally taking quantities of propagules substantially greater distances, on average, than other dispersal agents that over time would spread the same number of propagules shorter average distances radially in many directions. Even occasional storms and floods (such as those at 10-, 30-, or 100-year intervals) can be important plant-dispersing events, considering the persistence capabilities of many kinds of plants, once established. Dispersal between nearby places in the same riparian/shore system is therefore generally more effective (in the direction of water flow) than for comparably spaced upland or quiet-water places.

One can usually assume that water dispersal plays a significant role in species biology if the plant grows somewhere in a riparian corridor (suggested to include up to the 100-year floodplain), along the seashore, or along the shore of some other water body large enough to have large storm waves (such as large lakes). Because dispersal of plant seeds and other propagules in many riparian and shoreline systems is generally relatively linear rather than radial, the effective range of dispersal is greatly elongated along the direction of water flow. Therefore, it is appropriate to include two EO Features along such a riparian or shore system in the same EO even when separated by about three times the distance that would be selected if water currents were not involved. By their nature, riparian/shore systems are usually also dynamic systems as discussed further below, and so the separation distances that apply to upland dynamic systems serve as the starting point for deriving separation distances in riparian/shore systems. By multiplying these distances by 3, then rounding, the group arrived at 10 km (instead of 3 km) along the path of water flow, with at least 3 km (rather than 1 km) of intervening persisting unsuitable habitat considered a gap. Example species of riparian/shore systems include *Rorippa columbiae* (Columbia yellow-cress), *Rorippa subumbellata* (Tahoe yellow-cress), *Lobelia dortmanna* (water lobelia), *Ptilimnium nodosum* (harperella), *Marshallia grandiflora* (large-flowered Barbara's-buttons), *Micranthemum micranthemoides* (Nuttall's micranthemum), *Plantago cordata* (heart-leaved plantain), *Amaranthus pumilus* (seabeach amaranth), and *Armoracia lacustris* (lake-cress).

Ideally, for inclusion in the same EO over this extended separation distance, one should have evidence that water currents can flow from one of the two EO Features to the other, at least occasionally. However, in the usual lack of such site-specific knowledge, one may generally assume that proximity to the same water body indicates capability for sharing of water flow, for example single shores or riparian areas that are less than 1 km wide. If there is evidence that two EO Features within a riparian/shore system are not connected by water flow, even occasionally within a 50 year period, the water-current separation distances should not be used. For example, two EO Features on different upstream river tributaries, or two EO Features directly across from one another on a wide river, are not usually directly connected by water flow, and the non-riparian/shore guidance would apply to them instead. On the other hand, even on a wide river, there is likely to be propagule movement from one shoreline to the other shoreline well downstream (generally assumed when the downstream distance is at least 3 times the width of the flow).

Within riparian/shore dispersal-pattern systems, separation distance depends on whether appropriate sites for the element are continuous or discontinuous in the areas along the water-flow direction. For example, a system of gravel bars may extend for 20 km along a particular river. At any one time clusters of plants may be observed in specific portions of the gravel bars, but over the course of time one might find plants almost anywhere along the entire 20 km. This is a classic metapopulation dynamic, described for *Pedicularis furbishiae* by Menges[4]. Most riparian systems will not have "continuous" habitat in any one year, but when considered over 25 years, floods and other disturbances are likely to move gravel bars and other riverine landscape components, or at least move plants among them. Such a system may still be considered continuous even if it includes persisting discontinuities (habitat that is unlikely to become suitable within 50 years, and certainly not within 25 years) less than 3 km along the path of water flow. Therefore, in a continuous riparian/shore system, EO Features may be separated as much as 10 km along the flow path and still be part of the same element occurrence. However, if there is a gap of at least 3 km of persistently unsuitable habitat along the flow path, then they will be separate element occurrences.

IX. Using the Decision Tree

The group's recommendations are summarized in a decision tree (Figure 1), used to determine whether two nearby EO Features of an element should be included in the same Element Occurrence, or treated as separate EOs. In this strategy, the size and nature of the gaps between EO Features are considered to determine the appropriate separation distance (1 km, 2 km, 3 km, or 10 km) for particular situations (approximately 0.6, 1.25, 2, and 6

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[4]Menges, E. S. 1988. Conservation biology of Furbish's lousewort: Final report to Region 5, U.S. Fish and Wildlife Service. Holcomb Research Institute, Butler Univ., Indianapolis, Indiana. 55 pp.

miles, respectively). If custom element-specific or group EO specs exist, these should of course be applied instead when available data permit.

