

Current Knowledge and Conservation Status of *Astragalus oophorus* var. *clokeyanus* Barneby (Fabaceae), the Clokey eggvetch.

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SUMMARY: *Astragalus oophorus* var. *clokeyanus* was first discovered and collected in 1937 by Ira LaRivers and Newell F. Hancock in upper Lee Canyon of the Spring Mountains, Clark County, Nevada, but was thought to be *Astragalus artipes* A. Gray until Rupert C. Barneby named *A. oophorus* var. *clokeyanus* in 1954. *Astragalus oophorus* var. *clokeyanus* is a low perennial herb up to 10 cm high with green leaves divided into 9-19 rounded leaflets, stalks of bright reddish-purple and white pea-like flowers, and inflated, papery, egg-shaped mottled fruiting pods. *Astragalus oophorus* var. *clokeyanus* remains endemic to southern Nye and western Clark counties, Nevada, and until recently was thought to be confined entirely to the Spring Mountains. *Astragalus oophorus* var. *clokeyanus* appears to intergrade northward into var. *oophorus*, and its separation from that taxon needs further study. For now, var. *clokeyanus* is considered a distinctive genetic and geographic entity worthy of separate conservation concern.

As of the end of 1992, *Astragalus oophorus* var. *clokeyanus* was recognized from 3 or 4 sites in the northern Spring Mountains comprising at most a few hundred plants between 6800 and 8660 feet (2070-2640 meters) elevation. These sites were, and continue to be, subject to intensive recreational use by visitors from nearby Las Vegas. Because of these impacts and its rarity and continued vulnerability, *Astragalus oophorus* var. *clokeyanus* remained a category-1 candidate for federal listing since its original designation on 15 December 1980. Responding to this concern, the U. S. Fish and Wildlife Service, The Nature Conservancy, Bechtel Nevada, the departments of Defense and Energy, the Humboldt-Toiyabe National Forest, and the Nevada Natural Heritage Program sponsored and conducted various and extensive field surveys between 1992 and 2001 to verify and refine the historical reports, discover any additional populations, and document the biology, ecology, and conservation status of all populations. This report summarizes the results of all surveys since 1992, reviews all previous knowledge of the species, and recommends conservation actions designed to prevent it from becoming a threatened or endangered species.

The recent surveys compiled for this report greatly extended the previously known range of the variety. As now documented, *Astragalus oophorus* var. *clokeyanus* is known worldwide from 32 sites in 2 general groups, totaling at least 4443 plants and covering about 260 acres (105 ha) of Nellis Air Force Range (roughly 42%), Humboldt-Toiyabe National Forest (33.5%), Nevada Test Site (23.3%), and Private (1.2%) lands between 5365 and 9005 feet (1635-2745 meters) elevation. No sites are yet known to be extirpated. The most distant two extant occurrences are separated by about 86 miles (138 km), and the number of extant occurrences is reduced to 23 if a 1 km minimum separation distance between patches is imposed.

Astragalus oophorus var. *clokeyanus* does not exhibit the very narrow habitat tolerances typical of many rare plant species. In general, the taxon is found on dry to moist, often somewhat disturbed open slopes, flats, or drainage bottoms and adjacent foot-slopes of all aspects on gravelly, often basic silty-loam soils derived from

limestone, tuff, or other rhyolitic volcanics (sometimes on steep slopes of weathering tuff), in openings or shaded by trees and shrubs, sometimes near old burns, in ponderosa pine, white fir-limber pine, and Gambel oak-pinyon-juniper-sagebrush woodland vegetation. Recent surveys focusing on about 1900 acres (770 ha) of additional potential habitat in western Nevada and Eastern California have revealed no further populations of *Astragalus oophorus* var. *clokeyanus*.

The Spring Mountains populations, though now managed as part of the Spring Mountains National Recreation Area and covered by the Clark County Multiple Species Habitat Conservation Plan, are still vulnerable to impacts from recreational use and facilities developments, as well as road development and maintenance, feral horse populations, and historic and future fire suppression activities. The DOD and DOE populations are closed to the general public and much more remote, with impacts much lighter and limited mainly to road incursions. Increased commercial and military uses constitute the long-term threats to these populations. Even without these impacts and threats, *Astragalus oophorus* var. *clokeyanus* would remain rare and geographically limited enough to merit continued conservation concern. *Astragalus oophorus* var. *clokeyanus* is capable of recolonizing moderate to severe past disturbance, such as road cuts, within existing populations, but its ability to invade and spread along disturbance corridors outside its preferred habitat appears very limited or non-existent. The species likely depends on insect pollinators for most or all of its reproductive success, but nothing is known about the identity, specificity, rarity, status, current effectiveness, and viability trends of these pollinators. Currently *Astragalus oophorus* var. *clokeyanus* is managed as a "sensitive species" by the Humboldt-Toiyabe National Forest, but has no other legal status or protective designation.

Based on the best available scientific evidence, *Astragalus oophorus* var. *clokeyanus* does not now meet the definition of a candidate for listing as threatened or endangered under the Endangered Species Act. Its long-term viability remains a concern without protective management, however, and it could become a threatened or endangered species in the future if more than 10-20% of the known populations were lost. It therefore continues to meet criteria for sensitive species designation by the U. S. Forest Service. Currently, some level of protective management and/or monitoring is ongoing at all sites. This report recommends several conservation measures which, if successfully implemented, offer the best chance to eliminate any future need to list *Astragalus oophorus* var. *clokeyanus* as threatened or endangered. Primary among these are full implementation of existing monitoring plans and conservation agreements, management of existing threats to avoid further impacts, continued long-term surveys and monitoring of site conditions, genetic, taxonomic, and pollination studies, and careful design and mitigation of roads and fire suppression sites.

ACKNOWLEDGMENTS

I would like to thank Eric Watkins for allowing me to survey for *Astragalus oophorus* var. *clokeyanus* on Nellis Air Force Range over the years. Thanks also goes to Kent Ostler and David Anderson for sending me their report, specimen, and giving me access to the Nevada Test Site; to Gina Glenne for guiding me to a known population of the variety to collect ovule information; to Jan Nachlinger for collecting ovule information; and most importantly to the late Rupert Barneby for all his insights and knowledge of the genus *Astragalus*. I would also like to recognize Daniel Pritchett for doing the statistical analysis on the ovule number study. The herbaria cited in Appendix 1, Table 5, and their curators and parent institutions, maintained and made available the specimens in their care. The review and comments provided by David Anderson, Cheryl Beyer, and Arnold Tiehm were most helpful in improving this report and catching a few errors. James Morefield of the Nevada Natural Heritage Program edited the final report, and provided additional information for several sections.

All information contained in this report was believed current and complete on the date it was printed. Please submit any and all additions, corrections, updates, comments, or suggestions, whatever their magnitude, to the Nevada Natural Heritage Program or the U. S. Fish and Wildlife Service at the addresses above.

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- Letter 1. Rupert Barneby to Frank J. Smith, 24 September 1995.
- Letter 2. Frank J. Smith to Rupert Barneby, 16 March 1998.
- Letter 3. Rupert Barneby to Frank J. Smith, 28 April 1998.

I. CLASSIFICATION AND SYSTEMATICS

Scientific Name: *Astragalus oophorus* S. Watson var. *clokeyanus* Barneby (1954, p. 194).

Type Specimen: NEVADA, Clark County: "Lee Canyon Pipe Line Ridge, Charleston Mountains," 9000 ft, 11 July 1938, *Train 2141* (holotype: NA; isotypes: ARIZ, RENO, UC) (Tiehm 1996) (here interpreted to represent site 4).

Synonym(s): *Astragalus artipes* A. Gray (= *A. oophorus* var. *caulescens* [M.E. Jones] M.E. Jones), misapplied by Clokey (1942, 1951), not in the sense of Gray or Jones.

Vernacular Name(s): Clokey eggvetch. The entire species has been referred to as egg milk-vetch and spindle loco (Barneby 1989, p. 146).

Family: Fabaceae (buckwheat family).

| Major Groups: | Cronquist (1988) | Thorne (1992) |
|----------------------|--------------------------------|------------------------------|
| Class | Magnoliopsida (Dicotyledoneae) | Magnoliopsida (Angiospermae) |
| Subclass | Rosidae | Magnoliidae (Dicotyledoneae) |
| Superorder | [mostly Rosanae of Thorne] | Rutanae |
| Order | Fabales | Rutales |
| Suborder | ————— | Fabineae |

Review of Alternative Taxonomic Treatments: Barneby (1954, 1964) pointed out Clokey's (1942, 1951) error in applying the name *Astragalus artipes* A. Gray to Percy Train's type collection from the Spring Mountains, and named the plant in honor of Clokey's honest mistake. No one has since disputed Barneby's recognition or placement of *Astragalus oophorus* var. *clokeyanus*.

Rydberg (1929) placed *Astragalus oophorus* in a segregate genus as *Phaca oophora* (S. Watson) Rydberg; the species was also treated as *Tragacantha oophora* (S. Watson) O. Kuntze (1891). Barneby (1964) argued convincingly that Rydberg's (1929) and others' attempts to divide North American *Astragalus* into separate genera was based on mistaken assumptions about the meaning of differences in fruit morphology; all other botanists have since followed Barneby's treatment.

