ASSESSING AND MONITORING HABITAT INTEGRITY FOR *LEPIDIUM PAPILLIFERUM* (SLICKSPOT PEPPERGRASS) IN THE SAGEBRUSH-STEPPE OF SOUTHWESTERN IDAHO

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ABSTRACT

Lepidium papilliferum (slickspot peppergrass) is one of Idaho's highest priority plant conservation concerns. We have developed a Habitat Integrity Index to assess and monitor the ecological integrity of slickspot peppergrass habitat; both the discrete slickspot microsites which slickspot peppergrass is generally restricted, as well as the surrounding vegetation. Monitoring habitat focuses on the most important factor responsible for the decline of slickspot peppergrass, namely, the loss of high quality shrub-steppe vegetation in southwestern Idaho. The metrics for the Index use physical features, community composition, and community structure attributes to rate occurrence integrity. Attributes for the Index focus on wildfire, livestock grazing, and off-road motorized disturbances. All three are widespread, interrelated, and management concerns in southwestern Idaho.

In 1998, baseline Habitat Integrity Index data was collected at 37 extant slickspot peppergrass occurrences located on public land in southwestern Idaho. Results indicate all slickspot peppergrass occurrences are disturbed to varying degrees. Only 30% of the occurrences sampled were unburned. Most occurrences were grazed by livestock, and 64% of the individual slickspot microsites sampled showed signs of livestock disturbance. Off-road-vehicle use was absent or light at most occurrences, with impacts from this disturbance tending to be more localized.

Information from the Habitat Integrity Index will be used to monitor long-term trends regarding habitat quality and species conservation. The conservation of slickspot peppergrass is largely dependent on conserving its sagebrush-steppe habitat. Ideally, the Index can be one part of a more inclusive conservation approach on behalf of southwestern Idaho's shrub-steppe ecosystem. The decline of this ecosystem has biological and ecological implications far beyond slickspot peppergrass. Solutions to this problem will require commitment and coordination from multiple agencies, organizations, and private citizens.

ACKNOWLEDGMENTS

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INTRODUCTION

Lepidium papilliferum (slickspot peppergrass) is one of Idaho's highest priority plant conservation concerns. It is an annual and biennial plant species in the mustard (Brassicaceae) family endemic to southwestern Idaho (Figure 1). Its main range along the western Snake River Plain and adjacent foothills is approximately 100 miles long and 35 miles wide, extending from near New Plymouth in Payette County, to near Glenns Ferry in Elmore County. This is an elongate, northwest-southeast trending area north of the Snake River. There is a disjunct population center on the Owyhee Plateau in Owyhee County, approximately 40 miles south of the Snake River Plain. This area is approximately 10 miles by 10 miles in extent. Slickspot peppergrass is restricted to visually distinct, small-scale openings within the region's sagebrush-steppe ecosystem. The openings are known by various names - natric sites, mini-playas, playettes, and slick spots. These sparsely-vegetated microsites are created by unusual edaphic conditions and range in size from less than 1 m^2 to about 10 m^2. Microsite distribution is variable. In some places they are widespread and common, but patchy or rare in others. Slickspot peppergrass plants invariably occupy only a subset of available microsites in an area.

Like many short-lived plants growing in arid environments, the above-ground number of slickspot peppergrass individuals can fluctuate widely from year to year depending on seasonal precipitation patterns. Flowering individuals represent only a portion of the population, with the seed bank contributing the remainder, and apparently the majority in many years. Because of this life history, estimating the number of above-ground plants is by itself not a reliable measure for evaluating population and species viability. An assessment of habitat quality must be part of a monitoring strategy for species like slickspot peppergrass because it is less influenced by annual climate variations. In the case of slickspot peppergrass, monitoring habitat focuses on the most important factor responsible for the decline of the species, namely, the loss of high quality sagebrush-steppe vegetation.

Large-scale and ongoing degradation, fragmentation, and conversion of sagebrush-steppe vegetation has occurred throughout the range of slickspot peppergrass. Most of the remaining regional sagebrush-steppe is in an impoverished ecological condition due to intensive use dating back to the late 1800's. Many slickspot peppergrass populations appear to have been extirpated during the last century, and the long-term prospects for many of the extant populations is grim (Moseley 1994). Major land uses throughout the species' range are urbanization, irrigated agriculture, and rangeland livestock grazing. These have all contributed to the cumulative loss of high quality sagebrush-steppe habitat. The conservation of slickspot peppergrass is largely dependent on conserving what remains of the western Snake River Plain's sagebrush-steppe ecosystem. More detailed distribution, habitat, life history, population, and threat information regarding slickspot peppergrass is discussed elsewhere (Fisher et al. 1996; Meyer 1993; Meyer and Quinney 1993; Moseley 1994).

In 1997, we developed and conducted field testing of a Habitat Integrity Index (HII) to assess and monitor the ecological integrity of slickspot peppergrass habitat (Mancuso and Moseley 1997). The HII evaluates the integrity (quality) of both sagebrush-steppe and slickspot microsite habitats. Monitoring both habitats is necessary to assess conservation trends. The HII protocol is augmented by a viability rank assigned to each occurrence, the collection of plant community data, and repeat photo-documentation.

The second phase of the project was completed during the 1998 field season by using the index to collect baseline habitat integrity data at all known extant slickspot peppergrass occurrences located on public land. This information will be used to monitor long-term trends regarding habitat quality and species conservation. The 1998 data set provides the reference point against which future HII data will be compared, as well as a baseline assessment of habitat conditions and integrity. The HII promotes the use of long-term habitat trends

Figure 1 Distribution map for *Lepidium papilliferum*.

rather than the absolute number of plants to evaluate the conservation of slickspot peppergrass. This approach has been recommended for other rare species as well (Wikramanayake et al. 1998). This report summarizes our 1998 results.

METHODS

The Habitat Integrity Index monitoring protocol consists of four interrelated parts: the HII scorecard; an Occurrence Viability Rank scorecard; vegetation sampling; and photo points. Sampling in 1998 was conducted between May 19 and July 9. Copies of field data sheets, maps, and other support documentation referenced as appendices in this report are contained in a separate Technical Support document. The support document contains nine appendices. It is available upon request from the Idaho Conservation Data Center (CDC), Boise. Additional details outlining the HII monitoring protocols, and samples of the HII scorecard and other data forms are in Mancuso and Moseley (1997).

The land unit area being assessed with the HII is the Element Occurrence. An Element Occurrence represents a specific geographic location. It is the standard database record used by the Natural Heritage Program/Conservation Data Center network to track elements of conservation concern. Each occurrence is identified by a three-digit code (001, 002, etc.) for purposes of database record keeping at the CDC. We used this same three-digit identification code to identify and distinguish the slickspot peppergrass monitoring sites. Each occurrence also has a survey site name that relates to a nearby geographic reference.

A total of 37 occurrences were sampled in 1998 as part of HII project (Table 1). They represent nearly all of the extant occurrences located at least partially on public land, including land owned by the BLM, Idaho Department of Lands, Ada County, and Boise City. Three occurrences located on public lands in the Inside Desert area were not sampled in 1998 due to our failure to relocate them, or a lack of time. Occurrences located only on private land were not included in this study. Occurrences known only from historical records or those considered extirpated were also omitted from the study. The occurrences are grouped by general geographic area to help understand conservation patterns.

The location of HII transects was determined after we arrived at the occurrence site and conducted a general survey. At most occurrences, slickspot microsites are widespread, but slickspot peppergrass plants are limited to one or more series of slickspots covering a relatively small area. Because of this pattern transects were subjectively located. This ensured sampling was conducted in an area supporting slickspot peppergrass plants. This also allowed us to select an area where the vegetation was representative of the occurrence as a whole. In addition, transects were established with the thought of relocating them in the future. Wherever possible, small knolls, roads, fences, and powerlines serve as convenient reference markers in a landscape devoid of many topographic features.

After the general sample site was selected, the starting point and transect azimuth were randomly chosen. Occurrences consisting of only one or a handful of slickspots were an exception. Their small size eliminated any choice concerning the location of the transect. The beginning of each HII transect was permanently marked using a rebar stake hammered into the ground. GPS coordinates were recorded at the marker stake using a Garmin 12XL model. The transects were also marked on the appropriate 7.5' USGS topographic quadrangle (Appendix 1). A HII transect location form (contains directions, and a sketch showing roads, landmarks, bearings, GPS coordinates, and other navigational details) was completed to help relocate transects in the future (Appendix 2). Any sampling or other peculiarities about a transect, along with a list of all the transect azimuths are provided in Appendix 3.

Table 1. *Lepidium papilliferum* occurrences sampled for the 1998 Habitat Integrity Index monitoring project.

