Damele Slickspot Peppergrass Bladed Fenceline Monitoring Report

June 20, 2019

Tracking No. 01EIFW00-2019-CPA-0007

Participants: Steve Damele (private landowner and BLM Bowns Creek Allotment livestock permittee), Lindsy Asman (USFWS - Washington Fish and Wildlife Office), and Stefanie Blihovde and Barbara Schmidt (USFWS - Idaho Fish and Wildlife Office)

For the ninth consecutive year, slickspot peppergrass plants were counted in an area that was bladed in the fall of about 2005 along the property boundary between privately-owned lands and Bureau of Land Management (BLM)-administered lands that include the Bowns Creek Allotment #00830. This blading was thought to have been completed to prepare the private property for development by removing shrubs and barbed-wire fence along the property boundary. This barbed wire fence was subsequently replaced as it serves as the BLM allotment boundary fence.

Background

The bladed slick spot area is privately owned on the northwest side of the barbed-wire fence and is BLM-administered lands on the southeast side of the fence. Steve Damele is the BLM livestock permittee on the Bowns Creek Allotment. Mr. Damele discovered *Lepidium papilliferum* (slickspot peppergrass) growing in the bladed slick spot area in fall of about 2005 while replacing the BLM livestock grazing allotment boundary fence that had been removed by the adjacent private landowner. Mr. Damele took photographs of the bladed area on June 17, 2008 that showed flowering slickspot peppergrass plants on both sides of the barbed-wire fence (see top two and bottom left photographs in Figure 1). Mr. Damele's photographs taken on July 5, 2009 showed fruiting plants on both sides of the barbed-wire fence (Figure 2). The privately-owned portion of the bladed area appears to be for sale as a sign provides contact information for the Brandt Agency (208-466-7821) to inquire about purchasing the property.

Mr. Damele contacted the Idaho Fish and Wildlife Office (IFWO) of the U.S. Fish and Wildlife Service in winter of 2011 to report seeing many slickspot peppergrass plants in this bladed fenceline area. He observed that the number of plants in subsequent years at this bladed site declined as time went on from the blading incident, which suggests that the plant requires disturbance in order to thrive. In June of 2011, staff from the IFWO and the Four Rivers Field Office of the Bureau of Land Management (BLM) met with Mr. Damele at the site to document slickspot peppergrass at this site. Mr. Damele, IFWO staff, and BLM staff believe that the bladed area was likely to have originally contained slick spots that had since reformed following the blading incident. The soil surface at the bladed slickspot peppergrass site was relatively devoid of vegetation compared to adjacent portions of the bladed area, was highly reflective, and contained a few slickspot peppergrass plants.

Methods

The bladed fenceline site is located near the junction of Simco Road and Desert Wind Road (Figure 3) and has been incorporated into C-ranked Element Occurrence (EO) 15),[1] which is considered to have fair population viability. Between 2011 and 2019, slick spot microsites along the bladed fenceline and adjacent unbladed areas were examined for presence of slickspot peppergrass plants using the following methodology.

The entire portion of the bladed fence on both the private and the BLM side is walked to document any slickspot peppergrass plants present. Individual slick spot microsite locations are recorded using a hand-held GPS unit. All plants counted within each individual slick spot are categorized as either rosettes or flowering plants. Fruiting plants were included within the flowering plant category.

Larger size flowering plants that are significantly larger than the majority of flowering plants observed in any given year may be biennial flowering plants. Large flowering plants that are potentially biennial flowering plants are noted during the annual fenceline monitoring, although a separate biennial plant sub-category is not created for this monitoring effort as it is unknown whether larger plants observed are small biennial plants or large annual plants.

Plants are counted within each individual bladed and unbladed slick spot microsite. The bladed area along the fenceline is evident by shrub stature on both sides of the barbed-wire fence, with approximately 2-4 feet of lower-stature shrubs observed on the BLM side of the fence (Figure 4). Plant counts are further categorized by land ownership. If a slick spot microsite is located on both sides of the property line, the plants on the BLM side of the fence are counted separately from the plants located on the private land side of the fence.

Monitoring Results

A summary of slickspot peppergrass plant numbers observed in 2019 is provided in Table 1 below (see Figure 5 for individual slick spot locations).

[1] Using a protocol developed by NatureServe (2002, entire), Idaho Department of Fish and Game botanists rank individual slickspot peppergrass EOs based on measures of habitat quality and plant abundance. These slickspot peppergrass EO ranks can be used for assessing estimated population viability or probability of persistence and to prioritize conservation planning or actions (NatureServe 2002).

Table 1. Numbers of Slickspot Peppergrass Plants Observed During 2019 Fenceline Monitoring			
Site Name & Location	**2019**		
	Rosettes	**Flowering Plants**	**TOTAL**
Bladed Slick Spots			
Bladed Slick Spot A – Private side of fence	24	361	**385**
Bladed Slick Spot A – BLM side of fence	23	309	**332**
Bladed Slick Spot B – Private	24	27	**51**
Bladed Slick Spot C - Private	0	0	**0**
Bladed Slick Spot D - Private	0	0	**0**
Bladed Slick Spot E – Private side of fence	11	8	**19**
Bladed Slick Spot E – BLM side of fence	0	0	**0**
Bladed Slick Spot F – Private side of fence	0	0	**0**
Bladed Slick Spot F - BLM side of fence	0	0	**0**
Bladed Slick Spot G - Private	0	0	**0**
Bladed Slick Spot H - Private	0	0	**0**
Bladed Slick Spot I - Private	3	1	**4**

Table 1. Numbers of Slickspot Peppergrass Plants Observed During 2019 Fenceline Monitoring			
Site Name & Location	**2019**		
	Rosettes	**Flowering Plants**	**TOTAL**
Bladed Slick Spot K – BLM	0	0	**0**
BLADED SLICK SPOTS COMBINED TOTAL	**85**	**706**	**791**
BLADED SLICK SPOTS GRAND TOTAL	**791 plants**		
Unbladed Slick Spots			
Unbladed Slick Spot J – BLM	12	61	**73**
Unbladed Slick Spot L – Private	6	9	**15**
Unbladed Slick Spot M – Private	0	0	**0**
Unbladed Slick Spot N – BLM	0	1	**1**
UNBLADED SLICK SPOTS COMBINED TOTALS	**18**	**71**	**89**
UNBLADED SLICK SPOTS GRAND TOTAL	**89 plants**		
2019 GRAND TOTAL ALL SLICK SPOTS	**880 plants**		

As shown above in Table 1, a grand total of 880 slickspot peppergrass plants were observed in 2019 within both bladed and unbladed slick spots. Of these 880 plants, 103 were rosettes and 777 were flowering plants. Flowering plants observed in 2019 were a mix of smaller plants and larger plants, and, therefore, were indicative of both the annual and the biennial life forms of the plant. The majority of plants observed appeared to be annuals. On the June 20 monitoring date, reproductive plants were observed as both flowering and developing fruits.

Of the 880 total slickspot peppergrass plants observed in 2019, 791 plants (about 90 percent) were located within bladed slick spots (85 rosettes and 706 flowering plants). About 81 percent of all plants observed in 2019 were located within Slick Spot A (717 plants; Figure 6). Two flowering plants were observed just beyond the outer edge of Bladed Slick Spot A on the BLM side of the fence (Figure 7). The portion of Bladed Slick Spots A and E located on the private side of the fence and Bladed Slick Spots B and I (which are located entirely on private land) contained a combined total of 459 slickspot peppergrass plants. That portion of Bladed Slick Spot A located on the BLM-administered side of the fence contained a total of 332 slickspot peppergrass plants. No other slickspot peppergrass plants were observed within bladed slick spots on either the private or the BLM-administered side of the fence.

Unbladed slick spots contained a total of 89 slickspot peppergrass plants (18 rosettes and 71 flowering plants) in 2019. Unbladed Slick Spots J and N (which are located entirely on the BLM-administered side of the fence) contained a total of 75 slickspot peppergrass plants (12 rosettes and 62 flowering plants). Unbladed Slick Spot L (which is located entirely on the private side of the fence) contained a combined total of 15 slickspot peppergrass plants (6 rosettes and 9 flowering plants). No slickspot peppergrass plants were observed in Unbladed Slick Spot M (which is located entirely on the private side of the fence) in 2019. No other slickspot peppergrass plants were observed within unbladed slick spots on either the private or the BLM-administered side of the fence.

The number of slickspot peppergrass flowering plants was higher than the number of rosettes observed in both bladed and unbladed slick spots on both BLM and privately owned lands. Rosettes made up about 12 percent of the total slickspot peppergrass plants observed in slick spots (a total of 103 rosettes and 777 flowering plants documented in all slick spots; see Table 1). Similar to 2017 and 2018, the total number of slickspot peppergrass plants observed within bladed slick spots (791 plants, which represents 90 percent of all plants observed) was much greater than the number of plants observed in unbladed slick spots (89 plants). As also observed in 2017 and 2018, Owyhee harvester ants and their colonies were observed near slick spot microsites during 2019 monitoring (Figure 8).

Some evidence of ground disturbance within slick spot microsites was noted during the 2019 fenceline monitoring. Ground squirrel disturbance was documented within Bladed Slickspot A on both the BLM and the private side of the fence, Unbladed Slick Spot J on the BLM side of the fence, and Unbladed Slick Spot O on the private side of the fence. Ground squirrel disturbance in

Slick Spot A appeared to be concentrated along the allotment boundary fence (Figure 9), and occurred at lower levels than observed in 2017 in the same area. A single antelope track was also observed in Bladed Slick Spot H on the private side of the fence

Livestock-related ground disturbance within slick spots in 2019 was at similar levels as observed in 2018, which was much less evident than livestock hoof prints observed in 2017. Scattered livestock hoof prints and some feces were observed in Bladed Slick Spot A (Figure 10) and in Unbladed Slick Spot J on the BLM side of the fence. Scattered livestock tracks were also observed on both the BLM and private side of the fence in Bladed Slick Spot F. As was the case in 2018, no reddish clay indicative of potential penetrating trampling was observed within slick spots in 2019.