Some concerns have been raised about the taxonomy of *Astragalus oophorus* var. *clokeyanus*. When Barneby returned the collection of *Astragalus oophorus* I collected (*Smith 3916*) from the Belted Range in 1995 he noted, "Your material really does have the technical characters of var. *clokeyanus* including low ovule number, and I concur in your identification. Whether the taxon is any good is another matter. When I described it, it seemed strongly isolated geographically, but this has now faded." (Appendix 4, Letter 1). I found this statement to mean the variety is not distinct. In 1998 I sent Barneby a letter asking him to help me understand the taxonomy of *Astragalus oophorus*. I mentioned in this letter I thought *Astragalus oophorus* var. *clokeyanus* could be a distinct variety based on the small flower size, small calyx length and its geographic range. Barneby (*in litt.* 1998) wrote back basically agreeing with what I said, but he did refer to *A. oophorus* var. *clokeyanus* as a minor taxon. (Appendix 4, Letters 2-3).

When Barneby described the variety, one of the characters he used – in addition to flower size and calyx length – was the number of ovules per pod. He wrote that the ovule number for *A. oophorus* var. *clokeyanus* ranged from 23 to 28, and that for var. *oophorus* it ranged from 41 to

54 (Barneby 1989). To test this, I collected a single pod from 10 to 15 plants at each site in the Spring Mountains, Nevada Test Site (NTS), and on Nellis Air Force Base (NAFB) and counted ovules in each pod.

Results showed samples at the Spring Mountains, Echo Peak (NTS), Captain Jack Spring (NTS), Kawich Canyon (NTS), and Cliff Spring (NAFB) sites to be similar (i.e., 95% confidence limits for means overlapped -- see Appendix 2, Figure 8). The ovule number per pod ranged from 24 to 36. The mean ovule number for these sites ranged from 27 to 31.

Confidence limits for the mean ovule number for samples from Cedar Pass in the Kawich Range (NAFB) did not overlap with those from other samples: the mean ovule number was 39 (Appendix 2, Figure 8). The ovule number counted per pod ranged from 35 to 43. This population (site U14) had previously been reported as var. *clokeyanus*.

I returned to Cedar Pass (NAFB) on June 1, 1997, with the hope of measuring flowers but it was too late in the season. Fortunately, David Anderson of Bechtel Nevada was able to visit the site the next year and collect a specimen with both flowers and fruits. Flower length ranged from 13 to 17 mm with the average flower length being 14 mm. Though the average flower size was about halfway between the reported sizes for var. *clokeyanus* (12 mm) and var. *oophorus* (16 mm) (Morefield 1993), I concluded the specimen to be var. *oophorus* based on the higher mean ovule number of 39 (see Appendix 2, Figure 8).

The plants at Cedar Pass might also be treated as intermediates between var. *clokeyanus* and var. *oophorus*. It is unfortunate that the times I have been on the Nevada Test Site and Nellis Air Force Base searching for *Astragalus oophorus* var. *clokeyanus*, I have found few plants in flower and so have been unable to see the full range of variation in flower size.

In conclusion, in the southern distribution of *Astragalus oophorus* in Nevada there are sites with small flowers and low ovule number, while farther north flowers are larger and the ovule number increases. Flower length, calyx length, and ovule number can be variable within the range of a species. As it stands now the northern distribution limit of var. *clokeyanus* is in the Belted Range and just to the west in the Kawich Range occurs var. *oophorus*. Further morphometric and genetic studies should be conducted to determine the integrity of *A. oophorus* var. *clokeyanus*. I believe that calyx length, flower size, and ovule number can be weak characters for naming a taxon because of the variability that can occur over the range of a species.

Biogeography and Phylogeny: Since the range of *Astragalus oophorus* var. *clokeyanus* was discovered to extend northward outside the Spring Mountains, Morefield's (1993) discussion of its isolation and endemism no longer applies. The variety comprises part of the southwestern edge of the range of *Astragalus oophorus*, and appears to intergrade somewhat with var. *oophorus* northward toward the main range of the species. *Astragalus* is an exceedingly diverse genus, the most diverse of the legumes, with over 2000 species estimated, and the most diverse genus in North America with about 380 species (Barneby 1989, Spellenberg 1993). Another 100 species are found in South America, and the rest are in Eurasia and Africa. In North America, this diversity is centered in the western United States, with 156 species and 122 additional varieties found in the *Intermountain Flora* region alone (Barneby 1989). Many of these taxa are narrow geographic and/or substrate endemics that are rare and of conservation concern. The proliferation of North American *Astragalus* into so many forms and habitats is thought to be "*a relatively recent phenomenon that has not yet run its course*" (Barneby 1989).

Few definitive data exist on the evolutionary origin of *Astragalus oophorus* var. *clokeyanus*. Speculatively, its closest living relative appears to be var. *oophorus*. *Astragalus oophorus*, in turn, is placed by Barneby (1964) in his section *Megacarpus*, which also contains *A. megacarpus*

and *A. beckwithii*. Barneby (1964, p. 771) states that "The affinities of the section [*Megacarpis*] in the genus [*Astragalus*] are far from clear." He suggests a remote common ancestor with section *Argophylli*, and also places it near sections *Sarcocarpi* and *Pterocarpi* in his treatment. Sanderson's (1991) preliminary study suggests that the New World species of *Astragalus* may share a single common ancestor and, based on Barneby's placement, that *A. oophorus* may be moderately to highly derived within the New World group. The genus *Astragalus* as a whole appears most closely related (or perhaps ancestral) to *Oxytropis* in the tribe Galegeae of Fabaceae, and both appear to have originated in cold-temperate Eurasia, where both are exceedingly diverse and show potentially primitive traits (Barneby 1964, Sanderson 1991; from Morefield 1993).

II. TAXON HISTORY

Unless otherwise cited, reports and correspondence documenting the following chronology are on file with the Nevada Natural Heritage Program.

- 1937: First discovered and collected in by I. LaRivers and N.F. Hancock on 23 June in Lee Canyon, Spring Mountains
- 1938: Future type collection gathered in Lee Canyon by P. Train on 11 July.
- 1942: Lee Canyon specimens treated as *Astragalus artipes* A. Gray by I.W. Clokey (1942).
- 1951: Treatment maintained as *Astragalus artipes* A. Gray by Clokey (1951) with statement that it is known from a single locality.
- 1954: Formally named and described as a new variety, *Astragalus oophorus* S. Watson var. *clokeyanus* Barneby (1954) with statement that it is known only from the east slope of Charleston Peak, where it is fairly abundant in yellow pine forest between 8100 and 9100 ft.
- 1964: Barneby (1964) maintained treatment as *Astragalus oophorus* var. *clokeyanus*.
- 1968: Apparently first collected outside the Spring Mountains, in the Split Ridge area on the Nevada Test Site, by J. C. Beatley on 27 June, but not recognized as var. *clokeyanus*.
- 1970: First collected on the west slope of the Spring Mountains by J. Beatley and J. Reveal on 1 June.
- 1975: First recorded in Federal Register as a candidate for listing under the Endangered Species Act with recommendation for threatened status (U. S. D. I. Fish and Wildlife Service 1975, p. 27862).
- 1976: All specimens from the Nevada Test Site and adjacent areas treated as *Astragalus oophorus* var. *oophorus* by Beatley (1976).
- 1980-1996: Maintained as a federal category-1 candidate for listing by the U. S. D. I. Fish and Wildlife Service (1980, 1985, 1990, 1993).
- 1987: Included and recognized in Kartesz's (1987) flora of Nevada.
- 1989: Recognized in Barneby's (1989) treatment of *Astragalus* for the *Intermountain Flora*.
- 1992: Searched for but not rediscovered on 25-27 May by J. Morefield (1993) in the Spring Mountains.
- 1993-1994: Rediscovered at 12 sites in the Spring Mountains J. Nachlinger, F. Smith, and S. Sheldon throughout the summer seasons (Nachlinger 1994, Nachlinger and Sheldon 1995).

- 1995: First recognized on Nellis Air Force Range, in the Belted Range at Indian Spring, by Frank Smith, Jenny Heers, and Rob Starrett on 17 June (Knight and Smith 1996).
- 1996: Retained as a candidate for federal listing after candidate categories 1 and 2 were dropped from use by the U. S. D. I. Fish and Wildlife Service (1996).
- 1996: Biological monitoring plan for the Spring Mountains populations prepared by Nachlinger and Combs (1996).
- 1996: First recognized on the Nevada Test Site, in the Split Ridge area, by David Anderson of Bechtel Nevada on 22 May.
- 1997-1998: Intensive surveys conducted on the Nevada Test Site and adjacent areas by David Anderson and other Bechtel Nevada personnel throughout the late-spring and early-summer seasons.
- 1997-2000: Field surveys were conducted for this report.
- 1998: Removed from federal candidate status by U. S. D. I. Fish and Wildlife Service (1998).

III. PRESENT LEGAL OR OTHER FORMAL STATUS

International: Using a system established by NatureServe (formerly part of The Nature Conservancy), the various state Natural Heritage Programs rank sensitive taxa at state, national, and global levels on a scale of 1 to 5, with 1 being the most vulnerable and 5 the most secure. *Astragalus oophorus* var. *clokeyanus* was most recently ranked 2 by the Nevada Natural Heritage Program (2001) at all levels. The results of this report show that 2 is still the most appropriate rank.

Federal: *Astragalus oophorus* var. *clokeyanus* was designated a category-1 candidate for listing as endangered or threatened under 16 U.S.C. 1531 *et seq.*, the Endangered Species Act as amended in 1988, until the U. S. D. I. Fish and Wildlife Service (1996) eliminated that category. It then remained a candidate for listing until it was removed from the candidate list by the U. S. D. I. Fish and Wildlife Service (1998). *Astragalus oophorus* var. *clokeyanus* remains a "species of concern" to the Fish and Wildlife Service, but this term has no formal or legal status. *Astragalus oophorus* var. *clokeyanus* is on the sensitive species lists of the Humboldt-Toiyabe National Forest (Weixelman and Atwood 1990) and the U. S. D. I. Bureau of Land Management (1996). This report recommends that *Astragalus oophorus* var. *clokeyanus* be removed from the BLM sensitive species list, and that all other designations remain unchanged.

