

Habitat Conservation Assessment
for *Allium aaseae* (Aase's onion)

by

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SUMMARY

Allium aaseae (Aase's onion) is a small, early spring-flowering perennial plant endemic to southwestern Idaho, and has been a priority conservation concern for over 15 years. Its global range is restricted to the lower foothills, from Boise to Emmett, plus two disjunct population near Weiser. It occurs on open, xeric, gentle to steep sandy slopes, and usually associated with depauperate bitterbrush (*Purshia tridentata*) or bitterbrush/sagebrush (*Artemisia tridentata*) communities. Aspects are generally southerly, and elevations range from 2700 to 3700 feet, with a few exceptions to 5100 feet. Most, if not all populations are restricted to sandy alluvial soils of the Glens Ferry Formation.

There are 66 known occurrences for Aase's onion, ranging in size from less than one to over 200 acres. Most occurrences support more than 1000 individuals, but range from less than 100, to more than 30,000. A great majority (79%) of known occurrences occur at least partly on private land, with nearly half (48%) restricted to privately owned land. Populations are also known from City of Boise, Ada County, State Department of Lands, and BLM lands.

Segments of at least eight populations have been destroyed since originally discovered, and it is believed parts of at least several others were destroyed prior to discovering remnant portions. Across its range, the sandy foothill habitats of *Allium aaseae* has been subject to four main land uses since white settlement - urban/suburbanization, livestock grazing, sand mining, and various recreational activities. All pose direct or indirect threats to Aase's onion in portions of its range. Permanent habitat loss and fragmentation as a result of housing and other urban developments, especially in the Boise Foothills, represents the most serious and probably difficult to resolve of these threats.

Over the years, a number of conservation efforts, including extensive field inventories, propagation and life history research, taxonomic and genetic studies, and various protection Memorandum of Understandings have been undertaken on behalf of Aase's onion. In 1993, the Bureau of Land Management (BLM) established six new Areas of Critical Environmental Concern, primarily to protect populations of Aase's onion. In addition, the disjunct population near Weiser is located within the BLM's Rebecca Sand Hill Research Natural Area and is also protected. Because of these designations, the western half of the species distribution now seems secure. However, populations in the eastern half of its distribution, in the Boise Foothills, remain vulnerable, especially in light of the areas urban development patterns.

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TAXONOMY

Scientific name: *Allium aaseae* Ownbey

Full bibliographic citation: Ownbey, M. 1950. The Genus *Allium* in Idaho. Research Studies of the State College of Washington. 18(1):38.

Type specimen: Ownbey and Ward 3095, "low hills directly back of Collister schoolhouse, just n.w. of Boise, Ada Co., Idaho." Type specimen at WS.

Pertinent synonyms: None.

Common name: Aase's onion

Taxon codes: PMLIL02010 (Biodiversity Information Network and The Nature Conservancy).

Size of genus: Approximately 500 species, widely distributed in the Northern Hemisphere, with about 80 species in North America (Cronquist 1977).

Family name: Liliaceae.

Pertinent family synonyms: Alliaceae.

Common name for family: Lily.

Major plant group: Liliopsida (Monocots).

Comments on current alternative taxonomic treatments: *Allium aaseae* is similar to *A. simillimum* (dwarf onion), a more common and widespread species also found along the Boise Front, but generally at higher elevations (over 4200 ft.) than *A. aaseae*. Field investigators (e.g., Mancuso and Moseley 1991) have reported inconsistencies and overlap in morphological features typically used to differentiate the two onions. Hybridization involving *Allium aaseae* has been suspected at least since the late 1970's (Holsinger 1978), and more recent and thorough research has confirmed this likely to be the case between *Allium aaseae* and *A. simillimum*. A recent taxonomic study by McNeal (1993) has determined *Allium aaseae* to be a distinct and valid species from *Allium simillimum*. A genetic-based study by Smith (1995) substantiates McNeal's conclusion. McNeal (1993) has also modified the key and technical description for *Allium aaseae*.

DESCRIPTION

General nontechnical description: Aase's onion is an early spring-flowering member of the lily family. It is perennial with an underground bulb that is usually buried at least a couple inches below ground level in mature individuals. Bulb coat reticulations may or may not be evident. The scape is round to slightly flattened, not winged. The two linear, channeled leaves are 1-4 mm wide, at least twice as long as the scape and typically lying on the ground when observed in the field early in the season. Its six similar-looking tepals are pink, often richly so, but fading to white, 6-9.5 mm long and with entire to obscurely or strongly denticulate margins. Stamens are shorter than the tepals, the undehisced anthers and pollen are

yellow.

Technical description: Bulb ovoid, outer coats brownish, usually with obscure reticulations, the cells of which are transversely elongate and intricately contorted, the inner coats white to pink or reddish; scape (3) 5-11 (15) cm long, terete or slightly flattened, not winged; leaves two per scape, linear, channeled, 1-3 (4) mm wide, entire or the margins obscurely denticulate, 2 or more times longer than the scape, green (ie. not withering) at anthesis, tending to be deciduous at maturity; bracts of the inflorescence 2 (3), ovate, obtuse to acuminate; umbel 5-25-flowered, pedicels shorter than or +/- equal the perianth; perianth segments (6) 7-9.5 mm long, lanceolate to elliptic, entire to erose to obscurely or strongly denticulate with minute +/- glandular teeth, erect, flaring at the tips, bright pink, fading with age or pressing, rarely white; stamens 1/2-2/3 as long as the perianth; anthers yellow, pollen yellow; ovary crestless or with three minute 2-lobed central processes, style included, stigma punctate, entire, capsule crestless (McNeal 1993).

Local field characters: There are several onion species occurring within and near the range of *Allium aaseae*, and a key to the onions of southwestern Idaho is contained in McNeal (1993). *Allium aaseae* is most likely to be confused with *A. simillimum*, especially at mid-elevations in the Boise Foothills, where their distributions nearly overlap. The following key, adopted from McNeal (1993) can be used to distinguish the two. Populations with the purple-mottled anthers may actually be hybrids between the two species (J. Smith pers. comm.).

