ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Plant Abstract **Element Code:** PMLIL02120
Data Sensitivity: No

CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Allium gooddingii* Ownbey
COMMON NAME: Goodding Onion
SYNONYMS: None
FAMILY: Liliaceae

AUTHOR, PLACE OF PUBLICATION: Ownbey, G. S. 1947. Res. State Coll. Washington 15:221-224.

TYPE LOCALITY: Arizona: Apache County: White Mountains: Ft. Apache Indian Reservation: Bonita Creek.

TYPE SPECIMEN: ARIZ SN. L. N. Goodding 1233. 23 July 1912.

TAXONOMIC UNIQUENESS: *Allium* is mostly a northern hemisphere genus with 550-700 species worldwide and 96 in North America (FNA 2002). There are 13-15 species of *Allium* in Arizona (McNeal and Jacobsen 2002, SEINet).

During Rink's 2018-2019 field work and review of voucher specimens, he encountered some specimens that appeared to be intermediate between *Allium gooddingii* and *A. geyeri*. He believes this is an undescribed taxon and refers to it as "*Allium* sp. nov."

DESCRIPTION: Herbaceous perennial with an elongate bulb arising from short, thick iris-like rhizomes. Bulb coats are striate with parallel fibers (not reticulate). The leaves are broad, the widest ones ranging from (4)5-8(11) mm wide, flat, with rounded tip, drab-green in color, (4)5-8(10) in number, and shorter than the scape (flowering stalk). Numerous purplish-red to rose-pink flowers on erect scape up to 61 cm (24 in.) tall. Each umbel (terminal flower cluster) bears 8-28 flowers, and rarely can be doubly umbellate. Flowers with 6 tepals. Capsules not crested.

AIDS TO IDENTIFICATION: Leaves are more numerous and wider than other common *Allium* species in the area; *A. plummerae*, which is most similar to *A. gooddingii* in leaf number and size, and is also known from Sky Island mountains of southeastern Arizona, has reticulate fibers surrounding the bulbs and crested capsules, while the fibers of *A. gooddingii* are parallel and the capsules are not crested. Of those with fewer, narrower leaves, *Allium cernuum* has nodding heads, while those of *A. gooddingii* are erect. *Allium bisceptrum* has parallel fibers surrounding the bulbs like *A. gooddingii*, but the bulbs are ovoid and the tepals are acuminate, while the bulbs of *A. gooddingii* are elongate and the tepals are obtuse to acute.

In Arizona, *A. gooddingii* is most commonly confused with *A. geyeri*. The following key should serve to separate these two:

1. Leaves (4)5-8(10), the widest ones (4)5-8(11) mm wide, nearly flat upon drying; plant rhizomatous, often forming dense, nearly monospecific colonies; bulb coat fibers parallel; flowers never replaced by bulbils *Allium gooddingii*

1' Leaves (1)3-4(5), the widest ones 1-3(4) mm wide, longitudinally wrinkled upon drying; plants not rhizomatous; bulb coat fibers reticulate; flowers often replaced by bulbils *Allium geyeri*

ILLUSTRATIONS:
Line drawing: New Mexico Native Plants Protection Advisory Committee (1984:199)
Photos of plants and habitat: http://swbiodiversity.org/seinet/taxa/index.php?tid=3403.
Line drawing and photos: Arizona Rare Plant Field Guide (2001)
Photos of fire impacts (including erosion and sedimentation), habitats and plants (Rink 2019)

TOTAL RANGE: Eastern and south-central Arizona, and west and central New Mexico (Catron, Grant, Lincoln, McKinley, Otero, and San Juan counties).

RANGE WITHIN ARIZONA: White Mountains and Chuska Mountains in Apache and Greenlee counties, and the Santa Catalina Mountains in Pima County.

Rink (2019) conducted extensive surveys of north facing canyons, open meadows and springs in the Pinaleno Mountains in 2018. He failed to find any *A. gooddingii*, and believes that if the species existed or exists in the Pinalenos, it is reasonable to assume that any populations suffered the same level of reduction from the Frye (2017) and Nuttall Complex (2004) wildfires that happened to populations in the White and Santa Catalina mountains from fires in those areas. This level of reduction would have severely reduced chances of finding *A. gooddingii* in the Pinalenos.

SPECIES BIOLOGY AND POPULATION TRENDS

GROWTH FORM: Herbaceous perennial.

PHENOLOGY: Initiates above-ground growth in late spring following snow melt. Flowers from June through August and sets seed beginning in July and continuing into September. Above-ground growth persists through October and then dies back with the advent of frosts.