State: No formal status has been designated at the state level. *Astragalus oophorus* var. *clokeyanus* is on the Nevada Native Plant Society's Watch List (Nevada Natural Heritage Program, 2001). This report recommends no changes to this designation.

IV. DESCRIPTION

Non-technical: **Perennial** herb; **overall color** green with bright reddish-purple and white flowers, fruits mottled reddish; **stems** 5-10 cm long, spreading, leafy for > 5 cm, internodes shorter than the leaves or flower groups. **Leaves** 5-10 cm long, alternate, each divided into 1 terminal and 4-9 pair of lateral leaflets; **leaflets** egg-shaped to round, broadest toward the tips, 4-10 mm long, jointed to leaf axis, hairs none or a few attached by one end to the edges; **stipules** at base of leaf stalks with free edges, not forming cups around the stem. **Flowers** (late May-June) pea-like, bright reddish-purple with whitish eyespot and wing tips, in a loose group of 4-10, each group 1-5 cm long on a stalk 4-8 cm long, longest petal 11-12 mm long, keel petals 9.5-10 mm

long; **calyx** hairless, forming a cup around the base of the flower 4-4.3 x 2.5-3.5 mm with 5 narrow teeth 2-3 mm long; **bract** at base of each flower stalk narrowly triangular, 1.5-5 mm long. **Fruit** (June-July) a strongly inflated, opaque, papery pod with 1 chamber, 2-3.7 cm long, 1-2 cm wide, hairs none, rounded abruptly and jointed at base to a stalk 3.5-5.5 mm long within calyx, mottled reddish and detaching from stalk when mature, the pointed tip short and straight; **ovules** 23-34(36); **seeds** 3-3.7 mm long, brown, dull, finely dotted. (modified from Morefield 1993 and personal observations)

Technical: Perennial herb; **overall color** green with bright reddish-purple and white petals, pods mottled reddish; **stems** 5-10 cm long, spreading, leafy for > 5 cm, internodes shorter than the leaves or inflorescences. **Leaves** 5-10 cm long, alternate, odd-pinnate with 9-19 leaflets; **leaflets** obovate to round, 4-10 mm long, jointed to rachis, glabrous or sparsely appressed-ciliate, hairs basifixed; **stipules** free opposite petioles. **Flowers** (late May-June) papilionaceous, inflorescence 1-5 cm long, 4-10-flowered, peduncle 4-8 cm long, petals bright reddish-purple with whitish eyespot and wing tips, banner 11-12 mm long, keel 9.5-10 mm long; **calyx** glabrous, tube 4-4.3 x 2.5-3.5 mm, teeth subulate, 2-3 mm long; **bract** narrowly triangular, 1.5-5 mm long. **Fruit** (June-July) a strongly inflated, opaque, papery legume, unilocular, 2-3.7 cm long, 1-2 cm wide, glabrous, rounded abruptly and jointed to gynophore 3.5-5.5 mm long, mottled reddish and deciduous when mature, beak short, straight; **ovules** 23-34(36); **seeds** 3-3.7 mm long, brown, dull, finely punctate. (modified from Barneby 1964, 1989, and personal observations)

Field Characters: (see Appendix 2 figures) *Astragalus oophorus* var. *clokeyanus* is distinguished from similar taxa by its combination of small bicolored flowers, green rounded leaflets, and egg-shaped, stalked, inflated, papery, mottled pods with mostly 23-34 ovules. The following idealized key from Morefield (1993) is synthesized mainly from Barneby (1964, 1989) and personal observations, and will separate typical *Astragalus oophorus* var. *clokeyanus* from typical members of similar or co-occurring taxa. Specimens for which the key is ambiguous may be intermediate between varieties, and should be compared with more detailed descriptions:

1. Plants annual *or* stems leafy for < 5 cm *or* hairs dolabriform *or* hairs spreading *or* lower stipules sheathing opposite leaf stalks *or* leaves linear *or* keel petals < 9 mm long *or* pods not inflated *or* pods 2-chambered *or* stalk of pod above base of calyx absent *or* < 3 mm long.
..... **other *Astragalus***
- 1' Plants perennial, stems leafy for > 5 cm; hairs when present basifixed, appressed; lower stipules free opposite the leaf stalk; leaves regularly pinnate with jointed leaflets; keel petals > 9 mm long; pods inflated, 1-chambered, stalked > 3 mm within calyx.
 2. Pods linear to narrowly ellipsoid *or* < 15 mm long *or* with hairs > 1 mm long **other *Astragalus***
 - 2' Pods broadly ellipsoid to ovoid, > 15 mm long, hairs < 1 mm long or none.
 3. Pod persistent on receptacle *or* pod walls fleshy or leathery *or* flowers nodding **other *Astragalus***
 - 3' Pod disjointing from receptacle, walls more or less papery; flowers spreading to upright.
 4. Pod gradually narrowed to and/or continuous with stalk *or* stem between last leaf and first flower (peduncle) < 3.5 cm long *or* banner petal < 10.7 mm long *or* calyx tube > 9 mm long *or* calyx hairy..... **other *Astragalus***
 - 4' Pod rounded abruptly to joint with stalk; peduncle > 3.5 mm long; banner petal > 10.7 mm long; calyx glabrous, tube < 9 mm long ***Astragalus oophorus***
 5. Calyx tube 7.5-9 x 3.5-4.5 mm; pod stalk 10-12 mm long... **var. *lonchocalyx***
 - 5' Calyx tube 4-6.5 x 2-5 mm; pod stalk 3.5-10 mm long.

- 6. Petals of one color, white to pale yellow or pale lilac.
 - 7. Pod asymmetric, lower suture gently convex to concave in profile, upper suture strongly convex **var. caulescens**
 - 7' Pod subsymmetric, sutures both about equally convex in profile
..... **var. lavinii**
- 6' Petals of two colors, bright reddish purple and whitish.
 - 8. Calyx 7-12 mm long; banner petal 16-23 mm long, ovules 35-54.....
..... **var. oophorus**
 - 8' Calyx 6-7 mm long; banner petal 11-12 mm long, ovules 23-34.....
..... **var. clokeyanus**

Photographs and Line Drawings: A line drawing of *Astragalus oophorus* var. *clokeyanus* by Jeanne R. Janish was published in Mazingo and Williams (1980, p. 114) and in Weixelman and Atwood (1990, p. 76), and is reproduced in Appendix 2, Figure 1 of this report. Photographs of *Astragalus oophorus* var. *clokeyanus* and/or its habitat appeared in Weixelman and Atwood (1990), Nachlinger and Sheldon (1995), Knight and Smith (1996), Knight *et al.* (1997), and Anderson (1998). Photographs of *Astragalus oophorus* var. *clokeyanus* and its habitats were also made for this report, are reproduced in Appendix 2, Figures 2-7, are filed with the Nevada Natural Heritage Program, and are available on its public web site at <http://heritage.nv.gov>.

V. SIGNIFICANCE OF TAXON

Natural: *Astragalus oophorus* var. *clokeyanus* appears to represent a case of incipient geographic speciation, and could provide significant information for studies of evolution, biogeography, and autecology. As a legume, the species is presumably a nitrogen fixer, and undoubtedly plays a part in soil formation and retention, nutrient cycling, and annual biomass production. The flowers probably serve as a source of pollen or nectar, and the seeds as a source of food, for insects in the region.

Human: No studies of medicinal or other qualities of potential human benefit are yet known to have been performed on *Astragalus oophorus* var. *clokeyanus*. As a member of the legume family, *Astragalus oophorus* var. *clokeyanus* is closely related to numerous crop species. Its adaptation to limestone soils at high altitudes makes it a potential subject for physiologic studies with the possibility for improvements in crop breeding or other human benefits.

VI. GEOGRAPHIC DISTRIBUTION

Geographic Range: (Appendix 1, Table 1; Appendix 3 maps). Globally, *Astragalus oophorus* var. *clokeyanus* has been documented from at least 32 sites in 2 general groups, containing 46 total patches, in the Spring Mountains of western Clark County, and on Pahute Mesa and the surrounding mountains of southern Nye County, Nevada, on Nellis Air Force Range (roughly 42.0%), Nevada Test Site (23.3%), Humboldt-Toiyabe National Forest's (HTNF) Spring Mountains National Recreation Area (33.5%), and private (1.2%) lands. Within HTNF lands, sites in the Mount Charleston Wilderness Area comprise about 1.2% of the global population. Three historical sites are of uncertain status. The most distant two extant occurrences are separated by about 86 miles (138 km), and the number of extant occurrences is reduced to 23 if a 1 km minimum separation distance between patches is imposed.

Precise Occurrences: Site numbers and descriptions are given in Appendix 1, Tables 1-2. The tables cross-reference each site to its related maps and figures, as well as its most recent year observed and source(s) of documentation. The tables also show estimated areas and numbers of

individuals for each site, along with elevations, apparent land management status, and types of impacts or threats. The site numbers given in Table 1 correspond to the element occurrence numbers for *Astragalus oophorus* var. *clokeyanus* in the databases of the Nevada Natural Heritage Program.