1. Perianth segments white with green or reddish midveins, sometimes flushed with pink; anthers purple or mottled purple and white, pollen white or grayish; denticulations, particularly on the inner perianth segments obvious under a hand lens and regularly distributed on the distal 2/3 of the segment; occurring above 4200 feet elevation on various substrates *Allium simillimum*

1. Perianth segments bright pink with rarely a white individual in an otherwise pink population; anthers yellow, pollen yellow, denticulations +/- irregular in number and distribution on perianth segments, often missing at Rebecca Sand Hills RNA; usually restricted to lacustrine sands of the Glens Ferry Formation, generally below 3700 ft., except in Cartwright Canyon where occurring up to 5100 ft. elevation *Allium aaseae*

CONSERVATION HISTORY

Aase's onion was first collected by T.E. Wilcox in 1881, near Boise. A small number of other early collections supplemented collections made by Marion Ownbey when he described the species in 1950 (Ownbey 1950). Aase's onion has been recognized as a priority conservation concern for over 15 years, and since 1984, there have been intensive field surveys throughout its range. Steele (1977) recommended retaining Aase's onion on the proposed federal endangered list in the original evaluation of Idaho's rare plant taxa, noting land development to be the most serious threat with some populations already destroyed. This recommendation was made again in 1981 (Steele 1981). In 1979, a recommendation for Endangered status was made by Packard (1979) in the first status report for *Allium aaseae*.

In 1980, a listing package was submitted by the U.S. Fish and Wildlife Service's (USFWS) Boise Office supporting a listing of Aase's onion as an Endangered Species (U.S. Fish and Wildlife Service 1980a). Listing was deferred due to "decreased emphasis on endangered species listing and the newly instituted listing priority system". The Washington DC office encouraged the development of a Memorandum of Understanding (MOU) to provide interim protection for the species (U.S. Fish and Wildlife Service 1981). Subsequently, a MOU was agreed to between the City of Boise and the USFWS for populations within

two city park reserves - Old Military Reserve and Camelsback Reserve (U.S. Fish and Wildlife Service 1982). The primary action agreed upon in the MOU was to develop a species management plan for *Allium aaseae*. This was never accomplished and the MOU has since expired. A new agreement between the City of Boise and the USFWS covering *Astragalus mulfordiae*, and *Lepidium papilliferum*, as well as *Allium aaseae*, is pending in 1995. The emphasis of the initial Conservation Agreement will be the conservation of rare plant populations occurring within lower Hulls Gulch on land being transferred from the BLM to Boise City. A subsequent agreement covering Old Military and Camelsback Reserves is also scheduled. For Aase's onion this will include occurrences 006, 009, 011, 025, 058 and 059.

Discussions over preservation of certain core habitat areas were initiated in 1984, between the USFWS, The Nature Conservancy (TNC) and Robert Steele, Chairman of the Idaho Rare and Endangered Plants Technical Committee (Steele 1984). Acquisition of Boise foothills land containing Aase's onion by TNC did not materialize, however.

In 1985, the Idaho Natural Heritage Program first proposed the city of Boise sponsor an inventory for Aase's onion in the foothills within city limits and lands likely to be annexed (Caicco 1985). This suggestion was brought to fruition in 1992, when the The Idaho Conservation Data Center (formerly the Idaho Natural Heritage Program) was contracted by Boise City Planning and Zoning to conduct an inventory of the Boise Foothills for three rare plant species, including *Allium aaseae*. Overall objectives of the investigation were to compile a complete data base on the distribution and abundance of rare plants and communities in the Boise foothills, and to rank the ecological quality of each rare plant population or community occurrence on a relative scale for planning purposes (Moseley *et al.* 1992).

Under contract from Ada County Solid Waste Management, the Conservation Data Center also conducted a field investigation for *Allium aaseae* in Seaman Gulch, Ada County's landfill area, during the spring of 1987 (Moseley and Caicco 1989).

Aase's onion occurs on land mined for high grade silica by Unimin Mining Corporation near Emmett. A cooperative agreement between the Bureau of Land Management (BLM) and Unimin Corporation was signed in 1986, to sponsor life history and habitat ecology research for Aase's onion. These studies were aimed at developing reintroduction techniques to mitigate the loss of populations destroyed by sand mining (Bolin and Rosentreter 1986; Bureau of Land Management 1987; Prentice 1988; 1989). Additional bulb transplant and garden studies have also been initiated at Unimin, some of them still ongoing (C. Prentice pers. comm.), even though the land was patented in 1993.

The BLM and USFWS signed a Conservation Agreement in 1989, which outlined management efforts to protect Aase's onion. Three actions were identified: 1) BLM would establish at least three preserves for Aase's onion, 2) BLM and USFWS would work towards protection of certain Aase's onion populations on lands leased to the Unimin Corporation, and 3) USFWS would review all management plans and status reports, and provide of technical assistance, particularly in the form of monitoring. In 1993, the BLM established six Areas of Critical Environmental Concern (ACEC's) specifically to protect and conserve populations of *Allium aaseae* (Bureau of Land Management 1993). Recent taxonomic clarifications have revealed the putative *Allium aaseae* population at Hulls Gulch ACEC to be the closely related species, *A. simillimum*, or a hybrid between the two. Therefore, only five of the six ACEC's support true Aase's onion.

The Idaho Native Plant Society (INPS) petitioned the USFWS to list *Allium aaseae* as Threatened under

the Endangered Species Act in 1990 (Idaho Native Plant Society 1990). Presently, *Allium aaseae* is one of the species whose disposition as a federal candidate is to be decided under the terms of the Lujan vs. Fund for Animals *et al.* court settlement (U.S. Fish and Wildlife Service 1992).

Summary of field investigations for *Allium aaseae*.