Similar to 2018, invasive nonnative annual grass (cheatgrass) continued to dominate the understory in the areas surrounding slick spots in 2019 (Figure 11). No vehicle tracks were observed in slicks spots in 2019. As was first noted in 2018, a shallow berm that may have been a remnant of the original fenceline blading continues to be present in non-slick spot soils near Bladed Slick Spot H on the private land side of the allotment boundary fence (Figure 12).

Discussion

Plant Numbers. Similar to previous survey years, the majority of flowering plants observed in 2019 were small in stature, so were likely exhibiting the annual life history strategy of the plant. Most slickspot peppergrass plants observed in 2019 were flowering with some fruits beginning to develop by the June 20 survey date (see Figure 6). Delay of monitoring until mid-June 2019 was prudent as the late, cool spring appeared to delay forb flowering, including flowering of slickspot peppergrass.

Slickspot peppergrass plants were observed in bladed slick spots on both the private and the BLM-administered side of the fence. Slickspot peppergrass plants were not observed in any slick spots where they had not been seen before, and similar to 2018, many slick spots that contained plants in 2017 contained no above-ground plants during 2019 monitoring efforts. Similar to 2017 and 2018, Unbladed Slick Spot J on the BLM-administered side of the fence contained fewer total slickspot peppergrass plants than had been observed in past monitoring years.

Owyhee Harvester Ants. The presence of active Owyhee harvester ant colonies near known occupied slick spot microsites has the potential to reduce replenishment of seeds into the slickspot peppergrass seed bank. Owyhee harvester ants represent an emerging threat on good to poor viability populations of slickspot peppergrass, including within this monitored area of C-ranked EO 15. Because the density of Owyhee harvester ant colonies appears to be inversely related to sagebrush cover, and positively related to the amount of non-cheatgrass grasses found at a site (Robertson 2015, p. 9, Fig. 3), harvester ant presence could be addressed through protection of existing sagebrush cover and restoration of shrubs in populations that are dominated by grasslands.

Ground Disturbance. Ground disturbance observed within slick spot microsites in 2019 was primarily limited to ground squirrel activity. Livestock-related ground disturbance in slick spot microsites was minimal. With the exception of the shallow soil berm along the allotment boundary fence first noted in 2018 (Figure 12), no ridges or piles of soil or deep soil depressions/ditches were observed on the original bladed slick spot area to indicate deep soil disturbance had occurred during the original blading of the area. However, some remnant raised soil strips approximately 2 to 4 inches in height and up to about 2 inches wide that likely were formed when soil was cast off along the edge of a blade can be seen in photographs taken in 2008 (Figure 1); these raised soil strips were no longer evident in 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, or 2019 photographs of the site.

Evidence of deep soil disturbance on the bladed slick spots along the allotment boundary fence was also not apparent from the minimal extent of exposed reddish clay soil observed within the typical white slickspot surface as shown in photographs taken in 2008 and 2009, and in photographs of the site taken during fenceline monitoring from 2011 to the present. Reddish clay on a slickspot surface is indicative of soil disturbance such wildlife or livestock hoof prints "breaking through the restrictive layer under the surface silt layer of a slickspot during saturated conditions, [where] the restrictive layer of a slickspot is defined as the heavy clay (35-45% clay content) prismatic structured subsoil layer (Btn1 horizon) below the vesicular silt surface layer (E horizon) and above the lighter textured (28-35% clay content) blocky structured moist clay layer (Btn2 horizon)" as described in the Habitat Integrity and Population (HIP) monitoring protocol (Kinter et al. 2012, Appendix D, p. 10). A relatively small area of reddish clay soil on the surface of Bladed Slick Spot A was observed on the BLM side of the fence in 2008, 2009, 2011, 2012, and 2017 (see Figure 3 in the 2011 monitoring report, Figure 9 in the 2012 report, and Figures 1, 2, and 6 in the 2017 report). The exposed clay layer can be seen as a narrow, slightly depressed band located adjacent to the fenceline that appears to hold standing water when soils are saturated. The limited extent and location of this small exposed clay soil layer band makes it unlikely that it was created during blading of the entire slick spot area. It appeared to be a short section of the livestock trail located along the allotment boundary fence. No exposed reddish clay soil associated with livestock tracks was observed in 2018 or 2019. Exposed reddish clay soil within slick spots during 2019 monitoring was limited to areas of ground squirrel disturbance (Figures 9 and 10).

Soil disturbance such as blading can negatively affect the seed bank by burying or pushing slickspot peppergrass seeds too deeply into the soil for subsequent successful germination and emergence. Research conducted by Meyer and Allen (2005, pp. 6-8) found that seedling emergence success decreased with increasing seed depth in the soil, from a mean of 54 percent emergence success at the shallowest planting depth of 0.1 inch to a mean emergence success of 5 percent at a 1.2 inch planting depth. Therefore, although soil may have been smoothed over again since the time of the original disturbance such that that evidence of deep soil disturbance was obliterated, it is unlikely that the site would retain slick spot characteristics or contain

slickspot peppergrass plants if the slick spot soils were deeply mixed such that slickspot peppergrass seeds were buried deeper than about 1 inch.

Idaho Fish and Wildlife Office Botanist Karen Colson has observed rare plants recolonize disturbed sites (possibly due to disturbance-related exposure of seeds coupled with reduced competition for space, water, and nutrients from other plants), although the likelihood of these rare plants becoming established or persisting over the long term is low, depending on the level of disturbance (due in part to changes in soil structure and hydrologic function). In addition, as described above, some slick spot microsites subjected to light disturbance in the past may be capable of re-forming (Seronko 2006 in litt. p. 2). However, disturbances that alter the physical properties of the soil layers, such as deep disturbance and the addition of organic matter, may lead to the destruction and permanent loss of slick spots. For example, deep soil tilling and adding organic matter and gypsum have been recommended for eliminating slick spots from agricultural lands in Idaho (Peterson 1919, p. 11; Rasmussen et al. 1972, p. 142). Slick spot soils are especially susceptible to mechanical disturbances when wet (Rengasamy et al. 1984, p. 63; Seronko 2004, in litt. pp. 1–2). Such disturbances disrupt the soil layers important to slickspot peppergrass seed germination and seedling growth and alter hydrological function.

Meyer and Allen (2005, p. 9) suggest that if sufficient time passes following disturbance, slick spot soil layers may regain their pre-disturbance configuration yet not support the species. Thus, while the slick spot appears to have regained its former character, some essential component required to sustain the life history requirements of slickspot peppergrass has apparently been lost, or the active seed bank is no longer present. However, slickspot peppergrass plants found along the bladed allotment boundary fence appear to be associated with slick spots that were present prior to blading. In addition, the level of blading disturbance that occurred within fenceline slick spots appears to have been below the slick spot disturbance threshold level as slickspot peppergrass plants continue to persist within the bladed slick spots. In contrast to 2018, when the number of slickspot peppergrass plants observed within this portion of EO 15 are at the lowest numbers observed over the past 4 years of monitoring, in 2019 the highest number of slickspot peppergrass plants were observed over the 9 years since monitoring was initiated at this site in 2011.

Slickspot peppergrass plant numbers observed in bladed and unbladed slick spots from 2011 through 2019 relative to the high numbers of plants evident in the 2008 and 2009 bladed slickspot photographs appear to be aligned with slickspot peppergrass plant number trends observed HIP monitoring from 2009 through 2018 (Table 2). Note that no rangewide HIP monitoring data are available for 2017. Fenceline monitoring efforts from 2011 through 2018 did not appear to yield higher or lower slickspot peppergrass plant number trends than those observed along HIP monitoring transects across the range of the species. Slickspot peppergrass plant numbers observed in bladed slick spots from 2011 through 2019 may be related to environmental conditions such as temperature, precipitation, and the proximity of sagebrush shrubs. Total slickspot peppergrass numbers were greater within bladed slick spots than in

unbladed slick spots from 2017-2019; however, the opposite was true during 2012-2016 monitoring (Table 2).

Influence of Precipitation and Temperature on Slickspot Peppergrass Abundance. Like many short-lived plants growing in arid environments, above-ground numbers of slickspot peppergrass individuals can fluctuate widely from year to year, depending on seasonal precipitation patterns (Mancuso and Moseley 1998, p. 1; Meyer et al. 2005, pp. 4, 12, 15; Palazzo et al. 2005, p. 9; Sullivan and Nations 2009, p. 44). Precipitation and temperature data from two regional weather stations (the Boise Airport and a Remote Automatic Weather Station located in the vicinity of Orchard, Idaho) were used to examine trends in slickspot peppergrass numbers at the bladed fenceline site relative to annual spring weather patterns.

The Boise Airport is located about 12 miles northwest of the bladed fenceline monitoring site. Preliminary data from the National Weather Service website[2] indicates that spring precipitation (total precipitation in March, April, and May) at the Boise Airport in 2019 (7.28 inches) was is over 1.5 inches greater than any spring precipitation level recorded since 2011. In particular, May 2019 precipitation (3.98 inches) was exceptional, with about twice as much precipitation observed in May 2019 as was recorded during the second and third highest May rainfall years from 2011 to the present (1.81 inches in May 2011 and 1.88 inches in May 2018; see Figure 13).

The Range 2 Remote Automatic Weather Station (RAWS) is located about 11 miles west southwest of the bladed fenceline monitoring site on the Idaho Army National Guard's Orchard Combat Training Center[3]. In contrast to the Boise Airport precipitation data, total spring precipitation at the Range 2 RAWS in 2019 (2.56 inches) was the fifth highest level recorded from 2011 to 2019 (4.04 inches in 2011, 2.74 inches in 2012, 3.22 inches in 2017, and 2.78 inches in 2018; see Figure 14). Lowest recorded spring precipitation levels at the Orchard RAWS site were in 2013 and 2016 (about 0.8 inches and a little less than 2.0 inches, respectively). However, similar to the Boise Airport precipitation data, May 2019 precipitation recorded at the Range 2 RAWS in 2019 (2.21 inches) was the highest level since 2011; the second and third highest May precipitation levels at the Range 2 RAWS were recorded in 2015 (1.64 inches) and in 2018 (1.31 inches).