Information for most of the sites in Appendix 1 was compiled from several different sources whose survey methods were not always exactly comparable. For all sites, numbers of individuals were estimated by direct counting, and the areas, elevation ranges, and land management information given in Tables 1-2 were derived from the final mapped site boundaries. Threats and impacts were assessed from all available information, including but not limited to visual inspection on the ground, existing written documentation, and association with mapped disturbances. Because of the uncertainties involved with all the survey methods, the rough percentages given above for each surface management category are averages of the percentages based on numbers of populations, total surface areas, and total population estimates for each category.

Historical site(s) rediscovered or recently known extant: (Appendix 1, Table 1) Prior to 1993, there were 4 recognized locations for *Astragalus oophorus* var. *clokeyanus*, all within the Spring Mountains of Clark County (sites 1, 2, 4, and 9). Three other sites in southern Nye County had apparently been documented by specimens, but not yet recognized as var. *clokeyanus* (see below). The 1993-1994 Spring Mountains surveys, conducted by The Nature Conservancy and documented in Nachlinger and Sheldon (1995), revealed an additional 9 sites (3, 5-8, 10-13). Site 14 was discovered by Humboldt-Toiyabe National Forest personnel in 1995. The Nature Conservancy, under the U. S. Department of Defense's Legacy Resource Management Program, conducted surveys in 1995-1996 that documented 2 additional sites (15 and 16). Bechtel Nevada, under contract to the U. S. Department of Energy's Nevada Test Site (NTS), conducted surveys in 1996-1998 that were partially concurrent with those for the present report. These documented an additional 13 sites on NTS and adjacent military withdrawals of the Nellis Air Force Range (sites 19-25 and 27-32). The author had participated to some extent in all these earlier surveys. These 31 recent and historical sites are now estimated to comprise at least 4428 individuals in 40 separate patches, covering about 260 acres (105 ha) of NTS, Nellis AFR, National Forest, and private lands between 5365 and 9005 feet (1635-2745 meters) elevation.

Anderson (1998) cited historical herbarium specimens as *Astragalus oophorus* var. *oophorus* from 3 of the exact locations where var. *clokeyanus* was subsequently documented on the Nevada Test Site and adjacent Nellis Air Force Range. These include *Beatley & Kaaz* on 8 June 1969 from Cliff Spring (site 16), *Beatley* on 27 June 1968 from the Split Ridge area (site 18), and *Cochrane & Holland* on 20 May 1978 from Captain Jack Spring. *Beatley* (1976) apparently also considered the first two specimens to represent var. *oophorus*. These specimens still need careful re-examination, but most likely are var. *clokeyanus* and are therefore included among the specimens in Appendix 1, Table 5.

New site(s) discovered: (Appendix 1, Table 1) Site 17 on Nellis Air Force Range was newly documented for this report, and comprised at least 15 individuals in 3 separate patches covering about 0.3 acres (0.1 ha) between 7090 and 7240 feet (2160-2205 meters) elevation.

Historical site(s) searched for but not rediscovered: (Appendix 1, Tables 1 and 5) According to Nachlinger and Sheldon (1995), site 9 southeast of Willow Spring as docu-

mented by Duane Atwood's 1985 collection was searched both in 1993 and 1994 but no plants were found. The area around site 2 above Wheeler Well on the road to Wheeler Pass, documented by Beatley and Reveal's 1970 collection, was searched in 1992 (Morefield 1993), 1993, and 1994 to no avail (Nachlinger and Sheldon 1995). The exact locations of these vaguely described sites may not yet have been discovered, however (see discussions below).

Other site(s) searched where not discovered: (Appendix 1, Table 2) Sites U1-U21, comprising about 1990 acres (805 ha) between 6000 and 10,000 feet (1830-3050 meters) elevation in Clark and Nye counties, Nevada, have been surveyed by various past workers without encountering *Astragalus oophorus* var. *clokeyanus*. The map in Anderson (1998, p. 6) depicts additional survey areas where plants were not found.

Historical site(s) known or suspected to be erroneous reports: The UTM coordinates supplied with the survey sheets and maps in Anderson (1998), and with survey sheets and field maps supplied prior to 1998, are frequently up to several kilometers removed from the mapped locations due to use older GPS technology. These coordinates were therefore ignored, and the maps were assumed to represent the correct locations.

The final maps published in Anderson (1998) were generalized and did not correspond entirely to the field maps supplied earlier to the Nevada Natural Heritage Program. The published polygons were usually not exactly the same shape as the polygons drawn on the field maps. Beyond this, site 31 appeared on the field map that also included site 24, but did not appear on the published maps. And in Anderson (1998), the polygons for site 23 were placed at the next drainage confluence about 0.5 km east-southeast (downstream) from where they were depicted on the original field map. Because the field maps were on copies of 1:24,000 topographic quadrangles and were presumably recorded in the field, it was assumed that the above sites were more accurately represented on the field maps than on the final published maps, and the polygons from the field maps are therefore included in this report (Appendix 3, maps 14-15).

In two other cases, polygons appeared on the maps published in Anderson (1998) but not on the earlier field maps. These were site 32 and the western-most polygon of site 25 (Appendix 3, maps 14-15). Because these polygons corresponded to descriptions on the site sheets, they were assumed to represent valid locations omitted from the earlier field maps, and were therefore included in this report. Because they were digitized from generalized maps, however, their precision must be considered low.

The *Astragalus oophorus* first reported from site U14 (Appendix 1, Table 2; Appendix 3, map 19) was thought to be var. *clokeyanus*, but analysis for this report showed it to be var. *oophorus* instead (Appendix 2, Figure 8).

It is possible but very unlikely that site 2 is an erroneous report for *Astragalus aequalis* Clokey. The specimen documenting this site states "one plant, top of road bank, above Wheeler Well on road to Wheeler Pass, SW slope of Spring Mtns, Pahrump Valley drainage, in Artemisia-Pinyon Juniper, 6800 ft" (2075 m), 1 June 1970, Beatley & Reveal 10805 (NTS) (Beatley 1977). At this elevation along the present road to Wheeler Pass, plants of *Astragalus aequalis* were found on the road banks and on the slopes above the road by Morefield (1993) and Nachlinger and Sheldon (1995), but no *Astragalus oophorus* var. *clokeyanus* could be located. *Astragalus aequalis* has fruit superficially similar to those of *Astragalus oophorus* var. *clokeyanus* that would have been fully mature by the collection date. The foliage and habit are very different, however, making it unlikely that

two experienced botanists like Beatley and Reveal could have misidentified the plant, and Beatley (1977) indicated that Rupert Barneby had also annotated the specimen as *Astragalus oophorus* var. *clokeyanus*. It is therefore highly unlikely that the specimen was misidentified. Low numbers of Clokey eggvetch have also been documented more recently in very similar situations (sites 10-13) nearby, suggesting that the "one plant" collected by Beatley and Reveal may have extirpated the taxon from that site, or at least that it was a very small and impermanent population that has subsequently disappeared. A third possibility is that Beatley and Reveal were on the alternate jeep track to Wheeler Pass about 0.5 mile (0.8 km) north of the present road. The historical site is tentatively mapped there pending review of that location.

Historical site(s) known or assumed extirpated: No previously documented sites have yet been extirpated. It is possible that a few undocumented sites could have been lost to developments in Lee Canyon in the Spring Mountains, and less likely to activities on Nellis Air Force Range and the Nevada Test Site. Minor habitat losses may have occurred at sites (2, 4, 11, 14, 16-19, 24, 26, 28, and 30) where roads are known to have entered the population.

Historical site(s) where present status unknown: (Appendix 1, Tables 1 and 5) The exact location of the specimen documenting site 2 may not yet have been surveyed. See the discussion of this site above. The same may be true of sites 1 and 9. The stated collection location for site 9, 1/4 mile southeast of Willow Spring in the northeast quarter of Section 2, T18S R5E, at 1900 meters elevation, leaves a very small number of points that match all criteria, and none are included in the areas already searched. Further surveys are needed to determine whether site 9 is still extant.

Site 1 is based on interpretation of Barneby's (1954) original specimen citations and range description for *Astragalus oophorus* var. *clokeyanus*: "*Lee Canyon Pipe Line Ridge, Charleston Mts., Clark Co., alt. 9000 ft., Percy Train 2141; type Known only from the east slope of Charleston Peak, where fairly abundant in yellow pine forest between 8100 and 9100 ft. (La Rivers & Hancock 513, NA; Ripley & Barneby 4979).*" The *LaRivers & Hancock* specimen is labeled from 8500 feet elevation, and the *Train 2141* type collection is reported from 9000 feet, leaving the lower end of Barneby's elevation range unaccounted for. It is therefore assumed that the *Ripley & Barneby* specimen represents that lower end, and it is tentatively mapped in appropriate habitat at 8200 feet in Lee Canyon pending further searches and a check of the specimen. The other specimens cited by Barneby appear to match known and recently documented sites for the species (see Appendix 1, Table 5).

Potential site(s) meriting future field surveys: In the Spring Mountains, the remote area on the north side that includes the upper slopes found between McFarland Canyon and Cold Creek Canyon and dominated by montane forest communities appear to have the greatest potential to harbor additional, undiscovered populations of *Astragalus oophorus* var. *clokeyanus*. A second possibility with reasonable potential to harbor *Astragalus oophorus* var. *clokeyanus* is on the northwest side in the extensive area of oak and chaparral shrublands between Wheeler Pass and Clark Canyon (Nachlinger and Sheldon 1995).

