PETITION TO LIST THE
Aztec Gilia (*Aliciella formosa*)
UNDER THE ENDANGERED SPECIES ACT

Aztec gilia. Photo: New Mexico Rare Plant List

Petition Submitted to the U.S. Secretary of the Interior, Acting through the U.S. Fish and Wildlife Service

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WildEarth GUARDIANS

INTRODUCTION

WildEarth Guardians (Guardians) respectfully requests that the Secretary of the Interior, acting through the U.S. Fish and Wildlife Service (Service) list the Aztec gilia (*Aliciella formosa*) as "threatened" or "endangered" under the U.S. Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544). Guardians also requests that the Service designate critical habitat for the species concurrent with listing.

We base this petition on the most recent status report for the Aztec gilia (Roth & Sivinski, 2018). We hereby incorporate by reference all the articles cited in that status report. We also consider this petition a supplement and update to the listing petition for the Aztec gilia submitted in 2010 (WildEarth Guardians, 2010, *entire*). We hereby incorporate by reference that petition and all articles cited in that petition. If those articles are no longer readily available in the Services' files, Guardians can provide them upon request.

ENDANGERED SPECIES ACT AND IMPLEMENTING REGULATIONS

The ESA, 16 U.S.C. §§ 1531-1544, was enacted in 1973 "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). The protections of the ESA only apply to species that have been listed as endangered or threatened according to the provisions of the statute. The ESA delegates authority to determine whether a species should be listed as endangered or threatened to the Secretary of Interior, who has in turn delegated authority to the Director of the U.S. Fish & Wildlife Service. As defined in the ESA, an "endangered" species is one that is "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6); *see also* 16 U.S.C. § 533(a)(1). A "threatened species" is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20). The Service must evaluate whether a species is threatened or endangered as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

> A. The present or threatened destruction, modification, or curtailment of its habitat or range;
> B. Overutilization for commercial, recreational, scientific, or educational purposes;
> C. Disease or predation;
> D. The inadequacy of existing regulatory mechanisms; or
> E. Other natural or manmade factors affecting its continued existence.

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing. 50 C.F.R. § 424.11.

The Service is required to make these listing determinations "solely on the basis of the best scientific and commercial data available to [it] after conducting a review of the status of the species and after taking into account" existing efforts to protect the species without reference to the possible economic or other impacts of such a determination. 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). "The obvious purpose of [this requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 520 U.S. 154, 175 (1997). "Reliance upon the best available scientific data, as opposed to requiring absolute scientific

certainty, 'is in keeping with congressional intent' that an agency 'take preventive measures' *before* a species is 'conclusively' headed for extinction." *Ctr. for Biological Diversity v. Lohn*, 296 F. Supp. 2d 1223, 1236 (W.D. Wash. 2003) (emphasis in original).

In making a listing determination, the Secretary must give consideration to species which have been "identified as in danger of extinction, or likely to become so within the foreseeable future, by any State agency or by any agency of a foreign nation that is responsible for the conservation of fish or wildlife or plants." 16 U.S.C. § 1533(b)(1)(B)(ii); *see also* 50 C.F.R. § 424.11(e) (stating that the fact that a species has been identified by any State agency as being in danger of extinction may constitute evidence that the species is endangered or threatened). Listing may be done at the initiative of the Secretary or in response to a petition. 16 U.S.C. § 1533(b)(3)(A).

After receiving a petition to list a species, the Secretary is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). Such a finding is termed a "90-day finding." A "positive" 90-day finding leads to a status review and a determination whether the species will be listed, to be completed within twelve months. 16 U.S.C. §1533(b)(3)(B). A "negative" initial finding ends the listing process, and the ESA authorizes judicial review of such a finding. 16 U.S.C. § 1533(b)(3)(C)(ii). The applicable regulations define "substantial information," for purposes of consideration of petitions, as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1).

The regulations further specify four factors to guide the Service's consideration on whether a particular listing petition provides "substantial" information:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;
iii. Provides information regarding the status of the species over all or significant portion of its range; and
iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps.

50 C.F.R. §§ 424.14(b)(2)(i)-(iv).

Both the language of the regulation itself (by setting the "reasonable person" standard for substantial information) and the relevant case law underscore the point that the ESA does not require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004); *see also Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms"). Rather, the courts have held that the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species may be warranted" (emphasis added). Morgenweck, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A)); *see also*

Ctr. for Biological Diversity v. Kempthorne, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007) (holding that in issuing negative 90-day findings for two species of salamander, the Service "once again" erroneously applied "a more stringent standard" than that of the reasonable person).

CLASSIFICATION AND NOMENCLATURE

Common name. Common names for *Aliciella formosa* include "Aztec gilia" and "beautiful gilia." We refer to the species as "Aztec gilia" throughout this petition.

Taxonomy. The petitioned species is *Aliciella formosa*. The full species taxonomy can be found in Table 1.

Table 1. Taxonomy of *Aliciella formosa* (ITIS, 2018).

