**A Petition to List the Patagonia Eyed Silkmoth (*Automeris patagoniensis*) as an Endangered, or Alternatively as a Threatened, Species Pursuant to the Endangered Species Act and for the Concurrent Designation of Critical Habitat**

Photograph of the Patagonia Eyed Silkmoth by Kirby Wolfe, used with permission, available at: http://www.madrean.org/imglib/maba/fauna/MABA/201304/Automeris_patagoniensis-K.jpg

**Submitted to the United States Secretary of the Interior acting through the United States Fish and Wildlife Service**

Submitted: June 17, 2015

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## I. INTRODUCTION

Petitioner, Defenders of Wildlife ("Defenders"), is dedicated to the protection of all native animals and plants in their natural communities. With more than 1.2 million members, supporters, and activists, Defenders is a leading advocate for the protection of threatened and endangered species throughout the United States. Defenders has identified the Desert Southwest and borderlands area, the sole habitat of the Patagonia Eyed Silkmoth ("Moth"), as a key focal landscape in which to prioritize the organization's conservation work.

Petitioner, Patagonia Area Resource Alliance ("PARA"), is a grassroots, non-profit community alliance, based in Patagonia, Arizona. PARA is committed to preserving and protecting the Patagonia area and emphasizes the protection of all local flora and fauna, including the Moth, as a part of its conservation work.

Through this Petition, Defenders and PARA (collectively "Petitioners") formally request that the Secretary of the Interior ("Secretary"), acting through the U.S. Fish and Wildlife Service ("FWS") list the Patagonia Eyed Silkmoth (*Automeris patagoniensis*) as an "endangered," or alternatively as a "threatened," species under the Endangered Species Act ("ESA"), 16 U.S.C. §§ 1531–44. Additionally, because the ESA's definitions of both endangered and threatened species provide for listing species that are endangered or threatened "throughout all or a significant portion of [their] range," Petitioners request that, in reviewing this Petition, FWS specifically analyze whether the Moth is endangered or threatened throughout all or any significant portion of its range. *See* 16 U.S.C. §§ 1532(6), (20). Finally, Petitioners request that FWS designate critical habitat for this species, in areas under U.S. jurisdiction, concurrently with its listing. *See* 16 U.S.C. § 1533(b)(6)(C); 50 C.F.R. § 424.12. This Petition is submitted pursuant to the ESA, 16 U.S.C. § 1533(b)(3)(A), its implementing regulations, 50 C.F.R. § 424.14, and the Administrative Procedure Act, 5 U.S.C. § 553(e).

Petitioners anticipate that, in keeping with 50 C.F.R. § 424.14(a), FWS will acknowledge the receipt of this Petition in writing within 30 days. As fully set forth below, this Petition contains all the information requested in 50 C.F.R. §§ 424.14(b)(2)(i)–(iv) and 16 U.S.C. § 1533(a). All cited documents are listed in the concluding References section of this Petition and electronic copies of these documents accompany this Petition.

## II. GOVERNING PROVISIONS OF THE ENDANGERED SPECIES ACT

### A. Significant Portion of the Species' Range

The ESA defines an "endangered species" as any species which is "in danger of extinction throughout all or a significant portion of its range," 16 U.S.C. § 1532(6), and a "threatened species" as one which "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 ESA does not further define or explain the meaning of the "significant portion of its range" ("SPR") language. However, FWS and the National Oceanic and Atmospheric Administration ("NOAA") issued a final policy on the interpretation of this SPR language on July 1, 2014. 79 Fed. Reg. 37,577. According to this new policy, a portion of a species' range constitutes a "significant portion" if "the portion's contribution to the viability of the species is so important such that without the members in that portion the

species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range." 79 Fed. Reg. at 37,580.

Under this new definition, a species could only be listed under the SPR provision if FWS: (1) determined that the species is neither endangered nor threatened throughout all of its range; (2) determined the specific biological importance of that portion of the species' range where it is facing threats; and (3) determined that impairment of this portion of the species' range would increase the vulnerability of the species to the threats it faces to the point that the entire species would be in danger of extinction, or likely to become so in the foreseeable future. 79 Fed. Reg. at 37,583. The courts have consistently rejected this interpretation of the SPR language because it effectively requires that the species face a "species as a whole" extinction risk, thus reading the SPR language out of the statute. When faced with an entirely similar prior interpretation of the SPR language by FWS, the United States Court of Appeals for the Ninth Circuit explained:

> If . . . the effect of extinction throughout "a significant portion of its range" is the threat of extinction everywhere, then the threat of extinction throughout "a significant portion of its range" is equivalent to the threat of extinction throughout all its range. Because the statute already defines "endangered species" as those that are "in danger of extinction throughout all . . . of [their] range," the Secretary's interpretation of "a significant portion of its range" has the effect of rendering the phrase superfluous. Such a redundant reading of a significant statutory phrase is unacceptable.