BIOLOGY: Reproduces from seed and also vegetatively from bulbils that arise from division of the rhizomes. Pollinated by hymenopterans, dipterans, and lepidopterans (at least). Seeds germinate readily (Spellenberg 1982, Fletcher 1984). Stems may not grow from every bulb every year. May be locally abundant at certain sites and dominate the herbaceous understory. Occurs in open sites to sites with high levels of perennial herbaceous species cover. Seed dispersal may be by herbivory, certainly by elk and probably by deer, cattle and horses as well. Although Rink (2019) did not observe much grazing, when he did, it was usually only the tops that were eaten. Eating the tops of the plants won't have much impact on

the vegetative reproductive capacity of this rhizomatous plant, but does have the potential to disperse seeds to nearby drainages.

HABITAT: Often in moist shaded canyon bottoms or slopes above the bottoms in climax conifer forests. Located most frequently in mature forests, often along north-trending drainages, in a narrow strip at or near the bottom of perennial, intermittent and ephemeral stream courses with well-developed organic soils. Occasionally found in moist soils and weeping cliffs on north, northeast or west aspect slopes, usually (but not always) near adjoining stream bottom populations. Generally does not occur in meadows though has been found in open situations along the edge of large clearings or bordering streams, and in rocky open areas not near streams.

Though the most robust populations of *A. gooddingii* are on light, mature soils in dense forests, Rink (2019) also found locations where *A. gooddingii* plants were pioneering on new gravel and cobble substrates in the open. He concludes that neither closed canopy nor rich soils are the limiting factors for its germination or development. Habitat types not typically associated with *A. gooddingii*, but where it can occur, include lower steep slopes above riparian areas, on steep cliffs, and on open slopes not associated with riparian areas.

ELEVATION: 6,800 - 10,850 feet (2073 – 3310 m) in Arizona; up to 11,300 feet (3446.5 m) in New Mexico.

EXPOSURE: Typically north, northeast, and northwest aspects, but can be found on any aspect, including open exposures.

SUBSTRATE: Mollic Cryoboralf and Eutric Glossoboralfs; those in the stream bottoms are deeper with a greater loam and organic content. The latter description probably pertains to the White Mountains. Also occurs in fresh gravel and cobble terraces, as well as arising from bedrock cracks. Mafic rocks, including serpentine, were found underlying some *A. gooddingii* locations in the Santa Catalina Mountains. Mafic rocks can appear similar to basalt (which does not occur in the Santa Catalinas).

PLANT COMMUNITY: Ranging from *Abies lasiocarpa/Vaccinium myrtillus* habitat type at the upper end of the elevational range through the *Abies concolor/Pseudotsuga menziesii/Poa pratensis* and *Pinus ponderosa* habitat types at the lower end. In New Mexico, canopy cover on the Lincoln National Forest ranged from 0-100%; *A. gooddingii* is found in spruce-fir forests, in aspen stands or on lower and south facing slopes dominated by Douglas fir or ponderosa pine; also grows on open ski runs in NM, but not towards the middle of wider runs.

In the Santa Catalinas, associated plant species identified by Rink in 2018 include *Pseudotsuga menziesii, Abies* sp, *Picea* sp, *Jamesia americana, Acer grandidentatum, Pinus strobiformis, Rubus neomexicanum, Cornus sericea, Quercus gambelii, Robinia neomexicana, Pinus ponderosa,* and *Abies concolor.*

Rink (2019, Table Four) provides detailed lists of associated plants he found at 73 of the *A. gooddingii* sites he visited in the White Mountains. The most commonly associated woody

plants (with the frequency of their occurrence at the 73 sites) are: *Pseudotsuga menziesii* (53), *Picea* sp. (34), *Robinia neomexicana* (22), *Rosa* sp. (21), *Ribes* sp. (18), *Populus tremuloides* (16), *Pinus strobiformis* (14), *Abies* sp. (12), and *Pinus ponderosa* (10). The most commonly associated herbaceous plants were: *Mertensia franciscana* (44), *Geranium* sp. (36), *Rudbeckia laciniata* (35), *Pteridium aquilinum* (31), *Bromus ciliatus* (31), *Rubus strigosus* (31), *Cirsium* spp. (22), *Achillea millefolium* (20), *Viola* spp. (19), *Fragaria* spp. (18), *Thalictrum fendleri* (16), *Helenium hoopesii* (15), *Taraxacum* sp. (15), *Sidalcea neomexicana* (14), *Poa pratensis* (13), *Conioselinum scopulorum* (9), and *Iris missouriensis* (9).

