Assessing the status of *Abronia turbinata* in southeastern Oregon

2009 Progress Report

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A Challenge Cost Share project funded by
The Bureau of Land Management, Vale District *and*
Institute for Applied Ecology

PREFACE

This report is the result of a cooperative Challenge Cost Share project between the Institute for Applied Ecology (IAE) and the Bureau of Land Management. IAE is a non-profit organization dedicated to natural resource conservation, research, and education. Our aim is to provide a service to public and private agencies and individuals by developing and communicating information on ecosystems, species, and effective management strategies and by conducting research, monitoring, and experiments. IAE offers educational opportunities through internships. Our current activities are concentrated on rare and endangered plants and invasive species.

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ACKNOWLEDGEMENTS

Valuable assistance was provided by the Vale District BLM, particularly Jean Findley and Gillian Wigglesworth. Support was also provided by IAE staff: Matthew Barmann, John Grotefend, Tom Kaye, and Shell Whittington. **Cover photograph:** *Abronia turbinata* habitat (above) and individual (below). Photos by Rob Massatti.

REFERENCE

Massatti, R.T., A.S. Thorpe, and M. Mancuso. 2009. Assessing the status of *Abronia turbinata* in southeastern Oregon. Institute for Applied Ecology, Corvallis, Oregon and USDI Bureau of Land Management, Vale District. iv + 40 pp.

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INTRODUCTION

Figure 1. *Abronia turbinata* inflorescences. Photo by M. Mancuso.

Abronia turbinata (cover photo, Figure 1), transmontane sand verbena, is native to the Great Basin and Mojave Desert in Oregon, Nevada, and California. In Oregon, its range is limited to Harney and Malheur counties in the southeastern corner of the state. Because of this limited range, Oregon Natural Heritage Information Center (ORNHIC) considers it a List 2 species (taxa which are threatened, endangered or possibly extirpated from Oregon, but are stable or more common elsewhere) with a G5 global ranking (demonstrably widespread, abundant, and secure) and an S1 state ranking (critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; ORHIC 2007). This progress report documents the methods and results of surveys conducted on BLM lands from 2008 to 2009 and recommends areas for surveying in 2010.

Abronia turbinata is a member of the Nyctaginaceae (the four-o'clock family). The plants are annuals (infrequently perennials) with a decumbent habit, generally crawling across the ground with much branched and elongated stems (Galloway 2004). The stems are reddish at least basally and usually glandular-pubescent. Leaf blades are broadly ovate to orbicular with entire to undulate margins. *Abronia turbinata* may flower from spring through fall. The inflorescences are composed of 15-35 flowers with white to pale pink limbs (Figure 1). The fruits are winged and turbinate and are topped by prominent beaks (Galloway 2004).

Abronia turbinata is found on sandy soils in desert scrub plant communities at about 4,000 feet in the southeast Oregon. Range-wide, *A. turbinata* is restricted to sandy soils but may be a component of a broader array of desert scrub plant communities from 2,900 – 8,200 feet. In Oregon, the sand dunes typically have a shrub component composed of *Grayia spinosa, Atriplex canescens, Artemisia tridentata* ssp. *tridentata, Ericameria nauseosus, Chrysothamnus viscidiflorus,* and *Sarcobatus vermiculatus*. The herbaceous layer is typically sparse (<10% cover) and composed of *Tiquilia nuttallii, Oenothera caespitosa, Oryzopsis hymenoides, Malacothrix torreyi, Aliciella leptomeria, Mentzelia albicaulis,* and *Lupinus pusillus*.

As of 2008, eight populations of *A. turbinata* were on record with ORNHIC (Table 1). These populations were spread from between Burns Junction and Basque along Highway 95 west through Coyote Lake to the Alvord Desert, then south through the Pueblo Valley and the Sand Hills to the Nevada state line (Figure 2 & 3). This project was initiated because thorough surveys for *A. turbinata* in Oregon were lacking and the current status of documented populations was unknown. The goal of this project

is to conduct surveys to determine the distribution of *A. turbinata*, estimate the size of populations, and determine potential threats to these populations.

METHODS

Previously documented *A. turbinata* populations were relocated using Element Occurrence Records from ORNHIC and label descriptions from herbarium specimens. Field surveys were conducted from June 16 – 19, 2008 and June 9 – 11, 2009. We also identified and surveyed potential habitat for the presence of *A. turbinata*. Potential habitat was identified using binoculars, aerial photos, and/or topographic maps. At each site the Intuitive Controlled survey method was employed to determine the extent of the *A. turbinata* population (Whiteaker et al. 1998). A complete census of *A. turbinata* was conducted along the survey route; plant density, habitat, threats, and associated species were also documented. *Abronia turbinata* locations were documented using a navigation grade GPS unit. Additional GPS coordinates were periodically taken to document survey routes. Photographs were taken to show the habitat occupied by *A. turbinata* or other points of interest (Appendix B). Survey routes were delineated on USGS 7.5' topographic quadrangles whether or not *A. turbinata* was found (Appendix A). All survey results will be shared with ORNHIC.

RESULTS

Fieldwork in 2008 and 2009 resulted in the observation of ten occurrences of *A. turbinata* (Table 1). This includes five historical records and five new populations (two of which may be considered extensions of previously reported populations). Additionally, two historical populations were searched for and not relocated (Table 1, Figures 2 & 3, Appendix A). *Abronia turbinata* was relatively common and frequently located when surveys were conducted in appropriate habitat, although there was suitable habitat that was unoccupied. The density of some populations (i.e. Alvord Desert #1-3) was consistently high and distributed more or less evenly while the density of other populations (i.e. Sand Hills #1-2, North of Black Point) was low with a spotty and uneven distribution (Appendix B). Plants were almost always restricted to sandy openings on dunes harboring a desert shrub plant community. A few *A. turbinata* were found on the flats adjacent to dunes where propagules had been washed by rain or wind.

Disturbances were observed at each occurrence and generally included new and/or old cattle feces and prints. Little human disturbance was observed off of the roads used for access. None of the disturbance occurred at a scale that appeared to be a serious threat to *A. turbinata*. As long as destructive activities are not promoted in *A. turbinata* habitat, the long-term viability of these populations is good.

Table 1. *Abronia turbinata* occurrences in southeastern Oregon**.** Alvord Desert #4 will be resurveyed in 2010. The two historical collections were searched for in 2008 and not relocated. See Appendix A for specific population information.

Population	ORNHIC Element Occurrence #	Year (re)located
Alvord Desert #1	26860	2009
Alvord Desert #2	NA	2009
Alvord Desert #3	27506	2009
Alvord Desert #4	26861	(2010)
Mickey Basin	NA	2009
North of Black Point	NA	2009
South of Borax Lake	NA	2009
Coyote Lake	26953	2008
Crooked Creek	27459	2008
Sand Hills #1	26951	2008
Sand Hills #2	NA	2009
Historical collection (near Rome airport)	26954	extirpated? (2008)
Historical collection (S of Fields)	26952	extirpated? (2008)

FUTURE ACTIVITIES

In 2010 we will conduct additional *A. turbinata* surveys. The east sides of the Alvord Desert and Pueblo Valley should be searched more thoroughly to determine the continuity of the *A. turbinata* metapopulation. Potential habitat south of Alvord Desert populations #1-3 should be accessed through the Whitehorse Ranch. The Ranch should be called a week in advance to gain permission for entry (541-495-2222). Two-track roads through their land access Little Sandy Gap (T36S R35E S8) and Big Sandy Gap (T35S R35E S22). Big Sandy Gap would be the best way to access the ORNHIC population not yet revisited, Alvord Desert #4 (EO #26861). Whitehorse Ranch roads also cross over potential habitat that is contiguous to Coyote Lake (Figure 3, habitat is to the southwest of Coyote Lake). The southeast end of the Alvord Desert can alternatively be accessed via a two-track road north of Calderwood Desert Well (T37S R34E S22). Appropriate-looking habitat in the Pueblo Valley is found south of Black Point (see North of Black Point, Appendix A, for directions) and directly adjacent to the Point on its east side. Across the Trout Creek and Oregon Canyon Mountains to the east, potential habitat is present about 8 miles north-northwest of McDermitt, Nevada (Malheur County, west of McDermitt Road, T40S R42E S22, S23, & S15). Finally, very good potential habitat is present on the west side of the Steens Mountains in the basin north and east of the Bass Haines Place (Stickey Lake). This list of potential habitat is by no means complete; it represents some of the most obvious areas based on aerial photographs and satellite images.

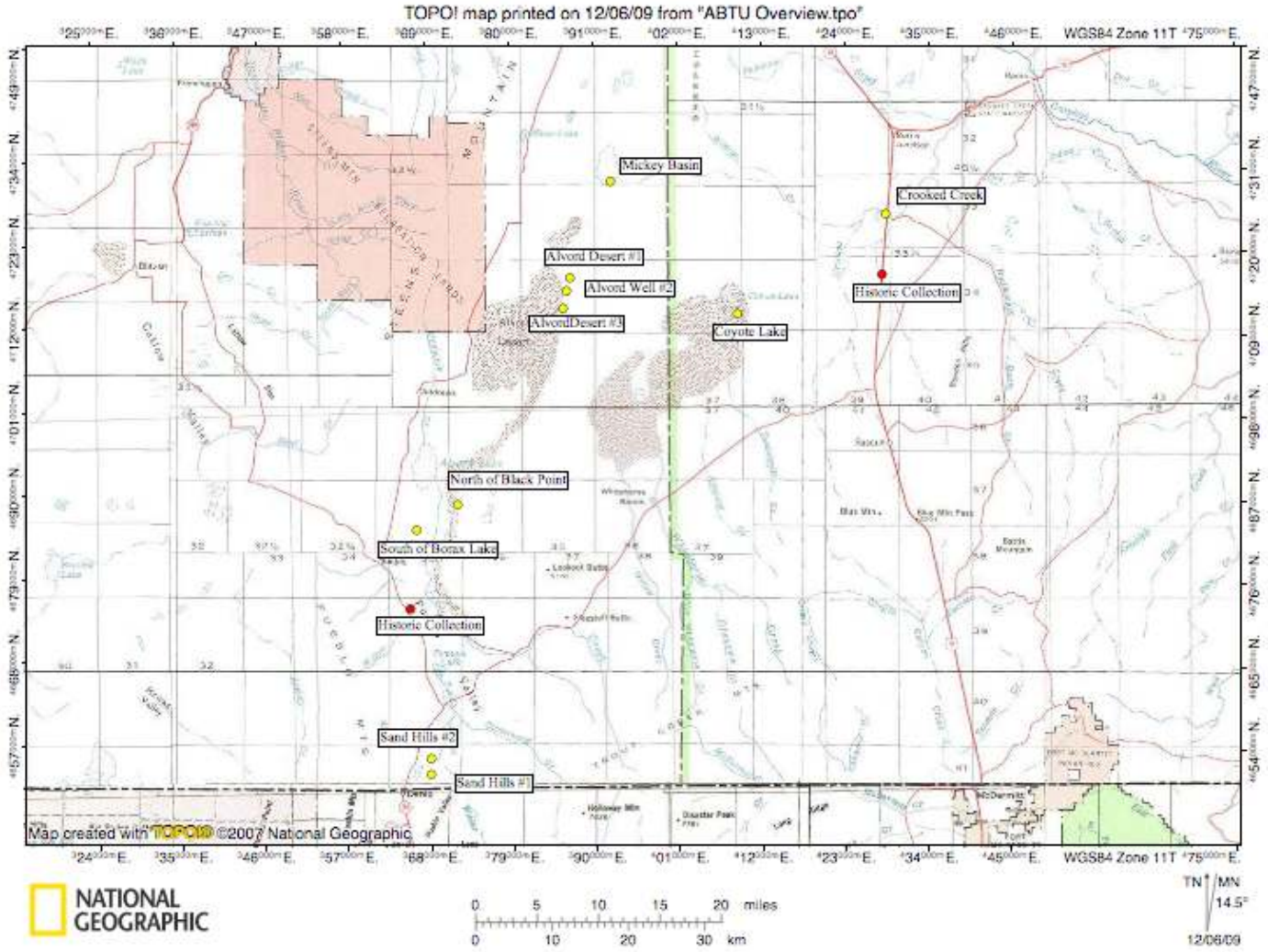

Figure 2. Overview of *Abronia turbinata* populations in Oregon. See population descriptions (Appendix A) for precise location information. Yellow points represent extant populations; red points represent presumably extinct populations. Only one other population is known in Oregon; it is located slightly south of the Alvord Desert #3 population and will be surveyed in 2010.