[2] Monthly precipitation data from 2011 through 2019 for the Boise Air Terminal was obtained on-line at: http://www.wrh.noaa.gov/boi/climo/precip%20monthly%20and%20annual%20table%20boise%20airport.txt (last accessed July 17, 2019). Monthly mean air temperature data for the Boise Air Terminal was obtained online at: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?id1022 (last accessed July 17, 2019).

[3] Precipitation, air temperature, and soil temperature data from 2011 through 2017 for the Range 2 RAWS location at the Orchard Combat Training Center was obtained online at: http://www.raws.dri.edu/cgi-bin/rawMAIN.pl?idIAN1 (last accessed July 17, 2019).

Table 2. Number of Slickspot Peppergrass Plants Observed in Bladed and Unbladed Slick Spots During 2011 - 2019 Bladed Fenceline Monitoring

Site Name & Location	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bladed Slick Spot A – Private N 43.34730 W -115.94481	5	2	0	154	9	37	128	26	385
Bladed Slick Spot A – BLM N 43.34730 W -115.94481	20	7	4	65	58	124	310	54	332
Bladed Slick Spot B – Private N 43.34732 W -115.94468	0	0	0	48	11	4	93	3	51
Bladed Slick Spot C – Private N 43.34732 W -115.94453	0	0	0	0	0	0	0	0	0
Bladed Slick Spot D – Private N 43.34732 W -115.94440	0	0	0	0	1	0	0	0	0
Bladed Slick Spot E – Private N 43.34732 W -115.94420	0	4	0	60	14	0	16	1	19
Bladed Slick Spot E – BLM N 43.34730 W -115.94419	NA	NA	NA	NA	0	0	3	0	0
Bladed Slick Spot F – Private N 43.34733 W -115.94410	0	0	0	5	0	0	4	0	0

Table 2. Number of Slickspot Peppergrass Plants Observed in Bladed and Unbladed Slick Spots During 2011 - 2019 Bladed Fenceline Monitoring

Site Name & Location	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bladed Slick Spot F – BLM N 43.34733 W -115.94410	NA	NA	NA	NA	0	0	0	0	0
Bladed Slick Spot G – Private N 43.34733 W -115.94401	0	0	0	0	0	0	0	0	0
Bladed Slick Spot H – Private N 43.34733 W -115.94394	0	0	0	0	0	0	3	0	0
Bladed Slick Spot I – Private N 43.34737 W -115.94386	0	0	0	2	0	0	3	0	4
Bladed Slick Spot K – BLM N 43.34729 W -115.94370	NA	NA	NA	NA	0	0	0	0	0
BLADED SLICK SPOTS TOTAL NUMBER OF PLANTS BY YEAR	**25**	**13**	**4**	**334**	**93**	**165**	**560**	**84**	**791**
Unbladed Slick Spot J – BLM N 43.34716 W -115.94473	Plants observed but not counted	23	24	225	72	365	237	11	73

Table 2. Number of Slickspot Peppergrass Plants Observed in Bladed and Unbladed Slick Spots During 2011 - 2019 Bladed Fenceline Monitoring

Site Name & Location	2011	2012	2013	2014	2015	2016	2017	2018	2019
Unbladed Slick Spot L – Private N 43.34755 W -115.94473	NA	NA	Plants observed but not counted	112	131	79	45	11	15
Unbladed Slick Spot M – Private N 43.34763 W -115.94468	NA	NA	NA	0	4	2	0	0	0
Unbladed Slick Spot N – BLM N 43.34272 W -115.94467	NA	NA	NA	NA	NA	NA	NA	NA	1
Unbladed Slick Spot O – Private N 43.34734W - 115.94511	NA	NA	NA	NA	NA	NA	NA	NA	0
UNBLADED SLICK SPOTS TOTAL NUMBER OF PLANTS BY YEAR	**NA**	**23**	**24**	**337**	**207**	**446**	**282**	**22**	**89**
TOTAL NUMBER OF PLANTS OBSERVED BY YEAR	**25**	**36**	**28**	**671**	**300**	**611**	**820**	**106**	**880**

The best available information was used to identify the location of slickspots observed to contain plants over time. When older GPS coordinates did not align with known bladed slickspot locations from 2016, 2017, 2018, and 2019 monitoring efforts, the older GPS coordinates were used to estimate the location of the slickspot where plants were observed. Although some slickspot peppergrass plants may not have been accurately identified in Table 2 as being present within a specific individual slick spot microsite, total annual plant numbers observed within bladed and unbladed slick spot microsites for each year are accurate.

Through their analysis of special use plot and rough census monitoring data, Sullivan and Nations (2009, p. 55) found that, in general, precipitation has a positive relationship with predicted slickspot peppergrass numbers. However, during some periods, this simple relationship becomes confounded by temperature. Sullivan and Nations (2009, p. 56) further stated that both temperature and precipitation can be important to predict the abundance of slickspot peppergrass, but the nature of the importance changes from fall through winter and into spring. Predicted slickspot peppergrass abundance is greatest following a fall or early winter when temperature or precipitation is high and the other is low.

In order to also consider the potential effects of temperature on slickspot peppergrass plant numbers, average monthly air temperature data for both the Boise Airport and Range 2 (Figures 15 and 16) were compiled, and soil temperature data were available from the Range 2 RAWS (Figure 16). Average spring air temperature appears to track with average spring soil temperature as shown by the Range 2 RAWS data, although average spring soil temperatures were slightly higher than average air temperatures recorded over the same time period. In 2019, March average monthly air temperature (40.1º F) was lower than in seven of the previous 8 years, and was about 3º F lower than the average March air temperature between 2011 and 2019 (43.0º F). In contrast, the May 2019 RAWS average air temperature (57.3º F) was lower than six of the eight previous years, but was only a little less than 1º F lower than the average May air temperature between 2011 and 2019 (58.1º F). Mean monthly temperatures at the Boise Airport tracked with average spring monthly air temperature trends at the RAWS site, but were about 3º F higher than at the RAWS site (Figures 15 and 16). The warmer air temperatures at the Boise Airport are likely due to its location in a highly urbanized area where air temperatures are influenced by the thermal effects of concrete and asphalt infrastructure.

Similar to average monthly air temperature data, the RAWS March 2019 average soil temperature was about 3º F lower than the average March soil temperature between 2011 and 2019 (44.3º F), and was the lowest since monitoring began in 2011. The May 2019 average soil temperature (61.5º F) was lower than all years except 2011 (58.5º F) and was about 3º F lower than the average May soil temperature between 2011 and 2019 (64.4º F).

Generally, precipitation has a positive effect on slickspot peppergrass numbers, with higher temperatures also beneficial during some time periods. Therefore, while air and soil temperature may be considered in accessing trends in plant numbers, additional analyses of existing long term data sets will likely be required in order to further clarify the relationship of spring air and/or soil temperatures on slickspot peppergrass abundance.

Without site-specific weather data for the fenceline monitoring site, it would be difficult to precisely determine the influence of spring precipitation and/or temperature on fluctuations in plant numbers over time at the fenceline monitoring site. Although located similar distances from the fenceline monitoring site, Boise Airport spring precipitation and air temperature (Figures 13 and 15) vary from precipitation and air temperature levels recorded at the Range 2 RAWS

location (Figures 14 and 16). While precipitation levels at the Boise Airport and the Range 2 RAWS are likely not identical to precipitation levels at the monitoring site, they are likely similar enough to explain trends in plant numbers observed over time. For example, the higher combined March and April precipitation levels in 2017 as demonstrated by the Boise Airport and Orchard Combat Training Center Range 2 RAWS data may have contributed to the higher total number of slickspot peppergrass plants observed in 2017 (820 total plants) in comparison to the number of plants observed in 2018 (106 total plants). Similarly, the atypically high May 2019 precipitation level was likely a key factor for 2019 monitoring efforts yielding the highest number of slickspot peppergrass plants (880 plants) observed since annual monitoring at this site began in 2011.

As described by Sullivan and Nations (2009, p. 55), temperature can confound the relationship between precipitation and slickspot peppergrass abundance. Reginato et al. (1976, p. 1620) found that as soil and air temperatures increased, soil water content decreased. Thus, if a given year has higher mean spring temperatures, less water may be available for plant growth and reproduction, including for slickspot peppergrass. In addition to the atypically high precipitation levels documented in May 2019, the higher March soil and air temperatures and the lower April and May soil and air temperatures in 2019 relative to 2018 levels (Figures 13, 14, 15, and 16) may have also contributed to the record high numbers of slickspot peppergrass plants observed. These lower soil and air temperature in April and May could have contributed to retention of soil moisture in slicks spots through reduced evaporation in slick spots, further facilitating the availability of water for slickspot peppergrass germination and seedling survival to the flowering life stage.

Comparison between Bladed Fenceline Plant Numbers and Rangewide Habitat Integrity and Population Monitoring Data. Overall variations in plant numbers at the bladed fenceline site from 2011 through 2019 (Figure 17) tracked very well with annual slickspot peppergrass plant number variations for the Snake River Plain geographic area (Figure 18) as well as annual variation in plant numbers the nearby Orchard Combat Training Center Management Area (Figure 19). No slickspot peppergrass data were collected at the bladed fenceline site in 2008 and 2009 when photographs documented many plants along the bladed fenceline (Figures 1 and 2). However, the photograph showing high numbers of slickspot peppergrass plants in 2008 follows the pattern of high plant numbers observed in 2008 during rangewide HIP monitoring efforts, with lower plant numbers observed rangewide in 2011, 2012, 2013, and 2018 (Figures 18 and 19). As previously described, it is also possible that the blading may have scarified seeds to stimulate seed germination, leading to higher numbers of above-ground slickspot peppergrass plants in 2008.