- 1986-Present BLM and Unimin Mining Corporation - Have conducted field surveys associated with ongoing propagation and life history studies (Prentice 1988; 1989).
- 1986-Present BLM - Intensive surveys for Aase's onion throughout its range, predominantly on BLM land took place in 1987 and 1988. Periodic, less intensive field surveys continue, often as part of project clearances and related work
- 1987 CDC - Under contract from Ada County Solid Waste Management, CDC botanists determined the status and distribution of Aase's onion on county land in Seaman Gulch (Moseley and Caicco 1989).
- 1991 CDC, INPS, and Friends of Military Reserve - Mapped the distribution and abundance of Aase's onion in Military Reserve Park, Boise.
- 1991 INPS, Wetlands Coalition, and Golden Eagle Audubon - Mapped the distribution and abundance of Aase's onion in lower Hulls Gulch, Boise.
- 1991 INPS and CDC - Mapped the distribution and abundance of Aase's onion in Camelsback Reserve Park.
- 1991 CDC - As a cooperative Challenge cost-share project with the Boise National Forest, CDC botanists conducted a status survey for Aase's onion on the Boise National Forest (Mancuso and Moseley 1991).
- 1992 CDC - Under contract from Boise City Planning and Zoning Department, CDC botanists conducted field surveys for Aase's onion throughout much of the Boise Foothills as one part of a rare plant and riparian inventory in the area (Moseley *et.al.* 1992).
- 1993 Dr. Dale McNeal (University of the Pacific) - in a cooperative Challenge cost-share project between the CDC and BLM conducted field work in association with his taxonomic investigation of Aase's onion (McNeal 1993).
- 1994 Dr. Jim Smith (Boise State University) - as a cooperative Challenge cost-share project with the BLM revisited a number of Aase's onion sites to support his genetic study of the species (Smith 1995).

PRESENT LEGAL OR OTHER FORMAL STATUS

International: None

National: *Allium aaseae* is listed as a federal category 1 candidate in the 1980, 1985, 1990 and 1993 Notices of Review for candidate plants (U.S. Fish and Wildlife Service 1980; 1985; 1990; 1993). Category 1 candidates include those taxa for which the U.S. Fish and Wildlife Service currently has substantial information on hand to support the biological appropriateness of proposing to list as Endangered or Threatened. Proposed rules have not been issued, but development and publication of such rules are anticipated (U.S. Fish and Wildlife Service 1993).

Allium aaseae is a BLM Sensitive Species for Idaho (Conservation Data Center 1994). The Biodiversity Information Network (International Association of Natural Heritage Programs and Conservation Data Centers) ranks *Allium aaseae* G3, a rank that includes taxa that are globally rare or uncommon, but not imperiled (Conservation Data Center 1994).

State - Idaho: Because *Allium aaseae* is endemic to Idaho, the Biodiversity Information Network state rank (S) equals the global (G) rank - S3.

The Idaho Native Plant Society maintains *Allium aaseae* on its list of current and recommended Federal Candidate Species, which includes all globally rare and threatened taxa in Idaho (Idaho Native Plant Society 1995).

GEOGRAPHICAL DISTRIBUTION

Geographical range: Aase's onion is endemic to southwestern Idaho, occurring in the foothills around Boise and arcing northwest to near Emmett, an aerial distance of approximately 18 miles. In the Boise Foothills, the easternmost populations are known from the Hulls Gulch and lower Cottonwood Creek areas, while the Freezeout Hill vicinity near Emmett contains the westernmost foothill populations. Disjunct populations have recently been confirmed near Weiser, at Rebecca Sand Hill RNA, and at Sagebrush Hill. Populations previously reported from the Danskin Mountains, east of Boise are really *Allium simillimum*. Populations are located in Ada, Boise, Gem and Washington counties. A map of the overall distribution of *Allium aaseae* is provided (Appendix 1).

Precise occurrences in Idaho.

Note: There is an Element Occurrence Record (formatted data base record) for each occurrence (population, or often a series of what can be considered subpopulations) of *Allium aaseae* within the Conservation Data Center (CDC) data base. Each Element Occurrence Record is identified by a three digit code (001, 002, 003, etc.) to facilitate referencing. This three digit identifier is used throughout the report. Records contain site name, location, date of original discovery, date of most recent observation, USGS quadrangles, legal description, latitude/longitude, population, habitat, land ownership, protection comments and other information. A set of Element Occurrence Records for *Allium aaseae* is contained in Appendix 2.

Populations currently or recently known extant: The Conservation Data Center data base contains 66 occurrences of *Allium aaseae* (001 to 066). According to CDC records, 43 occurrences were last

observed during the 1990's, 21 during the 1980's, and two in the 1970's. In reality, many of the populations near Emmett have been revisited more recently than the 1980's dates in the CDC occurrence records. Location maps for *Allium aaseae* occurrences are found in Appendix 1.

Under contract from the Boise City Planning and Zoning Department, the Conservation Data Center conducted field surveys for three rare plants - *Allium aaseae*, *Astragalus mulfordiae* and *Lepidium papilliferum* in the Boise Foothills in 1992. One of the objectives of this study was to rank the ecological quality of the rare plant populations on a relative scale for planning purposes (Moseley *et al.* 1992). Relative rankings (Categories A, B, C) were based on population size, habitat quality (disturbed or weedy vs. relatively undisturbed with high percentage of native species), proximity to ongoing disturbances, and to a lesser extent, the degree of isolation in fragmented habitats. Aase's onion category definitions, and respective ranks for the 37 occurrences included in the study area are presented below. Note that because many occurrences are comprised of two or more subpopulations, more than one rank may apply to the entire occurrence. Refer to Moseley *et al.* (1992) for a more detailed discussion of this Foothills investigation.

Category A - The largest populations, contain more than 5,000 individuals, which would contribute the most to the long-term persistence of *Allium aaseae* in the Boise Foothills portion of its range.

Category B - Mid-range populations (500-5,000 individuals), large populations on degraded or isolated sites, or small populations on ecologically high quality sites or occurring sympatrically with another rare plant species.

Category C - Very small populations (less than 500 individuals) and/or those on ecologically degraded sites where long-term viability is questionable.

Occurrences in the Cottonwood Creek, Freestone Creek and Hulls Gulch drainages:	Occurrences in the Crane Gulch and Miller Gulch drainages and Stewart Gulch upstream from Cartwright Road:	Stewart Gulch downstream from Cartwright Road, Polecat Gulch, Pierce Gulch, Seaman Gulch and Goose Creek drainages:
006 - B, C		
007 - B	005 - B, C	004 - B, C
009 - C	008 - A, B, C	024 - A, B, C
011 - B	010 - A, C	026 - B, C
012 - A, B, C	013 - C	027 - B, C
014 - A, B, C	019 - A, B, C	028 - C
020 - B, C	021 - A, B	029 - B, C
022 - C	023 - A, B	032 - A, B, C
025 - B, C	030 - B	036 - A, B, C
033 - C	044 - C	056 - A, B
058 - B	062 - C	057 - B, C
059 - C	064 - C	063 - A, B, C
060 - B		066 - A, C
061 - C		

Populations known or assumed extirpated: Portions of at least eight occurrences (007, 008, 015, 020,

021, 033, 063, 064) have been destroyed since they were originally discovered. It is also believed parts of several other populations were destroyed prior to discovering remaining portions.