EO #	Name	Ownership	USGS quadrangle	Size (ca. acreage)
New Plymouth/Emmett/Canyon Co. area				
066	New Plymouth SW	BLM	New Plymouth	2
Kuna/Boise area				
018	Kuna Butte SW	BLM	Kuna	280
019	Initial Point	BLM; State	Initial Point; Kuna; Coyote Butte	780
022	Pleasant Valley North	State; Pvt.	Owyhee	120
024	Kuna Butte	BLM	Kuna	50
025	Melba Butte	BLM	Kuna	35
032	Tenmile Creek	BLM; Pvt.	Cloverdale; Mora	615
048	South Cole Road/Tenmile Creek	BLM	Mora	<0.1
049	Fivemile Creek	BLM	Boise South	<0.1
057	Kuna Butte Northwest	BLM	Kuna	20
Boise/Eagle Foothills area				
012	Military Reserve Park	Boise City	Boise South	<0.1
038	Goose Creek	Ada Co.	Eagle	<0.1
040	Woods Gulch	BLM; Pvt.	Eagle	0.4
047	Willow Creek	BLM	Southeast Emmett	<0.1
052	Woods Gulch	BLM	Pearl	75
056	Willow Creek	BLM	Southeast Emmett	<0.1
065	Lower Seaman Gulch	Ada Co.	Eagle	<0.1
Orchard area				
015	Simco Road	BLM; Pvt.	Mayfield SW	150
020	Soles Rest Creek	BLM	Mayfield SW	2
027	West of Orchard	BLM; State	Orchard; Christmas Mountain	2500
028	Christmas Mountain N	BLM; State	Christmas Mountain	1850

EO #	Name	Ownership	USGS quadrangle	Size (ca acreage)
030	Soles Rest Creek	BLM; Pvt.	Mayfield SW	500
031	Bowns Creek	BLM; Pvt.	Mayfield SW	70
035	Orchard Southwest	BLM	Orchard	150
041	Orchard SSW	BLM	Orchard	1
053	Christmas Mountain	BLM	Christmas Mountain	30
060	West of Squaw Creek	BLM; State	Mayfield SW	15
Mountain Home/Glenns Ferry area				
008	Bennett Road	BLM; Pvt.	Hammett; Hot Springs Creek Reservoir	770
010	Chalk Flat	BLM	Indian Cove	<0.1
021	Fraser Reservoir East	BLM; State	Crater Rings	100
029	Mountain Home SE	BLM	Mountain Home South	110
050	West Side Canal/Slade Flat W	BLM	Mountain Home South	10
058	Glenns Ferry NW	BLM	Glenns Ferry	1
061	SE of Reverse	BLM	Reverse	15
Inside Desert area				
051	Post Office Reservoir	BLM	Poison Butte	15
059	Poison Creek North	BLM	Clover Butte South	20
063	Flat Draw Reservoir W	BLM; State	Poison Butte	60

Habitat Integrity Index

The Habitat Integrity Index is determined by completing the *Lepidium papilliferum* Habitat Integrity Index scorecard. This entails answering eight questions regarding slickspot attributes and six questions concerning attributes of the surrounding vegetation. The Index is scored at ten separate slickspot microsites along a transect, representing stations 1 through 10 on the scorecard. Scoring the attributes is done by determining which of the score choices best fits the slickspot or surrounding vegetation being evaluated. There is no set transect length, instead, the first ten slickspot microsites encountered along the transect azimuth are sampled. Slickspots within 10 m of the transect bearing can be sampled, because the azimuth line will intercept few microsites directly. For occurrences with only a few widely-spaced microsites, this was amended to include all slickspots within view from the transect line. Small occurrences containing fewer than ten slickspots

necessarily have less than ten scores. Two transects were established at several large occurrences and also at occurrences containing separate burned and unburned segments. Future monitoring should use the 1998 transects.

With the HII, the lower the index score, the higher the occurrence's ecological integrity. Possible scores for the slickspot attributes part of the index range from 0 to 14, while sagebrush-steppe attributes scores have a 0 to 23 range. The final index score is assigned by adding the two sub-scores together. It is called the combined average score on the scoresheet and can range between 0 and 37.

Occurrence Viability Rank

Occurrence viability concerns the prospects of a slickspot peppergrass population persisting at a particular location. The Occurrence Viability rank is meant to augment the HII by considering additional criteria important for monitoring and conservation planning purposes. The rank is determined by completing one Occurrence Viability Rank form for each occurrence. The rank subjectively rates viability criteria, defensibility criteria, and incorporates the combined average HII score. A rating of high, fair, marginal, or poor is determined for each of these three main criteria. The Occurrence Viability rank is an integration of these ratings.

Factors affecting viability include fire history; post-fire rehabilitation efforts; condition of the surrounding landscape; habitat fragmentation; threats such as urban development weed invasion and heavy livestock use; and the extent of suitable habitat. The defensibility grade evaluates factors that offer protection from extrinsic human factors that otherwise might degrade or destroy an occurrence. These factors include fire protection (e.g. detection, access, response time, priority); ownership and relationship to adjoining lands; manageability; special management protection or recognition; and ease of access for off-road-vehicles, or other potential land disturbing activities.

Occurrence Viability ranks range from A (the highest) to D (the lowest). The viability of an A-ranked occurrence is relatively high and reflects good quality sites with a minimum of serious and imminent threats. They tend to be relatively large in size and in good years probably support many slickspot peppergrass plants. B- to D-ranked occurrences reflect habitat that is progressively more disturbed, threatened, and difficult to protect.

Vegetation Sampling

Vegetation sampling is included in the monitoring protocol to help quantify composition and structural changes that may occur to the vegetation over time. It also allows baseline seral conditions to be assessed. Plant community data was collected for each HII transect using site and survey methods developed by The Nature Conservancy (Bourgeron et al. 1992). One 11.3 m (37 ft) radius circular plot (equals 0.1 acre) was established adjacent to HII transect station number five, a location more or less in the middle of the transect. For occurrences with less than ten slickspot microsite stations, the plot was established adjacent to station number one. Data collected at each plot includes a complete vascular plant species list and associated cover class estimates, and size category (structure) classes. Site specific location, physical features, ground cover, and general description information were also obtained for each plot. Occurrences with fairly homogenous vegetation were adequately sampled using one plot, but two plots were sampled at most sites with distinct burned and unburned sections.

Photo Points

Photo points furnish a long-term visual record of a site. Comparing photographs of the same site taken over a period of years provides visual evidence of changes to landscape features such as the vegetation, and will help with the interpretation of long-term monitoring data. One photo point for each occurrence was established in 1998. The HII transect permanent marker stake also marks the photo point location at each occurrence. Four photographs were taken for each photo point. One photograph is taken in the same direction as the transect azimuth. The others are taken 90^0, 180^0, and 270^0 from the first photo. Photographs for 1998 are on file at the CDC in Boise, with a duplicate set at the Idaho Army National Guard office in Boise. Additional details concerning the photo points methods are in Mancuso and Moseley (1997).

RESULTS

Baseline HII and associated viability rank and plant community data were collected at 37 slickspot peppergrass occurrences in 1998. A total of 45 transects were sampled. Although a single transect was used for most occurrences, at eight occurrences (008, 018, 019, 020, 022, 027, 028, 035) two transects were established. The extra transects were established to provide additional sampling coverage at selected large occurrences, several of which had distinct burned and unburned areas. Refer to Mancuso and Moseley (1997) for a description and explanation of the 14 HII attributes. Copies of our completed 1998 HII field forms are in Appendix 4, with the data tabulated in Appendix 5.

Habitat Integrity Index

Slickspot microsite attributes

There are eight attributes in the HII that focus on the integrity of individual slickspot microsites. The presence of any of these attributes is indicative of possible reduced slickspot integrity. Most transects consisted of ten sample stations, but five transects (012, 038, 040, 059, 065) had a fewer number due to the small size of the occurrence. A total of 408 individual slickspot microsite stations were sampled for the 45 transects. All occurrences had slickspots with one or more characteristics that may adversely effect their long-term integrity. The majority of slickspots sampled along the majority of transects had some level of organic material deposition/accumulation (attribute 1); some loss of slickspot perimeter distinctness (attribute 2); varying amounts of weed invasion (attributes 3 and 4); and disturbance by livestock (attribute 7). In contrast, only one transect had vehicle tracks present at a majority of slickspot stations (attribute 8). Just under half of the transects had a majority of slickspots with shrubs present (attribute 5). However, this number was skewed by the preponderance of sagebrush seedings that germinated during the wet spring of 1998. It is unlikely many of these will actually persist in the slickspots. About one-third of the transects had a majority of stations with rooted perennial forbs or grasses (attribute 6).

Table 2 summarizes the slickspot microsite data in two ways - by individual slickspots (n = 408 slickspot microsite stations), and by transect (n = 45 transects). For each attribute, the number of slickspot stations receiving a “0", “1", or “2" score is listed. These scores reflect the relative abundance of an attribute at the sample station. The number of transects in which 50% or more of the slickspot stations scored a “0", “1", or “2" is also tabulated for each attribute in Table 2. In cases where attribute scores of “1" and “2" combine for more than 50%, then the more common of the two scores along the transect is listed.