Conclusions

An upward trajectory of above-ground slickspot peppergrass plant numbers was observed between 2018 and 2019 for that portion of slickspot peppergrass EO 15 that exists at the bladed

allotment boundary fence area. This increase in plant numbers is likely related to atypically high precipitation levels and lower air and soil temperatures in May of 2019. The number of slickspot peppergrass plants that the site supported prior to the fenceline blading incident is unknown; thus, pre-disturbance plant numbers are not available to determine how the blading may have impacted or enhanced the slickspot peppergrass population at this site. However, 9 years of monitoring indicates that annual variation in slickspot peppergrass plant numbers at the bladed fenceline site appear to be linked to spring precipitation and temperature.

The primary threats of increased frequency and intensity of wildfire and competition by invasive nonnative plants (especially cheatgrass) as well as the secondary threats of development, seed predation by Owyhee harvester ants, and livestock use remain for slickspot peppergrass at the bladed fenceline site. Impacts of primary and secondary threats are reduced by implementation of conservation measures as described the State of Idaho's Candidate Conservation Agreement for Slickspot Peppergrass (State of Idaho 2006, entire) as well as the Conservation Agreement between BLM and the U.S. Fish and Wildlife Service for slickspot peppergrass (USBLM and USFWS 2014, entire). Habitat restoration to reduce invasive nonnative annual grass cover while increasing native deep-rooted perennial bunchgrasses, forbs, and sagebrush cover on BLM lands could provide for increased population resilience for this previously disturbed portion of slickspot peppergrass EO 15.

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Kudos to private landowner/BLM livestock permittee Steve Damele, Washington Fish and Wildlife Office Supervisory Biologist Lindsy Asman, and Idaho Fish and Wildlife Office Supervisory Biologist Stefanie Blihovde for their much appreciated assistance in completing the 2019 slickspot peppergrass monitoring effort at the bladed fenceline site.

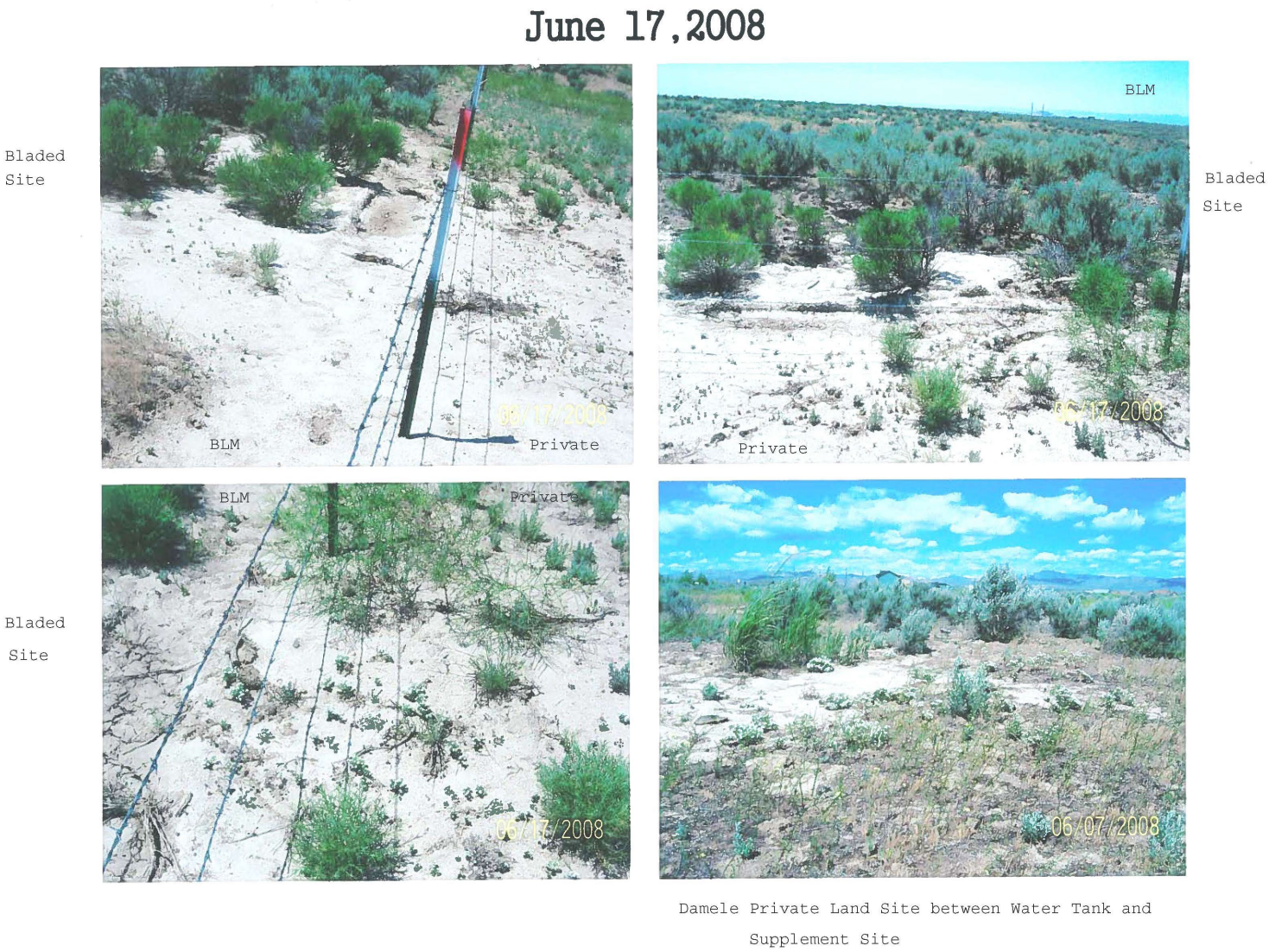


Figure 1. Photographs of bladed slick spots (top row and bottom row left photographs) and slick spots at Steve Damele's sister's private land (bottom row right photograph) documenting slickspot peppergrass presence in 2008. Photographs by Steve Damele.

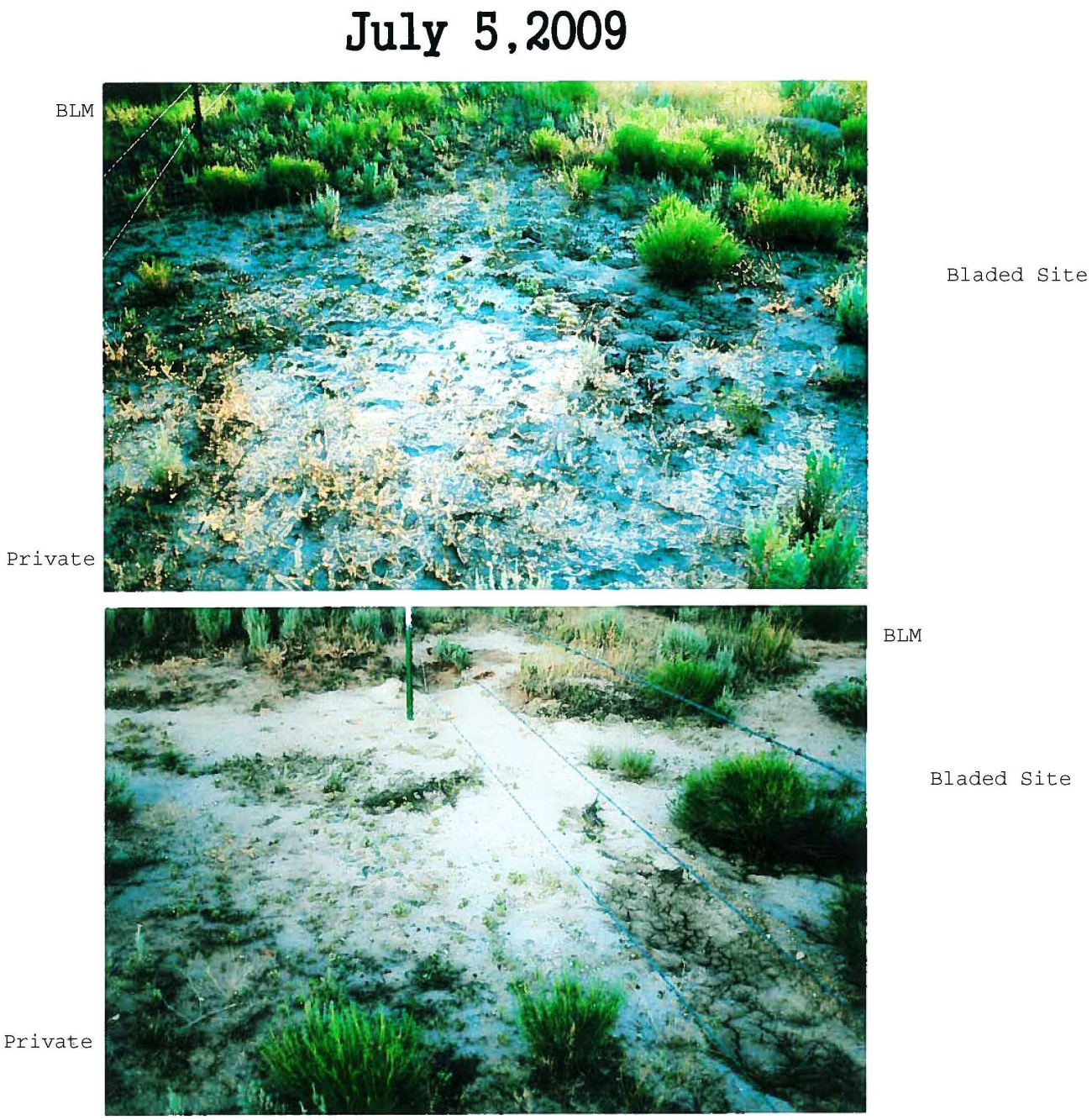


Figure 2. Photographs of bladed slick spots documenting slickspot peppergrass presence in 2009. Photographs by Steve Damele.