Historically known populations where current status not known: Urban development in the Boise Foothills is proceeding at a fairly rapid rate. A number of populations (e.g., 014, 054) are known from areas proximate to proposed or expanding housing developments. Although many were last observed as recently as 1992, it is unknown if subsequent development activities have impacted additional populations besides those listed above.

Locations not yet investigated believed likely to support additional natural populations: Additional low elevation, sandy habitat is known to occur near the recently confirmed disjunct populations near Weiser. Early season field surveys targeting *Allium aaseae* have never been conducted near Weiser, and the possibility exists that additional populations are present.

Reports having ambiguous or incomplete locality information: The location of one occurrence (031) is vague, given only as 3.2 miles north of Eagle. Its mapped location is a best estimate only.

Locations known or suspected to be erroneous reports: Recent detailed taxonomic (McNeal 1993) and genetic (Smith 1995) studies have confirmed that plants reported from higher elevations (above 4200 feet in most cases) in the Boise Foothills, and from the Danskin Mountains are the closely related species *Allium simillimum*, and not *A. aaseae*.

C. Biogeographical and phylogenetic history: Both McNeal (1993) and Smith (1995) speculate that *Allium aaseae* is derived from within *A. simillimum* and both are part of the *A. fibrillum/A. madidum* complex. Based on the genetic relatedness of the two onions, a possible scenario for the origin of *Allium aaseae* is that it is derived from *A. simillimum*, probably via populations isolated during the Pleistocene (Smith 1995).

GENERAL ENVIRONMENT AND HABITAT DESCRIPTION

General summary: Aase's onion is restricted to a narrow range of habitat conditions. It occurs on open, relatively barren, xeric, gentle to very steep, sandy slopes, generally with a southerly aspect, but ranging from east to west. It is usually associated with relatively sparsely vegetated bitterbrush (*Purshia tridentata*) or bitterbrush/sagebrush (*Artemisia tridentata*) communities. Most, if not all populations are restricted to the alluvial soils of the Glens Ferry Formation. This sandy substrate is of granitic origin and typically coarse textured, well-drained and relatively deep (Packard 1979; Prentice 1988). In the Boise Foothills, all populations occur on one of three sand-dominated geologic units - Pierce Gulch Formation Sand, Terteling Springs Formation Sand and Sandstone, and Terteling Springs Formation Sandy Sediments (Beck 1988). A large majority of Boise Foothill populations occur on three soil mapping units of Beck (1988): Quincy-Lankbush complex, Payette-Quincy complex, and Haw-Lankbush complex. Rarely, populations or portions of populations occur on other soil types, namely, Lankbush-Brent sand loam, Ada gravelly sand, and Searless-Rock outcrop complex. All known populations except for the two in Cartwright Canyon occur between 2700-4300 feet elevation, with the great majority below 3700 feet. Cartwright Canyon populations occur at 4950 and 5100 feet, and possibly indicate that soil characteristics such as texture are more important than elevation in determining the distribution of *Allium aaseae* (McNeal 1993).

Vegetation physiognomy and community structure: The immediate habitat of *Allium aaseae* is usually sparsely vegetated. Bitterbrush (*Purshia tridentata*) and to a lesser extent, sagebrush (*Artemisia tridentata*) or gray rabbitbrush (*Chrysothamnus nauseosus*) shrubs often occur with *Allium aaseae*. One or several bunchgrasses such as red threeawn (*Aristida longiseta*), bluebunch wheatgrass (*Agropyron spicatum*), squirreltail (*Sitanion hystrix*), needle-and-thread (*Stipa commata*), Sandberg's bluegrass (*Poa sandbergii*), Indian ricegrass (*Oryzopsis hymenoides*) and sand dropseed (*Sporobolus cryptandrus*) are often closely associated. Aase's onion sites are often bordered by *Artemisia tridentata* ssp. *wyomingensis* or ssp. *tridentata*/bunchgrass-dominated communities.

Regional vegetation type: Under Bailey's map (1980), Aase's onion lies within the Sagebrush-Wheatgrass Section of the Intermountain Sagebrush Province, Steppe Division, Dry Domain. In Kuchler's (1964) scheme it lies within the Sagebrush Steppe (*Artemisia-Agropyron*) zone. It occurs within the Snake River Basin/High Desert Ecoregion of Omerlink and Gallant (1986).

Frequently associated species: In addition to the shrub and bunchgrass species noted above, other associates include *Eriophyllum lanatum*, *Balsamorhiza sagittata*, *Achillea millefolium*, *Phacelia heterophylla*, and *Eriogonum ovalifolium*. A number of exotic species may be very abundant, especially *Bromus tectorum*, *Erodium cicutarium* and *Taeniatherum caput-medusae*.

Dominance and frequency: On a local scale, *Allium aaseae* can be very common. At some sites it is one of the dominant forbs in early spring. When considering its sagebrush-bitterbrush/steppe and foothill grassland habitats rangewide, however, it is a minor constituent.

Other endangered species: *Allium aaseae* populations in the Boise Foothills often occur in close proximity to *Astragalus mulfordiae*, a federal Category 1 candidate and/or *Lepidium papilliferum*, a Category 2 candidate. The lists below reveal the close association of these three species and why they largely share the same conservation concerns and problems.

<i>Astragalus mulfordiae</i> EOR#		<i>Allium aaseae</i> EOR#	Location
008	near	018	near Weiser
036	sympatric with part of	027	north of Eagle
038	sympatric with part of	036	" " "
012 and 029	near	059	Boise Foothills
009	sympatric with part of	012	" "
011	sympatric with part of	033	" "
030 and 031	near	006	" "
026	sympatric with part of	061	" "
015	sympatric with part of	011	" "
021	sympatric with part of	008	" "
033	sympatric with part of	019	" "
019	sympatric with part of	007	" "
022	sympatric with part of	062	" "
018	near	010	" "
004	near	009	" "
035	near	044	" "
039	sympatric with part of	020	" "

<i>Lepidium papilliferum</i> EOR#		<i>Allium aaseae</i> EOR#	Location
016 and 038	near	029	north of Eagle
039 and 040	near	050	" " "
052	near	054	Woods Gulch area
056	sympatric with part of	039	SE of Emmett
023 and 043	near	060	Boise Foothills
036	near	008	" "
037	near	062	" "
012	near	059	" "

Regional macroclimate: Along the western Snake River Plain, July is the warmest month and January the coldest. July also marks the beginning of a pronounced dry season, with only about 15% of the total annual precipitation falling during the July through October period. Two periods of peak precipitation occur, one in January, the other in May. Winter precipitation is the greatest with nearly 40% of the mean annual total of 8-13 inches falling between December and February. Mean annual temperature is approximately 50^o F, and frost-free periods range up to 160 days (Soil Conservation Service 1980).