Kingdom	Plantae
Division	Tracheophyta
Class	Magnoliopsida
Order	Ericales
Family	Polemoniaceae
Genus	*Aliciella*
Species	*formosa*

SPECIES DESCRIPTION

The Aztec gilia "is a rare plant endemic to San Juan County in New Mexico. It is a perennial herb with a branching basal caudex, entire leaves and tubular pink flowers that bloom from late April to early June. Plants germinate and establish between early April and early June, depending on moisture availability. Plants flower at 2-3 years of age and may live for 10 years or more" (Roth & Sivinski, 2018, p. 2, *internal citations omitted*).

HABITAT REQUIREMENTS

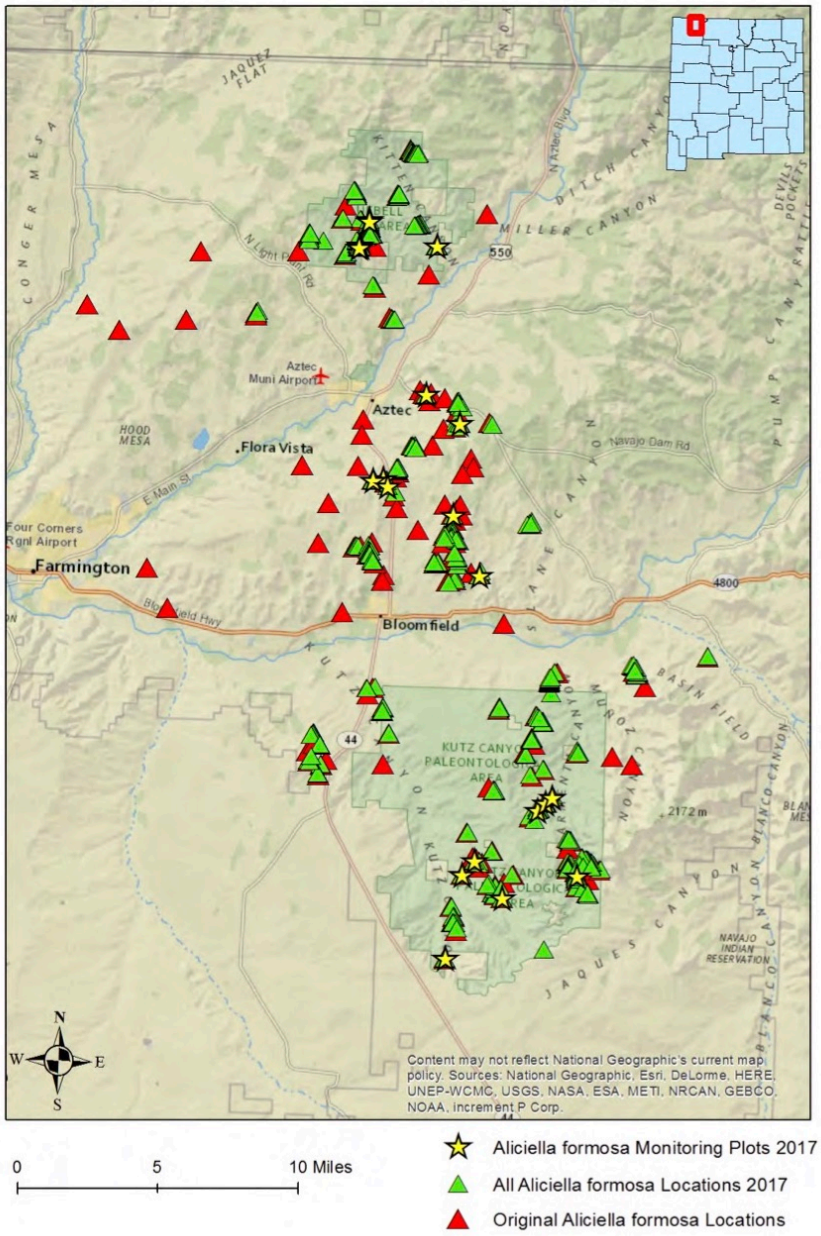
> In general, *A. formosa* occurs on eroding clayey sand soils on soft shaley sandstone strata in the northern badland regions of the Nacimiento Formation. The Nacimiento is well known for its Paleocene mammal fossils, but very little is published about the surface outcrops of its geologic strata. It is not a marine deposit, but its badlands are extensive, barren depositional shale, mudstone and soft sandstone. Occasional selenite crystals and gypsum crusts are found on the clayey sand soils. These gypseous substrates are most common north of the San Juan River and are classified as gypsum soils in the San Juan County soil survey. Habitat elevations range from 1,680 m to 1,940 m (5,500 – 6,360 ft). (Roth & Sivinski, 2018, p. 3, *internal citations omitted*)

GEOGRAPHIC DISTRIBUTION

"The total worldwide distribution of this species is limited to an area of approximately 50 miles x 35 miles" (Roth & Sivinski, 2018, p. 2). "It is endemic to San Juan County in New Mexico, with a range

extending from about 3 miles south of the Colorado border just west of the Animas River, then west to the vicinity of La Plata, then southeast to the Angel Peak badlands (upper Kutz Canyon), then east to Largo Canyon, then north to the vicinity of Cedar Hill on the Animas River" (Roth & Sivinski, 2018, p. 3, *see* Figure 1).