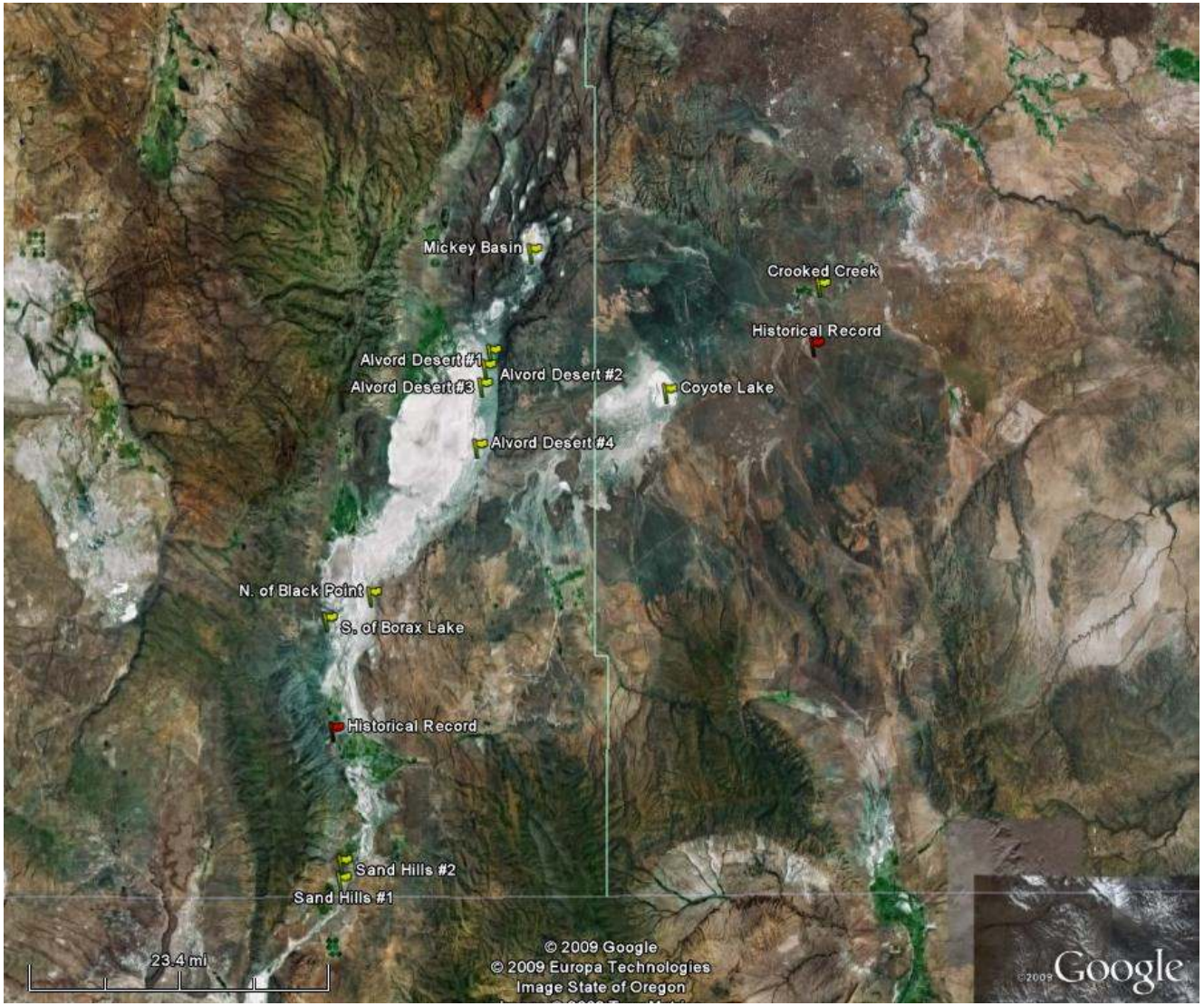

Figure 3. Satellite image of *Abronia turbinata* populations in Oregon. See population descriptions (Appendix A) for precise location information. Yellow flags represent extant populations; red flags represent presumably extinct populations.

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APPENDIX A. POPULATION UPDATE INFORMATION FOR *ABRONIA TURBINATA*

Alvord Desert #1

Survey Date: June 9, 2009

Observers: Rob Massatti and Matthew Barmann
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Location: Alvord Desert Area of Critical Environmental Concern (ACEC) near Alvord Well #2, Harney County. T34S R35E SE1/4 S10 and W1/2 S11. USGS 7.5' quads: Miranda Flat SE and Miranda Flat SW. About 15.5 miles northeast of Andrews, OR. From the Fields-Denio Road, turn east onto Wildcat Creek Road. After 2-3 miles, turn south on an unmarked two-track. Follow this road south about 5 miles. *Abronia* occurred in the dunes on the east side of road. UTMs: 11T 387365E 4717355N, Nad83.

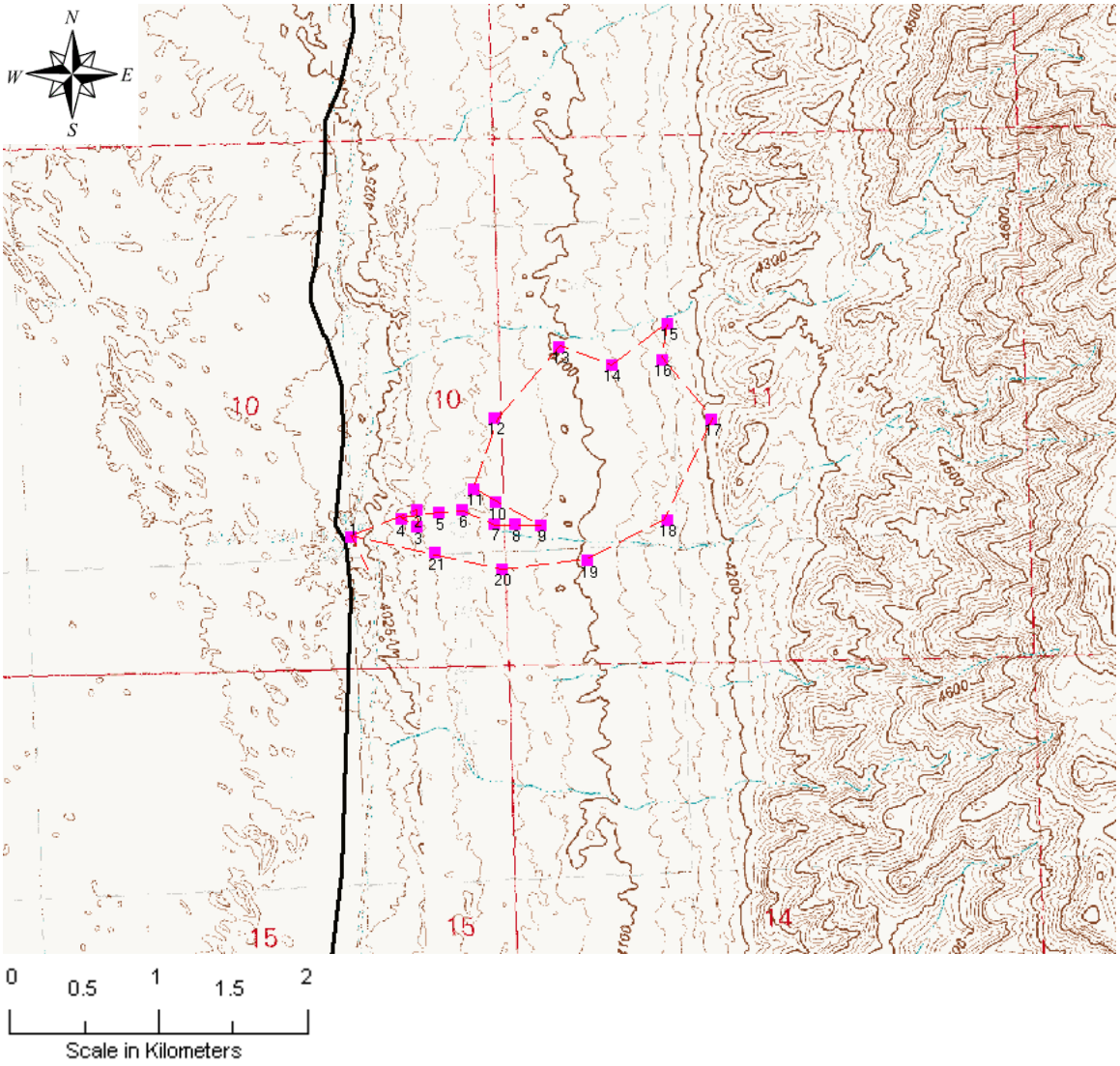
Population information: *Abronia turbinata* was found consistently throughout the dune system east of the two-track dirt road. A total of 411 plants (310 reproductive, 101 vegetative) were recorded during an Intuitive Controlled survey approximately 5 miles long.

Survey information: A population of *A. turbinata* had been located in this area in 1979. Although we began intensively searching each dune to create a complete census for *A. turbinata*, we found that too many plants were present. We changed our method to cover more terrain in order to determine the population boundaries. *Abronia turbinata* was reliably (but not consistently) found on every aspect and topographic position of the raised sandy dunes of the desert basin. The population became sparse and non-existent as we walked east and gained elevation; the topography to the east gradually changed into toeslopes and footslopes of the hills to the east. The survey indicated that *A. turbinata* was widespread and fairly reliable on the basin dunes. Density ranged from locally high to low. As we walked to the north and south, it became evident that the *A. turbinata* population was potentially widespread and continuous along the eastern edge of the Alvord Desert basin. Additional plants were undoubtedly present in areas that we did not walk. Other observations were made to confirm this hypothesis (see Alvord Desert #2 & #3 below and Future Activities section above). *Abronia turbinata* was less abundant to more abundant than other herbaceous species present in the dunes. Unlike the surveys of M. Mancuso, this site did not have any *Oenothera caespitosa*.

Habitat information: The eastern edge of the Alvord Desert is a deposition area for particulates (primarily sand) picked up by winds that sweep eastward across the basin. Particulates are dropped when the hills to the east deflect the winds upwards and cause them to lose speed. A whole series of dunes (and suitable habitat) was created along the eastern edge of the Alvord Desert by this process. The dunes are typically less than 4 meters tall and encompass a variety of shapes, from ridges to mounds. Flats in between mounds show evidence of flash-flooding. Dune plant communities are typically different than the plant communities on the flats; plants more tolerant of salt (i.e. *Distichlis*

spicata) are only found on the flats. Habitat intermediate between dunes and flats also exists and correspondingly harbors a mix of vegetation, including occasional *Abronia turbinata*. The substrate on dunes was typically loose sand, though more soil development occurred in areas of high vegetative cover, especially of shrubs. The substrate in flats was generally more consolidated so as to be a harder pan-type surface. Shrub species commonly associated with *A. turbinata* included *Grayia spinosa, Artemisia tridentata* ssp. *tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosus, Sarcobatus vermiculatus,* and *Atriplex canescens.* Less common shrubs included *Picrothamnus desertorum, Tetradymia glabrata*, and *Artemisia tridentata* ssp. *wyomingensis*. Herbaceous species commonly associated with *A. turbinata* included *Tiquilia nuttallii, Hesperostipa comata, Oryzopsis hymenoides, Bromus tectorum, Malacothrix torreyi, Malacothrix glabrata, Aliciella leptomeria, Mentzelia albicaulis, Salsola tragus, Lupinus pusillus, Stephanomeria exigua, Stanleya* sp., *Penstemon acuminatus,* and *Cleome luteus*.