The variety could be found farther north in the Belted Range and to the east in the Groom Range or Sheep Range. The Sheep Range was extensively collected by Tom Ackerman (1981), who did not encounter the variety. I believe there is a remote chance of finding

the variety in the Sheep Range. Other areas of potential habitat include Magruder Mountains, Stonewall Mountains and Grapevine Mountains (Anderson 1998). Anderson did mention *Astragalus oophorus* has been reported from these areas. These areas would be good sites at which to examine flower sizes and ovule numbers.

VII. HABITAT CHARACTERISTICS

Environment and Habitat Summary: (Appendix 2, Figures 6-7) *Astragalus oophorus* var. *clokeyanus* does not exhibit the very narrow habitat tolerances typical of many rare plant species. In general, the taxon is found on dry to moist, often somewhat disturbed open slopes, flats, or drainage bottoms and adjacent foot-slopes of all aspects on gravelly, often basic silty-loam soils derived from limestone, tuff, or other rhyolitic volcanics (sometimes on steep slopes of weathering tuff), in openings or shaded by trees and shrubs, sometimes near old burns, in ponderosa pine, white fir-limber pine, and Gambel oak-pinyon-juniper-sagebrush woodland vegetation between 5365 and 9005 feet (1635-2745 meters) elevation. The Spring Mountain sites are all on limestone and tend to be at higher elevations and on more open slopes, while the sites on the Nevada Test Site and vicinity are all on rhyolitic volcanics and tend to be at lower elevations in or near drainage bottoms or on steep eroding slopes. Associated species most frequently recorded at all sites include *Juniperus osteosperma*, *Pinus monophylla*, *Artemisia tridentata*, *Poa secunda*, *P. fendleriana*, *Bromus tectorum*, *Quercus gambelii*, *Ephedra viridis*, *Pinus ponderosa*, *Eriogonum caespitosum*, and *Streptanthus cordatus*.

Physical Characteristics:

Physiography: The range of *Astragalus oophorus* var. *clokeyanus* lies within the Basin and Range Province of Hunt (1967), and straddles the transition between the Great Basin and Mojave Desert. The Spring Mountains, surrounded by the northern Mojave Desert, represent a typical block-faulted range of the Basin and Range Province, but are distinguished as the highest mountain range in Clark County and as having the greatest topographic relief of any range in Nevada. Charleston Peak rises to 11,917 feet (3632 meters) elevation, about 9800 feet (3000 meters) above Las Vegas Valley. The core area is characterized by rugged terrain with high peaks, steep slopes, vertical cliffs, and large, deep canyons. Areas that support *Astragalus oophorus* var. *clokeyanus* are typically less rugged, rolling uplands with moderate relief.

Pahute Mesa and adjacent mountains in southern Nye County lie within the Great Basin, at the southern edge of Holmgren's (1972) Tonopah Section of the Great Basin Division of the *Intermountain Flora* region. This section is characterized by hot, dry, broad shade-covered valleys averaging 4000-5000 feet (1220-1525 meters) elevation, and relatively small, mostly north-south-trending, predominantly volcanic mountain ranges of moderate elevation, reaching about 8500-9447 feet (2590-2880 meters).

Climate: The entire range of *Astragalus oophorus* var. *clokeyanus* experiences a typical southern Great Basin climate, even though the Spring Mountains are strongly influenced by the Mojave Desert at lower elevations. Hidy and Klieforth (1990) aptly describe the climate of the Great Basin as ". . . one of the most extreme and variable climates on earth." This high variation occurs along horizontal and elevational gradients and at all time scales: hourly, daily, seasonally, annually, and over the tens of thousands of years of glacial cycles. The region's latitude, interior continental position, and high mountainous borders combine to create a generally arid climate. As in most arid regions, evapotranspiration greatly exceeds precipitation at all elevations, producing an average net loss of surface moisture (Hidy and Klieforth 1990). Most annual precipitation falls from about

November through April in Pacific storm systems from the west. Most of the Spring Mountains sites lie on the east slope and may experience a local rain shadow effect for Pacific moisture. The Great Basin also lies within the influence of sub-tropical summer moisture, which originates in the Gulfs of Mexico and California and spreads over most of Arizona during July and August. This "monsoonal" influence produces a secondary peak of precipitation particularly toward the eastern and southern parts of the region, averaging about a quarter to half of the annual total, and capable of delivering a substantial majority of annual precipitation to limited areas in any given year. Both summer and winter precipitation are highly variable from year to year, ranging between about 25% and 250% of the long-term averages. Variability decreases somewhat toward the northeast and at higher elevations.

Temperature variations range up to 40-50°F (22-28°C) in daily changes, in average differences between warmest and coldest months, and in departures of extreme highs and lows from seasonal averages (Hidy and Klieforth 1990, Holmgren 1972). This can result in differences up to 120-140°F (67-78°C) in the extremes experienced at any one site during a year. In general, temperature ranges at all the above scales tend to increase toward lower elevations and toward the northeast (more continental) part of the region. Daily variations further tend to be greatest at the lowest humidities during the spring and fall seasons. The average daily temperature range throughout the year is about 25-35°F (14-19°C).

Climatic conditions at the elevations where *Astragalus oophorus* var. *clokeyanus* populations occur tend to be somewhat less extreme and variable, with higher and more consistent annual precipitation. Annual precipitation averages about 11 inches (280 mm) at 6000 feet (1830 meters) and 28 inches (710 mm) at 11000 feet (3350 meters) (Knight 1992). At the altitudes for *Astragalus oophorus* var. *clokeyanus*, precipitation is probably about 15-20 inches annually. At the Kyle Canyon Ranger Station at 7000 feet (2135 meters), daily temperatures average about 40°F (4°C) for the low and 85°F (29°C) for the high during the summer (Knight 1992). At the elevations for *Astragalus oophorus* var. *clokeyanus* temperatures probably average up to 8-10°F (4-6°C) cooler. During the winter these elevations are above the average snow line, and the climate is cold with lows regularly falling toward or below 0°F (-18°C).

Geomorphology, aspect, and slope: Populations of *Astragalus oophorus* var. *clokeyanus* occur on all aspects on a variety of landforms, from drainage bottoms and adjacent foot-slopes to steep middle slopes to upper slopes and flats.

Geology: The geology and geomorphology of the Spring Mountains is complex. The main core is composed of Paleozoic limestones deposited in ancient marine environments (Longwell 1951). Older quartzites occur in the northwestern area and younger sandstones and shales occur primarily in the southeastern and southern foothills. Coarse materials eroded from the mountain block form extensive alluvial deposits on piedmont slopes and steadily grade into young fan deposits. The structural geology is the result of Cretaceous thrust faulting and folding and later Tertiary normal and parallel faulting episodes. The thrust faulting and folding was responsible for the Keystone Thrust, which placed Cambrian dolomites on top of younger Jurassic Aztec sandstone in the Red Rocks area. The more recent normal faulting produced the massive cliff faces at the head of Kyle Canyon. Sites that support *Astragalus oophorus* var. *clokeyanus* are underlain by

dolomites and limestones from Cambrian through Carboniferous in age, and by recently deposited Quaternary alluvium (Longwell *et al.* 1965).

The geology of the Nevada Test Site and the Nellis Air Force Range where the Clokey eggvetch occurs consists of Tertiary rhyolitic flows and shallow intrusive rocks as well as welded and non-welded silicic ash-flow tuffs (Beatley 1976).

Soils: In the Spring Mountains *Astragalus oophorus* var. *clokeyanus* is found on gravelly soils derived from dolomite or limestone parent materials. At four sites (5, 7, 8, and 11), soil pits were dug and soil characteristics were described for the purpose of a vegetation classification. Soil textures were silt loams with 20-30 percent gravel fragments and the soil pH was medium basic (8.4-8.6). Average depth of roots of herbaceous plants ranged 14-24 cm.

Hydrology: *Astragalus oophorus* var. *clokeyanus* is generally not associated with free water, and is mostly dependent on incident precipitation and its retention in the soil. The soils supporting most *Astragalus oophorus* var. *clokeyanus* populations are shallow, well drained, and highly permeable, with low water holding capacity. Many sites occur in or near the bottoms of dry drainages, which probably enhance run-off and soil moisture retention somewhat. Some plants at the Captain Jack Spring site (26) are reported to approach the local hydric vegetation and occur in fairly most soils. While Clokey eggvetch appears not to depend on such moisture conditions, its populations may be locally enhanced by them.

Air and water quality requirements: No specific requirements or unusual tolerances are known.

Biologic Characteristics:

Community physiognomy: *Astragalus oophorus* var. *clokeyanus* occurs in relatively open forest, woodland, and shrubland communities, although vegetation was sampled in woodland and shrubland community types only. At sites 7 and 8 on the northeast and east side of the Spring Mountains, the woodlands had about 25 percent tree cover that averaged about 12 m tall, while ground cover by herbaceous species was fully 30 percent. However, sites 5 and 11 on the drier west side had contrasting community physiognomies. Site 11 also classified as a woodland with 50 percent tree cover and 60 percent cover in the shrub stratum, while ground cover was a low 3 percent. In contrast, site 5 classified as a shrubland with only 3 percent tree cover, 40 percent shrub cover, and again a low ground cover of 3 percent (Nachlinger and Sheldon 1995).