POPULATION TRENDS: Populations in AZ and NM are declining due to fire effects (Phillips 2017, Rink 2019, Roth 2016).

A White Mountains survey in 2018 found significant reductions in 24 of the 32 EOs visited. This decline since the 1990s surveys was primarily caused by the Wallow Fire. Habitat loss, manifested by the removal of substrate from erosion and the burial of habitat from post-fire flooding, continued at least into 2018 and 2019 (Rink 2019). Many of the sites visited were reported to have had 10,000+ plants in the 1990s, but Rink found only 100s or less at many of these sites. A few still had a thousand or more. Rink failed to find any plants at six of the sites. Future monitoring will determine if these populations are actually extirpated. At two sites, where attempts had been made to introduce *A. gooddingii*, no plants were found and the experimental introduction was judged to have failed. Overall, Rink (2019) found a strong correlation between where *A. gooddingii* was severely reduced to where the Wallow Fire was most intense. Conversely, areas where populations had not changed much were areas where the Wallow Fire had little to no impact on the forest.

Although the post-fire soil movement processes caused by the Wallow Fire will continue to negatively impact populations into the future, Rink also believes that *A. gooddingii* will eventually re-populate on its own. He has observed that the species is pioneering into new areas, and that further dispersal into both new and extirpated areas might continue as seeds are dispersed by cattle, horse, deer and elk grazing. He also states that if we found *A. gooddingii* reductions in areas not affected by the Wallow Fire caused by unknown factors, then that would be cause for listing, in his opinion (Rink 2019).

In 1999, Myers reported that the Canyon del Muerto population in the Canyon de Chelly region had been extripated. Recently (2019) Rink found a population of about 1000 plants along Tsaile Creek to the east, and suggests that the Canyon del Muerto be re-surveyed.

The Santa Catalina Mountain population west of the ski area was very large and stable according to Reichenbacher (Reichenbacher--1991 Coronado National Forest Plant Workshop). More recently, post fire flooding since the 2003 Aspen Fire has impacted these sites and plant numbers are significantly reduced (Baker 2003, Rink 2019).

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: None (USDI, FWS 1999)

CCA (USFS & USFWS 1997)
[C USDI, FWS 1996]
[C1 USDI, FWS 1980]
[PTN-T USDI, FWS 1975]

STATE STATUS: Highly Safeguarded (ARS 1993 - 2016)

OTHER STATUS: Forest Service Sensitive (USDA, FS Region 3 2013
[Forest Service Sensitive USDA, FS Region 3 1990]
[Forest Service Sensitive USDA, FS Region 3 1990]
Group 3 (NNDFW, NESL 2000 - 2008)

MANAGEMENT FACTORS: Degradation of riparian habitat due to livestock management and timber harvesting (watershed management); habitat disturbance associated with fire and fire suppression, silvicultural operations; construction of ski recreation areas and associated facilities; both erosion and burial of both plants and habitat due to post-fire flooding.

Allium gooddingii is readily grazed by elk, deer, cows, and horses. Populations seem to be less vigorous after several years of consistent grazing (Bob Vahle pers comm 1990). Persistent grazing may eliminate all sexual reproduction within a population. However, it also seems likely that *Allium gooddingii* is dispersed by grazing.

Major wildfires are a major threat to *A. gooddingii*. In particular, the 2011 Wallow Fire had a devastating impact. First, it burned through the majority of the White Mountain populations. Post fire surveys (Phillips 2017, Rink 2019, Roth 2016) found a very significant decline in population numbers. Second, the effect of these fires appears to be very direct. Rink (2019) speculates that one of these effects might be scorching of the soil. Another major effect is post-fire flooding, which impacts the species by both removal and burial of habitat. Furthermore, this simultaneous erosion and deposition process is ongoing, and may continue for many years or even decades.

One positive result from these post-fire surveys is that in some areas, *A. gooddingii* shows signs of recovery in flooded canyon bottoms, with plants growing in the open, on recently deposited gravels, cobble beds, and in bedrock cracks.

CONSERVATION MEASURES TAKEN: *Allium gooddingii* is listed as Highly Safeguarded by the State of Arizona Native Plant Laws, Endangered (Group 3) by the Navajo Nation and as Sensitive by the USDA Forest Service. It is *not* listed under the USFWS Endangered Species Act. However, the USFWS and the Forest Service did enter into Conservation Agreement in 1997, but this agreement expired after ten years.