Disturbance and threat information: This area was largely undisturbed. The two-track road that runs adjacent to the dune habitat showed little sign of use; only a couple of dirt bike tracks were evident. The road becomes impassable to the south without an OHV. No vehicle tracks were witnessed off of the road. Little other human disturbance was evident in the area. A developed well next to the road serves as a watering hole for cattle in season. Cow tracks and flops were present, but were only in high abundance directly adjacent to the well. Another cattle congregation zone was witnessed to the east closer to the hills; cattle may prefer to stay at higher elevations because there seemed to be a stronger graminoid component higher up. Invasive species were restricted to *Bromus tectorum* and *Salsola tragus*. These species were widespread but had very low cover throughout the inventoried area. The poor sandy soils probably prevent a more dense or rapid invasion.



Topographic map with GPS waypoints for the Alvord Desert #1 *A. turbinata* population. The estimated survey route is marked with a red dashed line. Most of the documented *Abronia* occurred west of waypoints 14 - 17.

Alvord Desert #2

Survey Date: June 9, 2009

Observers: Rob Massatti and Matthew Barmann
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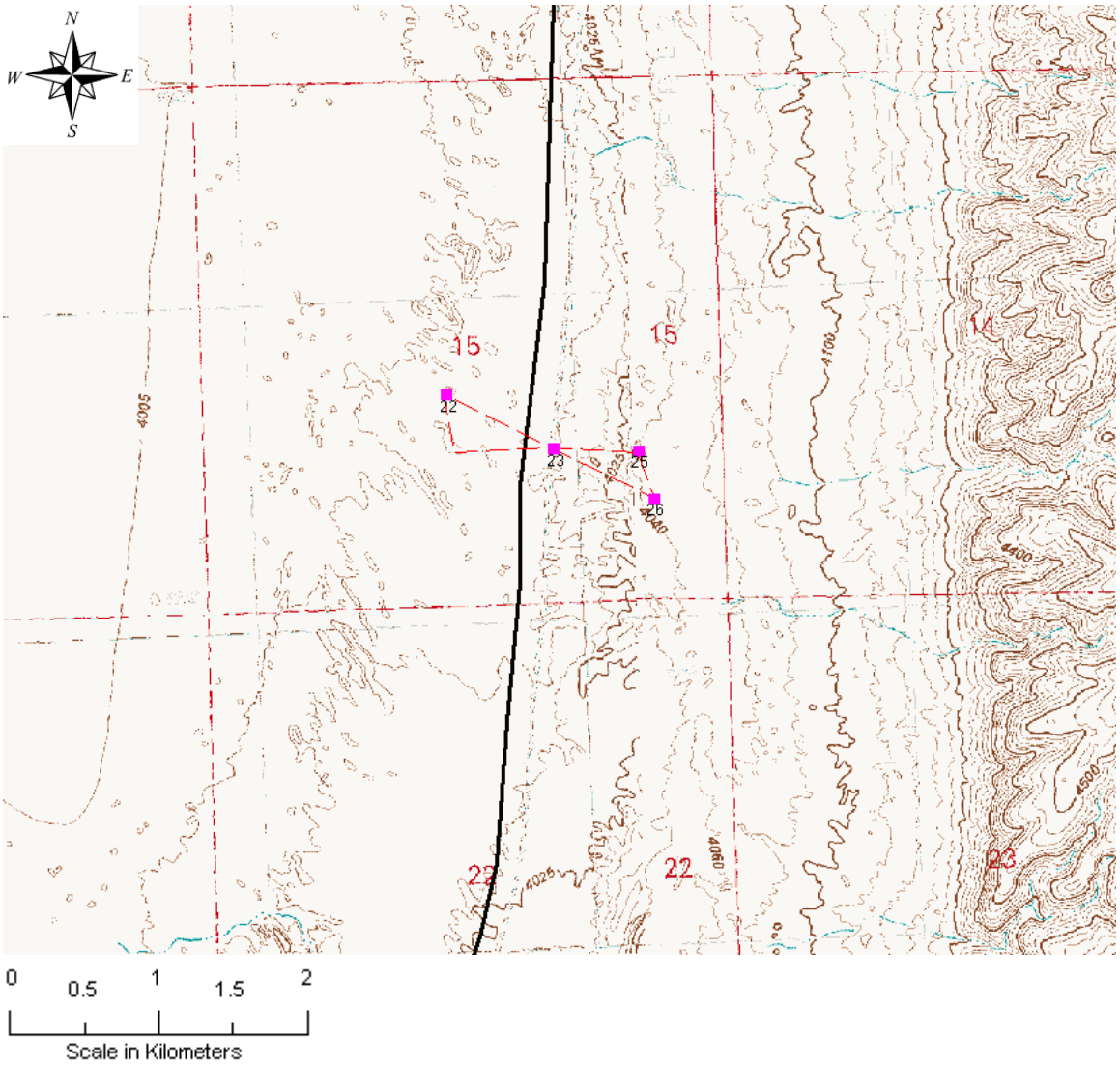
Location: Alvord Desert ACEC, about 1 mile south of Alvord Well #2, Harney County. T34S R35E SE1/4 S15. USGS 7.5' quads: Miranda Flat SE and Miranda Flat SW. About 15 miles northeast of Andrews, OR. From the Fields-Denio Road, turn east onto Wildcat Creek Road. After 2-3 miles, turn south on an unmarked two-track. Follow this road south about 6 miles. *Abronia* occurred in the dunes on the east side of road. UTMs: 11T 387112E 4715715N, Nad83.

Population information: We surveyed approximately 1 mile of habitat using the Intuitive Controlled method and counted 51 plants (38 reproductive and 13 vegetative). The plants occurred on several dunes; compared to Alvord Desert #1, a lower percentage of dunes was populated.

Survey information: We stopped at this point, which was roughly halfway between two historical populations, in order to assess the prospect that *A. turbinata* is continuous along the eastern edge of this portion of the Alvord Desert basin. Although the habitat was extremely similar to that of the Alvord Desert #1 population, *A. turbinata* was not as reliably present. We did not conduct a more intensive search after we determined that *A. turbinata* was present.

Habitat information: The habitat at this point was very similar to the habitat described in Alvord Desert #1 above. More surface area was covered by washed out flats and associated salt tolerant species such as *Picrothamnus desertorum* and *Distichlis spicata*.

Disturbance and threat information: See this section for Alvord Desert #1. This area did not have an adjacent well and no cattle congregation areas were noted, but *Bromus tectorum* and *Salsola tragus* were present in similar densities.



Topographic map with GPS waypoints for the Alvord Desert #2 *A. turbinata* population. The estimated survey route is marked with a red dashed line. Most of the documented *Abronia* occurred near waypoints 25 and 26.

Alvord Desert #3

Survey Date: June 9, 2009

Observers: Rob Massatti and Matthew Barmann
Institute for Applied Ecology
POB 2855
Corvallis, OR 97339-2855

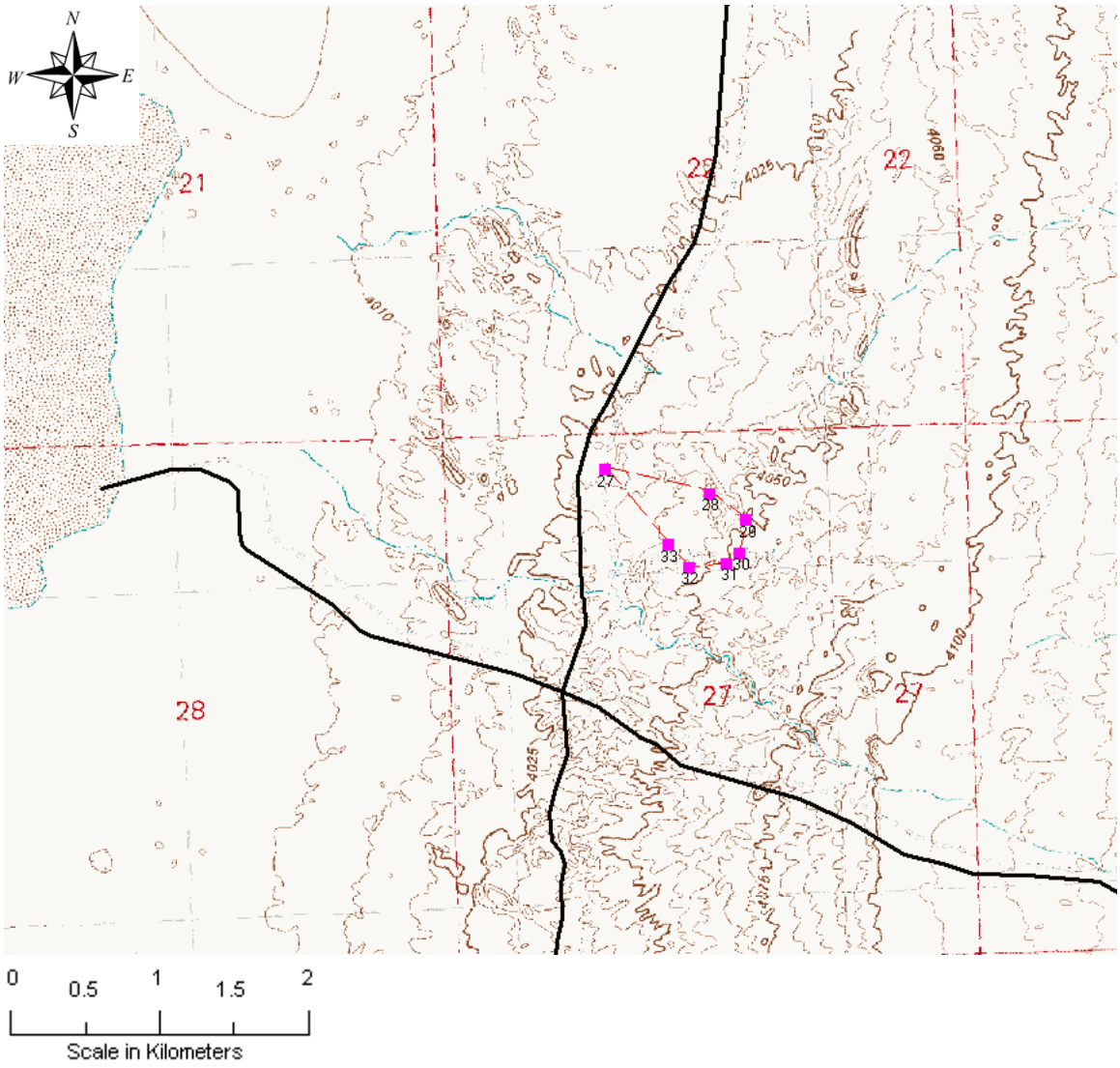
Location: Alvord Desert ACEC, near Alvord Well #3, Harney County. T34S R35E NW1/4 S27. USGS 7.5' quads: Miranda Flat SE and Miranda Flat SW. About 14.5 miles northeast of Andrews, OR. From the Fields-Denio Road, turn east onto Wildcat Creek Road. After 2-3 miles, turn south on an unmarked two-track. Follow this road south about 7.5 miles. *Abronia* occurred in the dunes on the east side of road. UTMs: 11T 386428E 4713286N, Nad83.

Population information: This site was similar to Alvord Desert #1; *A. turbinata* was found in most of the areas with suitable habitat. We counted 369 plants (260 reproductive and 109 vegetative) while conducting an Intuitive Controlled survey approximately 1.5 miles long.

Survey information: A population of *A. turbinata* had been located in this area in 1998. We found a high density of plants on most of the dunes that we encountered during our survey. Additional plants were noted but not included in our population count.

Habitat information: The habitat at this point was very similar to the habitat described in Alvord Desert #1 above. Unlike the former points, this area had *Oenothera caespitosa* associated with the *A. turbinata*. On one of the largest dunes with the highest densities of plants, shrub cover was 20%, graminoid cover was less than 2%, and forb cover was about 5%. The plants were concentrated on the crest and north and east slopes of the dune.

Disturbance and threat information: See this section for Alvord Desert #1; this area was very similar in that it had an adjacent well with cattle congregation areas. *Bromus tectorum* and *Salsola tragus* were present in similar densities as above. *Abronia turbinata* was noted to have been highly grazed in this area. The two-track road becomes impassable to highway vehicles less than 0.5 miles to the south.