The HII’s slickspot microsite attribute protocol has a provision to collect quantitative data for the number of

slickspot peppergrass plants at each microsite station. The number of slickspot peppergrass plants at a sample station were counted or estimated and given an abundance class score. We estimated a total of over 17,800 genets for the 45 HII transects, ranging from 0 to over 3,000 plants along any one transect. There were 19 transects (42%) with plants in at least half of its slickspot stations, including two (4%) with plants in all ten stations. Ten transects (22%) had no slickspot peppergrass plants. Despite a general reconnaissance conducted prior to establishing the HII transect, no slickspot peppergrass plants were found at four occurrences (047, 048, 049, 060). Of the 408 slickspots sampled, 156 (38%) had one or more slickspot peppergrass plants. Slickspot peppergrass abundance class data are summarized in Table 3. Plant counts for individual microsites are recorded on the HII scorecard (see Appendix 4).

Table 2. HII slickspot microsite attribute score summary. 408 slickspot microsites stations were sampled at 45 transects in 1998 (see text for explanation).

	[1]**Attribute scores by slickspot microsite** number of slickspots (%)				**Attribute scores by transect** number of transects (%)		
Slickspot microsite attributes [2]	**0**	**1**	**2**		**0**	**1**	**2**
1. Is organic debris or soil being deposited and accumulating within the slickspot?	141 (35)	186 (45)	81 (20)		9 (20)	25 (56)	11 (24)
2. Are the slickspot boundaries (perimeter) compromised?	173 (42)	154 (38)	81 (20)		14 (31)	24 (53)	7 (16)
3. Are weedy annual species present in the slickspot?	19 (5)	389 (95)	-		2 (4)	43 (96)	-
4. What is the average density of weedy annual species?	211 (52)	165 (40)	32 (8)		21 (47)	22 (49)	2 (4)
5. Are rabbitbrush or other shrub species established within the slickspot?	208 (51)	200 (49)	-		23 (51)	22 (49)	-
6. Are perennial forbs or grasses established within the slickspot?	244 (60)	164 (40)	-		29 (64)	16 (36)	-
7. How much livestock disturbance sign (tracks and/or scat) is present within the slickspot?	146 (36)	157 (38)	105 (26)		17 (38)	19 (42)	9 (20)
8. Are ORV or other vehicle tracks present across the slickspot?	386 (95)	22 (5)	-		44 (98)	1 (2)	-

1. Scores for each attribute. Attribute # 1: 0 = none, 1= <10%, 2 = >10%; Attribute #2: 0 = no, 1= <10%, 2 = >10%; Attribute #3: 0 = none, 1 = one or more; Attribute #4: 0 = <10 plants/sq.ft., 1 = 10 to 50 plants/sq.ft., 2 = >50 plants/sq.ft.; Attribute #5: 0 = no, 1 = yes; Attribute #6: 0 = 3 or fewer plants, 1 = more than 3 plants; Attribute #7: 0 = none, 1 = 1 to 10, 2 = >10; Attribute #8: 0 = no, 1 = yes.

Table 3. Summary of abundance class data for *Lepidium papilliferum*. N = 408 slickspot microsites.

Abundance classes	Number of *Lepidium papilliferum* plants	Number of slickspot microsites (%)
0	0	252 (62)
1	1-9	32 (8)
2	10-100	71 (17)
3	>100	53 (13)

To help quantify livestock disturbance the HII scorecard has a field to record the number of livestock signs at each slickspot microsite station. This is completed in tandem with attribute question #7. The number of individual livestock prints and scats were counted or estimated at each sample station and given an abundance class score. Only sign confidently caused by livestock was counted. We observed mostly cattle sign, with occasional evidence of horses. There were 27 (60%) transects with livestock sign in at least half of the slickspot microsites, including 14 (31%) with evidence at all ten transect stations. Ten transects (22%) had no livestock sign. Of the 408 slickspots we sampled, 262 (64%) had livestock-related disturbance. The HII scorecards have the livestock sign tally for each microsite station (see Appendix 4). Livestock abundance class data are summarized in Table 4.

Table 4. Summary of HII livestock sign abundance class data. N = 408 slickspot microsites

Abundance classes	Number of livestock tracks and scat in slickspot microsite	Number of slickspot microsites (%)
0	0	146 (36)
1	1-10	154 (38)
2	>10	108 (26)

Sagebrush-steppe attributes

The second half of the HII is dedicated to the vegetation characterizing an occurrence. There are six attributes scored in this section. The first (attribute 9) looks at occurrence fire history. The fire history attribute is scored as either unburned, burned, or a mosaic burn pattern. Using each sample station along the transect as the point of reference, four fire-extent scales are scored. However, for analysis purposes attributes 9c (3-50 acres) and 9d (50+ acres) were combined because many occurrences are considerably less than 50 acres in size. At all scales the majority of scores were either for burned or mosaic burn pattern. The number of burned and/or mosaic burn scores increased as the zone of reference increased from 0.1 acre, to 0.1 - 3 acres, to 3-50+ acres. Of the 37 occurrences we sampled, only 11(30%) were not burned. Seven (19%) were completely burned, while the other 19 (51%) had a mosaic burn pattern. In most occurrences with a mosaic burn, a large majority of the area was burned. Figure 2 summarizes the fire history results and is based on attribute scores from 408 microsites. Occurrence fire history information is incorporated into Table 8 (pg. 17).

The other five attributes focus on livestock use, off-road-vehicle use, and vegetation characteristics. The majority (71%) of occurrences were grazed by livestock (attribute 10), but only a relatively few (13%) showed recent use to be heavy. Evidence used to judge the degree of near-term livestock grazing included forage consumption, prints and scats, broken shrubs, and bunchgrass pedestaling. Invasive annual grasses (attribute 12) dominated or co-dominated the herbaceous vegetation at most occurrences (82%). This can be the case at either burned or unburned sites. Weedy forbs (attribute 13) were patchy to abundant at relatively fewer locations (53%). They tended to be abundant only in burned areas. We observed signs of past or current off-road-vehicle use (attribute 11) at 34% of the occurrences. However, only nine occurrences (20%) had evidence of off-road-vehicle use at a majority of transect stations (this includes tank tracks at the Orchard Training Area). In all cases, use was rated to be light to moderate. Finally, we estimated microbiotic crust coverage (attribute 14) to average 10% or less at nearly two-thirds (63%) of occurrences. High quality sagebrush-steppe in southwestern Idaho is expected to have substantially higher microbiotic cover (Kaltenecker 1994). Table 5 summarizes scores for sagebrush-steppe attributes 10-14. Again, the data are summarized in two ways - by individual slickspots (n = 408 slickspot microsite stations), and by transect (n = 45 transects). The number of slickspot stations receiving scores of "0", "1", "2", or "3" are tabulated for each attribute. For each transect, the number of microsites receiving these scores at 50% or more of the slickspot stations is also tabulated by attribute. In cases where scores of "1" and "2" (or "1" and "3" for attribute 12) combine for more than 50%, then the more common of the two scores is listed.

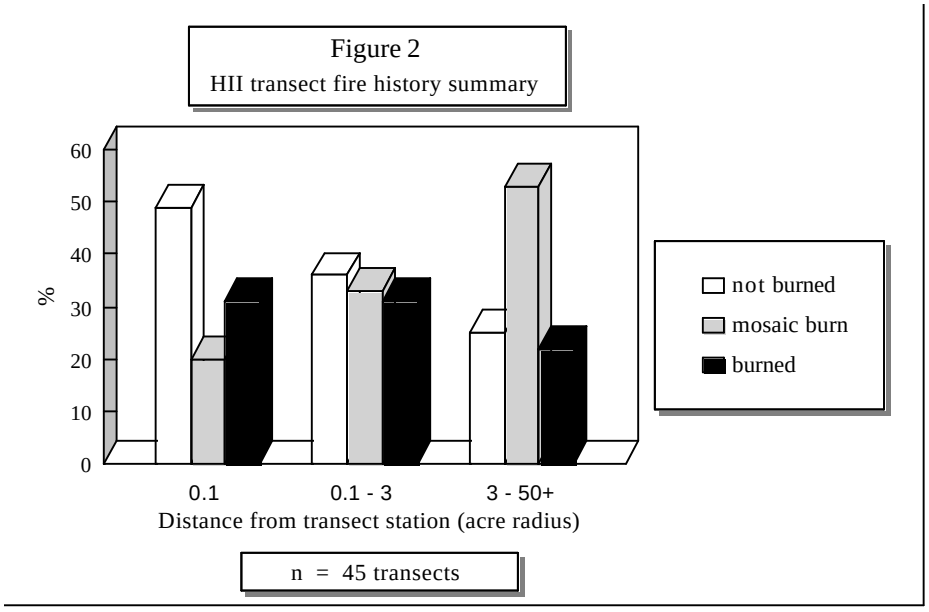


Table 5. HII sagebrush-steppe attribute score summary. 408 slickspot microsites stations were sampled at 45 transects in 1998. Fire history (attribute 9) is not included in this summary (see text for explanation).