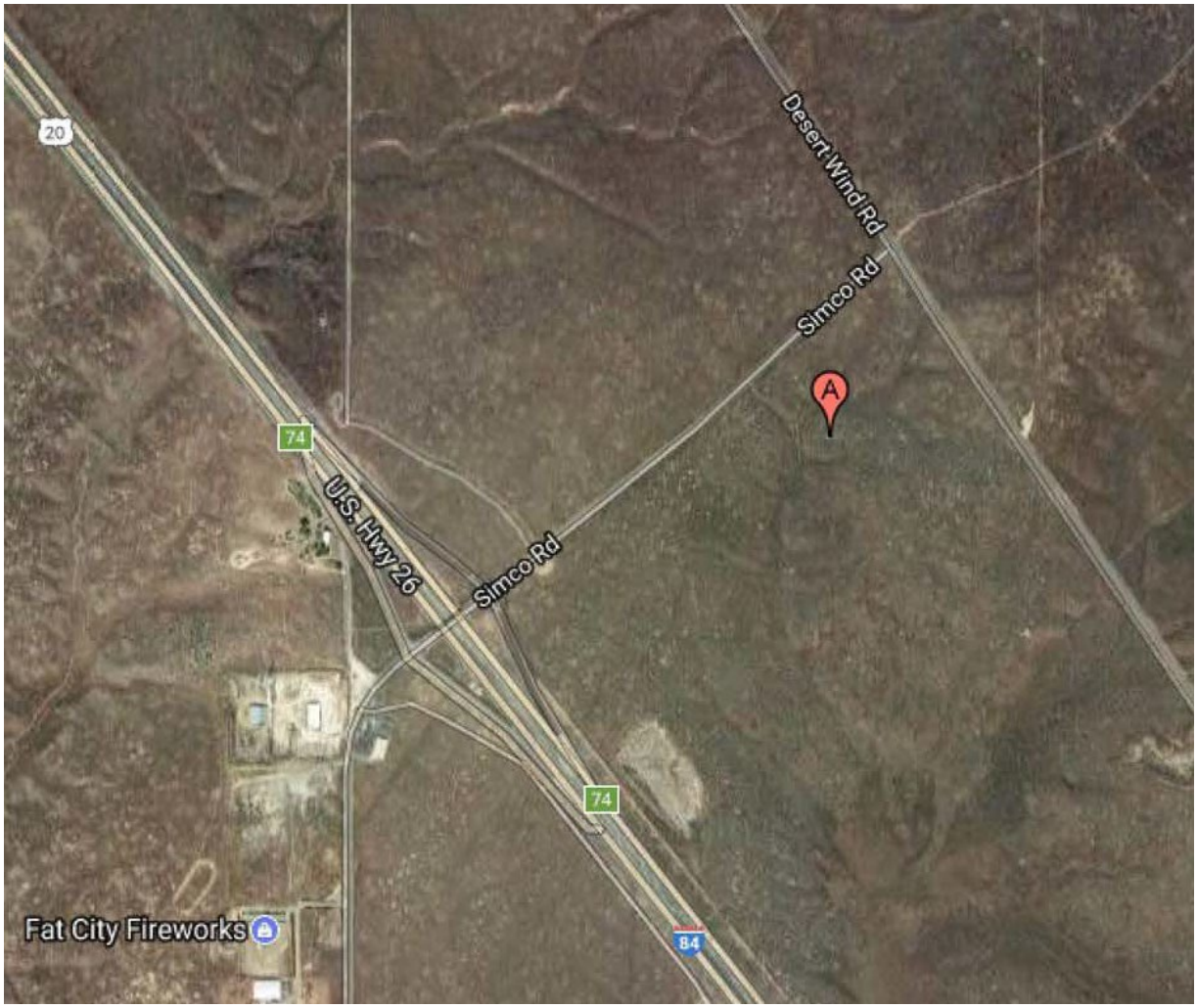


Figure 3. Location of the bladed fenceline monitoring site near the intersection of Simco Road and Desert Wind Road southeast of Boise, Idaho. Red marker "A" points to Bladed Slick Spot A.

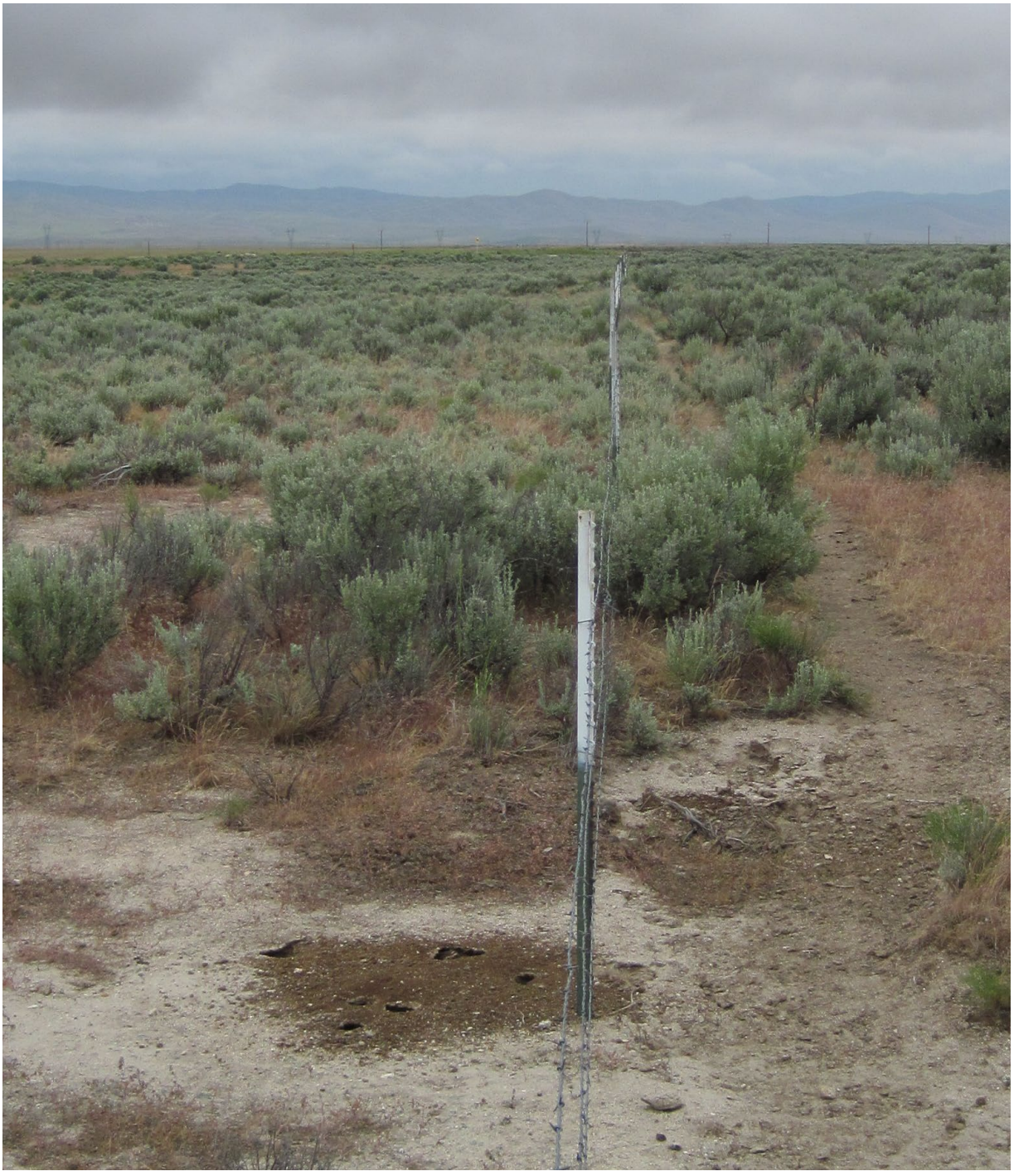


Figure 4. View to the east from Bladed Slick Spot A in 2016, showing shorter-statured sagebrush plants within the original bladed area along the fenceline and taller sagebrush in unbladed areas

Figure 5. Approximate locations of Slick Spots A through O included in the 2019 slickpot peppergrass bladed fenceline monitoring effort.

Figure 6. Numerous slickspot peppergrass rosettes and reproductive plant exhibiting flowers in Bladed Slick Spot A on the private lands side of the allotment boundary fence.

Figure 7. White arrows highlight two flowering slickspot peppergrass plants beneath a rabbitbrush shrub just beyond the boundary of Slick Spot A on the BLM-administered side of the allotment boundary fence. Numerous flowering plants within Slick Spot A are apparent at the top of the photograph.

Figure 8. An active Owyhee harvester ant colony observed between Bladed Slick Spot D and Bladed Slick Spot E on the BLM-administered side of the BLM allotment boundary fence.

Figure 9. Ground squirrel disturbance observed in 2019 within Bladed Slick Spot A on the private land side of the allotment boundary fence.

Figure 10. Scattered shallow livestock tracks and feces present on the BLM-administered portion of Bladed Slick Spot A.

Figure 11. Cheatgrass continued to dominate many areas surrounding slick spots, including adjacent to Bladed Slick Spot A on the BLM-administered side of the allotment boundary fence.

Figure 12. GPS unit at the base of a shallow berm (which was first observed in 2018) near Bladed Slick Spot H on the private land side of the allotment boundary fence.