Topographic map with GPS waypoints for the Alvord Desert #3 *A. turbinata* population. The estimated survey route is marked with a red dashed line. Most of the documented *Abronia* occurred from waypoints 28 - 33.

Mickey Basin

Survey Date: June 11, 2009

Observers: Rob Massatti and Matthew Barmann
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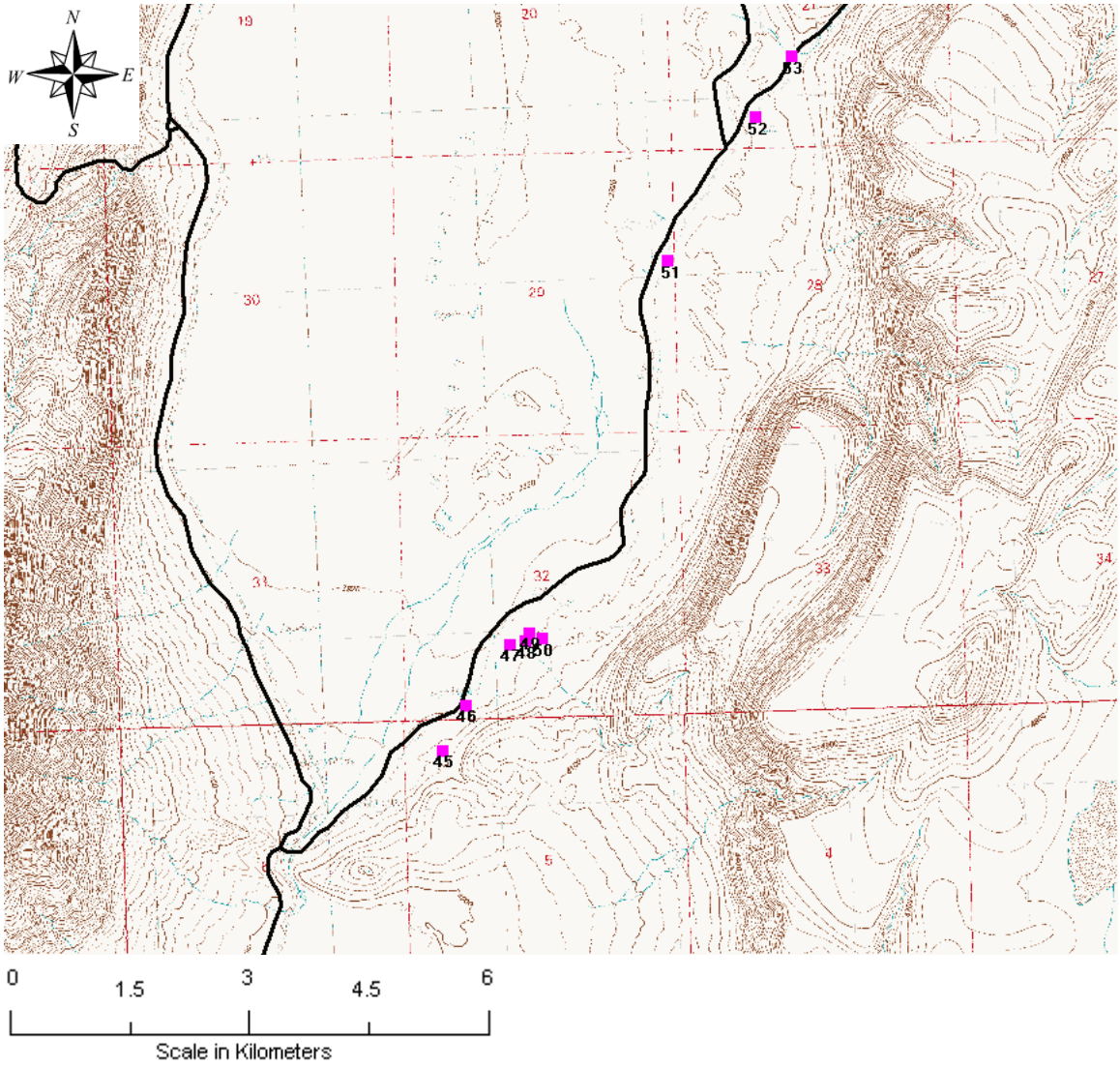
Location: Table Mountain Wilderness Study Area (WSA) and Winter Range WSA, Mickey Basin, Harney County. T32S R36E SW1/4 S32 and SW1/4 S21. USGS 7.5' quads: Mickey Springs and Coffin Butte. About 24 miles northeast of Andrews, OR. From the Fields-Denio Road, turn east onto Wildcat Creek Road. Drive about 10 miles until you reach Mickey Basin. The plants were located on the east side of the road at the southern end of the Basin and on the west side of the road at the northern end of the Basin. UTMs: 11T 393122E 4730191N, Nad83.

Population information: The *Abronia turbinata* population had a patchy distribution throughout this dune system. An extensive subpopulation (122 plants: 100 reproductive and 22 vegetative) was located in the southeast corner of Mickey Basin. We also located 9 reproductive plants that occurred in a 10 m^2 patch at the northeastern end of the basin. These plants represent the northern-most documented occurrence of *A. turbinata.* Plants are potentially found scattered throughout the dune system east of Wildcat Creek Road (and to the west of the road when it climbs out of the basin in the northeast). There are also isolated dunes that potentially harbor plants located in the central-southeast portion of the basin.

Survey information: An Intuitive Controlled survey was conducted in the southeast corner of Mickey Basin that covered approximately 2 miles of potential habitat. We then drove north on Wildcat Creek Road; potential habitat occurred primarily east of the road, but also in isolated patches to the west. We stopped and surveyed habitat at the northeast end of the Basin, before Wildcat Creek Road climbs over a small saddle.

Habitat information: Similar to the eastern edge of the Alvord Desert, the eastern edge of Mickey Basin is a deposition zone for sand carried by winds sweeping across the basin. This process has created an extensive zone of suitable habitat composed of sandy dunes interspersed with flats. Shrub species commonly associated with *A. turbinata* included *Grayia spinosa, Artemisia tridentata* ssp. *tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosus, Sarcobatus vermiculatus,* and *Atriplex canescens.* Less common shrubs included *Picrothamnus desertorum, Tetradymia glabrata*, and *Artemisia tridentata* ssp. *wyomingensis*. Commonly associated herbaceous species included *Tiquilia nuttallii, Oryzopsis hymenoides, Bromus tectorum, Malacothrix torreyi, Malacothrix glabrata, Aliciella leptomeria, Mentzelia albicaulis, Salsola tragus, Lupinus pusillus, Stephanomeria exigua, Astragalus geyeri*, *Penstemon acuminatus,* and *Phacelia* sp.

Disturbance and threat information: Few direct threats to the dunes harboring *A. turbinata* were observed. There is a closed road that runs around the periphery of Mickey Basin that may get occasional use, but it largely does not go through appropriate habitat. There are also several places adjacent to Wildcat Creek road where vehicle disturbance is heavy; again, these areas do not correspond to *Abronia* habitat. No vehicle tracks were witnessed in the dunes around the *Abronia* populations, probably in part because the shrub cover was relatively thick (>25% cover). Cattle feces were noted in several areas during the Intuitive Controlled surveys, but they were highly decomposed. *Bromus tectorum* and *Salsola tragus* were both noted in low densities (<5% cover in localized patches).



Topographic map with GPS waypoints for the Mickey Basin *A. turbinata* population. Intuitive Controlled surveys were conducted around each waypoint. Most of the documented *Abronia* occurred around waypoints 48-50, although a few were found near 53 as well.

Sand Hills #2

Survey Date: June 10, 2009

Observers: Rob Massatti and Matthew Barmann
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POB 2855
Corvallis, OR 97339-2855

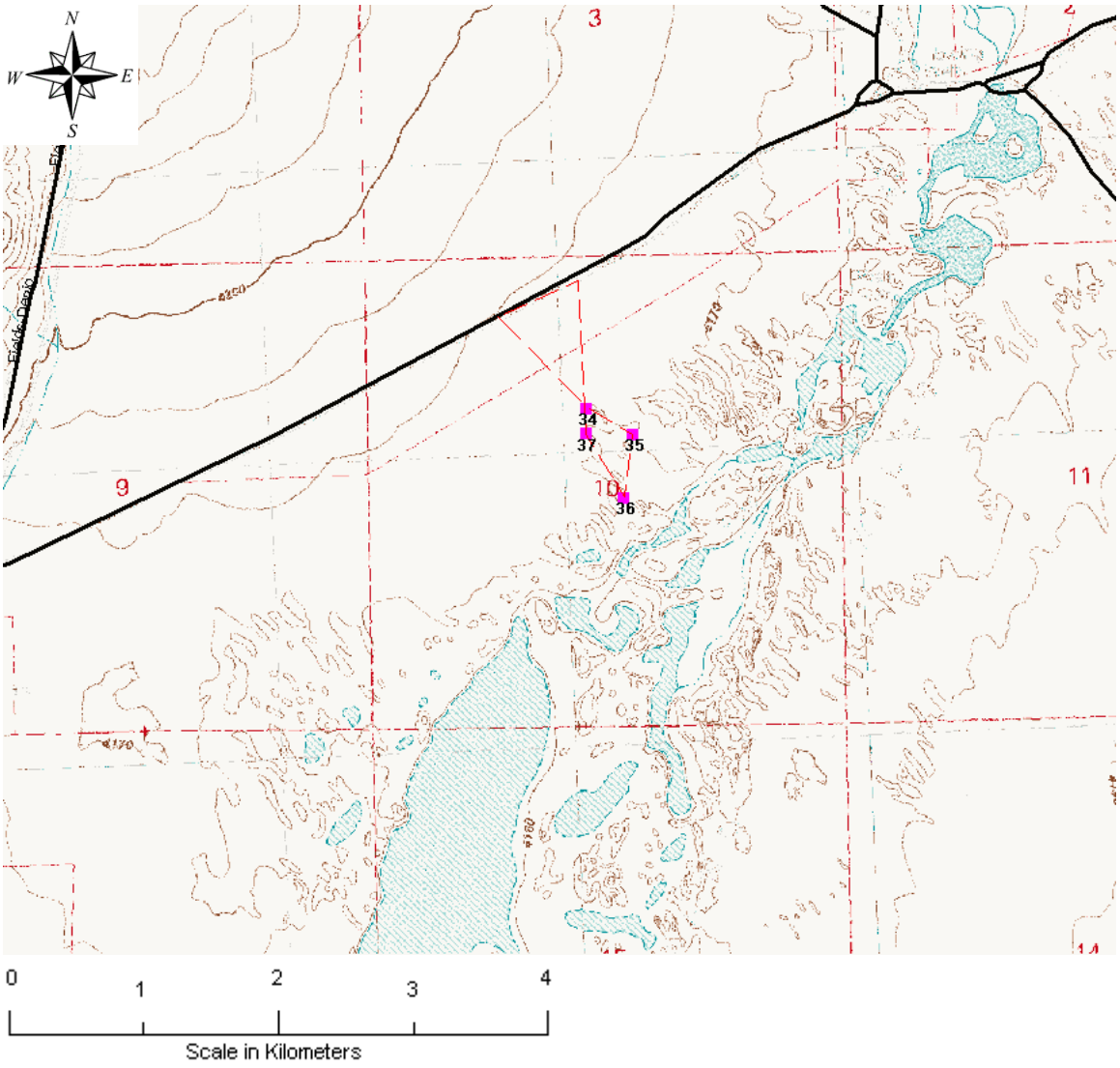
Location: Sand Hills area, Harney County. T41S R35E NW1/4 S10. USGS 7.5' quad: Colony Ranch. About 17 miles south-southeast of Fields, OR and 3 miles northeast of Denio, NV. From the Fields-Denio Road, turn east onto an unnamed two-track that runs northeast, located 2.5 miles north of the Nevada – Oregon border. Plants were located south of the two-track road. UTMs: 11T 368003E 4654352N, Nad83.