	[1]**Attribute scores by slickspot microsite** number of slickspots (%)				**Attribute scores by transect** number of transects (%)		
Sagebrush-steppe attributes	**0**	**1**	**2/3**		**0**	**1**	**2/3**
10. Do livestock use the general occurrence area?	86 (21)	271 (66)	51 (13)		13 (29)	28 (62)	4 (9)
11. Do ORV's or other vehicles go off-road in cross-country fashion?	314 (77)	94 (23)	0 (0)		36 (80)	9 (20)	0 (0)
12. The grass layer associated with the sagebrush habitat is?	87 (21)	95 (23)	226 (56)		8 (18)	13 (29)	24 (54)
13. Are weedy annual or seeded forbs present?	229 (56)	121 (30)	58 (14)		23 (51)	14 (31)	8 (18)
14. How much microbiotic crust is there?	196 (48)	133 (33)	79 (19)		19 (42)	16 (36)	10 (22)

1. Scores for each attribute. Attribute #10: 0 = no evidence, 1 = light to moderate use, 2 = heavy use; Attribute #11: 0 = no, or rare, 1 = light to moderate use, 2 = heavy use; Attribute #12: 0 = clearly dominated by native bunchgrasses, 1 = both bunchgrasses and exotic annual grasses common, 3 = clearly dominated by exotic annual or seeded grasses, native bunchgrasses reduced to remnant status or largely extirpated; Attribute #13: 0 = sparse or absent, 1 = patchy, 2 = widespread and abundant; Attribute #14: 0 = high/moderate (>10%), 1 = low (1-10%), 2 = trace or absent (<1%).

Habitat conditions

During the development and testing of the HII, we tentatively determined the range of possible scores for rating sagebrush-steppe, slickspot microsites, and the occurrence's habitat as a whole, into three broad categories - good, fair, and poor. Data from 1998 were used to fine-tune the rating system (Table 6). These general categories help put the scores into a habitat condition context. A "good" rating requires relatively intact sagebrush and slickspot microsite habitat for all or most of the occurrence. A "fair" rating requires at least a portion of the occurrence habitat to be intact, while a "poor" rating will be the case if large segments of habitat have been destroyed or seriously impacted.

Using this rating system, no occurrences had scores rated "good" in both attribute groups. A large majority of the 37 occurrences we sampled had slickspot microsite attributes rated as "fair" (30). For sagebrush-steppe attributes, there were more occurrences rated in the "poor" (18) category than either "fair" (12), or "good" (7). Only seven occurrences (19%) had combined average scores rated in the "good" category. These were the same seven occurrences with the sagebrush-steppe attributes also scoring "good". The seven "good" occurrences all had slickspot microsite attributes in the "fair" category. All 15 occurrences (41%) with a combined average score in the "poor" category also had the sagebrush-steppe attributes rated "poor", but

only one of the slickspot microsite attributes were also scored “poor”. Fifteen occurrences (41%) had a combined average score in the “fair” category. Most of these were rated “fair” for both slickspot microsite and sagebrush-steppe attributes. The extra weight given the HII’s sagebrush-steppe attributes versus the slickspot microsite attributes is reflected in these results. Average scores for the slickspot microsite and sagebrush-steppe sets of attributes, along with the associated combined average HII scores are listed for each occurrence in Table 7. This table also includes the integrity condition rating for each occurrence. Figure 3 displays the integrity condition ratings based on the 1998 data set.

Table 6. Integrity condition ratings for HII scores. The way the HII is designed, the lower the score the higher the integrity rating.

Rating	Sagebrush-steppe attributes average score	Slickspot microsite attributes average score	Combined average score
Good	0 - 4	0 - 3	0-8
Fair	5 - 11	4 - 7	9-17
Poor	12 - 22	8 - 14	18-37

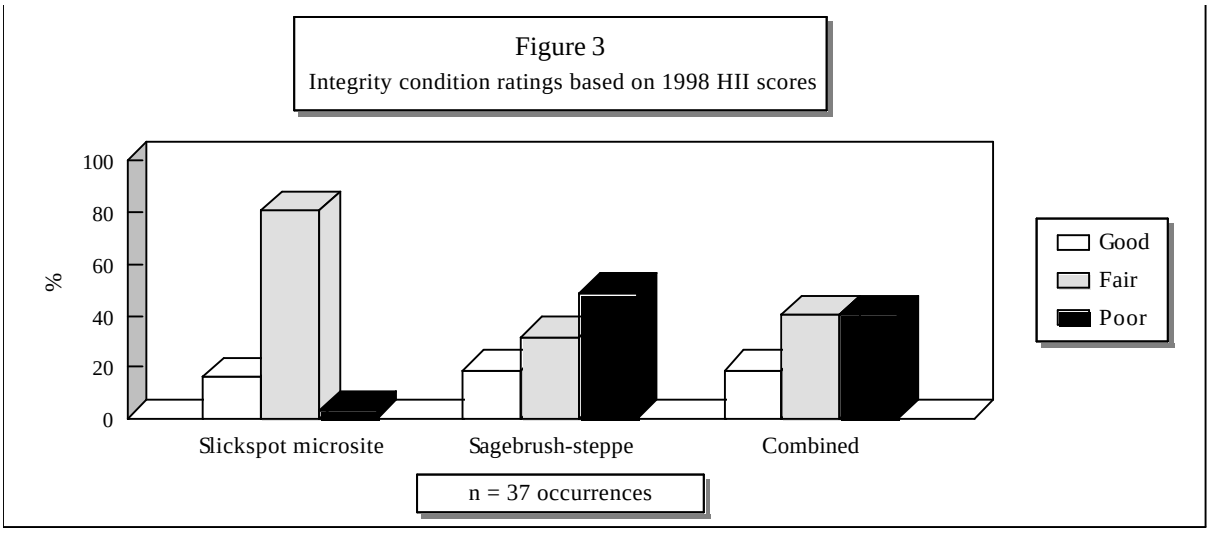
Table 7. HII scores and associated integrity condition ratings.

EO #	**Slickspot microsite attributes avg. score**	**Sagebrush-steppe attributes avg. score**	**HII combined avg. score**	**Integrity condition rating**
New Plymouth/Emmett/Canyon Co. area				
066	4.5	9.6	14.1	Fair
Kuna/Boise area				
018*	3.0	14.1	17.0	Fair
019*	5.5	19	24.5	Poor
022*	4.4	13.1	17.5	Poor
024	4.1	16.6	20.7	Poor
025	8.0	14.7	22.7	Poor
032	5.4	2.5	7.9	Good
048	4.5	3.0	7.5	Good
049	5.8	13.0	18.8	Poor
057	5.1	4.9	10.0	Fair

EO #	Slickspot microsite attributes avg. score	Sagebrush-steppe attributes avg. score	HII combined avg. score	Integrity condition rating
Boise/Eagle Foothills area				
012	5.0	19.0	24.0	Poor
038	2.0	16.0	18.0	Poor
040	4.7	3.0	7.7	Good
047	5.2	20.0	25.2	Poor
052	3.4	14.0	17.4	Poor
056	5.7	14.8	20.5	Poor
065	3.0	8.0	11.0	Fair
Orchard area				
015	4.6	20.0	24.6	Poor
020*	6.1	12	18.1	Poor
027*	6.5	5.7	12.2	Fair
028*	5.0	1.7	6.7	Good
030	4.6	2.1	6.7	Good
031	5.4	7.9	13.3	Fair
035*	4.4	9.3	13.8	Fair
041	4.8	17.0	21.8	Poor
053	6.5	9.0	15.5	Fair
060	6.7	7.5	14.2	Fair
Mountain Home/Glenns Ferry area				
008*	4.6	13.6	18.3	Fair
010	6.3	14.7	21.0	Poor
021	5.6	2.0	7.6	Good
029	3.7	10.1	13.8	Fair
050	2.5	8.8	11.3	Fair
058	4.2	1.6	5.8	Good

EO #	Slickspot microsite attributes avg. score	Sagebrush-steppe attributes avg. score	HII combined avg. score	Integrity condition rating
061	5.7	11.5	17.2	Fair
Inside Desert area				
051	3.3	6.3	9.6	Fair
059	6.5	18.7	25.2	Poor
063	4.6	6.0	10.6	Fair

* Indicates occurrences with two transects. The HII scores for these occurrences are based on an average of both transects.



Occurrence Viability Rank

For the 37 occurrences we visited, seven (19%) received an "A" Occurrence Viability rank, six (16%) a "B" rank, 15 (41%) a "C" rank, and nine (24%) a "D" rank. A summary of the "high", "fair", "marginal", and "poor" ratings for the viability, defensibility, and habitat integrity criteria are graphed in Figure 4. Details explaining why an occurrence received a particular Occurrence Viability ranks are described on our field forms (Appendix 6). The 1998 Occurrence Viability ranks are listed in Table 8. Element Occurrence (EO) ranks for all known occurrences are also listed, including updates for those visited in 1998.