The tree may be used when one has two (or more) observations of the same element at different but nearby places. The EO Features being considered with the decision tree must each independently meet the minimum EO criteria for the element – the only question addressed here, and in the decision tree, is whether the two places belong to the same EO, or to two different EOs. Multiple nearby EO Features should be considered pairwise and aggregated into EOs as appropriate.

The decision tree provides an easy, readily referenced method of documenting the process for why a particular separation distance was used in assigning two (or more) EO Features to a single EO or to different EOs. While this tree is designed to be simple to use, it is based on many assumptions or inferences (patch dynamics, metapopulation dynamics, unsuitable or apparently suitable habitat, and dispersal mechanisms). When information on which to base such inferences or assumptions is completely lacking, the decision tree leads to the default 1 km separation distance.

In using the decision tree, distances between EO Features are measured edge-to-edge, if the extent of the element's presence within the EO Features is known, rather than center-to-center, after locational uncertainty has been addressed. In the context of the Biotics EO Methodology, such measurements should be made between Basic Features when available, although Procedural Features may also be used. Any two EO Features closer than 1 km would ordinarily be included in the same EO, and any EO Features more distant than 10 km would ordinarily be included in different EOs (unless additional intervening EO Features bridge the gap). As noted above, these and other distance numbers in the decision tree may be adjusted slightly in individual cases if needed (see Table 1), with an explanation of the need for the adjustment noted in the pertinent EO records.

In cases where persistently unsuitable habitat occurs as isolated patches within a relatively continuous matrix of apparently suitable habitat (whether stable or dynamic), distances between EO Features should be measured along a path through the apparently suitable habitat that avoids or minimizes the width of intervening unsuitable habitat. For the special case of riparian or shore systems, distance measurements should follow the general path of water flow, rather than take a direct path across such areas as upland habitat, broad wetlands, or wide water bodies. In other habitats, distances should be measured along paths that minimize gaps in apparently suitable habitat, as well as along straight lines, and the two observation sites should be included in the same EO if that result is reached by either means.

Minor incidental presence of generally upland elements in riparian/shore situations may be ignored if water-current dispersal can be considered to have negligible effect on the element's overall local distribution. Similarly, for elements generally characteristic of stable habitats, minor incidental presence in adjacent dynamic landscape mosaics may be ignored if the dynamic system does not involve the element's more characteristic local habitats.

Where EOs become very large, exceeding 20 km in any direction (as might happen along major rivers), they may be split arbitrarily into two or more EOs if preferred for data management or conservation planning purposes. However, such splitting is not required, and should not change EO rank or Element rank.

X. Tiered Implementation

The EO separation distances used throughout the Network vary widely, and the practical conversion of plant EOs to a single standard (this habitat-based strategy when custom EO specs are not available) may take several years. To support and track the progress of member subnational programs during this process, the following tiered system of implementation will be used. Tier 3 is the goal; Tiers 1 and 2 are considered in temporary compliance only. Network members will always use the highest implementation tier practicable as their Program-wide default tier, both for new EOs and retrospectively for existing EOs, and will use tiers lower than 3 only temporarily and as a last resort, until Tier 3 can be achieved.

- **Tier 1:** Continue to use a previously adopted, single, consistent separation distance LESS THAN 1 km (such as ¼ mile [~0.4 km] for California), so that EOs can be aggregated automatically via software to generate Tier-2 implementation when necessary.
- **Tier 2:** Use a 1 km separation distance for all plant EOs.
- **Tier 3:** Use custom EO specs when available for an Element, and otherwise use full habitat-based delimitation guidance, to extent supporting information is available.

The attached decision tree (Figure 1) presents Tier 3 implementation.

For elements for which EOs are being tracked by more than one member subnational program, and especially for globally rare elements that are most likely to be the object of multijurisdicational data requests, programs should coordinate implementation levels for those elements, with the help of NatureServe if necessary, and should ideally all use the same, highest practicable implementation level for each such shared element.

The EO delimitation strategy used will be documented in Biotics at least on an element-by-element basis, and preferably at the element-occurrence level, by each subnational program. Programs may also choose and specify the highest default tier they are able to implement program-wide at a particular point in time, but the effects of this choice must still be documented for each element or occurrence (which can be done through “batch” database updates).