Population information: Only 2 small subpopulations were found despite what looked like extensive suitable habitat. We found a total of 29 plants (10 reproductive and 19 vegetative) after walking about 1 mile using the Intuitive Controlled survey method. *Abronia turbinata* populations are probably continuous between this area and the area surveyed by Mike Mancuso in 2008 about 1.5 miles south (see Sand Hills #1 below).

Survey information: This survey was conducted to establish the presence of *A. turbinata* at the northern end of the Sand Hills dune complex. After walking through what seemed like optimal habitat, we had found only 29 plants, indicating that *A. turbinata* was indeed widespread, but with a spotty distribution as M. Mancuso had suggested (see Sand Hills #1 below). Contrary to what M. Mancuso suggested, the northern part of the Sand Hills is not unsuitable habitat for *Abronia turbinata*.

Habitat information: Sand Hills #2 is a continuation of the habitat described by M. Mancuso (see Sand Hills #1 below). The dune system encompasses a large area and has substantial potential habitat for *A. turbinata*. The dunes are of various sizes, but are generally less than 4 meters tall and run in long parallel ridges. Common shrub species noted around this point included *Atriplex canescens, Sarcobatus vermiculatus, Chrysothamnus viscidiflorus, Tetradymia glabrata, Ericameria nauseosus,* and *Artemisia tridentata* ssp. *tridentata.* Common forb species included *Oenothera caespitosa, Leptodactylon nuttallii, Oryzopsis hymenoides, Hesperostipa comata,* and *Bromus tectorum*. There was more *Oenothera caespitosa* located in this area than in the other areas surveyed in 2009.

Disturbance and threat information: Little disturbance was noted in this area. No motorized vehicle disturbance was noted except for what was present on the access road. One mining claim was encountered, but no signs of active mining were present. The only invasive species present was *Bromus tectorum*, which was widespread at low cover (<1%). We did not notice any signs of livestock.



Topographic map with GPS waypoints for the Sand Hill #2 *A. turbinata* population. The estimated survey route is marked with a red dashed line. Most of the documented *Abronia* occurred around waypoint 34.

North of Black Point

Survey Date: June 10, 2009

Observers: Rob Massatti and Matthew Barmann
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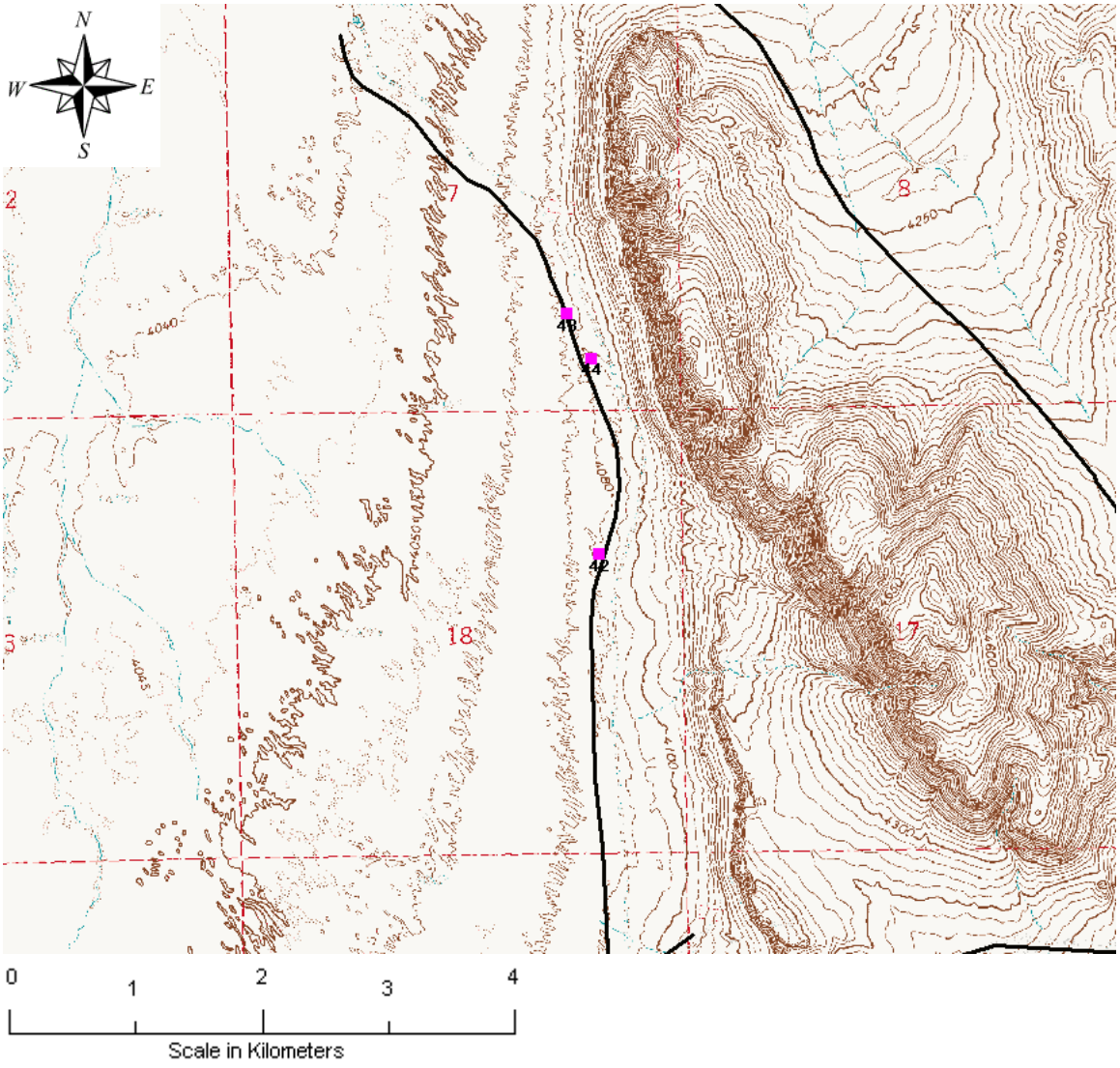
Location: Eastern edge of the Pueblo Valley, Harney County. T37S R34E NE1/4 S18. USGS 7.5' quad: Borax Lake. About 7.5 miles northeast of Fields, OR and 2 miles north of Black Point Well. From the Fields-Denio Road, turn east onto an unmarked two-track that runs adjacent to powerlines located approximately 1.75 miles north of Fields. Follow this road across Pueblo Valley and make a left onto another unnamed two-track (about 6.25 miles). Drive a little more than 1 mile. The plants were located on the west side of the two-track. UTMs: 11T 372257E 4687532N, Nad83.

Population information: There are not many developed dunes in this area, thus the habitat for *A. turbinata* is limited. Only one small population with 9 plants (4 reproductive and 5 vegetative) was discovered after walking about 1 mile using the Intuitive Controlled survey method. More populations are probably scattered throughout the area, but in a very low density.

Survey information: These dunes were located as we were scouting the east side of the Pueblo Valley. As mentioned above, suitable habitat in this area is limited. Along the two-track that we drove, there was at most one to two long dune ridges paralleling the road to the west. Along many portions of the road, there were no dunes at all. When we found habitat that looked suitable, we searched it intensively. It is notable that *Abronia turbinata* was present in this seemingly disjunct location.

Habitat information: This dune system may not be well developed because it is not close to a sand source for extensive dune building processes. Similar species inhabit the dunes; common shrub species included *Sarcobatus vermiculatus, Grayia spinosa,* and *Atriplex canescens*. Common herbaceous species included *Oryzopsis hymenoides, Hesperostipa comata, Malacothrix torreyi,* and a white form of *Camissonia claviformis*.

Disturbance and threat information: Stochastic events may be the primary threats to this population. Several years of low seed production and/or inclement growing conditions could cause this small population to become extinct. If extirpated, it is unclear where propagules would disperse from for reestablishment. Cow tracks and manure were observed in the dunes around the *A. turbinata* population. *Bromus tectorum* was also noted throughout the area at a low density (<1% cover).



Topographic map with GPS waypoints for the North of Black Point *A. turbinata* population. Intuitive Controlled surveys were conducted around the waypoints marked. Several *Abronia* occurred around waypoint 42.

South of Borax Lake

Survey Date: June 10, 2009

Observers: Rob Massatti and Matthew Barmann
Institute for Applied Ecology
POB 2855
Corvallis, OR 97339-2855

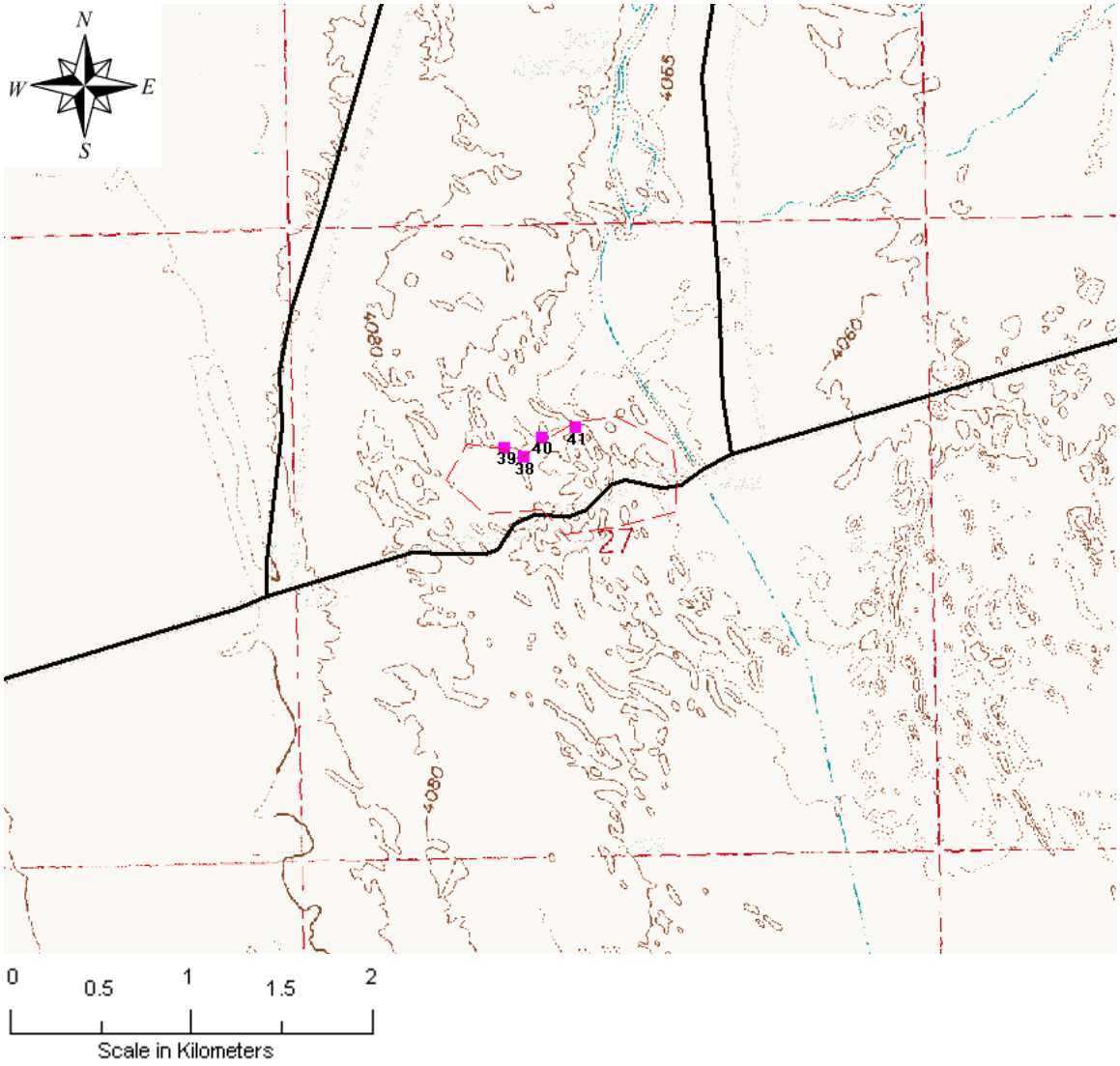
Location: Center of the Pueblo Valley, Harney County. T37S R33E NW1/4 S27. USGS 7.5' quad: Borax Lake. About 4 miles northeast of Fields, OR and 2 miles south-southwest of Borax Lake. From the Fields-Denio Road, turn east onto an unmarked two-track that runs adjacent to powerlines located approximately 1.75 miles north of Fields. Follow this road 2.5 miles. The plants were located on the north side of the two-track. UTMs: 11T 366750E 4684473N, Nad83.