Local microclimate: Aase's onion flowers earlier (late winter to early spring) than most species in southwestern Idaho, when nightly frosts still typically occur and soil moisture is still abundant. Aase's onion most commonly occurs on southeastern to southerly exposures. These receive early morning sun that relatively quickly warm the light-colored soil surface and presumably the low-growing onion plants.

POPULATION BIOLOGY

General summary: There are 66 occurrences for *Allium aaseae* in the Conservation Data Center's data base. As a consequence of urban development in the Boise Foothills, portions of at least seven occurrences have been destroyed in recent years. Portions of other populations have also been lost over the years to sand mining, landfill activities and other disturbances. Population sizes vary from less than 100 to more than 35,000 plants. From information contained in the CDC data base, the rangewide population estimate for *Allium aaseae* is 400,000 plants. This is a conservative number for a number of reasons: 1) the full extent of a number of occurrences is unknown, and it is very likely additional plants occur in unsurveyed suitable habitat; 2) no population estimates are available for five occurrences and their contributions remain uncounted in the above rangewide tally; 3) for populations or subpopulations estimated at 10,000+ plants, only 10,000 were added to the tally; 4) although the majority of areas likely to support plants have been searched, some places, especially on private lands remain unsurveyed; 5) plants that are not flowering are difficult to see and their numbers are likely underestimated during field investigations. This conservative estimate of 400,000 plants reflects increased survey work for this species over the years. For instance, in 1978, Holsinger (1978) estimated less than 15,000 individuals rangewide, while ten years later Moseley and Caicco (1989) estimated 260,000 plants for 57 location sites.

For the 66 occurrences of *Allium aaseae*, 17 (26%) are estimated to contain more than 10,000 individuals, 32 (49%) are estimated between 1000-10,000 plants, 11 (17%) are estimated between 100-1000 plants, and only one (1%) at fewer than 100. Abundance information is unknown in five (8%) instances.

Population estimates for *Allium aaseae* occurrences (Conservation Data Center 1995).

1-100 plants - 059

100-1000 plants - 001, 022, 028, 033, 044, 051, 054, 055, 061, 062, 064

1000-10,000 plants - 003, 004, 005, 007, 008, 009, 010, 013, 014, 017, 018, 019, 020, 023, 026, 027, 029, 030, 037, 038, 041, 042, 043, 045, 046, 047, 048, 050, 052, 053, 058, 060

>10,000 plants - 006, 011, 012, 015, 021, 024, 025, 032, 034, 036, 039, 049, 056, 057, 063, 065, 066

unknown - 002, 016, 031, 035, 040

Only 39 of 66 (59%) occurrence records for *Allium aaseae* contain estimates of the population's aerial extent. These estimates were obtained during field inventory work. Extent of the other 27 (41%) occurrences has been estimated from maps on file at the CDC that delineate locations of the population or subpopulations. Occurrences range in size from 0.1 to over 200 acres. For the 66 occurrences, 6 (9%) are estimated less than one acre, 13 (20%) are estimated between 1 and 5 acres, 7 (10%) are estimated between 5 and 10 acres, 15 (23%) are estimated at 10 to 50 acres, 10 (15%) are estimated at 50 to 100 acres, and 15 (23%) > 100 acres. The total aerial extent for the species is approximately 4700 acres. However, depending on the site, *Allium aaseae* occupies only a portion of the acreage estimated for a given occurrence, as the distribution of suitable habitat is often scattered.

Size estimates for 39 *Allium aaseae* occurrences (Conservation Data Center).

<1 acre - 020, 033, 044, 058, 059, 064

1-5 acres - 001, 002, 013, 016, 025, 030, 031, 035, 051, 054, 060, 061, 062

5-10 acres - 005, 027, 038, 043, 047, 049, 050

10-50 acres - 003, 006, 018, 019, 021, 022, 023, 028, 029, 037, 042, 046, 048, 055, 066

50-100 ares - 007, 009, 014, 017, 040, 045, 053, 056, 057, 065

> 100 acres - 004, 008, 010, 011, 012, 015, 024, 026, 032, 034, 036, 039, 041, 052, 063

Phenology: Seed germination typically begins in late winter when snow melts, soil moisture increases and temperatures are cool. In late February, seedling roots emerge and the cotyledon, with the seed coat at the end of the single leaf, pushes up through the sand. The bulb begins to develop when the leaf is 1-2 cm long. It starts as a tiny bump on the root about 1.5 cm below the surface. The plant continues to grow until the leaf withers due to increasing moisture and temperature stresses. First- and second-year plants produce only one leaf, the bulb does not divide, nor produce flowers. Presence of a second leaf indicates an older individual, and appearance of a third and eventually a fourth leaf indicates the bulb is dividing (Prentice 1988; 1989).

Established plants (from bulbs) begin root growth and emerge in late winter (generally late February-early March, but in some years as early as late January). In mature bulbs, flower buds develop at ground level

between the two leaves soon after emergence, and *Allium aseae* is one of the first native plants to flower in the Boise Foothills. (Prentice 1989). Anthesis varies from plant to plant, but seems to peak in early spring in most years. Higher elevation populations flower later than lower sites. In dry years, flowers are quite ephemeral, and may scarcely last a week, while during wet springs flowering plants can be found into May. Seeds can usually be found by late March (Packard 1979). Plants are dormant much of the year, generally from about May until February.

Type of reproduction: Aase's onion can reproduce from both seed and bulb division. Seed viability from different sites is variable, as is seed production from year to year (Prentice 1989).