The Occurrence Viability rank is related to the Element Occurrence rank used by the Natural Heritage Program/Conservation Data Center network. EO ranks were assigned to all known slickspot peppergrass occurrences in 1994 as part of a rangewide status survey prepared for the U.S. Fish and Wildlife Service

(Moseley 1994). In 1998, EO ranks were re-evaluated for the 37 occurrences we visited. The number of slickspot peppergrass plants is a critical factor in determining the EO rank, but is not considered when assigning the Occurrence Viability rank. This is the main reason why the two rankings do not always match. Population number is not one of the variables for the Occurrence Viability rank primarily because slickspot peppergrass populations are subject to wide annual fluctuations. Both ranking systems have an "A" (the highest) to "D" (the lowest) range.

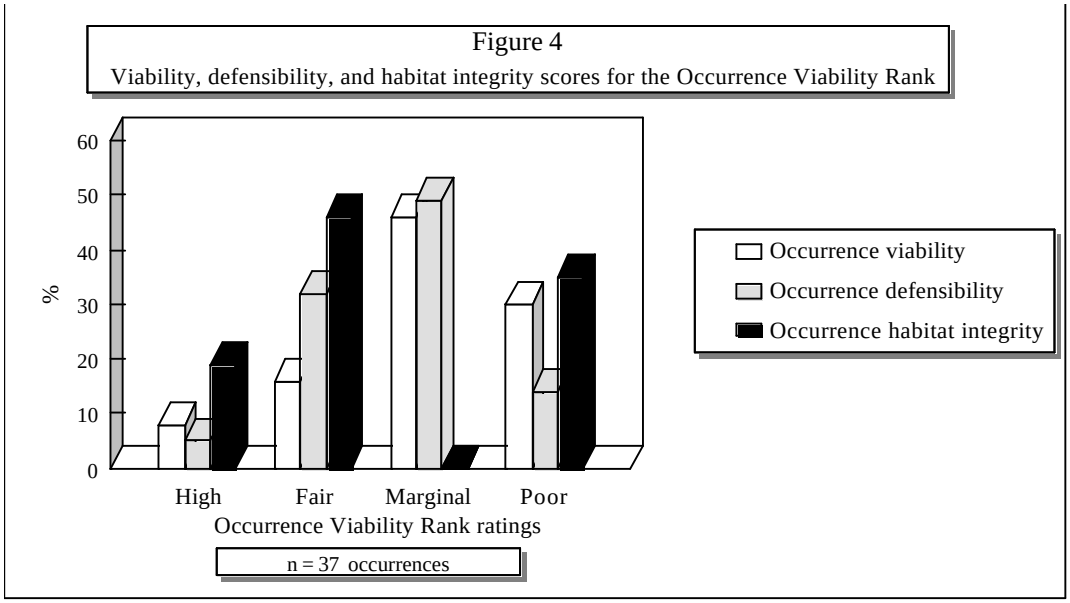


Table 8. *Lepidium papilliferum* Occurrence Viability and Element Occurrence ranks.

[1]EO #	Name	Occurrence Viability Rank	[2]EO Rank 1998	[3]EO Rank 1994
New Plymouth/Emmett/Canyon Co. area				
004	Nampa	-	-	X
006	Emmett	-	-	H
007	5 miles west of Emmett	-	-	X
009	Parma	-	-	X
011	New Plymouth	-	-	X
013	Sand Hollow	-	-	H
017	Caldwell	-	-	X

EO #	Name	Occurrence Viability Rank	EO Rank 1998	EO Rank 1994
055	Faulk Cemetery SE	-	-	X
066	New Plymouth SW	C	C	C (1997)
Kuna/Boise area				
003	Barber	-	-	X
005	Kuna	-	-	H
018	Kuna Butte SW	B	B	B
019	Initial Point	D	D	A
022	Pleasant Valley North	C	C	B
024	Kuna Butte	C	C	A
025	Melba Butte	D	D	D
032	Tenmile Creek	A	A	A
048	South Cole Road/Tenmile Creek	A	B	BC
049	Fivemile Creek	D	D	B
057	Kuna Butte NW	B	B	C
Boise/Eagle Foothills area				
012	Military Reserve Park	D	D	D
023	Lower Hulls Gulch	-	-	D
033	Spring Valley Ranch	-	-	H
036	Hackberry Divide	-	-	D
037	Horse	-	-	C
038	Goose Creek	C	D	D
039	Woods Gulch	-	-	D
040	Woods Gulch	C	C	B
043	Lower Hulls Gulch South	-	-	D
047	Willow Creek	D	D	D
052	Woods Gulch	C	B	B
056	Willow Creek	D	D	B
065	Lower Seaman Gulch	B	C	(1998)

EO #	Name	Occurrence Viability Rank	EO Rank 1998	EO Rank 1994
Orchard area				
014	Pioneer power plant site	-	-	X
015	Simco Road	D	D	A
020	Soles Rest Creek	C	C	C
027	West of Orchard	A	A	A
028	Christmas Mountain N	A	A	C
030	Soles Rest Creek	A	A	B
031	Bowns Creek	B	B	C
035	Orchard Southwest	B	B	D
041	Orchard SSW	C	C	C
053	Christmas Mountain	B	D	D
054	Pan Alberta Pipeline	-	-	X
060	West of Squaw Creek	C	D	D (late 1994)
Mountain Home/Glenns Ferry area				
001	Mountain Home	-	-	X
008	Bennett Road	C	C	A
010	Chalk Flat	D	D	C
021	Fraser Reservoir East	A	A	B
029	Mountain Home SE	C	C	B
034	Glenns Ferry	-	-	X
044	Ada County-Elmore County Line	-	-	X
045	10 miles south of Mt. Home	-	-	X
046	Rattlesnake Creek	-	-	H
050	West Side Canal/Slade Flat West	C	C	C
058	Glenns Ferry NW	A	B	D
061	SE of Reverse	C	C	D (1995)
Inside Desert area				
042	Mosquito Lake Reservoir	-	-	C (1995)

EO #	Name	Occurrence Viability Rank	EO Rank 1998	EO Rank 1994
051	Post Office Reservoir	C	C	B
059	Poison Creek North	D	D	B
062	Juniper Butte	-	-	C (1996)
063	Flat Draw Reservoir W	C	C	B (1996)
064	Juniper Butte N	-	B	C (1996)

1. Note: EO #002 (Mink Creek), located south of Pocatello has an EO rank = H
2. EO Ranks: A-D = extant; H = Historical; X = Extirpated
3. Several occurrences were not discovered and subsequently ranked until after 1994.

Vegetation sampling

The two main disturbances throughout the range of slickspot peppergrass are livestock grazing and fire. In the western Snake River Plain, these two types of disturbance may selectively affect the sagebrush and herbaceous life-form layers in different ways (Hall et al. 1995). In areas open to livestock grazing, but not recently burned, the result is usually vegetation with an intact sagebrush layer, but displacement of most or all late seral bunchgrass species by either mid-seral bunchgrass species such as Sandberg's bluegrass (*Poa secunda*) or invasive grasses, especially cheatgrass (*Bromus tectorum*). In areas of recent wildfire, the sagebrush layer is eliminated while the understory tends to be dominated by cheatgrass and invasive weedy forbs. One result of the western Snake River Plain's disturbance history is that pristine slickspot peppergrass habitat is a thing of the past. Instead, the regional sagebrush-steppe is a mosaic of seral conditions.

The main habitat types supporting slickspot peppergrass populations belong to the *Artemisia tridentata* var. *wyomingensis* and *Artemisia tridentata* var. *tridentata* series of Hironaka et al. (1983). One way to assess baseline vegetation condition at slickspot peppergrass occurrences is to look at the site's current (1998) seral status. Plant community plot data was collected for each occurrence (Appendix 7) and used to interpret seral status for both shrub and herbaceous layers using the definitions of Hall et al. (1995). There were no occurrences with vegetation characteristic of the site's Potential Natural Community (PNC). We sampled 11 seral community types at the 37 occurrences that are part of the HII project. Five of these types were sampled at only a single occurrence. Seven of the community types have a sagebrush component, and four do not. Table 9 lists the habitat type, present plant community type, baseline seral status, and fire history for the occurrences included in this study. Along with baseline seral status information, Table 9 also list the seral status category for each occurrence. The four seral status categories are explained below.

From an ecological perspective, it's possible to group the plant community data we collected into four main seral status categories. A seral status descriptor for the shrub and herbaceous layers is included for each category. The four categories are identified as Potential Natural Community (PNC)/mid-seral; late seral/mid-early seral; mid-seral/early seral; and early seral/early seral. The PNC/mid-seral sites are characterized by a PNC or late seral sagebrush layer, and a mid-seral herbaceous component. The herbaceous layer is dominated by native bunchgrasses such as Sandberg's bluegrass and squirreltail (*Sitanion hystrix*), with only trace amounts of invasive annual grass or forb cover. Late seral grasses such as bluebunch wheatgrass (*Agropyron*

spicatum) and Thurber's needlegrass (*Stipa thuberiana*) may be present, but only with low cover. Sites in the late seral/mid-early category have mostly either a PNC or late-seral sagebrush layer, but about equal cover of invasive annual grasses compared to mid-seral native bunchgrasses. The mid-seral/early seral category has the most variability regarding actual seral status conditions. Most sites in this category have sagebrush ranging from PNC to mid-seral condition, and an early seral herbaceous layer. Cheatgrass is typically the dominant grass species and weedy forb cover may also be high. Sites with an early seral sagebrush layer and mid-seral herbaceous layer also fall into this category. The early seral/early seral category is reserved for sites with sagebrush and herbaceous layers both in an early seral condition. There is little if any sagebrush left, low bunchgrass cover, very high cheatgrass cover, and usually high weedy forb cover. It is noteworthy that not even the best slickspot peppergrass site represents excellent ecological conditions.