Population information: Subpopulations of *A. turbinata* with medium to high density are scattered throughout this dune system. We found 50 plants (27 reproductive and 23 vegetative) centralized in 2 areas after walking roughly 2 miles using the Intuitive Controlled survey method. Abundant habitat is present and more plants no doubt exist in the area.

Survey information: This area was located while we were en route to look for habitat on the east side of the Pueblo Valley. There is an extensive dune system around the survey point to the north and the south, and much of it looks like suitable habitat for *A. turbinata*. The habitat to the south looks to be inaccessible to vehicles; the habitat to the north can be accessed by two-track roads that lead to Borax Lake. Our survey established that plants are present on some dunes, but they are not ubiquitous.

Habitat information: The habitat in this area is dominated by shrubs including *Sarcobatus vermiculatus, Grayia spinosa,* and *Atriplex canescens*. The herbaceous layer is sparse and is dominated by *Oryzopsis hymenoides* and *Malacothrix torreyi*. *Abronia turbinata* is located on all aspects and positions of the dunes; the largest population that we surveyed covered approximately 400 m^2.

Disturbance and threat information: The road accessing this area is well maintained and probably receives a fair volume of traffic. Despite the maintained access, no human disturbance was noted during our survey. The habitat seems nondescript enough to keep people from stopping and getting out of their vehicles. No invasive species were noted along the survey route, but *Bromus tectorum* was seen along the roadside. Evidence of cattle and wildlife were not noted.



Topographic map with GPS waypoints for the South of Borax Lake *A. turbinata* population. The estimated survey route is marked with a red dashed line. Most of the documented *Abronia* occurred around waypoint 41.

Sand Hills #1

Survey date: June 18, 2008

Observer: Michael Mancuso, 20 N. Wilson St,, Boise, ID 83706

Location: Crescent Dunes in the Pueblo Valley, roughly 2 miles northeast of Denio and 1 mile north the Nevada state line. Off the Fields-Denio Road, turn east onto the Cottonwood Creek Road approximately 0.5 mile north of Denio. Continue east for approximately 3 miles to the Pueblo Slough bridge. *Abronia* occurs south of the bridge and also further east off the Cottonwood Creek Road.

Population information: *Abronia* occurred as widely scattered individuals or in small groups. A total of 53 plants were recorded at 17 scattered locations over an approximately 60 acre area.

Survey information: Moderately thorough survey over a portion of the large Crescent Dunes complex. Crescent Dunes and related sand dune complexes in adjoining areas cover several square miles. The survey purposefully searched several different portions of the dune complex to get a sense of the distribution pattern and abundance of *Abronia* in the area. The survey indicated *Abronia* was widespread, but spotty, and with very low density. No *Abronia* was found in many patches of suitable-appearing dune habitat between scattered individuals and small clusters. The *Abronia* was much less common than other forb species on the dunes, including other annuals, which were generally widespread and common. However, additional *Abronia* plants were undoubtedly present in at least some unsurveyed portions of the dune complex in Oregon, which extends southward into Nevada as well. Based on the absence of *Oenothera caespitosa* and several other commonly associated herbaceous species, portions of the dune complex (especially to the north) appeared to have conditions unsuitable for *Abronia*. *Distichlis spicata* was relatively more common in some sandy area, perhaps indicating conditions too saline for *Abronia*. Other segments of the dune complex had relatively high shrub cover that may have precluded *Abronia*, which usually occurred in open patches of reduced shrub canopy

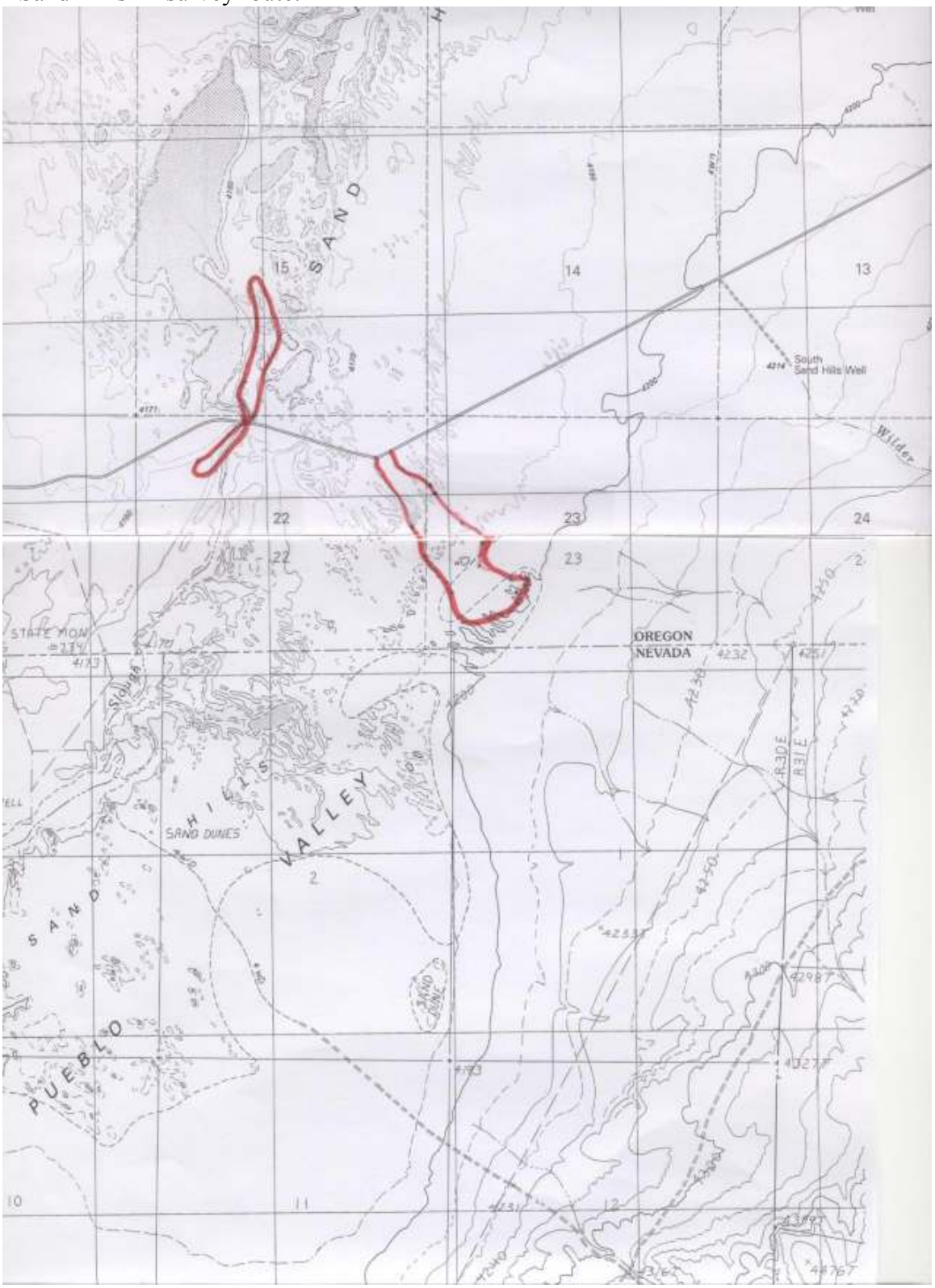
Habitat information: Crescent Sand Dunes is a large complex of elongated, low, vegetated dunes of relatively loose sand, up to approximately 5 m tall and 5 m wide. The low dunes are separated by intervening flats comprised of more consolidated, often crusty sand. Desert shrub vegetation tended to be more consistent and with higher cover on the flats, compared to the dunes. *Abronia* occupied open areas on the dune slopes, and less commonly along the crest, or base of the dunes. Common shrub species included *Atriplex canescens, Grayia spinosa*, *Artemisia tridentata* ssp. *tridentata*, *Ericameria nauseosus*, *Chrysothamnus viscidiflorus*, and *Sarcobatus vermiculatus.* Other associates included *Achnatherum hymenoides, Oenothera caespitosa, Tiquilia nuttallii*, *Psoralidium lanceolatum, Mentzelia albicaulis*, *Aliciella leptomeria*, *Cryptantha circumscissa,* and *Bromus tectorum*. Several species such as *Atriplex confertifolia*, *Artemisia tridentata* ssp.

wyomingensis and *Artemisia spinescens* occurred on the sandy flats, but not on the dunes. Overall ecological condition of habitat within the occurrence assessed as good.

Disturbance and threat Information: The dune complex was largely undisturbed. Old horse feces and evidence of wildlife use were scattered in the area. No sign of ATV or other motorized use was observed within surveyed portions of the dune complex. Two mining claim markers were encountered, but no evidence of sand mining. *Bromus tectorum* was widespread at trace (<1%) cover throughout the dunes. No other non-native plant species were observed. The relatively sparse distribution of bunchgrass species may reflect historic livestock use in the area, but recent cattle or sheep sign was not see. Bird hunters and probably other people use the dunes for non-motorized recreational purposes. Potential threats to *Abronia* habitat in the area included off-road motorized vehicle use, sand mining, and wildfire. Prospects for the long-term persistence of the occurrence if conditions do not change assessed as good.

Collector/Collection #/Herbarium: Michael Mancuso, #3298, Oregon State University

Sand Hills #1 survey route.



Coyote Lake

Survey date: June 16 and 17, 2008

Observer: Michael Mancuso, 20 N. Wilson St,, Boise, ID 83706

Location: In the vicinity of the southern and eastern shorelines of Coyote Lake, approximately 15 miles north of Whitehorse Ranch, and 15 miles southwest of Burns Junction. From Highway 95, travel approximately 12 miles westward on the Whitehorse Ranch road. Approximately 0.5 mile west of the turnoff to Twelvemile Ranch, turn north onto the unmarked, dirt 2-track road that leads approximately 10 miles to Coyote Lake. A high clearance vehicle (4-WD helpful) required for segments of this access road. Accessing Coyote Lake via the Oregon Central Military Road is not recommended. UTMs for south shore populations: 11T 408038E 4711634N, Nad83.

Population information: A total of 70 plants in 10 widely scattered small patches containing 1 to 24 individuals. Patches ranged in size from approximately 1 m^2 - 500 m^2. All patches were located within 0.3 mile of the southern or eastern margins of Coyote Lake (playa). Nine of the patches occurred in the vicinity of Coyote Lake's southern edge, and one patch was found off the eastern shore area. Most plants had flowers, but a few small individuals did not.

Survey information: The survey included traverses of the eastern shore area, nearly to the northern end of the lake; all of the southern shore and selected areas extending further southward; and from the southern shore approximately half-way up the western shoreline. A few "islands" on the playa were also searched. No segment of the northern shore area was surveyed. Large segments of the dunes around Coyote Lake appeared to be unsuitable habitat for *Abronia*. Plants were never found in areas with a wind-scoured, hardened crust sand surface, or in areas covered with a thin, fine layer of minute rock/cinder that gave the surface a dark or black cast. These surface conditions apparently represented unsuitable habitat. Other sandy areas around Coyote Lake appeared to be only marginal habitat due to relatively high shrub cover, or the absence or near absence of common associated species such as *Oenothera caespitosa* and *Malacothrix* spp. Most sand habitat on the east side of Coyote Lake appeared unsuitable for *Abronia*, especially further north along and near the shore. No suitable habitat was observed on the west side of the lake, with forb species generally rare or absent in this area. The majority of sandy habitat suitable for *Abronia* occurred in the low, gently rolling dunes near the south end of Coyote Lake. A less extensive zone continued around the southeastern margin of the lake northward in a relatively narrow band along the eastern shore. *Abronia* was absent from many areas that looked to be good potential habitat. Overall, *Abronia* was found to be more widespread near the southern end of Coyote Lake than previously mapped. In contrast, plants were found at only one small site on the east side of the lake, a much smaller area than previously mapped.