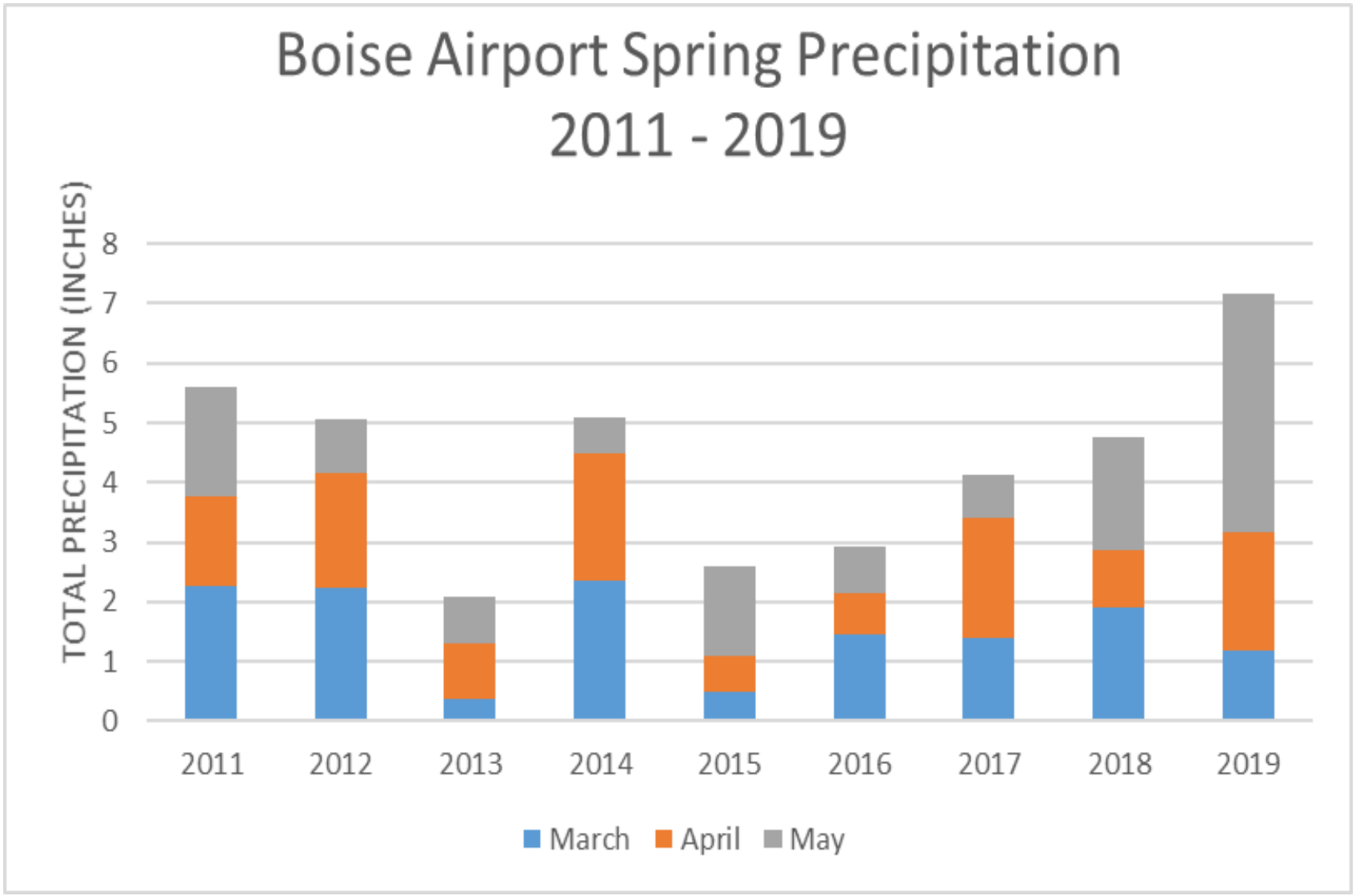


Figure 13. Total spring precipitation recorded at the Boise Airport during the months of March, April, and May in the years 2011 through 2019 (National Weather Service preliminary local climate data).

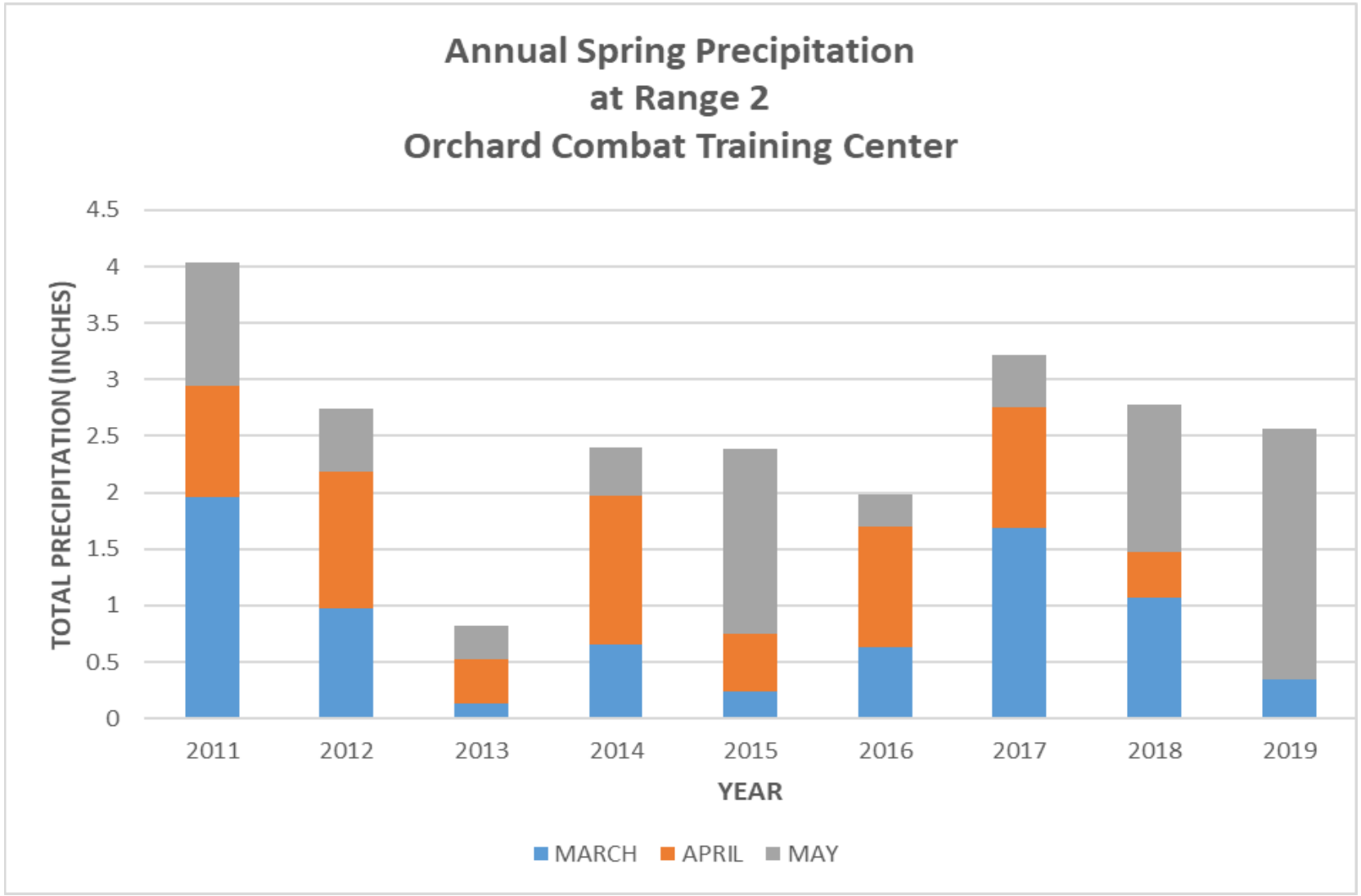


Figure 14. Total spring precipitation recorded at the Range 2 RAWS site on the Idaho Army National Guard's Orchard Combat Training Area during the months of March, April, and May in the years 2011 through 2019 (Western Regional Climate Center local climate data).