Pollination: The pollination biology of Aase's onion is unknown, although it has been reported to have no specific pollinators, and its flowers visited by many types of insects (Bolin and Rosentreter 1986). Aase's onion flowers early in the season and likely makes use any and all insect taxa active at this time. Smith (1995) notes the importance of determining its pollination biology to make better management decisions. Two types of anthropogenic-related disturbances are particularly detrimental to bees and may be important regarding gene flow for *Allium aseae* - 1) the use of pesticides that may be harmful to all insects, and 2) livestock grazing that results in the trampling of underground insect nests, particularly species of *Bombus* (Smith 1995 and references cited within).

Seed dispersal: Not known. Probably at least partly by the detached umbel being blown around (Packard 1979).

Seed biology: The number of seeds per pound is estimated at 622,000. Seed viability from different sites is highly variable, as is often the case in wild plant populations (Prentice 1988). The mean viability from four different sources was 55% in a study conducted by Prentice (1988). Seed production is variable from year to year. Fall planted seeds have higher germination rates than attempts using laboratory conditions, including artificially stratified seeds (Prentice 1988). Bolin and Rosentreter (1986) also conducted seed germination studies for *Allium aseae*. They found that seed maintained at 5^o C germinated at a rate above 50%, while seed kept at 20^o C showed no appreciable germination. Various scarification and stratification seed pretreatments were also tested. Their results suggests that seeding techniques can influence both the rate of germination and the total percent germination.

Cultivation: *Allium aseae* can be propagated from bulbs and seed. Prentice (1989) recommends bulbs as the rehabilitation source of choice because they provide reproduction within two years. Techniques, site characteristic recommendations, and other propagation and related life history information is discussed by Prentice (1988; 1989). Bolin and Rosentreter (1986) discuss seed treatments that are applicable to cultivation concerns.

POPULATION ECOLOGY

General summary: There is little quantitative data regarding the effects of herbivores, disease, competition, hybridization or allelopathy on population viability. No native plant species appear to substantially compete with *Allium aseae* for moisture, and only red three-awn seems to compete for space (Prentice 1988). Two exotic winter annuals, cheatgrass and storksbill apparently are important interspecific competitors. Vigor of *Allium aseae* populations can be reduced where these weeds are prolific (Prentice 1988). Livestock grazing on *Allium aseae* is minimal, although indirect effects, such as habitat degradation and trampling are more serious. The most serious insect pest seems to be an unknown

seed predator that bores into and devours inner portions of the seed (Prentice 1988). A rust is common on populations in the Woods Gulch area, and maybe other places as well (J. Smith, pers. comm.). Hybridization and introgression are likely occurring between *Allium aaseae* and the more widespread *A. simillimum*, and this is thoroughly discussed by Smith (1995).

CURRENT LAND OWNERSHIP

General nature of ownership: Populations occur on private, City of Boise, Ada County, State Department of Lands, and BLM lands - often in mixed ownership.

Specific landowners: For the 66 known *Allium aaseae* occurrences, 31 (48%) occur solely on private land, while five (8%) are restricted to City of Boise land, two (3%) to Ada County land, four (6%) to State land, and one (2%) to BLM land. Where land ownership is mixed, 13 occurrences (19%) are on private and BLM land, one (2%) is on BLM and State land, one (2%) is on BLM and Ada County land, and 8 (12%) are on private and some other entity or mix of entities (Ada County, State, BLM). Lands under private ownership dominate for *Allium aaseae*. Fifty-one of the 65 (79%) known occurrences are at least partly on private land. The other principal land owner is the BLM, with 16 (25%) occurrences at least partially on land they administer.

Summary of land ownership for *Allium aaseae*.

Private land - 001, 003, 004, 007, 008, 011, 012, 014, 016, 019, 020, 021, 022, 028, 030, 031, 033, 042, 044, 045, 047, 051, 052, 055, 060, 061, 062, 063, 064, 065, 066

City of Boise - 006, 009, 025, 058, 059

Ada County - 056, 057

State Department of Lands - 002, 005, 013, 040

BLM - 018 (Rebecca Sand Hill RNA)

Private and BLM - 017, 034, 035(?), 037, 038, 041, 043, 046, 048, 049, 050, 053, 054

Private and Ada County - 036

Private and State - 010, 023, 024, 032

Private, State and BLM - 039

Private, State and Ada County - 027, 029

BLM and Ada County - 026

BLM and State - 015

Land ownerships for the 66 occurrences of *Allium aaseae* are also noted in their respective Element

Occurrence Records (Appendix 2).

Easements, conservation restrictions, special designations, etc: Populations on City of Boise, and BLM land occur within areas already, or scheduled to be at least partly dedicated to the conservation of *Allium aaseae*. A Conservation Agreement for the conservation of *Allium aaseae* on Boise City lands is pending between the U.S. Fish and Wildlife Service and Boise City Park Department. This Agreement will potentially affect populations in Military Reserve Park (006, 025,058, 059), Camelsback Reserve (009) and lower Hulls Gulch (011). A Cooperative Agreement between the BLM and Unimin Corporation regarding the propagation of *Allium aaseae* was signed in 1987 (Bureau of Land Management 1987). Portions of the Unimin Corporation sand mining operations near Emmett support an extensive population of *Allium aaseae* (015). Propagation and related research is ongoing, even though Unimin now owns the land (it was patented in 1993).

In 1993, an amendment to the BLM's Cascade Resource Management Plan designated six Areas of Critical Environmental Concern (ACEC's) to specifically protect populations of *Allium aaseae* (Bureau of Land Management 1993). The six ACEC's (and their associated Element Occurrence Record number) are Cartwright Canyon (037), Sand-capped Knob (049), Sand Hollow (034), Willow Creek (039), Woods Gulch (053) and Hulls Gulch. Recent taxonomic analysis has revealed the Hulls Gulch population to be the closely related taxon *Allium simillimum*, or a more likely a hybrid with *Allium aaseae*. A copy of the Cascade Resource Management Plan Amendment, with maps, is contained in Appendix 3.

One disjunct population (018) of *Allium aaseae* near Weiser is located within the BLM's Rebecca Sand Hills Research Natural Area (RNA), and is therefore protected.