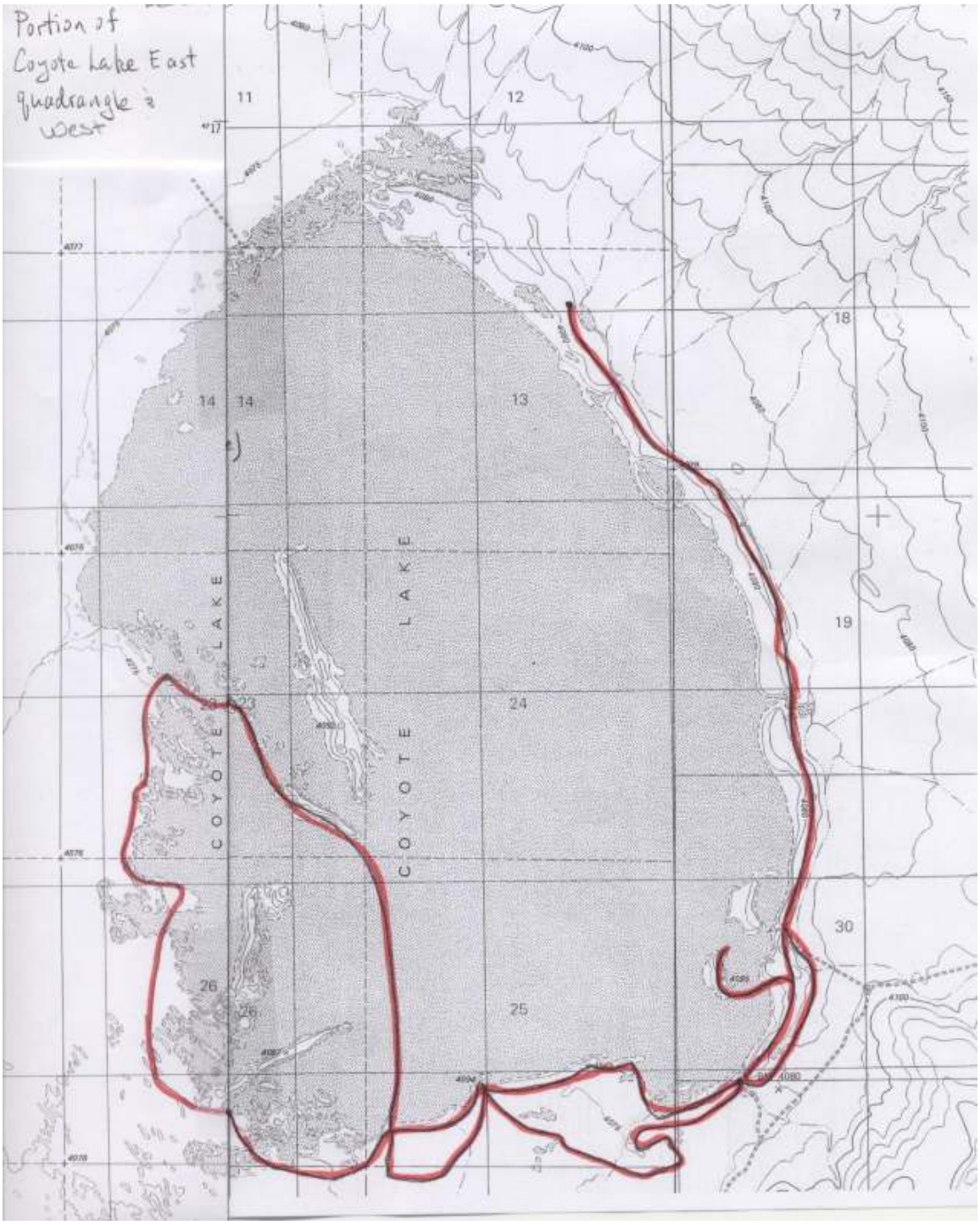
Habitat information: Low, intricate, undulating dunes of loose sand. Abronia often in small swale positions. Common associate species included *Atriplex canescens, Grayia*

spinosa, *Artemisia tridentata* ssp. *tridentata*, *Achnatherum hymenoides, Oenothera caespitosa, Tiquilia nuttallii*, *Malacothrix torreyi*, *Malacothrix glabrata*, and *Bromus tectorum*.

Disturbance and threat information: Wild horses use the Coyote Lake area at least seasonally. Both 2008 and previous year's horse feces were common and scattered throughout the area, including at and near *Abronia* patches. Some old cattle feces may have been present in places, but was sufficiently deteriorated to possibly all be old horse feces. Motorcycle tracks were widespread on the playa, and one motorcyclist was observed riding across Coyote Lake playa. Three recent single tracks were observed cutting through the dunes within the occurrence. *Bromus tectorum* was widespread at low (varied from <1 to <5%) cover throughout the occurrence. A few other non-native plant species occurred sporadically with sparse cover, including *Sisymbrium altissimum* and *Halogeton glomeratus*.

Collector/Collection #/Herbarium: Michael Mancuso, #3297, Oregon State University

Coyote Lake survey route



Crooked Creek

Survey date: June 16, 2008

Observer: Michael Mancuso, 20 N. Wilson St,, Boise, ID 83706

Location: Crooked Creek at its crossing of Highway 95, approximately 7 miles south of Burns Junction. South side of Crooked Creek, west side of highway. UTMs: 11T 429071E 4725268N, Nad83.

Population information: An estimated 200 plants; 181 counted in an area roughly 1 acre in size. Plants occurred as scattered individuals or in small groupings; estimated 80% in flower, and 20% smaller, non-reproductive individuals. Neither mature fruits, nor any insect visitors observed. The eastward end of the occurrence within 30 meters of the highway.

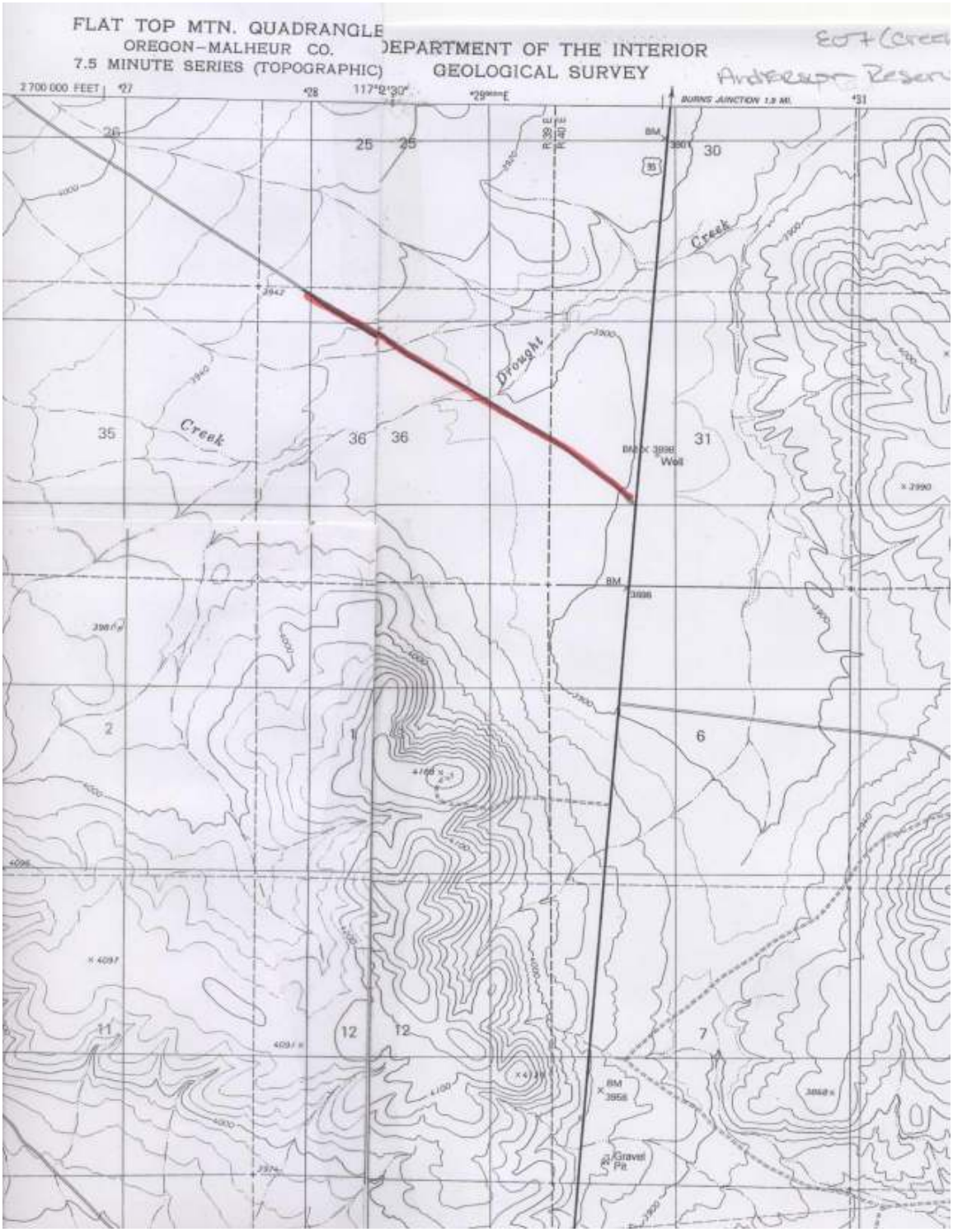
Survey information: *Abronia* was not observed on nearby slopes to the south, on the north side of creek, or east of Highway 95. Additional habitat suitable for Abronia may occur upstream on private land but was not searched. Neither *Abronia*, nor suitable sandy habitat was found on BLM property further upstream near Crooked Creek Spring.

Habitat information: Flat to low (<1m tall) sand mounds on low bench extending away from creek channel in the valley bottom. Desert shrub-dominated plant community with *Artemisia tridentata tridentata*, *Ericameria nauseosus*, and *Sarcobatus vermiculatus*. *Oryzopsis hymenoides* was the main bunchgrass, but present at only low cover. *Distichlis spicata* was less common in areas occupied by *Abronia* than adjacent portions of the bottomlands. *Bromus tectorum* was widespread at low cover. Associated forbs included *Oenothera caespitosa*, *Leucocrinum montanum* (flowers and fruits absent), *Tiquilia nuttallii*, *Malacothrix torreyi*, *Gilia leptomeria*, and several other native annual forbs.

Disturbance and threat information: A dirt road bisected the western section of the occurrence. Cattle feces were scattered about, but not abundant, and none of recent vintage. Cattle were present upstream on private land. A minor amount of relatively recent littering evident, but old, rusted metal cans were more prevalent. Construction of Highway 95 may have eliminated some former *Abronia* habitat, but present operations do not pose any obvious threat. Use of the sandy bottom for any kind of 'staging' area for future road projects would be a potential threat. *Bromus tectorum* was the only non-native, weed species observed. It averaged approximately 3% cover.