Figure 1. Distribution of Aztec gilia in San Juan County, New Mexico (Roth & Sivinski 2018, p. 7)



POPULATION STATUS: HISTORIC AND CURRENT

The total worldwide distribution of this species is limited to an area of approximately 50 miles x 35 miles. Based on past surveys, there are 42 known populations (Element

> Occurrences) within that area. Only about 10% of known sites have been documented since 1995. No repeat surveys have been done to determine the current status of these populations since the 1990s and clearance surveys for oil & gas development projects have largely been negative. Sensitive plant surveys throughout the Nacimiento Formation in 2015 have documented this species from only a handful [of] locations, all within the previously known distribution range. The largest site contained 16 plants. No new populations were located in suitable habitat outside the known distribution. (Roth & Sivinski, 2018, p. 2, *internal citations omitted*)

For most sites surveyed in 2018, the researchers had "little information on the number of plants originally documented, the survey effort, or extend of the surveys, making comparisons unsuitable" (Roth & Sivinski, 2018, p. 6). However, several monitoring plots established in 1991 and 1992 offered an opportunity to assess long-term population trends. The results were not encouraging. "Overall, there appeared to be a significant decline in the total number of plants recorded in the 22 monitoring plots that could be located in 2017" (Roth & Sivinski, 2018, p. 8).

> The highest number of plants was found in 1995, when a total of 3,312 plants were found in the monitoring plots. The lowest number of plants was found in 2017, when only 488 plants were found. This represents a decline of 52% over initial counts in 1992 and even larger declines from 1993 (59%) and 1995 (85%) values. The average number of plants found in the 20 monitoring plots was consistently between 50 and 60 plants between 1991 and 1993. This number rose dramatically during the 1995 monitoring season, when an average of 165 plants were found in the 20 monitoring plots. In 2017, the average number of plants in the monitoring plots had declined to only 24 plants. (Roth & Sivinski, 2018, p. 8)

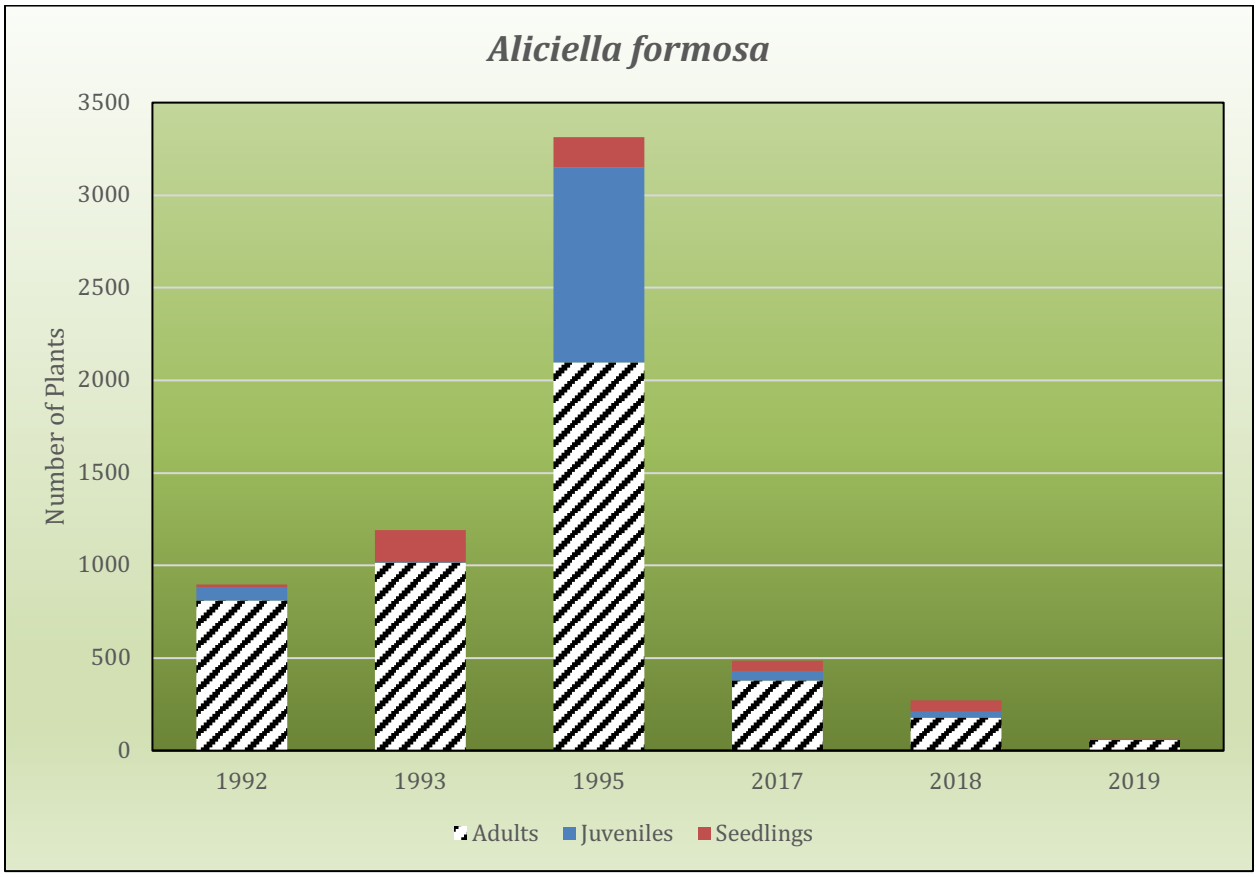
Observations from the other locations surveyed were not encouraging either:

> [G]eneral observations from the 107 locations surveyed support the declining trend data observed in the monitoring plots. Several of the revisited locations had very sparse patches of plants with many having fewer than 5 plants remaining. Thirty-four of the 173 locations reported originally contained over 100 plants per site (up to many thousands of plants)… In 2017, few sites had several hundred plants (31 of 469 waypoints, including monitoring sites). (Roth & Sivinski, 2018, p. 6)

Monitoring data from the New Mexico Forestry Division (NMFD, 2019, *entire*) shows a steep decline in populations in monitored plots between 1995 and 2019 (Figure 2). In 2018, a Forestry employee wrote: "Only 273 plants were found in the monitoring plots in 2018, down from 487 last year, and down from 3312 in 1995. I find this very alarming" (FOIA response 2018, p. 8).

In addition, during 140 Biological Survey Reports conducted in Clover's cactus habitat (which commonly overlaps with Aztec gilia habitat) between Oct. 2010 and Sept. 2016, no Aztec gilia were found (FOIA response received Sept. 2016).

Figure 2. Population numbers of Aztec gilia in monitored plots, 1992-2019 (NMFD, 2019).



IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The Service must evaluate whether a species is "threatened" or "endangered" as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

> A. The present or threatened destruction, modification, or curtailment of its habitat or range;
> B. Overutilization for commercial, recreational, scientific, or educational purposes;
> C. Disease or predation;
> D. The inadequacy of existing regulatory mechanisms; or
> E. Other natural or manmade factors affecting its continued existence.

Seed plants are experiencing heightened levels of extinction compared to background rates. "Extinction of seed plants is occurring at a faster rate than the normal turnover of species. We found that, on average, 2.3 species have become extinct each year for the past 2.5 centuries" (Humphreys et al., 2019, p. 1,043).

(Factor A) The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Oil and gas development.

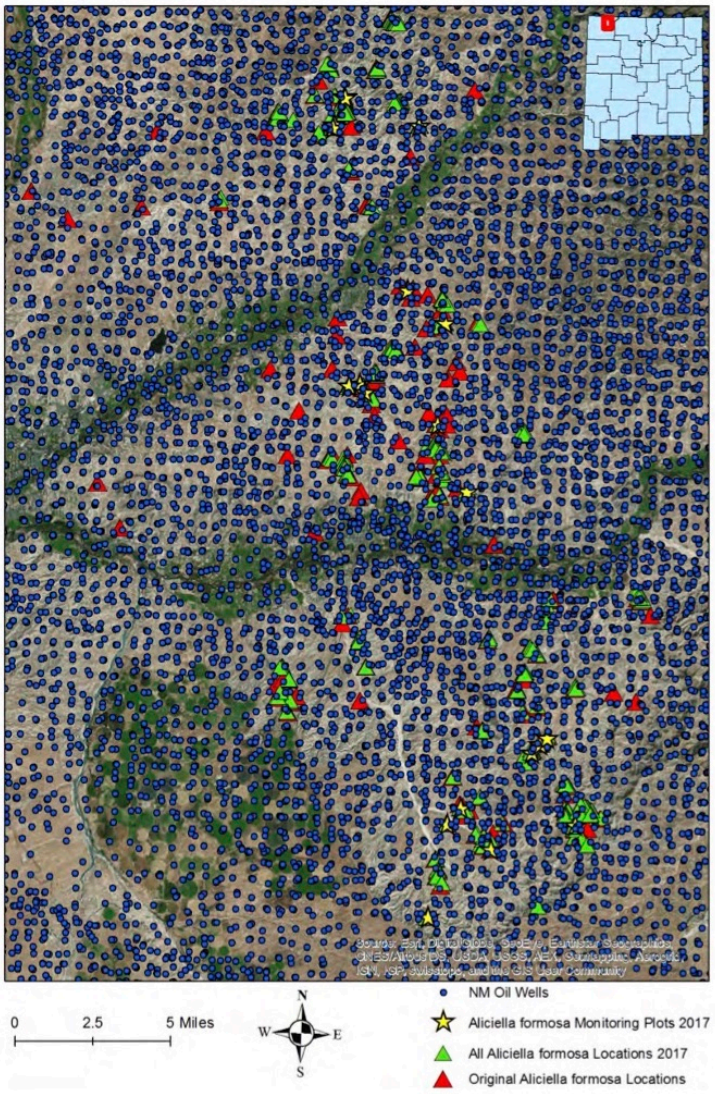
> The prevailing and most destructive land use in the habitats of *Aliciella formosa* is exploration and development of oil and natural gas, including oil & gas wells and associated infrastructure such as access roads, storage sites, and pipelines. San Juan is the second largest natural gas-producing and third largest oil producing county in New Mexico. Natural gas wells have long been producing from the Nacimiento Formation and the formations directly below the Nacimiento are reservoirs for oil. The natural gas well fields currently impacting *A. formosa* habitats are relatively old, but new methods such as horizontal drilling and hydraulic fracturing of shale strata are expected to open new opportunities to develop additional wells in areas already highly impacted by single vertical wells. A recent assessment of reasonably foreseeable shale oil well production predicts approximately 2,000 additional wells to make natural gas available from the Mancos shale – mostly from the central part of the formation near the Colorado border. This could continue to impact the Bloomfield/Aztec region, which is an area already densely developed by more traditional vertical wells. (Roth & Sivinski, 2018, p. 10, *internal citations omitted*)
>
> Gas and oil wells and their associated road and pipeline infrastructure are already established or actively developing throughout all *A. formosa* habitats, regardless of surface ownership. Direct impacts of gas and oil development are mostly associated with the surface activities of creating well pads and connecting them with broad and extensive networks of pipelines and roads. *Aliciella formosa* has occasionally been observed recolonizing well field ground disturbance, if the original surface soils are used for construction. Significant earth movement such as cut and fill for well pads and roads tends to eliminate this species from that part of the habitat. (Roth & Sivinski, 2018, p. 11)
>
> Plants not directly impacted by energy exploration and development can suffer indirect impacts when in close proximity to roads and pipelines including impacts of dust, chemicals, air pollution, invasive species, and impacts on pollinators. Fugitive dust from vehicles traveling unpaved roads will settle on nearby plants and can reduce photosynthesis and decrease water-use efficiency. Dust can interfere with pollination and pollination success, potentially reducing seed set. (Roth & Sivinski, 2018, p. 12, *internal citations omitted*)