EVIDENCE OF THREATS

General summary: There are two main factors contributing to the serious conservation concern for *Allium aaseae*: 1) it has a very limited distribution and occurs in a restricted habitat, and 2) its location adjacent to a major population center subject to numerous threats (Moseley and Caicco 1989). Across its range, the sandy foothill habitats supporting *Allium aaseae* have been subject to four main land uses since white settlement - urban/suburbanization, livestock grazing, sand mining, and recreational uses, such as ORV's (off-road vehicle), equestrians, hikers and mountain bikers. Permanent habitat loss and fragmentation as a result of housing and other urban developments (including landfill operations), especially in the Boise Foothills, has accelerated in recent years, is expected to continue, and represents the most serious and probably difficult to resolve threat facing *Allium aaseae*. The effects of livestock grazing on *Allium aaseae* are mainly indirect, principally the ecological decline of foothills habitat. Occurring mainly in the Pearl Mining District near Emmett, sand mining is impactful and permanent where substrate is removed. Recreational impacts are generally local, although they may be more extensive where more concentrated or destructive in nature such as at the Little Gem Motorcycle Park near Emmett. As population within the Boise area continues to grow, so will recreational demands and conflicts in the foothills.

Public land managing agencies, notably the BLM, have taken several steps for the conservation of *Allium aaseae*. Portions of five populations are located within BLM ACEC's (Cartwright Canyon, Sand-capped Knob, Sand Hollow, Willow Creek, and Woods Gulch) which were designated in 1993, primarily to protect Aase's onion. In addition, a disjunct population of Aase's onion near Weiser is located within the Rebecca Sand Hill RNA. These ACEC's support some of the largest and most extensive populations known. Due to the establishment of the ACEC's and the protection they afford, the long-term persistence

of Aase's onion in the western half of its distribution now appears secure. The eastern half of its distribution remains vulnerable, however, especially in light of urban development patterns and the preponderance of private lands in the Boise Foothills.

The BLM has also sponsored several Challenge cost-share projects to investigate and clarify the taxonomic disposition of *Allium aaseae* (McNeal 1993; Smith 1995), and has completed extensive field surveys to define its range and abundance. Other entities such as the Boise National Forest, Ada County, and Boise City have funded additional survey work in the Boise Foothills area (Moseley and Caicco 1989; Mancuso and Moseley 1991; Moseley *et al.* 1992). When conservation plans are completed and implemented, populations within Military Park Reserve (006, 025, 058, 059) and Camelsback Reserve (009) should be better protected than at present. The majority of *Allium aaseae* populations occur on private land, however, and subject to few conservation options. Conservation agreements involving private entities have not been pursued to any great degree. One success involves Unimin Mining Corporation, which has been sponsoring propagation research for several years. Mixed ownership patterns and the preponderance of private lands throughout the range of *Allium aaseae* indicates cooperation, coordination, and innovation will be important for the species long-term viability. A lack of on-the-ground commitment from the private sector would be a serious drawback to the conservation of rare plants in the Boise Foothills. If this proves to be the case, populations on public land will be invaluable for the long-term persistence of Aase's onion and other rare plants found in the Boise Foothills.

Present or threatened destruction, modification, or curtailment of habitat or range.

Past threats: Substantial reduction in habitat and populations has occurred due to past land uses, although the exact amount is unknown. Habitat has been directly lost to urban development, especially in the Boise Foothills. Habitat and plants have also been lost due to sand mining and gravel pit operations, primarily in the Emmett area. Habitat decline due to the indirect effects of livestock grazing, such as weed invasion and altered fire frequencies, is widespread in southwestern Idaho, including within foothills habitat of *Allium aaseae*. More directly, livestock trampling can destroy plants, at least locally (Prentice 1988). Habitat impacts due to recreational uses, most notably ORV use, threatens at least portions of several populations.

Existing and potential threats: The threat of habitat and population loss and fragmentation through continued expansion of Boise City into the surrounding foothills is the most serious threat to the long-term persistence of *Allium aaseae*. Portions of least seven (11%) populations (007, 008, 020, 021, 033, 063, 064) have been directly destroyed by housing development projects. Twenty-two (34%) additional occurrences (004, 010, 011, 012, 013, 014, 019, 022, 023, 029, 030, 032, 036, 042, 047, 050, 054, 060, 061, 062, 065, 066) are known to occur at least partly on private land and in locations potentially subject to development, although future plans for these parcels are unknown. Additional private properties may also be subject to various future development. Segments of populations at the Hidden Hollow landfill (026, 027, 056, 057) may be potentially threatened over the long-term due to landfill expansion.

Livestock grazing is expected to remain a widespread land use throughout the range of *Allium aaseae*. Due to its early phenology, small and low growth habit, and typical occurrence in microsites with sparse associated forage, *Allium aaseae* is less prone to direct livestock impacts than many other native plants. Livestock use is not expected to result in the direct loss of onion habitat. However, in response to indirect effects such as fostering the invasion of cheatgrass (*Bromus tectorum*), storksbill (*Erodium cicutarium*), medussahead wildrye (*Taeniatherum caput-medusae*), rush skeleton weed (*Chondrilla juncea*) and other

weeds, habitat quality may remain in decline in many places and for a long time. Management of the BLM's five ACEC's is designed to minimize impacts from livestock in these designated areas.

Portions of one occurrence (022) in Hulls Gulch has been destroyed by 4-wheel drive roads and associated destructive land rehabilitation actions. Portions of the large Sand Hollow population (034) are within the Little Gem Motorcycle Club area and have been impacted by off-trail riding disturbances (BLM 1990). Four-wheel drive roads and ORV use are known to threaten at least parts of several other populations, such as 003, 014, 021 and 065. There is more uncertainty regarding potential impacts in other places within or near 4-wheel drive road and ORV-use areas. Other recreational users potentially threaten local sections of populations in the Hulls Gulch (011, 014, 022, 060), Military Reserve Park (006, 025, 058, 059), Camelsback Reserve Park (009) and other places as well (021, 065).

Overutilization for commercial, sporting, scientific, or educational use.

Past threats: None known.

Existing and potential threats: Minimal. Packard (1979) comments that *Allium aaseae* is an attractive, early spring wildflower and has some horticultural possibilities.

Disease, predation, or grazing.