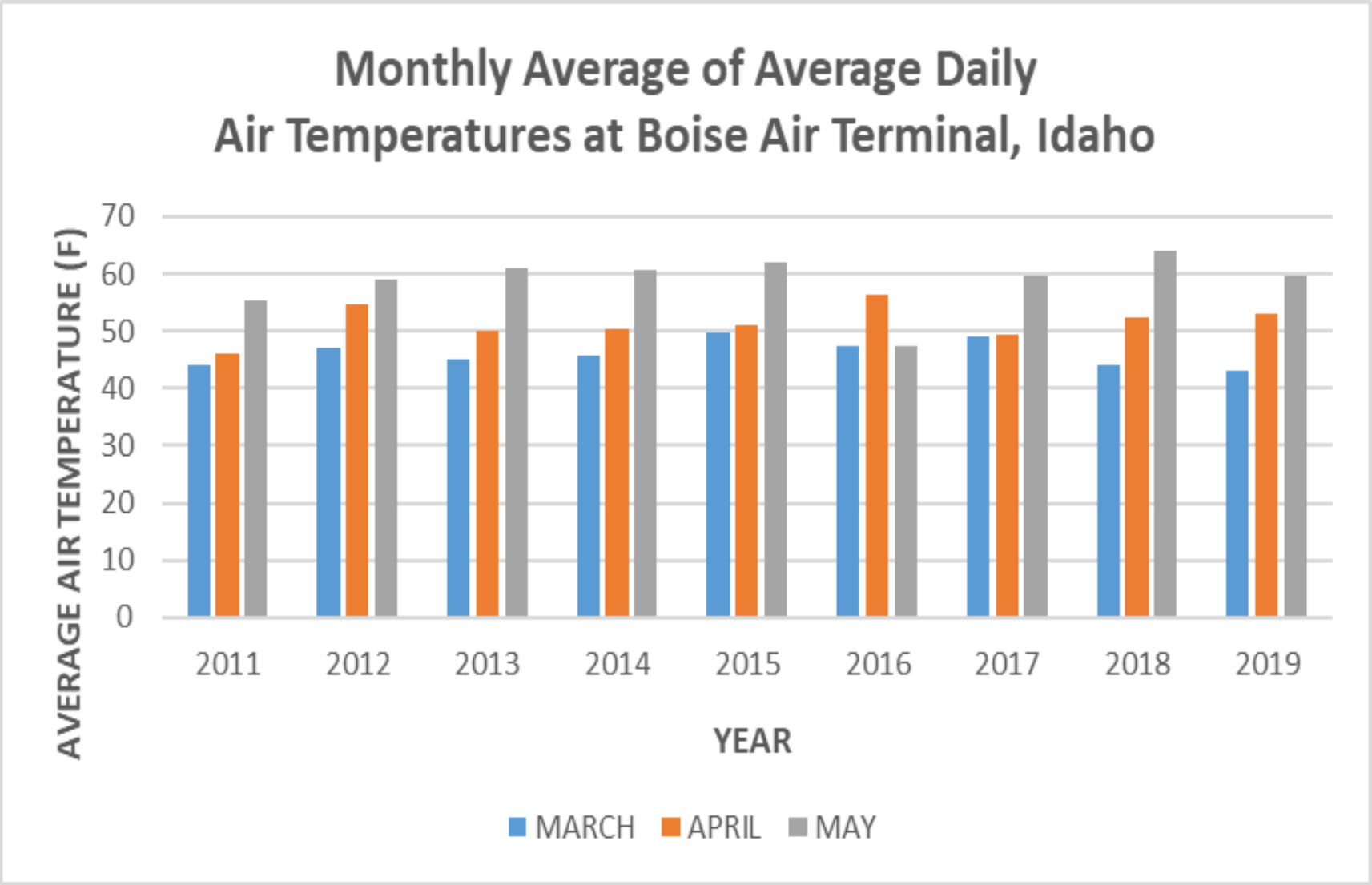
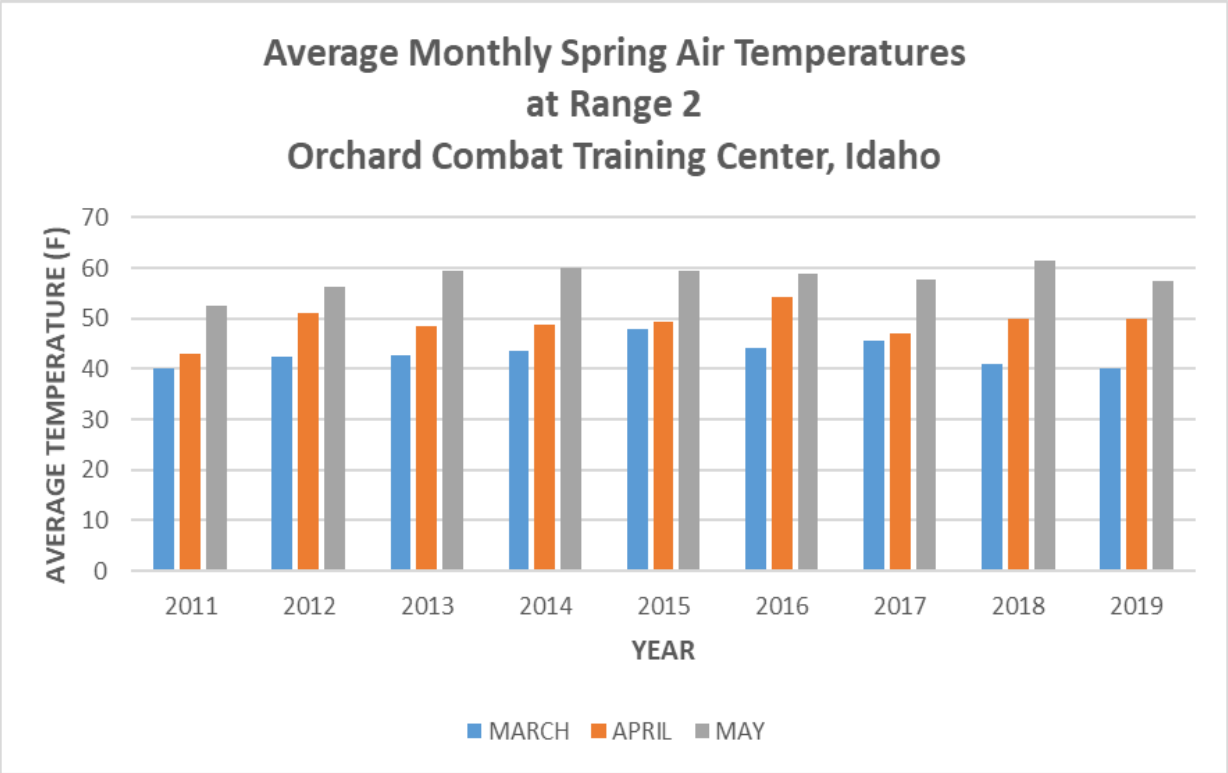


Figure 15. Spring monthly average of average daily air temperature recorded at the Boise Airport during the months of March, April, and May in the years 2011 through 2019 (National Weather Service preliminary local climate data).



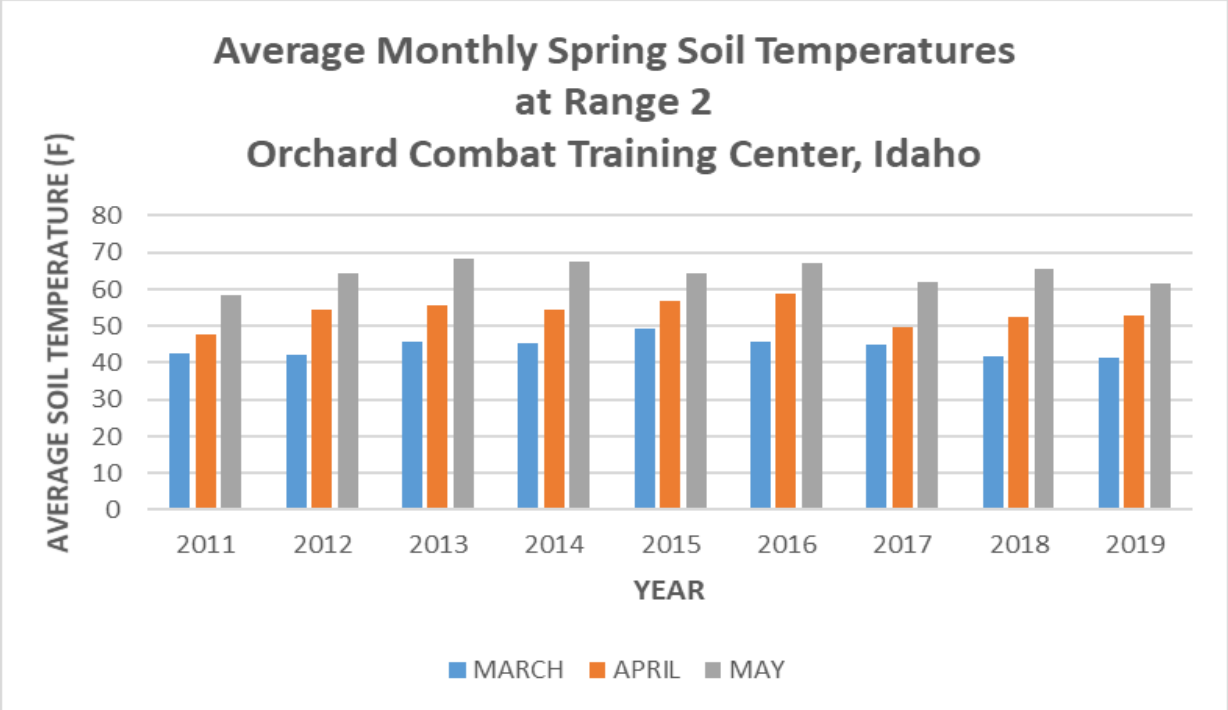


Figure 16. Average monthly spring air and soil temperatures recorded at the Range 2 RAWS site on the Idaho Army National Guard's Orchard Combat Training Center during the months of March, April, and May in the years 2011 through 2019 (Western Regional Climate Center local climate data).