Vegetation type: *Astragalus oophorus* var. *clokeyanus* sites generally support the zonal vegetation for the elevations at which they occur. This ranges from pinyon-juniper / sagebrush woodland, sometimes with a strong Gambel oak component, through ponderosa pine - white fir forest to subalpine conifer forest. According to Nachlinger and Sheldon (1995), four sites (5, 7, 8, and 11) were sampled in 1994 as part of a vegetation study conducted by TNC for the Humboldt-Toiyabe National Forest. These sites classify into three broad plant community types of forest and woodlands that include *Abies concolor* var. *concolor*-*Pinus ponderosa* var. *scopulorum*-*Cercocarpus ledifolius* var. *intermontanus* forest (site 7), *Abies concolor* var. *concolor*-*Pinus flexilis* woodland (site 8), and *Pinus monophylla*/*Quercus gambelii*-*Cercocarpus ledifolius* var. *intermontanus* woodland (sites 5 and 11). However, at a finer level of community analysis, *Astragalus oophorus* var. *clokeyanus* was found in the following plant associations:

Pinus ponderosa var. *scopulorum*/*Linanthus nuttallii*-*Pedicularis semibarbata*
var. *charlestonensis* woodland (site 7)

Abies concolor var. *concolor*-*Pinus flexilis*/*Linanthus nuttallii* woodland (site 8)

Quercus gambelii/*Pinus monophylla*-*Artemisia tridentata* woodland (site 11)

Artemisia tridentata-*Quercus gambelii*/*Pinus monophylla* shrubland (site 5)

Associated plant species: All associates observed at 7 *Astragalus oophorus* var. *clokeyanus* sites are listed in Appendix 1, Table 3. The most frequent species associated with *Astragalus oophorus* var. *clokeyanus* were (in descending order): *Juniperus osteosperma*, *Pinus monophylla*, *Artemisia tridentata*, *Poa secunda*, *P. fendleriana*, *Bromus tectorum*, *Quercus gambelii*, *Ephedra viridis*, *Pinus ponderosa* var. *scopulorum*, *Eriogonum caespitosum*, and *Streptanthus cordatus* var. *cordatus*.

Other endangered, threatened, and sensitive species: Due largely to its occurrence in the Spring Mountains, *Astragalus oophorus* var. *clokeyanus* is associated with an extraordinary diversity of rare and sensitive plant and animal species, and several such species are found on the Nevada Test Site and vicinity as well. At least 64 other sensitive plant and animal species are known in and near the range of *Astragalus oophorus* var. *clokeyanus*, and are listed in Appendix 1, Table 4. Of these, 25 are documented to occur within or adjacent to *Astragalus oophorus* var. *clokeyanus* sites. Conserving Clokey egg-vetch populations therefore presents an unparalleled opportunity to conserve many other endemic and imperiled species at little or no additional cost. Once any pollinators of *Astragalus oophorus* var. *clokeyanus* become known, any that prove to visit this or other rare plant species exclusively could also be regarded as sensitive.

Land Management: (Appendix 1, Table 1) For all sites, management status was determined based on the best maps, GIS data, and other information available, but generally was not further verified. Ownership status of associated minerals and water rights was not determined for any site, nor was the presence or absence of any easements or other encumbrances.

Nellis Air Force Range, U. S. Department of Defense: Roughly 42% of the global *Astragalus oophorus* var. *clokeyanus* populations occur on military withdrawal lands used as the Nellis Air Force Range (NAFR). The lands are closed to general public entry, and much of the area is in relatively pristine condition. Military construction and activities have caused localized heavy impacts, however, as have growing feral horse populations. NAFR is an ongoing participant in the Department of Defense's Legacy Resource Management Program, which has funded several years of field surveys to document sensitive species occurrences on the withdrawn lands. With better knowledge of the location and condition of its sensitive biologic resources, NAFR should be able to avoid or minimize impacts to those resources while carrying out its defense-related missions.

Humboldt-Toiyabe National Forest (HTNF), Spring Mountains National Recreation Area (SMNRA), U. S. Department of Agriculture: Roughly 33.5% of the global *Astragalus oophorus* var. *clokeyanus* population occurs on public lands managed by HTNF as the Spring Mountains National Recreation Area. An insignificant portion of these lands are currently within the Mount Charleston Wilderness Area. In general these lands are managed under multiple use/sustained yield principles (U. S. D. A. Forest Service 1986). The main use in the Spring Mountains consists of localized and dispersed recreation. The recent designation of these lands as a National Recreation Area brought both recreation opportunities and resource protection needs into sharper focus. The Spring Mountains are generally recognized as one of the most biologically significant mountain

ranges in North America, with one of the highest known concentrations of endemic species. The HTNF is paying close attention to conservation and protection of these unique resources as population and recreation pressures from nearby Las Vegas Valley continue to increase dramatically. Among other things, HTNF has implemented the monitoring plan recommended by Nachlinger and Combs (1996), and some of the results are discussed under Demographics below. *Astragalus oophorus* var. *clokeyanus* is also a covered species under the recently completed Clark County Multiple Species Habitat Conservation Plan, which places it among the highest conservation priorities on the SMNRA.

Nevada Test Site, U. S. Department of Energy: Roughly 23.3% of the global *Astragalus oophorus* var. *clokeyanus* population occurs on the Nevada Test Site. The lands are closed to general public entry, and significant portions of the area are in relatively pristine condition. Construction and activities related to past nuclear testing have caused heavy impacts in many other areas, however, as have growing feral horse populations. Since the mid-1970s NTS has conducted proactive surveys and inventories of its sensitive biologic resources, and it uses the resulting information to minimize mission-related impacts to those resources. An adaptive management plan and 5-year monitoring program were also established in 2001 for all sensitive plant species on the Nevada Test Site, with results pending. Resource protection on NTS will become more challenging, though, as its mission expands into commercial development of such projects as wind generating farms and space launch and recovery facilities.

Private lands: At most about 1.2% of the global *Astragalus oophorus* var. *clokeyanus* population occurs on lands identified as privately managed (part of site 14). Disturbance or development on private lands is likely to remain a very minor concern for the species.

VIII. BIOLOGY AND ECOLOGY

Population Summary: Based on the information gathered for this report, the total known global population of *Astragalus oophorus* var. *clokeyanus* was estimated to be at least 4443 individuals, and to occupy about 260 acres (105 ha) of habitat divided among 32 sites in 2 general groups, containing 43 total patches, in the Spring Mountains and the Pahute Mesa area of western Clark and southern Nye counties, Nevada, between 5365 and 9005 feet (1635-2745 meters) elevation. The most distant two occurrences are separated by about 86 miles (138 km), and the number of extant occurrences is reduced to 23 if a 1 km minimum separation distance is imposed.

Demography: Absence of *Astragalus oophorus* var. *clokeyanus* from numerous apparently suitable sites provides circumstantial evidence that the species may have undergone population declines at least during prehistoric times, and/or that it may have limited ability to disperse and to establish new populations in unoccupied habitat.

A long-term monitoring study was initiated in 1995 for *Astragalus oophorus* var. *clokeyanus* on the Spring Mountains National Recreation Area. A biologic monitoring plan for *A. oophorus* var. *clokeyanus* was produced by Nachlinger and Combs (1996). This plan outlines in detail the methodology for sampling. Two sites (7 and 8) have been monitored and every three years a total count of individuals has been obtained for each site (Cheryl Beyer, personal communication, 25 March 2002). The preliminary results are as follows:

| Year | Bristlecone (site 7) | Bonanza (site 8) |
|------|-------------------------|---------------------|
| 1995 | 1253 | 198 |
| 1998 | 1367 | 165 |
| 2001 | 732 | 41 |

These seem to suggest a current downward trend at the two sites, but there is no information yet on possible causal factors, or on whether the data may reflect natural population fluctuations. No long-term monitoring of *Astragalus oophorus* var. *clokeyanus* has yet been conducted on the Nevada Test Site and Nellis Air Force Range.

From estimates of the total individuals within total occupied habitat (see population summary, above), an average density of 17.1 plants per acre (6.9/ha) can be estimated. However, individual site estimates ranged from about 1 plant per acre (0.4/ha; site 26) to about 1000 plants per acre (405/ha; site 14; Appendix 1, Table 1). Local spot densities occasionally may be even higher.

Phenology: *Astragalus oophorus* var. *clokeyanus* flowers in late spring, from mid-May through June. Pods develop in June with the majority ripening in late June through mid-July. From mid-July to mid-August the fruits dehisce and many individuals show signs of senescence in vegetative growth.

Genetics: No studies of the genetic structure in *Astragalus oophorus* var. *clokeyanus* are known.

Reproduction and Dispersal: No studies of reproduction or dispersal are known for *Astragalus oophorus* var. *clokeyanus*. Based on flower morphology, it is likely a sexual reproducer dependent on pollinating insects. Butterflies have been observed visiting flowers (Appendix 2, Figure 5). Because the flowers of *Astragalus oophorus* var. *clokeyanus* are the smallest of any variety in the species, it is also possible that the plants are at least self-compatible.

Because its seeds remain enclosed in the light, papery, inflated pod until the latter falls from the plant, wind and water can transport them over substantial distances on occasion. After falling, the fruit develops a small apical opening, allowing the seeds to slowly "leak out" as the fruit is transported.

Hybridization: *Astragalus oophorus* var. *clokeyanus* may intergrade with var. *oophorus* toward the north end of its range, which is to be expected with taxonomic varieties. It is unknown whether this apparent intergradation represents a zone of primary contact and differentiation, or whether it represents secondary contact and subsequent hybridization. No hybridization with any other taxon has been observed or reported.

Pathology: No pathogens or pathogenic symptoms were observed affecting any *Astragalus oophorus* var. *clokeyanus* plants.

Predation: Nachlinger and Sheldon (1995) and other workers have noted evidence of predation, possibly by insects or rodents, on fruit and seed at various sites. Certain beetle groups such as the Bruchidae are known to feed and/or oviposit on legume fruits and seeds (Johnson 1981).

Competition: *Astragalus oophorus* var. *clokeyanus* appears to be a moderate competitor, since it occurs either in openings or shaded by other vegetation, and in low to fairly high densities.