Using these four seral status categories to assess occurrence baseline vegetation conditions - most (41%) of the 37 occurrences sampled fall into the early seral/early seral category, followed by the mid-seral/early seral (24%), late seral/mid-early seral (22%), and PNC/mid-seral (14%) categories. The average cover, and the number of species in each of five species groups (shrubs, native grasses, native forbs, exotic grasses, and exotic forbs) are shown for the four seral status categories in Figures 5 and 6, respectively. A summary of the vegetation plot data by species group is presented in Appendix 8.

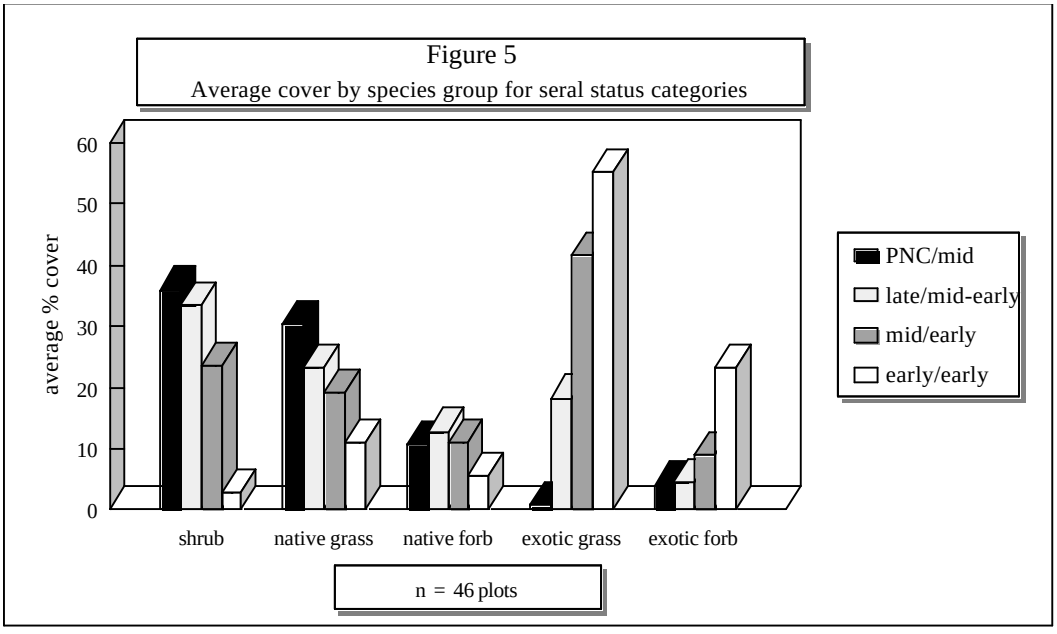
Table 9. [1]Vegetation, seral status and fire history summary for *Lepidium papilliferum* occurrences.

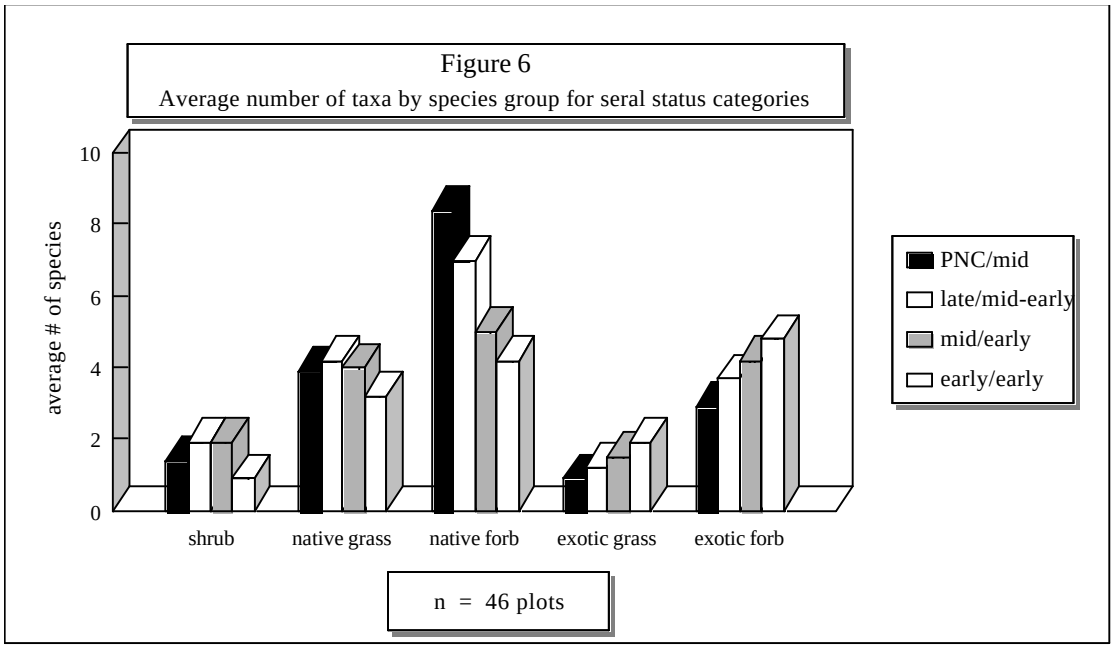
EO#	Habitat type	Plant community type	Seral status (shrub layer/ herb layer)	[2]Seral status category	Fire history
New Plymouth/Canyon Co. area					
066	Artrtr/Stco?	Artrtr/Agcr	mid/early	3	Mosaic burn; surrounded by burns
Kuna/Boise area					
018	Artrwy/Stth	annual grassland; Artrwy/Brte	early/early	4	Mosaic, but mostly burned
019	Artrwy/Stth	Agcr seeding; annual grassland	early/early	4	Burned; post-fire rehab. has destroyed many slickspots
022	Artrwy/Agsp?	annual grassland; Artrwy/Brte	early/early	4	Mosaic, mostly burned; remainder very vulnerable to fire
024	Artrwy/Stth	annual grassland (with native seed.)	early/early	4	Mosaic, mostly burned; fire rehab. impacted many slickspots
025	Artrwy/Agsp	annual grassland; Artrwy/Brte	early/early	4	Mostly burned; unburned patches very vulnerable to fire
032	Artrwy/Stth	Artrwy/Pose-Brte	PNC/mid	2	Unburned
048	Artrwy/Stth?	Artrwy/Pose-Brte	PNC/mid	2	Unburned
049	Artrtr/Agsp?	Artrtr/Brte	mid/early	3	Mosaic; vulnerable to more fire
057	Artrwy/Stth	Artrwy/Pose-Brte	PNC/mid	2	Unburned; surrounded by burns

EO#	Habitat type	Plant community type	[2]Seral status (shrub layer/ herb layer)	[3]Seral status category	Fire history
Boise/Eagle Foothills area					
012	Artrwy/Agsp?	annual grassland	early/early	4	Burned
038	Artrwy/Agsp?	Artrwy/Sihy	early/mid	3	Mosaic, but mostly burned
040	Artrwy/Agsp?	Artrwy/Brte	mid/mid	3	Unburned
047	Artrwy/Agsp?	annual grassland	early/early	4	Burned
052	Artrwy/Agsp?	Chna/Arlo	early/mid	3	Mosaic, but mostly burned
056	Artrwy/Agsp?	annual grassland	early/early	4	Mosaic burn
065	Artrtr/Agsp	Artrtr/Sihy	late/mid	2	Unburned; light burn in recent past
Orchard area					
015	Artrwy/Stth	annual grassland	early/early	4	Burned completely in 1996
020	Artrwy/Stth?	Artrwy/Pose-Brte; annual grassland	PNC/mid	2	Unburned north of Old Highway 30; burned south of road
027	Artrwy/Stth	Artrwy/Pose; Artrwy/Brte	PNC/mid	1	Unburned
028	Artrwy/Stth	Artrwy/Pose	PNC/mid	1	Unburned
030	Artrwy/Stth?	Artrwy/Pose	late/mid	1	Unburned; nearby areas burned
031	Artrwy/Stth	Artrwy/Pose-Brte	late/mid	2	Unburned; nearby areas burned
035	Artrwy/Stth	Artrwy/Pose; Artrwy/Pose-Brte	PNC/mid	2	Mostly unburned; some burned patches
041	Artrwy/Stth	Chvi/Brte	early/early	4	Burned
053	Artrwy/Stth	Artrwy/Pose	mid/mid	2	Mosaic burn
060.	Artrwy/Stth?	Artrwy/Pose-Brte	mid/mid	3	Mosaic; very vulnerable to fire
Mt. Home/Glenns Ferry area					
008	Artrwy/Agsp?	Agcr (seeded); Artrwy/Pose	early/early	4	Unburned east of Bennett Rd; but west of road has burned
010	Artrtr/Stco	Artrtr/Brte	mid/early	3	Mosaic burn
021	Artrwy/Agsp?	Artrwy/Pose	PNC/mid	1	Unburned
029	Artrwy/Agsp?	Artrwy/Pose-Brte	PNC/early	3	Strip of unburned sagebrush
050	Artrwy/Agsp?	Artrwy/Brte	late/early	3	Mosaic, but mostly unburned