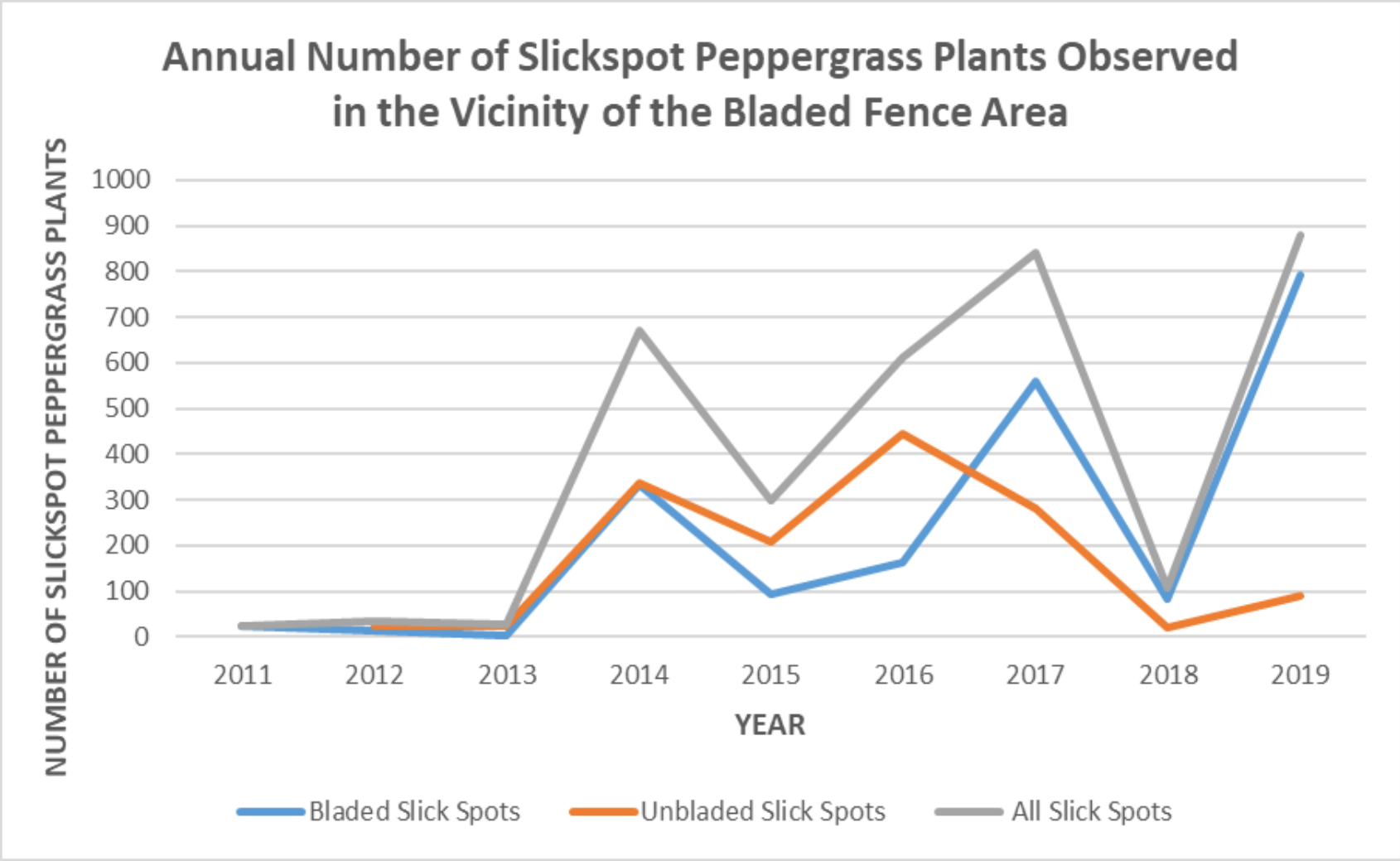


Figure 17. Plant numbers observed during fenceline monitoring between 2011 and 2019 showing variation in total slickspot peppergrass plant numbers in bladed slick spots, unbladed slick spots, and all slick spots combined. The pattern for the total plant numbers over time is similar to annual plant numbers observed from 2011-2018 in the Snake River Plain geographic area (Figure 19) and in the nearby Orchard Combat Training Center Management Area (Figure 20).

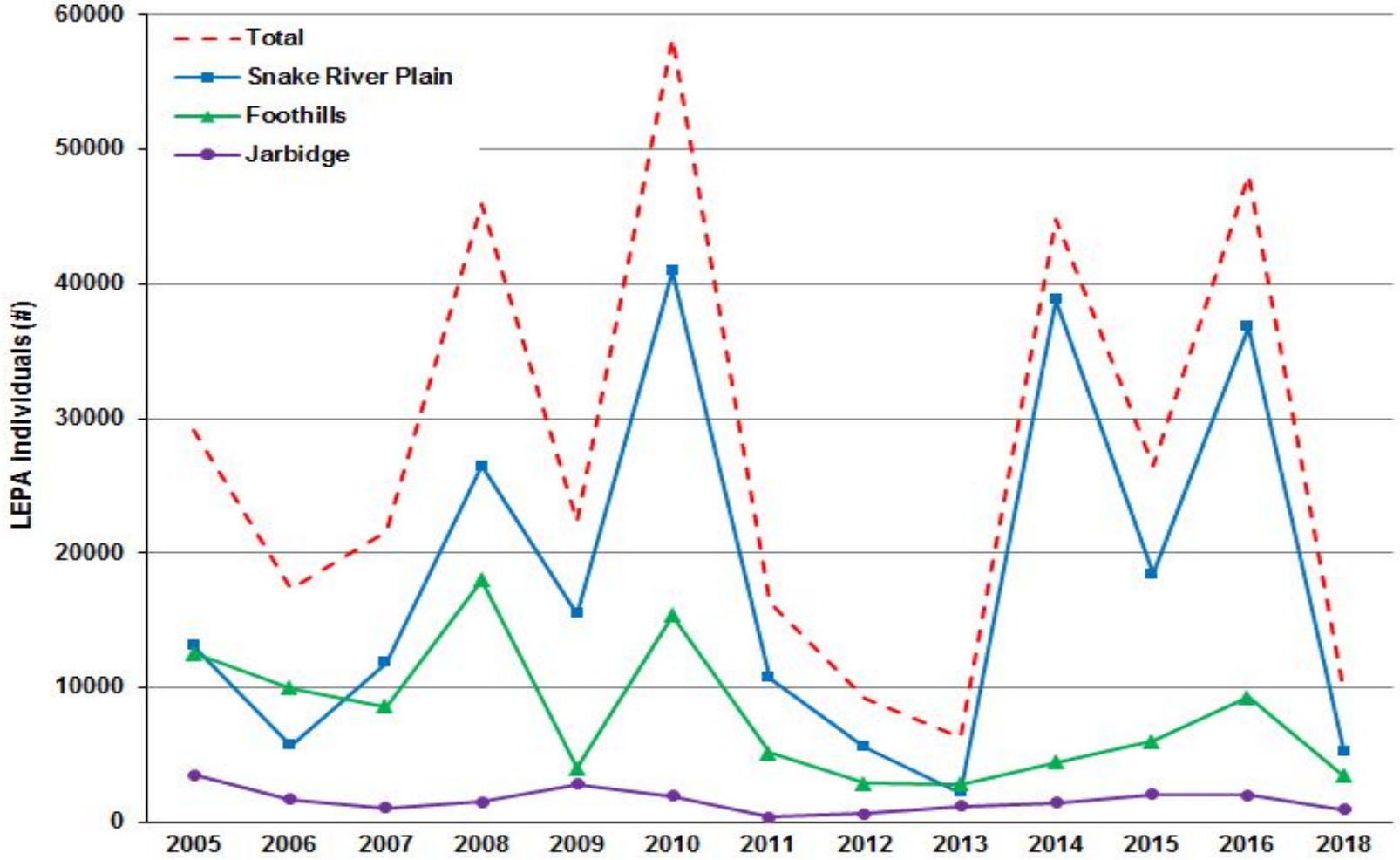


Figure 18. Habitat Integrity and Population (HIP) monitoring data from 2005 though 2018 showing annual variation in slickspot peppergrass plant numbers on transects by geographic area (chart created by IDFG, March 2019). No rangewide HIP data are available for 2017.

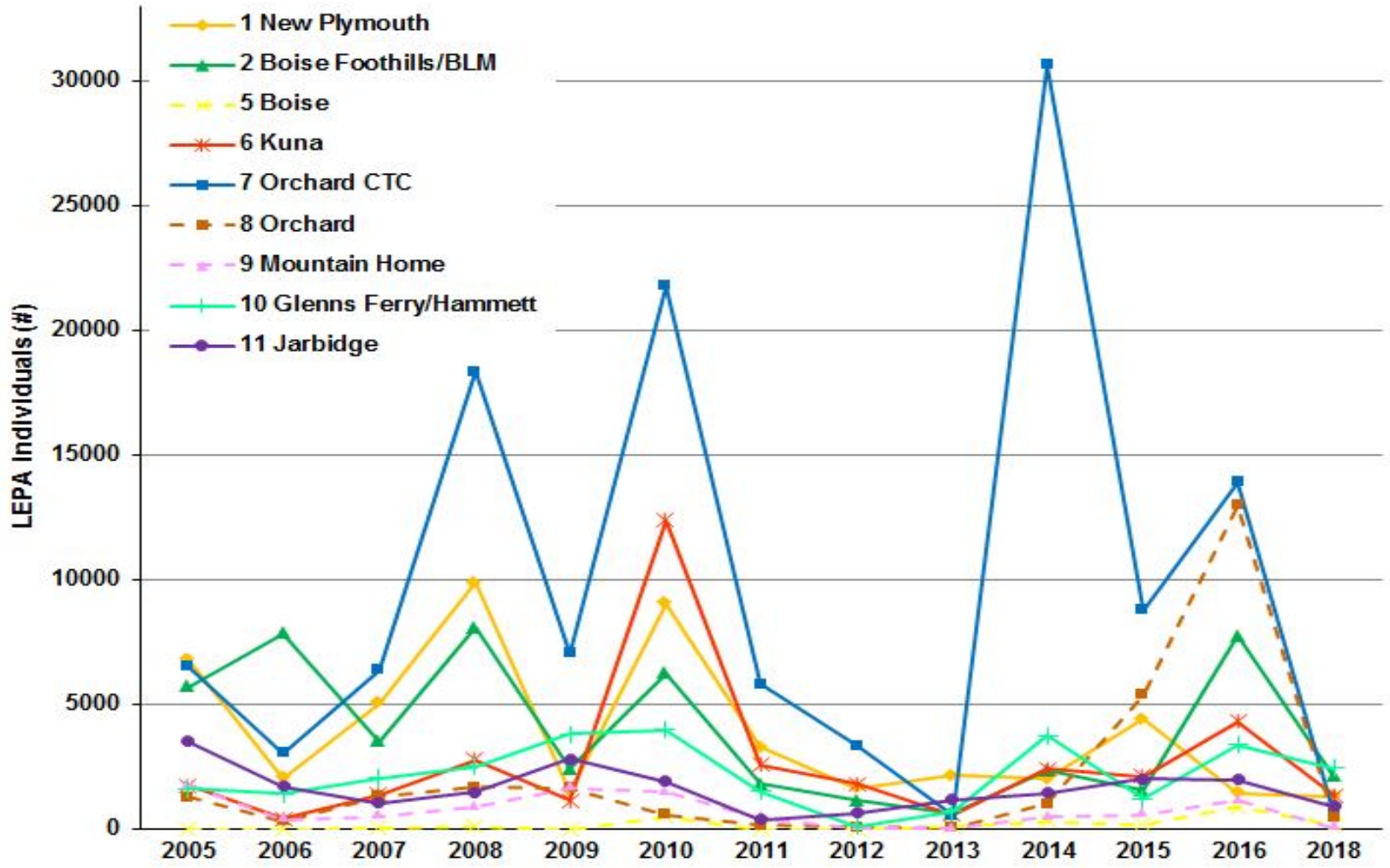


Figure 19. Habitat Integrity and Population (HIP) monitoring data from 2005 though 2018 showing annual variation in slickspot peppergrass plant numbers on monitoring transects by Management Area (Chart created by IDFG, March 2019). No rangewide HIP data are available for 2017. Slickspot Peppergrass Management Areas are described in the Slickspot Peppergrass Candidate Conservation Agreement (State of Idaho 2006).