Past threats: Disease and predation likely take place, just as in most wild plant populations, but these factors do not threaten *Allium aaseae*. Deer have been observed feeding on *Allium aaseae* in early spring and chukars are known to eat bulbs in later spring (Bureau of Land Management 1990). However, the degree of herbivory by native animals is unknown, but likely minor and is not deemed a serious threat. Herbivory by domestic livestock is likewise not known to be a threat. Both wild and domestic herbivores are known to trample plants, and disturbance resulting in plants being unearthed and desiccated has been documented (Prentice 1988). A rust has been observed on populations in Woods Gulch, and may be more widespread (J. Smith pers. comm.). These threats pale in comparison to habitat destruction.

Existing and potential threats: See Past threats.

Inadequacy of existing regulatory mechanisms.

Past threats: None known.

Existing and potential threats: In 1992, the Conservation Data Center completed a contract with Boise City Planning and Zoning to conduct rare plant inventories in the Boise Foothills. This study provided rare plant population and habitat information, one of several information gaps hindering formulation of a comprehensive foothill planning document. Presently, the Boise Foothills Plan is under review by the Planning and Zoning Commissions of both Boise City and Ada County. Its adoption is not anticipated before early summer, 1995. At this stage, it is unclear how strong the Plan will be regarding rare plant conservation, but early indications are not encouraging in this regard (a policy statement supporting the protection of rare plant populations is expected, but there may be little concerning techniques/options of how to do so). During the several years interim between completion of the inventory and expected Plan adoption, there apparently has been no consistent policy for the protection of rare plants such as *Allium aaseae* in foothill areas scheduled for development. The absence of enforceable regulatory mechanisms on

private lands may be viewed as an inadequacy by some.

There is also a MOU currently being drafted addressing the implementation of consistent and uniform regulations and management for the foothills area. This MOU will likely include City of Boise, Ada County, Idaho Department of Lands, State Department of Agriculture, Agricultural Resource Services, U.S. Forest Service, BLM, Idaho Department of Fish and Game and other entities. What emphasis or role this will have concerning rare plant conservation is unknown.

Due to the nature of the 1872 General Mining Law, management options and regulations are limited regarding sites on public land supporting mining claims. The commercial quality of Glens Ferry Formation sand deposits, especially around Emmett, will likely insure the continued mining of sand mining within the range of *Allium aaseae*.

Other natural or manmade threats.

Past threat: See below.

Existing and potential threats: As stated above, urbanization, mining, ORV use, and weed invasion have all contributed to the species decline. Invasion by weedy annuals is largely the result of past disturbances associated with intensive livestock grazing and increases in range fire frequency patterns. *Allium aaseae* appears to survive fire and in a few places where exotic weed invasion is not severe, dense subpopulations are known from areas recently burned (Mancuso pers. obser.).

Monitoring activities and further research needs.

For the five BLM ACEC's containing *Allium aaseae*, a monitoring plan has been prepared in consultation with the USFWS. Monitoring plots have been established and baseline trend and habitat data was collected in 1991, 1992, 1994 (Bureau of Land Management 1992).

Unimin Corporation continues to sponsor propagation and related research for *Allium aaseae*.

Research related to pollination biology has been identified as a gap in our knowledge of *Allium aaseae* that would be applicable to better management and conservation decisions (Smith 1995).

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Appendix 1.

Location Maps for *Allium aaseae*

- Map 1. Rangewide distribution of *Allium aaseae*. Portions of Boise, Idaho; Oregon (revised 1976) and Baker, Oregon; Idaho (revised 1974) 1:250:000 U.S.G.S. maps.
- Map 2. *Allium aaseae* occurrences 025, 058, 059. Portion of Boise South 7.5' U.S.G.S. quadrangle, 1972.
- Map 3. *Allium aaseae* occurrences 006, 007, 008, 009, 011, 012, 014, 019, 020, 021, 022, 023, 033, 060, 061, 062. Portion of Boise North 7.5' U.S.G.S. quadrangle, 1976.
- Map 4. *Allium aaseae* occurrences 004, 005, 010, 013, 024, 030, 032, 044, 063, 064. Portion of Boise North 7.5' U.S.G.S. quadrangle, 1976.
- Map 5. *Allium aaseae* occurrences 046, 047. Portion of Boise North 7.5' U.S.G.S. quadrangle, 1976.
- Map 6. *Allium aaseae* occurrences 026, 027, 028, 036, 056, 057, 060. Portion of Eagle 7.5' U.S.G.S. quadrangle, 1979.
- Map 7. *Allium aaseae* occurrences 029, 046, 047, 048. Portion of Eagle 7.5' U.S.G.S. quadrangle, 1979.
- Map 8. *Allium aaseae* occurrences 031, 049, 050. Portion of Eagle 7.5' U.S.G.S. quadrangle, 1979.
- Map 9. *Allium aaseae* occurrences 035, 042, 046, 049, 051, 052, 053. Portion of Pearl 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 10. *Allium aaseae* occurrences 003, 038, 050, 054, 055. Portion of Pearl 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 11. *Allium aaseae* occurrences 001, 002, 045. Portion of Pearl 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 12. *Allium aaseae* occurrences 015, 016, 034, 041. Portion of Southeast Emmett 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 13. *Allium aaseae* occurrences 015, 017, 041. Portion of Southeast Emmett 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 14. *Allium aaseae* occurrences 039, 040. Portion of Southeast Emmett 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 15. *Allium aaseae* occurrence 034. Portion of Northeast Emmett 7.5' U.S.G.S. quadrangle, Provisional edition 1985.
- Map 16. *Allium aaseae* occurrence 046. Portion of Cartwright Canyon 7.5' U.S.G.S. quadrangle, 1976.
- Map 17. *Allium aaseae* occurrence 037. Portion of Cartwright Canyon 7.5' U.S.G.S. quadrangle, 1976.
- Map 18. *Allium aaseae* occurrence 018, and boundaries of the Rebecca Sand Hills RNA. Portions of Mann Creek SE 7.5' U.S.G.S. quadrangle, Provisional edition 1987 and Weiser Cove 7.5' U.S.G.S. quadrangle, 1952.
- Map 19. *Allium aaseae* occurrence 043. Portion of Weiser North 7.5' U.S.G.S. quadrangle, Provisional edition 1987.

Appendix 2.

Element Occurrence Records from the Conservation Data Center for *Allium aaseae*.

Appendix 3.

Copy of the BLM's Cascade Resource Management Plan Amendment.