Habitat fragmentation.

> Roads and pipelines also fragment habitats into smaller pieces and that potentially creates smaller patches of *A. formosa* from fewer larger patches. Distribution of *A. formosa* is naturally very patchy with distances between patches often exceeding 100 m and some patches containing only a few isolated individuals. Gene flow between patches may be almost entirely mediated by flying insects carrying pollen. Habitat fragmentation by 10 m-wide roads is unlikely to inhibit pollinator movement and gene flow. However, dust deposition may negatively impact pollination and pollination success. Seed dispersal for this species appears to be generally localized around maternal plants, but occasional longer distance dispersal by animal vectors and cyclonic whirlwinds likely occurs. These habitat fragments may, or may not, be as stable as the larger undisturbed patches, but the long-term impacts of habitat

fragmentation in well fields have not been studied for plants or their pollinators. (Roth & Sivinski, 2018, p. 13)

Figure 3. Density of oil and gas wells in the habitat of Aztec gilia (Roth & Sivinski, p. 11)



Off-road vehicle use.

Off-road vehicle (ORV) traffic is an ongoing threat to some patches of *A. formosa* because ORVs run over them and indirectly impact habitat by destruction of fragile soil crusts that may aid germination and establishment, cause soil compaction, contribute to dust deposition, leave deep tracks and ruts that alter drainage patterns and cause erosion. The 2017 survey found significant amounts of soil disturbance from bicycle and motorized ORV traffic on most BLM lands north of the San Juan River in the regions around Bloomfield, Aztec and La Plata, especially along ridges. ORV impacts to habitats in that region were not as severe as the disturbances caused by roads and infrastructure supporting energy

> development, but were quite noticeable in the northern part of the survey area. Many of these trails are marked by BLM for public use. These trails and associated off-trail diversions only add to the general surface disturbance of oil and gas well fields in this highly impacted region. (Roth & Sivinski, 2018, p. 13)

NatureServe notes that "[r]ecreational offroad vehicles pose a significant threat. It has been observed that in areas with high offroad vehicle traffic the number of juvenile plants is reduced" (NatureServe, 2018, p. 2).

Livestock grazing.

> Land use within the *Aliciella formosa* habitat has historically been livestock grazing and all sites are located within active grazing allotments. Livestock impacts were observed in the vicinity of 58% of the reported waypoints [plant locations]. The majority of livestock impacts were observed in the southern portion of the survey area, south of the San Juan River, portions of which are grazed year-round. Although *A. formosa* may not be palatable to livestock, individuals are easily trampled, which may result in direct death or injury of the plant which in turn will influence the reproductive potential of the population over time. Indirect impacts include dust deposition, increased erosion, soil compaction, and the introduction of invasive species. Invasive species including cheatgrass (*Bromus tectorum)* and Russian thistle (*Salsola kali)* were documented throughout the survey area, especially in the vicinity of disturbed areas, such as roads and well pads. A few sites documented halogeton (*Halogeton glomeratus*), an aggressive invasive plant which has invaded much of the Mancos shale habitats throughout the BLM Farmington District. (Roth & Sivinski, 2018, p. 14)

(Factor C) Disease or Predation

> Porter and Floyd (1993) observed predation by a microlepidopteran moth larvae (Gelechiidae), which bores into the lower woody caudex region of *A. formosa*. The moth larvae caused mortality of at least one entire population of plants over the course of one summer and contributed significantly to the mortality of monitored adult plants over a 4 year period. In addition to drought related mortalities, this tiny moth may be partly or entirely responsible for the severe decline of *A. formosa* in many of the permanent monitoring plots. No significant numbers of dead adult *A. formosa* were observed in the 2017 field survey, but we were there in the spring and not the heat of summer. Microlepidoptern moth predation may be causing a high level of *A. formosa* mortality that is currently going undocumented… Increases in moth larvae predation may have contributed to the decline of the species already and should be studied further. (Roth & Sivinski, 2018, p. 16, *some internal citations omitted*)

(Factor D) The Inadequacy of Existing Regulatory Mechanisms

Federal.