EO#	Habitat type	Plant community type	Seral status (shrub layer/ herb layer)	Seral status category	Fire history
058	Artrwy/Agsp?	Artrwy/Pose-Brte	PNC/mid	2	Unburned
061	Artrwy/Stth?	Agcr (seeded); Artrwy/Pose-Brte	early/early	4	Mostly burned mosaic; remnant sagebrush very vulnerable to fire
Inside Desert area					
051	Artrwy/Agsp	Agcr (seeded); Artrwy/Pose	early/early	4	Burned and unburned sections; rehab. destroyed many slickspots
059	Artrwy/Agsp	Agcr (with native seeding)	early/early	4	Burned (1996); rehab. has destroyed most if not all slickspots
063	Artrwy/Agsp	Agcr (with native seed.); Artr/Pose	early/early	4	Burned (1996) except for one area near Three Creek Well

1. Species codes: Artrwy = *Artemisia tridentata wyomingensis*; Artrtr = *Artemisia tridentata tridentata*; Chna = *Chrysothamnus nauseosus*; Chvi = *Chrysothamnus viscidiflorus*; Agcr = *Agropyron cristatum*; Arlo = *Aristida longiseta*; Brte = *Bromus tectorum*; Pose = *Poa secunda*; Sihy = *Sitanion hystrix*; Stco = *Stipa comata*; Stth = *Stipa thurberiana*; Annual grassland = community dominated by one or more invasive annual grass species, mostly *Bromus tectorum*.
2. Represents the predominant seral status condition of the occurrence. Many occurrences have inclusions of other seral states.
3. The four seral status categories are: 1 = PNC/mid-seral; 2 = late seral/mid-early seral; 3 = mid-seral/early seral; 4 = early seral/early seral.





DISCUSSION

Integrity implies an unimpaired, intact condition or quality. Ecological integrity implies an adaptive assemblage of organisms with their composition, richness, and functional organization comparable to the "natural" conditions in a region (Karr 1993). The first biological index to receive widespread acceptance for natural resource monitoring was developed to assess and monitor biological conditions in rivers in the Midwestern United States (Karr 1981). This index of biological integrity (IBI) and similar indices are based on a series of assumptions about how species assemblages change with increased environmental degradation, and are now a monitoring tool used all over the world (Karr 1990). Although primarily used for aquatic habitats, application to a sagebrush ecosystem has recently been undertaken in Washington state (Kimberling et al. 1997). An occurrence's HII score is a single numeric value, but one that reflects the values of individual indicators of disturbance and ecological condition. Each metric was chosen because it represents a specific disturbance or ecological/biological element that changes as human-related impacts increase. In this way, the HII is related to the IBI concept (Karr and Chu 1997).

The HII equates habitat quality with habitat integrity. It is based on the premise that sagebrush-steppe at PNC, or in late seral condition, represents the highest integrity and best habitat for slickspot peppergrass. Deviation to progressively earlier seral conditions represent a continuum of decreased habitat integrity and suitability for the long-term persistence of slickspot peppergrass. Certain changes to slickspot microsites and sagebrush-bunchgrass community characteristics, such as annual weed invasion, are indicative of ecological degradation and associated losses in habitat integrity. These changes, or complex of changes occupy a continuum from PNC to early seral conditions, and are generally related to the disturbance history of a site. The HII provides a relative scale to position the habitat integrity of a particular slickspot peppergrass occurrence along the continuum for monitoring and assessment purposes.

A basic assumption concerning the conservation of slickspot peppergrass is that ecologically intact sagebrush-steppe habitat is necessary for the species long-term viability. However, habitat loss, degradation, and fragmentation has, and continues to occur throughout the species' range. The ecological demise of the regional shrub-steppe habitat required by slickspot peppergrass is further substantiated by the data collected for the HII project.

The HII purposely focus on three types of disturbance that are widespread, interrelated, and of management concern in southwestern Idaho - wildfire, livestock grazing, and off-road motorized vehicle use. The rationale for choosing attributes used in the HII is the direct and indirect links between the effects of these disturbances and the integrity of slickspot peppergrass habitat. Just as importantly, these disturbances have largely anthropogenic roots. This implies they can be addressed by management decisions and actions. The HII was limited to occurrences at least partially located on public land. The majority of occurrences located on private land have either been extirpated, or are known only from the historical record. The few remaining extant occurrences on private land are small and isolated. The loss of populations on private land is a large factor in the decline of slickspot peppergrass. Because of this, slickspot peppergrass conservation depends on its conservation on public lands.

Our results indicate all slickspot peppergrass occurrences are disturbed to one degree or another. Livestock grazing continues to be a pervasive disturbance throughout the range of slickspot peppergrass, although overall, this use is considerably less compared to historical levels. Still, there is heavy seasonal livestock use in some areas, especially occurrences southeast of Boise. The most common direct disturbance we observed was livestock trampling in and around the margins of slickspot microsites. Trampling and tracking seem to be especially damaging in the spring when the sites are wet. Long-term quantitative data regarding the effects of livestock grazing on slickspot peppergrass viability or microsite integrity are lacking, however.

Wildfires have converted extensive portions of shrub-steppe habitat in southwestern Idaho to a new state dominated by annual grasslands (Knick and Rotenberry 1997). Areas converted to annual grasslands are subject to increased fire intensity and a significant shortening of the fire frequency cycle (Whisenant 1990). This is devastating to the recovery of the shrub-steppe vegetation. The long-term effects of this altered fire ecology on slickspot microsite integrity, and by association, on slickspot peppergrass, are less clear. Although slickspots can retain their identity following wildfire, at least for a period of time, it remains a big question how long they can maintain a threshold of integrity sufficient for slickspot peppergrass. The HII monitoring program may provide some insights for this question. There are several occurrences where slickspot peppergrass persists in areas that burned more than ten years ago (e.g. 008). There are also relatively recently burned areas where this species has apparently been extirpated (e.g., parts of 020, 054).

Wildfire is an escalating threat to unburned slickspot peppergrass occurrences. The cumulative acreage and distribution of burned land is increasing, and the distance between burned and unburned areas is decreasing annually. Only 30% of the occurrences we sampled were unburned. Most occurrences that are burned have done so in the past ten years, including at least seven (015, 018, 019, 024, 051, 059, 063) since 1994.

Another aspect of wildfire is post-fire rehabilitation/restoration. Mechanical disturbances (e.g., tilling) associated with reseeding efforts have destroyed slickspot microsites at a few occurrences (e.g., 019, 059). In a few places we also observed seeded species establishing in slickspots where the post-fire prescription did not include ground disturbing activities (e.g., 062, 063). We interpret this to be a loss of microsite integrity.

Off-road-vehicle use was absent or light at most occurrences and impacts tended to be local. Compared to

livestock grazing and wildfire it is much less of direct factor affecting slickspot and sagebrush-steppe integrity. Only one transect had vehicle tracks at a majority of slickspot stations. This was at an occurrence (028) within the Orchard Training Area (OTA), and was associated with old tank tracks. Areas known to support slickspot peppergrass are now off-limits to tank-training exercises within the OTA.

There are 63 occurrences for slickspot peppergrass in the CDC data base (Conservation Dater Center 1998). Of these, 13 (21%) are considered extirpated and five (8%) are considered historical. The historical category is comprised of old collections that have not been relocated due to vague or insufficient location information. It is uncertain if they are extant. An account of location, habitat, population, ownership, and threat information is contained in the CDC's Element Occurrence Record for each occurrence. Copies of the records for occurrences we visited in 1998 are in Appendix 9.

Element Occurrence ranks for all known slickspot peppergrass occurrences are presented in Table 8 (see pg. 15). Because ranks were updated for occurrences visited in 1998 as part of the HII project, we can compare these pre-1998 (mostly 1994) EO ranks against the updated 1998 ranks. The EO rank did not changed at 14 (39%) of the 36 occurrences which have both pre-1998, and updated 1998 ranks. At another 14 occurrences (39%), EO ranks went down, including two (015, 019) that changed from an "A" to "D" rank, and three (049, 056, 059) that changed from a "B" to "D" rank. Each of these five occurrences has burned or been seriously degraded since 1994. EO rank went up at eight occurrences (22%), including two (035, 058) that were updated from a "D" to "B" rank, and one (028) from a "C" to "A" rank. These updates are related to better information about the occurrence and not improved habitat conditions.