Silvicultural practices have been altered. Apache-Sitgreaves National Forest requires a 100-foot buffer (minimum, determined in part by slope) of all timber sales to maintain shading for populations along stream corridors.

Plants were introduced at Phelps Botanical Area and the Little Colorado River on the Apache-Sitgreaves NF, however those plants have not persisted (Rink 2019).

SUGGESTED PROJECTS:

Prepare and implement Habitat Management Plans (HMP) for the species on each National Forest. Management recommendations from from Laurenzi et al 1987 and Rink 2019 include:

1. Inventory and map populations.
2. Construct and maintain fences around RNAs to exclude livestock.
3. Amend Apache-Sitgreaves National Forests Land Management Plan to include protection of this species in the management emphasis for Black River Management Area 14 and East and West Forks of the Black River Management Area 15.
4. Restrict timber harvesting from stands that support this species and stands that are upstream of this species, with the intent of reducing human-induced flooding.
5. Manage livestock to restore riparian ecosystems.
6. Designate a Special Management Area that includes at least one high density population.
7. Eliminate wild horses from the areas where *Allium gooddingii* exists on National Forest lands.
8. Manage forests to reduce the chance of catastrophic wildfire.
9. Within Allotment Management Plans (AMPs) include surveys and adjust livestock distribution and management.

Survey the Bonita Creek locality of the Fort Apache Indian Reservation. This is the type locality for the species. These portions of the Apache Reservation were not burned in the Wallow Fire and could harbor extensive populations of *A. gooddingii*, perhaps enough plants to allay concerns about its decline in the USFS-managed portions of its range.

In 2019, while searching for Hevly's original collection site (no date), Rink discovered a population of about 1000 plants along Tsaile Creek. He recommends a survey of the length of Tsaile Creek to determine how common the species is in the area. This or other populations along Tsaile Creek is also the likely source of the Canyon del Muerto collection made by Halse in 1971, but not encountered since. Rink believes the Halse collection in Canyon del Muerto could have been a waif, but thinks that the Canyon del Muerto deserves to be re-surveyed. Note that Tsaile Lake was constructed along Tsaile Creek in 1964. This lake lies between the original Hevly and very recent Rink collections and the Halse Canyon del Muerto collection. It may or may not be a barrier to downstream translocation of plant material from the eastern reach of Tsaile Creek and Canyon del Muerto. Note too that although the locality "Canyon de Chelly" has been used in conjunction with collections of *A. gooddingii* in this area, there are no known collections from Canyon de Chelly itself. Furthemore, Canyon de Chelly is about nine miles south of the Canyon del Muerto collection site and has no direct connection to Tsaile Creek/Canyon del Muerto until 17 miles southwest of the collection site, where both canyons enter into Chinle Wash.

Other recommended studies and projects include: 1) Determine relative recruitment contribution of sexual and vegetative reproduction based on habitat and management parameters; 2) Develop standardized monitoring procedures (cannot identify individuals because of asexual reproduction by rhizomes; must monitor population size and density of stems); and 3) Establish long-term monitoring plots and assure that their location information is maintained independently from the HDMS EO (Element Occurrence) identifiers since these can change over time (the monitoring plot would still be included within an appropriate EO as it still reflects a known location of plants, but the monitoring system would also include a separate listing to identify each plot (or transect) name and location).

The following EOs still need to be re-visited (as of 2019) to determine whether populations are extant: EO 2 – West Fork of the Black River and Hayground Creek; EO 36 - Fish Creek below Deep Cienega Draw (First Source Feature); EO 66 – NW side of Escudilla Mountain,; EO 69 - Mt. Lemmon below Bill Williams Spring; EO 74 – Grant Creek and springs in the south forks of Grant Creek; EO 77 - Canyon de Chelly (the Halse 1971 Canyon del Muerto, site); and EO 78 – Noble Mountain.

LAND MANAGEMENT/OWNERSHIP: Arizona: USFS - Apache-Sitgreaves and Coronado National Forests; BIA Navajo and White Mountain Apache reservations. New Mexico: USFS Gila and Lincoln National Forests; BIA Mescalero Indian Reservation.

SOURCES OF FURTHER INFORMATION INCLUDING CITATIONS

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ADDITIONAL INFORMATION:

Plants under cultivation at the Arboretum at Flagstaff. Observations there indicate that the species may be apomictic (self-fertile).

Revised: 1990-12-26 (SR)
1991-10-18 (BKP)
1991-12-04 (SR)
1992-09-14 (BKP)
1997-10-07 (SMS)
1999-12-20 (DJG)
2019-09-26 (Rink)

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