Bureau of Land Management. The New Mexico state office of the Bureau of Land Management (BLM) lists the Aztec gilia as "sensitive."

Regulations regarding sensitive species appear to be focused on avoiding listing under the ESA and the associated mandatory duties under federal law, rather than prioritizing species conservation and recovery, as the ESA does.

> [T]he BLM shall designate Bureau sensitive species and implement measures to conserve these species and their habitats, including ESA proposed critical habitat, to promote their conservation and *reduce the likelihood and need for such species to be listed pursuant to the ESA*. (BLM Manual § 6840.2 (2008), *emphasis added*)

"Designating measures" to "promote" species conservation is not necessarily equivalent to protecting a species.

> When BLM engages in the planning process, it shall address Bureau sensitive species and their habitats in land use plans and associated NEPA documents... When appropriate, land use plans shall be sufficiently detailed to identify and resolve significant land use conflicts with Bureau sensitive species without deferring conflict resolution to implementation-level planning. Implementation-level planning should consider all site-specific methods and procedures needed to bring species and their habitats to the condition under which management under the Bureau sensitive species policies would no longer be necessary. (BLM Manual § 6840.2B (2008))

To "address" sensitive species in land use plans is not the same as to protect them. The rest of this regulation is discretionary and carries no affirmative duty to conserve and recover sensitive species:

> On BLM-administered lands, the BLM shall manage Bureau sensitive species and their habitats to minimize or eliminate threats affecting the status of the species or to improve the condition of the species habitat, by:
>
> 1. Determining, to the extent practicable, the distribution, abundance, population condition, current threats, and habitat needs for sensitive species, and evaluating the significance of BLM-administered lands and actions undertaken by the BLM in conserving those species.
> 2. Ensuring that BLM activities affecting Bureau sensitive species are carried out in a way that is consistent with its objectives for managing those species and their habitats at the appropriate spatial scale.
> 3. Monitoring populations and habitats of Bureau sensitive species to determine whether species management objectives are being met.
> 4. Working with partners and stakeholders to develop species-specific or ecosystem-based conservation strategies…
> 5. Prioritizing Bureau sensitive species and their habitats for conservation action based on considerations such as human and financial resource availability, immediacy of threats, and relationship to other BLM priority programs and activities.
> 6. Using Land and Water Conservation Funds, as well as other land tenure adjustment tools, to acquire habitats for Bureau sensitive species, as appropriate.
> 7. Considering ecosystem management and the conservation of native biodiversity to reduce the likelihood that any native species will require Bureau sensitive species status.
> 8. In the absence of conservation strategies, incorporate best management practices, standard operating procedures, conservation measures, and design criteria to mitigate

> specific threats to Bureau sensitive species during the planning of activities and projects. (BLM Manual § 6840.2C (2008))

These regulations are much weaker and less enforceable than protections under the ESA. Firstly, the BLM is not required to eliminate threats, only to eliminate *or minimize* them. The BLM must ensure that its activities are consistent with "objectives for managing [sensitive species] and their habitats," but does not here define those management objectives or require them to be science-based or measurable. The rest of these regulations are discretionary or require only "consideration" or "prioritization" of species rather than enforceable protections as would be required by an ESA listing. BLM sensitive species designation is not an adequate regulatory mechanism to protect species on the brink of extinction.

New Mexico. The State of New Mexico lists the Aztec gilia as a New Mexico Endangered Plant Species. "This state law only prohibits unauthorized collection and transport of species on the state endangered plant list and does not protect them from destruction within their natural habitats" (Muldavin et al., 2015, p. 7, *internal citations omitted*).

The Aztec gilia is considered "under conserved" in the New Mexico Rare Plant Conservation Strategy (NMFD, 2017, p. 50).

Navajo Nation. The Navajo Nation includes the Aztec gilia in Group 4 of its endangered species list (NNDFW, 2008, p. 3). "Group 4 is a candidate list of species or subspecies for which the Navajo Nation Department of Fish and Wildlife does not have sufficient information to support their being listed as endangered, but has reason to consider them and is actively seeking additional information" (Muldavin et al., 2015, p. 7).

(Factor E) Other Natural or Man-made Factors Affecting its Continued Existence

Climate change. The Southwest is already feeling the impacts of climate change. "The predicted Southwest hot spot of climatic change looks much the same during the next 30 years as at the end of this century. And that future hot spot bears a strong resemblance to the drying and warming of the Southwest during the past decade or so" (Kerr, 2008, p. 909).