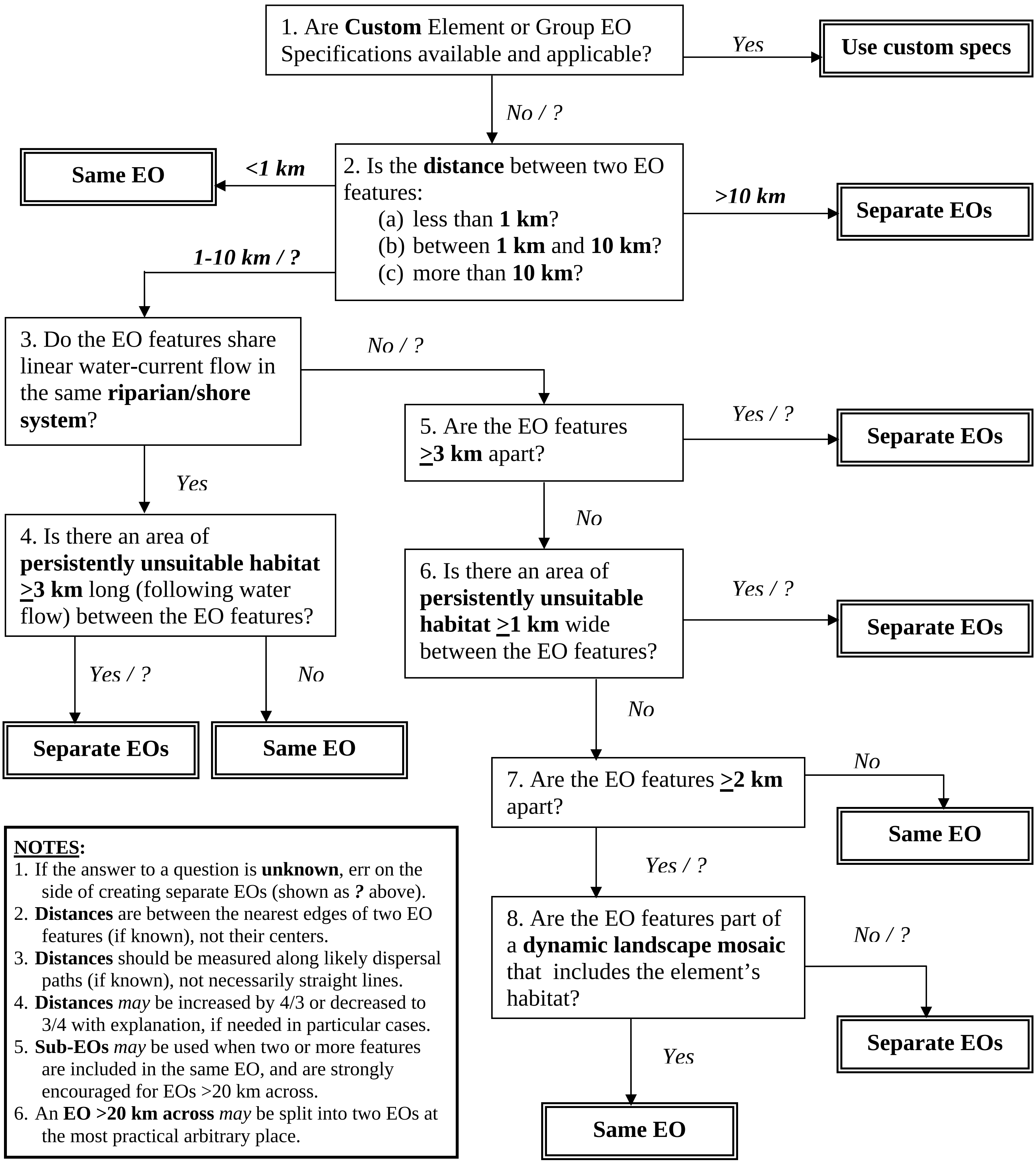
This tiered system is intended for the internal use of NatureServe and its member programs, in supporting and tracking members at various stages of implementation. Individual programs with data at Tier 1 and Tier 2 implementation levels are at least temporarily in compliance with EO specification standards and can inform external clients as such, explaining that "in accordance with data standards, we separate occurrences by .... (whatever your *default Tier 1 or Tier 2* criteria are) .... except when otherwise specified for particular taxa."