Response to Disturbance: Its frequent occurrence in drainage bottoms, on roadsides, along foot trails, and occasionally on steep unstable slopes or recent burns, suggests that *Astragalus oopho-*

rus var. *clokeyanus* is capable of opportunistically exploiting temporary disturbances, and may even be adapted to low levels of disturbance. It shows no signs of being aggressively invasive or migratory, though, and seems to maintain naturally low population sizes at most sites. Permanent loss of plants is likely when disturbance is continuous and/or severe.

Other Interactions: No other interactions have been noted.

IX. EVIDENCE OF THREATS TO SURVIVAL

Causes of impacts and threats observed or reported for the known sites are summarized in Appendix 1, Table 1.

Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range:

Recreational use and facilities development: impacts from recreational activities are the major threat to the Spring Mountains sites, and have been particularly notable at sites 4, 7, and 8. The largest population, site 7 in upper Lee Canyon, is adjacent to the much-used Bristlecone Trail and the recreational facilities at Ski Lee. Year-round recreational activities adjacent to and within this site include hiking, picnicking, camping, mountain biking, and skiing. The soil surface is disturbed by hikers and wild horses. Litter and tree stumps indicate current recreational use and past logging activities. Similar disturbance is present at site 4, the second largest population. This site occurs just above the main road in Lee Canyon and is sandwiched between the concentrated recreational activities occurring at the Lee Canyon Youth Camp and the Foxtail Canyon group campground. The two remaining sites in Lee Canyon show evidence of disturbance from hikers and horses as well, although use is somewhat lower because they are farther along the Bristlecone Trail and they receive less recreational use. Site 8 along the Bonanza Trail shows signs of recreational use similar to the level at the latter sites in Lee Canyon. Hiker campsites occur adjacent to site 3 and within site 8. The northern sites, in general, are more remote and receive relatively fewer recreational impacts.

Road development and maintenance and off-road vehicle use: Several sites are entered or bisected by roads, which may have eliminated some plants while providing marginal disturbances for others to colonize. Careless maintenance or widening of such roads may pose a greater threat than did the original disturbance, if populations have preferentially re-established near the road margins. Such roads may also encourage off-road vehicle use in the vicinity which could damage populations.

Public purpose uses: The ongoing military training mission on the Nellis Air Force Range, and any future resumption of nuclear testing on the Nevada Test Site, always have the potential to impact rare species populations unless they are carefully planned to avoid such impacts. It is possible that one or a few undocumented populations could already have been lost to such activities in the past.

Commercial development: The Nevada Test Site is increasingly attractive to developers of commercial projects such as wind generating farms and space launch and recovery facilities. Such projects will remain only a general threat, though, until specific projects begin affecting known sites.

Utility corridor development and maintenance: Utility corridors have the potential to be associated with other recreational or commercial development activities in Lee Canyon and on the Nevada Test Site.

Grazing or trampling by domestic or feral animals: The areas occupied by *Astragalus oophorus* var. *clokeyanus* are all currently closed to livestock grazing. Most sites are vulnerable to increasing feral horse populations, however, particularly those located near water sources on the Nevada Test Site and Nellis Air Force Range.

Water development or diversion: Sites near springs on the Nevada Test Site and Nellis Air Force Range are vulnerable to direct and indirect impacts if those water sources are ever developed or diverted for domestic or wildlife use.

Fire and fire suppression activities: All known *Astragalus oophorus* var. *clokeyanus* sites occur in habitat where natural periodic fires are the norm. The presence of human-caused disturbance at most *Astragalus oophorus* var. *clokeyanus* sites may indicate a requirement for some level of disturbance to maintain its habitat. Human and horse trampling and past logging may be substitutes for the role that fire may have played in maintaining *Astragalus oophorus* var. *clokeyanus* habitat. The species has been found in old burns. Fire occurs less frequently in Lee Canyon than it did in the past because of fire suppression policies. The composition and condition of the plant communities in upper Lee Canyon may be showing evidence of past suppression with greater cover of *Abies concolor* var. *concolor* and fewer seedlings of *Pinus ponderosa* var. *scopulorum* than expected. The low numbers of scattered individuals of *Astragalus oophorus* var. *clokeyanus* at the west-side sites in *Pinus monophylla*-*Quercus gambelii*-*Cercocarpus ledifolius* var. *intermontanus* communities may indicate a lack of frequent ground fires and no current substitute for such disturbance. However, the role of natural fire in *Astragalus oophorus* var. *clokeyanus* habitat is unclear and is in need of study. When fires do occur, some of the *Astragalus oophorus* var. *clokeyanus* sites may also occupy places attractive for staging suppression operations, and could be impacted by such activities as well.

Invasion of exotic plant species: Only minor covers of exotic plant species such as cheatgrass (*Bromus tectorum*) and red brome (*Bromus rubens*) have been noted at some *Astragalus oophorus* var. *clokeyanus* sites, and do not appear to have created significant impacts so far. By dramatically increasing the flammability of the surrounding vegetation, however, such invasions could eventually create indirect impacts by increasing the likelihood and frequency of fires and the need for the fire suppression activities discussed above. The introduction of exotic plant species for erosion control on the Ski Lee slopes may be adding the stress of competition for limited resources.

Over-utilization for Commercial, Recreational, Scientific, or Educational Purposes: Some of the scientific collections that have been taken to document populations (Appendix 1, Table 5) may have impacted sites where population numbers were already low. No other uses of the species for such purposes are known.

Disease or Predation: In the Spring Mountains there was evidence of predation, possibly by rodents, on fruit and seed in late summer (3 August 1993, 16 September 1993, and 11 July 1994) at sites in upper Lee Canyon. The role of herbivory on decreasing the long-term fitness of *Astragalus oophorus* var. *clokeyanus* versus the positive aspect of dispersing seed is unknown. No evidence of disease was noted. On the Nevada Test Site and Nellis Air Force Range insect damage was observed at some of the sites.

Inadequacy of Existing Regulatory Mechanisms: No enforceable protective designations are known to exist for *Astragalus oophorus* var. *clokeyanus* or its habitat. Unless it is listed as endangered or threatened (50 CFR 17.61, 17.71) and occurs within federal jurisdiction, a plant has no formal protection under the federal Endangered Species Act (ESA), except for regulatory

determinations by some federal land management agencies (Forest Service, BLM) that candidate and other sensitive species will be managed in order to avoid the need for listing. No federal protection currently extends to plants under non-federal jurisdiction unless they are listed as endangered and removing, cutting, digging up, damaging, or destroying them would be "*in knowing violation of any law or regulation of any state or . . . of a state criminal trespass law*" [ESA Sect. 9(a)2(B)], and that law extended to non-federal jurisdictions. The Endangered Species Act and the various agency regulations implementing it are also in direct conflict with provisions of the mining law of 1872 (30 U.S.C. 21 *et seq.*), and are therefore of uncertain protective value when mineral-related projects are involved. Mining projects are currently highly unlikely within the known range of *Astragalus oophorus* var. *clokeyanus*, however.

Astragalus oophorus var. *clokeyanus* is managed as a sensitive species on the Humboldt-Toiyabe National Forest. U. S. D. A. regulation 9500-4 directs the Forest Service to manage "*habitats for all existing native and desired nonnative plants, fish, and wildlife species in order to maintain at least viable populations of such species,*" and to avoid actions "*which may cause a species to become threatened or endangered.*" Forest Service objectives further state that viable populations of all species must be maintained "*in habitats distributed throughout their geographic range on National Forest System lands*" (Forest Service Manual [FSM] 2670.22). Designation of *Astragalus oophorus* var. *clokeyanus* as a sensitive species identifies it as a species "*for which population viability is a concern as evidenced by . . . significant current or predicted downward trends in population numbers or density or . . . in habitat capability that would reduce a species' existing distribution*" (FSM 2670.5). Current Forest Service policy on species designated sensitive is to "*review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species*" as part of the NEPA process, to "*avoid or minimize impacts*" from such activities or, if impacts cannot be avoided, to "*analyze the significance*" of those impacts for the species as a whole. Any decision to allow impacts "*must not result in loss of species viability or create significant trends toward Federal listing*" (FSM 2670.32). Department regulation 9500-4 has the force of law at least until changed; specific provisions of written Forest Service policy implementing that regulation are of uncertain legal standing in specific cases.

Since the early 1980s, the U. S. Department of Energy has voluntarily carried out pre-activity surveys for all sensitive species on the Nevada Test Site, including *Astragalus oophorus* var. *clokeyanus*. During that time, no significant impacts are known to have affected any of the Clokey eggvetch populations there. An adaptive management plan and 5-year monitoring program were also established in 2001 for all sensitive plant species on the Nevada Test Site, with results pending. Though not necessarily mandated by law or regulation, these voluntary measures have made much progress in implementing many of the conservation recommendations contained in this report.

Astragalus oophorus var. *clokeyanus* is not listed as "critically endangered" under Nevada Revised Statutes (NRS) 527.270. Such listing would provide that ". . . no member of its kind may be removed or destroyed at any time by any means except under special permit issued by the state forester firewarden" on any lands in Nevada. The adequacy of this law, however, depends on informed and cooperative land managers, or on some form of deterrent enforcement, for either of which the current law does not provide. It also depends on the state forester firewarden's discretion in issuing or withholding permits, and in placing protective conditions on permits that are issued. Recently enacted regulations in Nevada Administrative Code (NAC) Chapter 527 greatly expanded and clarified the requirements and procedures for obtaining such a permit, and better ensured the long-term survival of state-listed plants in Nevada.