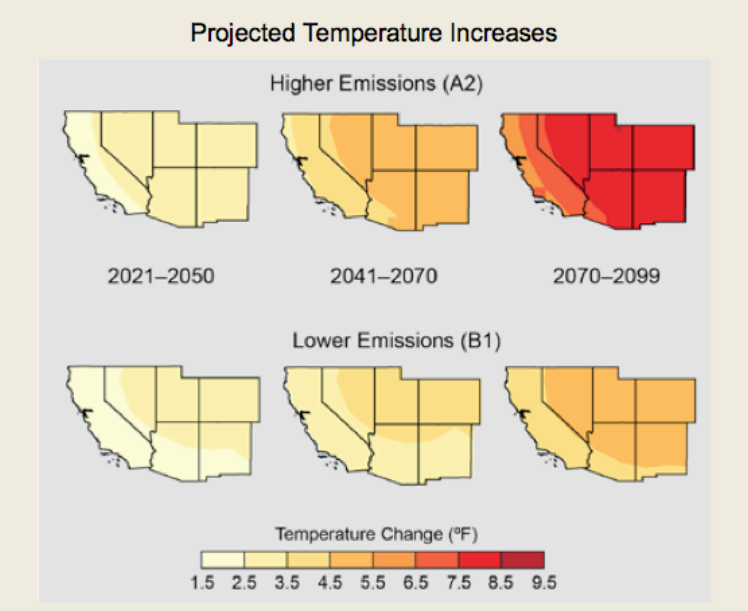
> Climate change is well under way in [the southwestern United States and northern Mexico] with clear trends of both warming and drying. This is partially a consequence of a northward shift in the track of winter and spring storms. Temperatures are expected to increase by 2.0 to 3.0 °C [3.6-5.4 °F] by 2050 and 2.2 to 5.5 °C [4.0-9.9 °F] by 2100, and spring precipitation is anticipated to decrease by 20 to 40% by the end of the century, but the contribution of summer monsoon remains uncertain. Monsoons have been delayed by approximately 10 [days] in northern Mexico over the last half century. Multiyear droughts are projected to increase by mid-century, with some persisting for a decade or more. In spite of this drying trend, flooding events are anticipated to increase in response to greater storm intensities falling on a larger proportion of bare soil. (Polley et al., 2013, p. 503, *internal citations omitted*)

> The current prognosis for global climate change impacts on the Southwest include fewer frost days; warmer temperatures; greater water demand by plants, animals, and people; and an increased frequency of extreme weather events (heat waves, droughts, and floods).

> Furthermore, warmer nights and projected declines in snow pack, coupled with earlier spring snow melt, will reduce water supply, lengthen the dry season, create conditions for drought and insect outbreaks, and increase the frequency and intensity of wildfires. Temperatures currently considered unusually high will occur more frequently. These model-based projections align with observations made in the region over the past decade. (Archer & Predick, 2008, p. 23)

Temperature. The Southwest "has heated up markedly in recent decades, and the period since 1950 has been hotter than any comparably long period in at least 600 years" (Garfin et al., 2014, p. 464). The National Climate Assessment predicts that regional annual average will "rise by 2.5 °F to 5.5 °F [1.4-3.0 °C] by 2041-2070 and by 5.5 °F to 9.5 °F [3.0-5.2 °C] by 2070-2099 with continued growth in global emissions (A2 emissions scenario), with the greatest increases in the summer and fall. If global emissions are substantially reduced (as in the B1 emissions scenario), projected temperature increases are 2.5 °F to 4.5 °F [1.4-2.5 °C] (2041-2070), and 3.5 °F to 5.5 °F [1.9-3.0 °C] (2070-2099)" (Figure 4). Other models project "a notable increase in annual mean temperature of +4.5 °C [8.1 °F] (Notaro et al., 2012, p. 1,370).

Figure 4. Maps show projected changes in average, as compared to 1971-1999. Top row shows projections assuming heat-trapping gas emissions continue to rise (A2). Bottom row shows projections assuming substantial reductions in emissions (B1) (Garfin et al., 2014, p. 464).



Precipitation. Climate models predict that "by the second half of the 21st century, the number and duration of extreme dry events increases markedly, with most of the projected dry spells lasting longer than five years and in three cases exceeding 150 months—more than 12 years… Composited over the 11 extreme drought years, the aggregate Southwest precipitation was reduced to 77% of its 1951-1999 average, April 1 snow water equivalent was reduced to 50%, and runoff was reduced to 63%" (Cayan et al., 2010, p. 21,273). Soil moisture is projected to decrease as a result of the

precipitation deficit: by the end of the 21st century, "the soil moisture deficits range from 1.7 to more than 2 standard deviations below the mean" (Cayan et al., 2010, p. 21,274).