To summarize occurrence viability and conservation planning concerns in a geographic context, we divided the range of slickspot peppergrass into six population centers (see Figure 1, pg. 2). The New Plymouth/ Emmett/Canyon County area comprises the westernmost population center. This is an area containing no public land outside of a block of BLM land extending from south of the Emmett Valley, west nearly to Highway 95. The majority of this BLM land has low rolling hills that has burned to one degree or another. Intact sagebrush patches are small and fragmented. Both burned and unburned segments tend to be very weedy. Most of the private land in this area is either under cultivation or subject to urban/commercial development, especially in Canyon County. High quality shrub-steppe habitat is gone from this portion of slickspot peppergrass' range. Only one of the nine occurrences located within this area is known to be extant. Six are considered extirpated, and two are historical records. The single extant occurrence (066) received a "C" Occurrence Viability rank. Habitat degradation related to wildfire and weed invasion are the main threats at this occurrence.

The Kuna/Boise area encompasses a series of populations extending southwest from Boise to near the town of Melba. It is almost all private land until south of Kuna where large blocks of BLM land occur. Slickspot peppergrass occurrences north of Kuna are found on undeveloped, isolated tracts of BLM or State land, mostly surrounded by cropland or pasture. The area supports nine extant occurrences. All are included in the HII project. There are also one extirpated and one historical records from the area. In addition, mechanical post-fire rehabilitation has destroyed all the slickspots in portions of the Initial Point occurrence (019). Parts of this once extensive occurrence must now be considered extirpated. Occurrence Viability ranks are mostly "C" or "D". Two occurrences received an "A" rank, but ironically at one of them (048), no slickspot peppergrass plants were observed in 1998. Miles of former sagebrush-steppe vegetation has been lost to the asphalt of Boise, and ongoing development threatens several extant occurrences. Recent wildfires have been particularly devastating to slickspot peppergrass occurrences in this area. All unburned occurrences in the Kuna/Boise area are very vulnerable to future wildfires. Livestock use is heavy in the Fivemile Creek area

(049), but lighter at the other occurrences. Off-road-vehicle use was noted at several occurrences, but appears to be light in areas with slickspot peppergrass.

The Boise/Eagle foothills population center is located north of the Boise River, extending from Boise to the low rolling hills southeast of Emmett. Slickspots tend to be perched on slopes, and overall, are less common compared to the nearby plains. Occurrences are nearly all small in extent and number of plants, with several consisting of only one, or a handful of slickspot microsites. Private land dominates the area, although there are several State and Ada County parcels close to Boise, as well as some BLM land north of Eagle. The 13 occurrences known from this area are found on both private and public lands. Twelve of these are believed to be extant and one is a historical record. Seven occurrences from this area are part of the HII project. It seems a little premature to declare the Willow Creek occurrence (047) extirpated. This area burned completely a few years ago and is now a sea of weeds. Slickspot microsites are still distinguishable, but we found no plants in 1998, despite a thorough search. With one exception, the Occurrence Viability ranks are either “C” or “D”. Current livestock use is absent or minimal except at the Willow Creek occurrences. Urban development threatens several occurrences on private land in the Boise foothills. Recreational use is another potential threat at a few occurrences.

Southeast of Boise is the Orchard population center consisting of 12 occurrences. Ten are extant, while two are considered extirpated. In addition, a portion of the Soles Rest Creek occurrence (020) has been extirpated. The Orchard area contains a large block of public (BLM and some State) land west and south of Orchard, including a portion of the Birds of Prey National Conservation Area. The area also includes the OTA, used by the Idaho Army National Guard for military training. Further east, land ownership is a mix of private and public. This area has three occurrences with “A” and three with “B” Occurrence Viability ranks, the most of any of the six population centers. Two of the “A” and two of the “B” occurrences are located within the OTA. The OTA contains the largest patches of sagebrush vegetation remaining in the Birds of Prey Area, but wildfire is an ever-present threat. Areas with an early seral understory are the most vulnerable, and make nearby higher quality sites more vulnerable. The other main threat to habitat integrity is livestock grazing. Slickspot microsites at all occurrences are impacted by livestock trampling, in many cases severely. An exception is at the Orchard SSW occurrence (041) where exclosures protect the slickspots. Development of private land close to some occurrences east of Orchard could cause further habitat fragmentation.

The Mountain Home/Glenns Ferry area represents the eastern edge of slickspot peppergrass range north of the Snake River. Southeast of Mountain Home, to Glenns Ferry, is predominately public (mostly BLM) land, although substantial blocks of private land also occur. West of Mountain Home is more of a mix of public and private land ownership. Twelve occurrences are known from the area. Four are considered extirpated and one a historical record. The seven extant occurrences are included in the HII project. Four of these received an Occurrence Viability rank of “C”. There was only one “A” and one “B” rank for this area. The main land use in this area is livestock grazing. Most slickspot microsites are impacted by livestock trampling to some degree. The area supports some large unburned patches of vegetation, but wildfire has also destroyed extensive sections of sagebrush habitat. A few occurrences are isolated by large adjoining tracts of unsuitable habitat.

The Inside Desert population center is located on the Owyhee Plateau nearly 50 miles south, and 2,000 feet higher than Glenns Ferry. Three of the six occurrences in this area were included in the HII project and received Occurrence Viability ranks of either “C” or “D”. Recent wildfires have destroyed miles of sagebrush-steppe in the general region, and the majority of all six occurrences have burned. Rehabilitation efforts at the Poison Creek North occurrence (059) have obliterated all, or nearly all slickspots. A few

scattered slickspot peppergrass plants were observed in 1998, but the outlook for this occurrence appears bleak. The same can be said for the majority of the Post Office Reservoir occurrence (051). Post-fire seedings have contributed to the destruction of slickspot microsites. Livestock grazing is presently the main land use in this remote area. Livestock trampling in slickspot microsites was common. The Juniper Butte area is scheduled to be used as a training area for the U.S. Air Force. The affects of training on habitat integrity remains to be seen.

The largest slickspot peppergrass occurrences, both in terms of habitat integrity and number of plants, are in the Orchard area. Several occurrences in the Kuna/Boise and the Mountain Home/Glenns Ferry areas are also large and received relatively good HII scores. Protecting the long-term integrity of the best occurrences must be an integral part of any conservation strategy for slickspot peppergrass. However, all extant occurrences are important in light of how much habitat and how many populations have been lost over the years. Information collected for the HII can help guide conservation efforts now and in the future.

The documented extirpation rate of slickspot peppergrass is the highest known for any of Idaho's rare flora (Moseley 1994). The actual (undocumented) rate has probably been much higher during the past century. The cause of this decline can be attributed to the widespread loss and degradation of the sagebrush-steppe in southwestern Idaho. Without a concerted effort to conserve what is left of the regional shrub-steppe, the decline of slickspot peppergrass will continue. More than just slickspot peppergrass is at stake. Other species linked to the sagebrush-steppe will also continue to suffer regional decline (Knick and Rotenberry 1994). By monitoring the integrity of slickspot peppergrass habitat, the HII can be one part of a broad-spectrum conservation program for the shrub-steppe of southwestern Idaho. This sort of conservation program will require coordination and commitment from all agencies and organizations managing extant populations.

RECOMMENDATIONS

1. To provide more meaningful results, we recommend modifying two of the HII attributes.

    a) For attribute number 4, the scores should change to: 0 = (<10 plants/sq.ft.); 1 = (10-25 plants/sq.ft.); 2 = (>25 plants/sq.ft.).

    b) For attribute number 5, the scores should change to: 0 = (2 or fewer plants); 1 = (>2 plants). Seedlings should not be counted when determining this attribute, only juvenile or mature shrubs. This is because there may be a sagebrush or rabbitbrush germination flush following spring rains, but few if any of these will persist within the slickspot microsite.

2. Transects need to be resampled at intervals that will prove timely to land managers. We recommend all transects be resampled either in 1999 or 2000, to further document conditions at the start of this long-term monitoring project. After this time, resampling can be adjusted to approximately every three years. Averaging three transects/day will require three weeks of field time to sample all 45 transects. If allocating this much time and funding is impossible, a prioritized subset of transects can be resampled each year. In this way, all transects can be resampled during a two or three year period.

Future sampling should include all portions of the monitoring protocol. Analysis will be possible beginning with the second year of data collection. Results should be analyzed and summarized in a short report each year resampling is completed. Besides providing timely information to land managers, analysis after each data collection cycle also allows a regular assessment of the HII monitoring approach (Elzinga et al. 1998).

3. One option to make the Occurrence Viability Rank less subjective is to have a checklist of factors for the viability and defensibility portions of the rank. The rank would reflect the checklist results.

4. Three occurrences (042, 062, 064) in the Inside Desert were not sampled in 1998. All three are located on public land and should be added to the HII monitoring program if possible. There may be an opportunity to coordinate with the U.S. Air Force (or their contractors responsible for biological monitoring) to help get this done.

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