Collector/Collection #/Herbarium: Michael Mancuso, #3288, Oregon State University

Crooked Creek survey route - north



Crooked Creek survey route - south

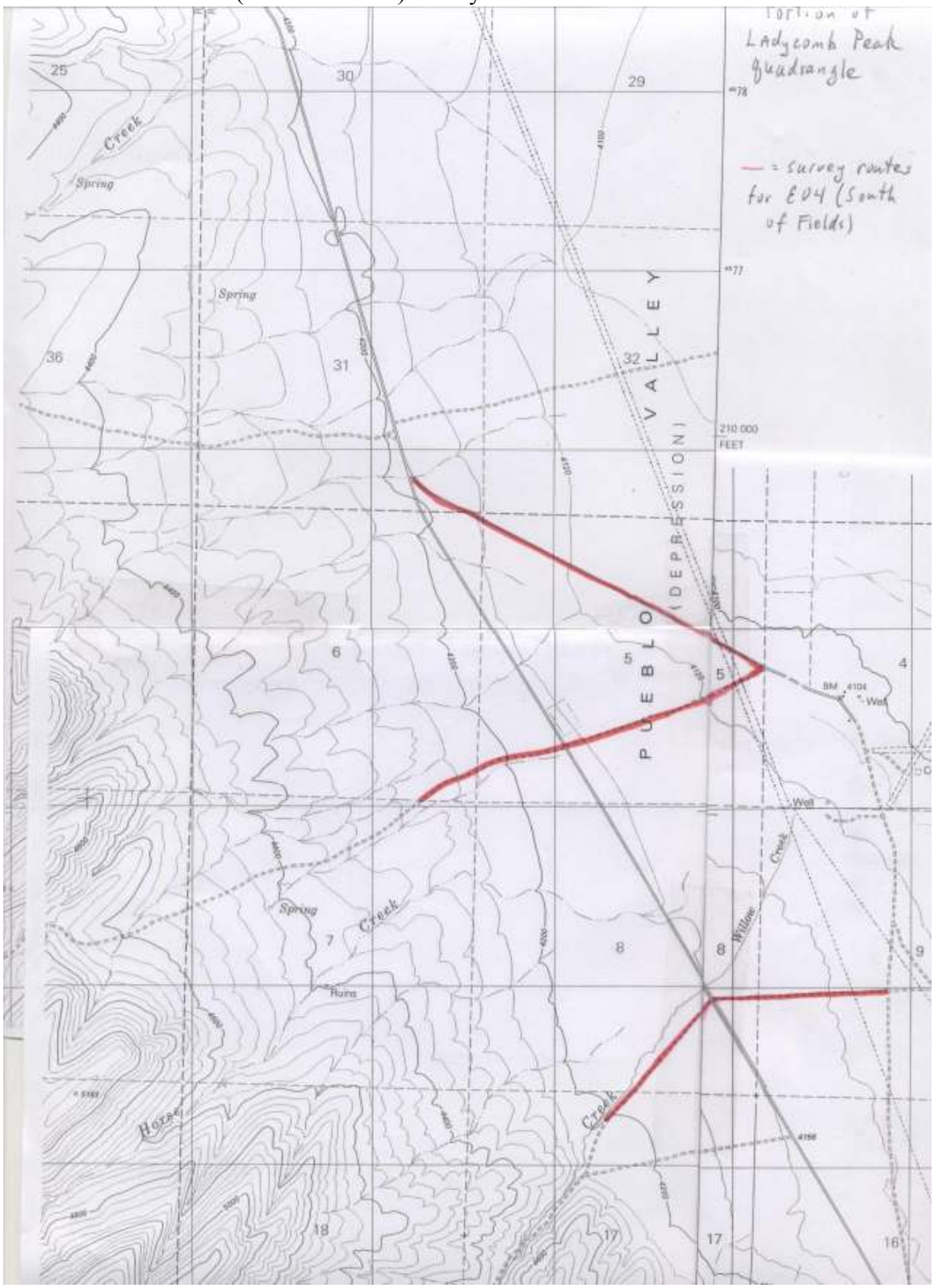
Historical collection - South of Fields

Survey date: June 18, 2008

Observer: Michael Mancuso, 20 N. Wilson St,, Boise, ID 83706

This historical occurrence is based on a 1936 collection by M.E. Pack, reportedly on dry sandy ground fives miles south of Fields. I did not encounter any suitable-looking habitat for *Abronia turbinata* in the general area south of Fields. Non-agricultural portions of the Pueblo Valley south of Fields were dominated by stands of *Sarcobatus vermiculatus* (black greasewood) with a sparse/depleted herbaceous understory. Soils were mostly silty-sandy with intermixed gravels in the few places I checked. Flats, gentle slopes, and low hills extending westward from the valley bottom supported sagebrush-steppe, or more often mixed desert scrub vegetation. Sandy habitats were not observed from numerous vantage points along the main Fields to Denio Road, or along several spur roads south of Fields. The mapped location of the occurrence is largely private land, some of which has been converted to agricultural use. I do not know if pockets of potentially suitable sandy habitat occurred further east along Trout Creek, an area that was all private land. It is also possible that the original 1936 collection site has since been converted to agricultural land.

Historical collection (south of Fields) survey route



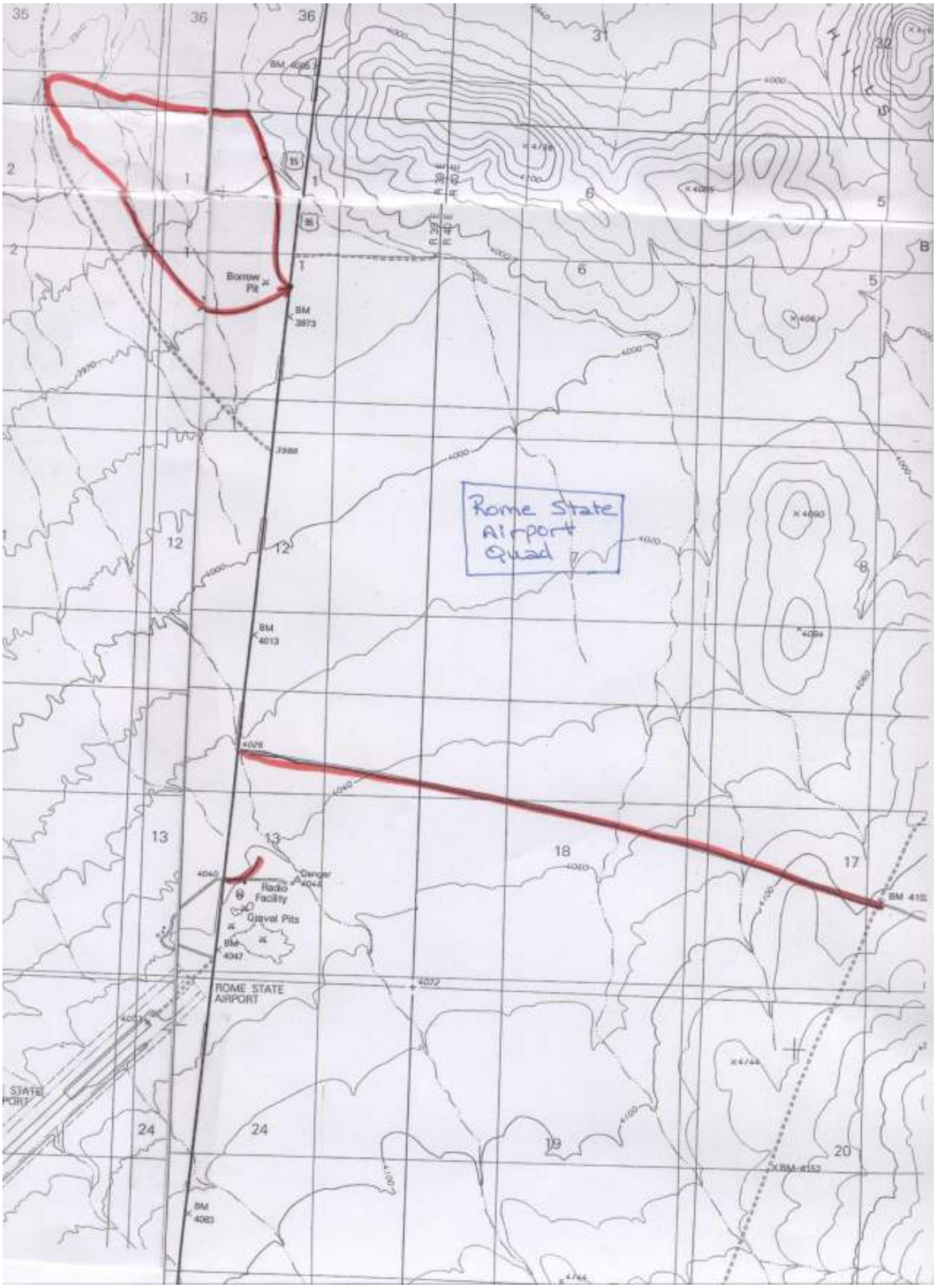
Historical collection - Southwest of Rome

Survey date: June 16, 2008

Observer: Michael Mancuso, 20 N. Wilson St,, Boise, ID 83706

This historical occurrence is based on a 1943 collection by M.E. Pack, reportedly on a sandy slope 24 miles southwest of Rome. This is vague information to try and relocate. I did not encounter any sandy habitat suitable for *Abronia turbinata* along the Highway 95 corridor from Crooked Creek southward to south of the Rome State Airport. This area is roughly 20 to 26 miles south of Rome. Extensive stands of *Artemisia tridentata wyomingensis* dominated the vegetation and volcanic rocks the geology across the entire area. Was the original collection site actually at Crooked Creek?

Historical collection (southwest of Rome) survey route



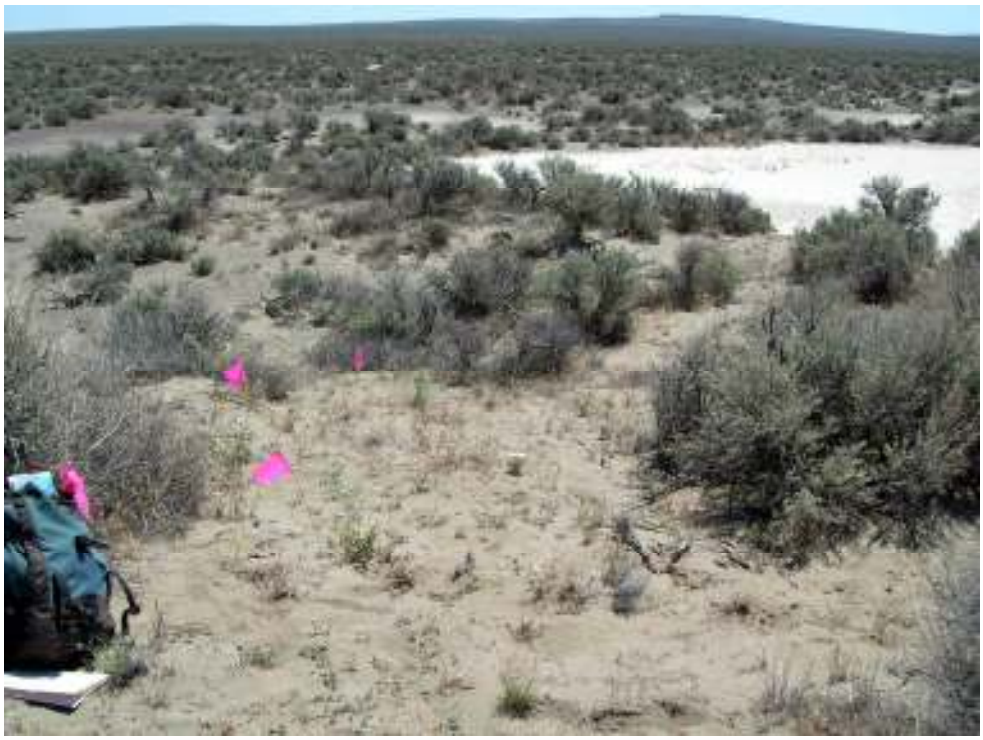
APPENDIX B. *ABRONIA TURBINATA* HABITAT AND FLOWER PHOTOGRAPHS.

Sand Hills #1 *Abronia turbinata* (pink flagging) and habitat. The large white flowers are *Oenothera caespitosa.* UTMs: 11T 369260E 4650768N, Nad83.

Sand Hills #1 *Abronia turbinata* (pink flagging) and habitat. UTMs: 11T 367811E 4651864N, Nad83.

Sand Hills #1 *Abronia turbinata*. UTMs: 11T 368853E 4650835N, Nad83.

Crooked Creek *Abronia turbinata* and habitat near eastern end of occurrence; view is facing northwest.



Crooked Creek *Abronia turbinata* (pink flagging) and habitat. UTMs: 11T 408356E 4711757N. Nad83.

Coyote Lake *Abronia turbinata* with flowers near western end of occurrence; view is eastward.