> Water inputs are expected to decline due to reduced precipitation. Water losses are also likely to increase due to elevated evapotranspiration rates at higher temperatures and greater run-off losses associated with increased frequencies of high intensity convectional storms. Urban expansion will also increase human demand for water and further reduce water availability for wildland ecosystems. (Archer & Predick, 2008, p. 25)

Projections of precipitation changes are less certain than temperature changes, but precipitation will become more variable and drought more extreme. "Despite a small decrease in mean precipitation (-4%) during 2000-2100 under the A2 scenario, the frequency of extremely dry years is expected to increase substantially. During the 1953-1956 drought annual mean precipitation across the [southwestern United States] was only 25 cm [10 in]. According to the CMIP3 models, by 2070-2099 one in every five years will be characterized by 25 cm [10 inches] of annual precipitation or less, making such extreme drought a regular occurrence" (Notaro et al., 2012, p. 1,370). Projections of weather type frequencies across the U.S. found that "[t]he strongest significant drying trends are found in the Central Southwest and the Southern Rockies" (Prein et al., 2019, p. 1,275). "Our observational-based results support projections of climate models that show a pronounced increase of droughts and aridity in the Southwest during the latter half of the 21st century due to a poleward extension of the subtropical dry zones leading to increasing anticyclonic conditions" (Prein et al., 2019, p. 1,277).

"Rising temperatures will exacerbate droughts, along with their ecological impacts, through enhanced evapotranspirational demand" (Notaro et al., 2012, p. 1,366):

> Average summer-fall evaporative demand has been increasing steadily in recent decades of atmospheric warming, and it has been the highest on record since 2000. Recent research documents that summer-fall atmospheric evaporative demand is just as important as winter precipitation in stressing montane plants, and that this available water deficit has impacted Southwestern forests for centuries during periods of warming and/or drought. In fact, climate model projections of winter precipitation and summer-fall evaporative demand suggests that megadrought-type forest drought-stress conditions will exceed those of the megadroughts of the 1200s and 1500s on a regular basis by the 2050s, and that this condition has prevailed over about 30% of the past 13 years in the Southwest. (Brusca et al., 2013, p. 3,313)

The Colorado Plateau ecoregion of New Mexico, where the Aztec gilia is found, is projected to experience significant impacts from climate change:

> Encompassing the far northwestern portion of New Mexico, with the remaining portion extending into the Four Corner states of Arizona, Utah, and Colorado, the ecoregion is considered ecologically important as a result of its complex geological formations and its more than 300 endemic plant species. Of the 18 conservation areas in the New Mexico portion of the ecoregion, the Carracas Mesa/Navajo Reservoir site (#118) ranked highest in climate exposure (91.7th percentile) not only as a result of consistent warmer-drier conditions, but because of the variation experienced in temperature across the two departure

> periods. Moreover, the site had significant positive trends in both T*min* and T*max* between 1970-2006… The mean and median climate exposure score for the ecoregion was in the 78th percentile. (Enquist & Gori, 2008, p. 20, *internal citations omitted*)

It is unclear how climate change may impact the plants directly, though decreased rainfall will likely lead to decreased recruitment as "[r]ecruitment is generally associated with good rainfall amounts during the winter and spring months" (Roth & Sivinksi, 2018, p. 15).

Climate change may also impact the plants indirectly by increasing survival of the microlepidopteran moth larvae that predate on the plants:

> "The southwestern climate is predicted to warm, so future droughts will be coincident with higher temperatures. Warmer winters could increase moth survival and longer summers potentially add another generation to the life cycle of this particular moth species" (Roth & Sivinski, 2018, p. 16, *internal citations omitted*)

Observed declines are likely synergistic impacts of these combined stressors:

> "Despite a few recent years with good rainfall amounts, impacts of prolonged drought and climate change may have already impacted this species, contributing to the overall observed decline. A moth larva may be contributing significantly to the mortality of plants and the observed decline. More likely than not, the decline is a long-term trend caused by the combination of these stressors on the species" (Roth & Sivinski, 2018, p. 15)

Research suggests that species and ecosystems will need to shift (northward, away from the equator) an average of 0.42 km per year to survive the deleterious effects of increasing temperatures associated with climate change (Loarie et al. 2009, p. 1,052). The Aztec gilia may not be able to adapt to changing climate given its restricted range over the Nacimiento Formation and given the loss and fragmentation of habitat already caused by the prolific oil and gas development across the plant's range.

CONCLUSION AND REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the U.S. Fish and Wildlife Service under the Department of Interior to list the Aztec gilia (*Aliciella formosa*) as a "threatened" or "endangered" species under the Endangered Species Act. Listing is warranted, given ongoing and future threats, most notably oil and gas development. The Aztec gilia is threatened by at least four of the five listing factors under the ESA: the present or threatened destruction, modification, or curtailment of its habitat or range; disease or predation; inadequate regulatory mechanisms; and other natural or manmade factors affecting its continued existence. A U.S. Fish and Wildlife Service employee stated: "At the end of the day, there is a building body of evidence that suggests declines in both species, some of which may be attributed to energy development and the lack of proper conservation management." (FOIA response 2018, p. 2).

WildEarth Guardians requests that critical habitat be designated for the Aztec gilia in occupied and unoccupied suitable habitat concurrent with final ESA listing. Designating critical habitat for this species will support its recovery and protect areas crucial to long-term survival of Aztec gilia

populations.

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