Other Natural or Man-made Factors: Because of its small population sizes and numbers, *Astragalus oophorus* var. *clokeyanus* may be vulnerable to natural events such as climatic shifts or unprecedented extremes of heat, cold, or drought. To the extent that *Astragalus oophorus* var. *clokeyanus* may depend upon insect pollinators for successful reproduction, any natural or man-made factors affecting the viability of such insects would also affect the viability of *Astragalus oophorus* var. *clokeyanus*.

X. GENERAL ASSESSMENT AND RECOMMENDATIONS

General Assessment: As now known, the global population of *Astragalus oophorus* var. *clokeyanus* consists of at least 4443 individuals restricted to about 260 acres (105 ha) of private and public lands divided among 32 sites in 2 general groups, containing 43 total patches, in the Spring Mountains of western Clark County, and on and near the Nevada Test Site in southern Nye County, Nevada, between 5365 and 9005 feet (1635-2745 meters) elevation. The most distant two occurrences are separated by about 86 miles (138 km), and the number of extant occurrences is reduced to 23 if a 1 km minimum separation distance between patches is imposed. *Astragalus oophorus* var. *clokeyanus* appears to intergrade with var. *oophorus* toward the north, raising questions as to its distinctness. Flower and fruit size, and consequently the number ovules, may be correlated along that northward gradient and may merely reflect changing environmental conditions. I believe that calyx length, flower size, and ovule number can be weak characters for naming a taxon because of the variability that can occur over the range of a species. Until morphometric and genetic studies can be brought to bear on the question, however, the variety is still assumed to be a significant geographic and genetic entity warranting separate conservation concern. Clokey eggvetch is found on dry to moist, often somewhat disturbed open slopes, flats, or drainage bottoms and adjacent foot-slopes of all aspects on gravelly, often basic silty-loam soils derived from limestone, tuff, or other rhyolitic volcanics (sometimes on steep slopes of weathering tuff), in openings or shaded by trees and shrubs, sometimes near old burns, in ponderosa pine, white fir-limber pine, and Gambel oak-pinyon-juniper-sagebrush woodland vegetation.

Even without the significant existing, ongoing, and threatened impacts to many of its known populations, *Astragalus oophorus* var. *clokeyanus* would remain rare and limited enough to warrant special conservation concern. For now the species remains vulnerable to human-caused declines in the long-term as pressures from urban growth continue in the region surrounding Las Vegas, Nevada. The 14 (44%) of the global sites located in the Spring Mountains have significant and ongoing impacts from recreational use and facilities development, and viability of some of the smaller sites remains in doubt. The remaining sites, on and near the Nevada Test Site, are much more remote and less impacted, but remain vulnerable to increased commercial development or other mission activities in the future.

Status Recommendations: *Astragalus oophorus* var. *clokeyanus* was classified as a category-1 candidate for listing by the U. S. D. I. Fish and Wildlife Service (1975-1993). That category was eliminated on 28 February 1996 (U. S. D. I. Fish and Wildlife Service 1996), but Clokey eggvetch variety was retained as a candidate for listing until 1998. Based on the best available scientific evidence, the species does not now meet the definition of a candidate for listing as threatened or endangered under the Endangered Species Act. It should remain a "species of concern" to, and be reviewed and monitored frequently by, the U. S. Fish and Wildlife Service, however. With active, long-term, cooperative management to reduce or eliminate further habitat destruction, and appropriate long-term monitoring, any trend toward federal listing can be stopped, and human-caused extirpation or extinction can be avoided. Absent such management,

the long-term possibility of significant population losses will remain, and federal listing could become justified if more than about 10-20% of the known populations were lost to preventable causes.

The species is also designated a Sensitive Species by the Humboldt-Toiyabe National Forest and the Nevada State Office of the Bureau of Land Management, is ranked 2 (imperiled) at the global and state levels by the Nevada Natural Heritage Program, and is on the Watch list of the Nevada Native Plant Society (NNNPS). Because of its small population numbers, limited range, and ongoing threats, 2 remains the most appropriate heritage rank for *Astragalus oophorus* var. *clokeyanus*. Because it does not occur on Bureau of Land Management (BLM) lands, BLM should remove the variety from its sensitive species list. No other changes in status are recommended pending the outcome of further taxonomic studies.

Critical Habitat Recommendations: If critical habitat were ever designated through the provisions of the Endangered Species Act or any other law or regulation, it should include all populations then known, along with a 250-foot (75-meter) horizontal buffer zone on each side of the populations. Critical habitat should not be formally designated in cases where it might subject *Astragalus oophorus* var. *clokeyanus* to increased threats to its survival, would interfere with habitat management, or would subject managers of the habitat to problems of trespass by curiosity seekers.

Conservation and Recovery Recommendations: The following recommendations, roughly in descending order of priority, are offered as the best opportunities to maintain the long-term viability of *Astragalus oophorus* var. *clokeyanus*, to avoid any future need to list it as threatened or endangered, and to reduce the overall long-term management costs for the species. They generally do not take into account limited agency resources or other conservation priorities, which may preclude implementation of some recommendations. Some of the recommendations may already have been implemented. If monitoring (outlined in recommendation 5 or 7) indicates that preventable declines in viability of the species are occurring, then more aggressive conservation and recovery measures should be identified and pursued.

1. All provisions of the Clark County Multiple Species Habitat Conservation Plan, the resulting Section 10(a) permit, and other conservation agreements and species management plans affecting the Spring Mountains, should be fully implemented.
2. The Humboldt-Toiyabe National Forest (HTNF) should continue to implement its monitoring plan for *Astragalus oophorus* var. *clokeyanus*, and should seek the necessary resources to expand monitoring activities to additional sites for a more representative sample. When the current plan expires in 2005, it should be renewed for at least another 10 years, first incorporating any needed modifications to improve the plan.
3. All appropriate entities should carefully and aggressively manage recreational uses, feral horse populations, and domestic livestock to avoid or minimize impacts in *Astragalus oophorus* var. *clokeyanus* habitat.
4. Conduct or fund a morphometric and genetic study to elucidate the appropriate taxonomic status of *Astragalus oophorus* var. *clokeyanus*.
5. HTNF, the U. S. Fish and Wildlife Service (USFWS), and any other parties interested in participating, should cooperatively field-check as many Spring Mountains *Astragalus oophorus* var. *clokeyanus* sites as possible at least every 3 years, and more often where significant impacts have previously occurred or are reasonably foreseeable, to detect any new or intensified impacts, and should take immediate steps to eliminate and correct any

such impacts on lands under their management. Field checks should include field tours for appropriate personnel as needed to familiarize them with the plant and its habitat. If extirpations or new significant impacts become likely for more than 10% of the known populations, yearly monitoring efforts should be initiated.

6. HTNF, Nevada Test Site (NTS), and Nellis Air Force Range (NAFR) should conduct or require additional surveys, following recognized professional standards (Nelson 1994), for known and undocumented *Astragalus oophorus* var. *clokeyanus* populations prior to implementation of projects within potential habitat of the species, and any populations found should be thoroughly documented. Impacts to new and previously documented populations should be avoided or minimized during project implementation. Whenever funding and personnel permit, similar surveys should be continued outside of the project evaluation process as well.
7. NTS, NAFR, and USFWS should cooperatively field-check as many NTS and NAFR *Astragalus oophorus* var. *clokeyanus* sites as possible at least every 5 years, and more often where significant impacts have previously occurred or are reasonably foreseeable, to detect any new or intensified impacts, and should take immediate steps to eliminate and correct any such impacts on lands under their management. Field checks should include field tours for appropriate personnel as needed to familiarize them with the plant and its habitat. If extirpations or new significant impacts become likely for more than 10% of the known populations, yearly monitoring efforts should be initiated.
8. HTNF, and the Nevada Division of Forestry (NDF) should plan future fire-suppression actions and strategies, including identifying potential sites for fire breaks, access roads, landing pads, etc., to avoid or minimize impacts to known *Astragalus oophorus* var. *clokeyanus* populations and other sensitive resources.
9. Any artificial revegetation actions in and near the range of *Astragalus oophorus* var. *clokeyanus* should only use plant species native to the local area. HTNF, NDF, and other agencies anticipating the need for artificial revegetation should plan for reasonably foreseeable needs to ensure sufficient sources and/or supplies of 100% native-species seeds. In appropriate cases, other species documented not to persist under local conditions could be added at non-competitive levels for temporary stabilization until the native species can establish.
10. Studies of pollinator populations, and their effectiveness in the reproductive success of *Astragalus oophorus* var. *clokeyanus*, should be encouraged and supported. If found to play a significant role, pollinators should be monitored on the same schedule as *Astragalus oophorus* var. *clokeyanus* to detect any downward trends that could contribute to reproductive failure in *Astragalus oophorus* var. *clokeyanus*, and the cause(s) and possible remedies of any such declines should be assessed.
11. HTNF should plan any future road development and maintenance to avoid or minimize impacts to known populations. Roads should avoid known habitat, and impacts from grading or other maintenance activities should be contained within the existing roadbed.

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 Quartet Dome, Nevada (1962)
 Rainier Mesa, Nevada (1997)
 Timber Mountain, Nevada (1961-1982, photoinspected 1992)
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Specimens: All specimens known to document *Astragalus oophorus* var. *clokeyanus* sites are listed by site in Appendix 1, Table 5. The list was compiled from all available published and unpublished sources, but is not necessarily complete. Although new collections from previously documented sites are discouraged, the Nevada Natural Heritage Program welcomes further additions or corrections to this table as they become known.

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