Appendix I. Decision Tree and Definitions Summary for Habitat-based Plant EO Delimitation Guidance (2004)

Figure 1. Habitat-based Plant Element Occurrence Delimitation Guidance, 1 October 2004. [Decision tree]

Notes and Definitions for Plant EO Delimitation Guidance, 1 October 2004

Figure 1. Habitat-based Plant Element Occurrence Delimitation Guidance, 1 October 2004



__NOTES__:
1. If the answer to a question is **unknown**, err on the side of creating separate EOs (shown as ***?*** above).
2. **Distances** are between the nearest edges of two EO features (if known), not their centers.
3. **Distances** should be measured along likely dispersal paths (if known), not necessarily straight lines.
4. **Distances** *may* be increased by 4/3 or decreased to 3/4 with explanation, if needed in particular cases.
5. **Sub-EOs** *may* be used when two or more features are included in the same EO, and are strongly encouraged for EOs >20 km across.
6. An **EO >20 km across** *may* be split into two EOs at the most practical arbitrary place.

Notes and Definitions for Habitat-based Plant EO Delimitation Guidance, 1 October 2004

EO Features – This Habitat-based Plant Element Occurrence (EO) Delimitation Guidance addresses whether two separate observations of the same element belong to the same EO, or to two different EOs, in the absence of more specific guidance (for example, element or group custom EO specifications). In the context of the Biotics EO Methodology, Basic Features should be compared, to assure consideration of locational uncertainty. (However, note that the differences between Basic and final Procedural Features are negligible here.) Each observation must independently meet the minimal EO criteria (see EO Data Standard) for that element prior to comparison.

Persistently unsuitable habitat – Surveyed or unsurveyed areas that, under natural conditions, are virtually certain to remain incapable of supporting viable individuals of an element during the next 25 years or more. Such areas are neither *apparently suitable habitat* nor parts of a *dynamic landscape mosaic* that includes the element (see definitions below). The potential for rare or highly irregular events (such as tornadoes, unusual hurricanes, earthquakes, 300-year floods, rare fires, or catastrophic volcanism) may be ignored. Similarly, incremental effects of long-term phenomena (such as slow erosion or deposition, climate change, or sea-level rise) may usually be ignored on the timescale of interest here; over longer times, almost everything changes.

Apparently suitable habitat – Surveyed or unsurveyed areas not known to be occupied by an element, but which appear capable (under natural conditions) of supporting viable individuals of that element, based on one or more observed or mapped factors (soils, geology, hydrology, vegetation, topography, aspect, elevation, etc.) known to delimit or predict other occurrences (current or historical) of the same element.

Dynamic landscape mosaics – Landscape or habitat mosaics (other than *linear riparian/shore systems*; see below) in which an area of potentially suitable habitat includes natural disturbance patches (or similar phenomena) which are produced and subsequently fade in various places within the area, with a natural disturbance return interval of about 5-50 years, considering both past and expected future conditions. Elements in such areas typically grow in (or are excluded from) the dynamic disturbance patches, persisting as seed (or other dormant stages) in patches not currently suitable for growth, or dispersing readily among suitable patches. Examples include many chaparral- or pine-dominated fire systems, dune blowouts, and beaverdam wetlands. Note that such habitats as intermittent wetlands, in which the conditions appropriate for growth (or exclusion) of an element may not be met every year, are still considered stable if their locations and extents remain generally constant for 25 years or more.

Linear riparian/shore systems – Systems dominated by water-current dispersal in a linear zone generally <1 km wide (riparian corridors, shores, and similar narrow systems), including those with dispersal by occasional events (major floods, storm waves, etc.) with significant potential to occur during the next 25 years. Examples include many "100-year" riparian floodplains, coastal shorelines, shorelines of big lakes with large waves, estuarine shorelines and tidal zones, and floodplains of small streams or dry drainages subject to frequent flash floods. Small, quiet ponds and lakes, as well as wide marshes or backwater swamps, generally would not be included here. EO features are assumed to share linear flow if they are aligned in a reasonable flow direction along a river, stream, shore, etc., unless contrary data exist. This is usually not the case with upstream EO features on different tributaries, or with EO features on opposite shores of rivers >1 km wide; however, such features may be indirectly connected if they each share flow with a common downstream EO feature. For an aquatic element inhabiting open water of a river, assume connection by water-current flow unless evidence suggests that this is unlikely.