*Defenders of Wildlife v. Norton*, 258 F.3d 1136, 1145 (9th Cir. 2011).

FWS' new SPR Policy also appears to require that the loss of the species in the portion of its range at issue result in a risk of extinction to the species throughout its entire range in order for that portion to be classified as significant. Therefore, this new interpretation is similarly inconsistent with the language of the ESA and is also in violation of the Ninth Circuit's holding in *Norton*. *See* 16 U.S.C. §§ 1532(6), (20); *Norton*, 258 F.3d at 1145. Nonetheless, as detailed below, under any reasonable interpretation of the ESA's SPR language, and even under FWS' new overly restrictive, and likely illegal, policy, the Moth is endangered or threatened in at least a significant portion of its range and should therefore be listed throughout its range. Petitioners urge FWS to consider this SPR issue in its review of this Petition.

### B. Listing Factors

FWS must make its determination of whether a species is endangered or threatened based solely on the following five 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; and
E. Other natural or manmade factors affecting its continued existence.

In order to be listed, a species need only face a sufficient threat under a single factor. *See Humane Soc'y of the U.S. v. Pritzker*, No. 11-01414, 2014 WL 6946022, at *2 (D.D.C. Nov. 14, 2014) (citing *Sw. Ctr. For Biological Diversity v. Babbitt*, 215 F.3d 58, 60 (D.C. Cir. 2000)). Any combination of threats, considered cumulatively under multiple factors, will also support listing. As discussed in detail in this Petition, the Moth faces threats under all five of the listing factors and clearly warrants listing (*see generally* Section IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING, *infra*).

### C. 90-Day and 12-Month Findings

"To the maximum extent practicable," FWS is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted" within 90 days of receiving a petition to list a species. 16 U.S.C. § 1533(b)(3)(A). This is referred to as a "90-day finding." A "negative" 90-day finding ends the listing process and is a final agency action subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii). A "positive" 90-day finding leads to a formal, more comprehensive "status review" and a "12-month finding" determining, based on the best available science, whether listing the species is warranted, not warranted, or warranted but precluded by other pending listing proposals for higher priority species. 16 U.S.C. § 1533(b)(3)(B). "Not warranted" and "warranted but precluded" 12-month findings are also subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii).

FWS' regulations define "substantial information," for purposes of 90-day petition findings, 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). In making a finding as to whether a petition presents "substantial information" warranting a positive 90–day finding, FWS considers whether the petition:

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 a 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). FWS' own guidance on "substantial information" states that the information presented should merely be "adequate and reliable," not conclusive (Fish and Wildlife Service & National Marine Fisheries Service, 1996 at 12).

### D. Reasonable Person Standard

Both the relevant case law and the language of FWS' regulation, by setting the "reasonable person" standard for substantial information, 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. *See, e.g., Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004); *see also* 50

C.F.R. § 424.14(b)(1). In reviewing negative 90-day findings, the courts have consistently held that the evidentiary threshold at the 90-day review stage is much lower than the one required under a 12-month review. *See, e.g.*, *Ctr. for Biological Diversity v. Kempthorne*, No. CV 07-0038-PHX-MHM, 2008 WL 659822, at *8 (D. Ariz. Mar. 6, 2008) ("[T]he 90-day review of a listing petition is a cursory review to determine whether a petition contains information that warrants a more in-depth review."); *see also Pritzker*, 2014 WL 6946022, at *5-7 (holding that NMFS was arbitrary and capricious when it determined that conflicting evidence or "some level of uncertainty" was sufficient to show that the petitioner had failed to provide "substantial evidence" that listing was appropriate at the 90-day finding stage); *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" and that "the standard in reviewing a petition . . . does not require conclusive evidence.").

In fact, courts have characterized the 90-day finding determination as a mere "threshold determination" and have held that it 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." *See Pritzker*, 2014 WL 6946022, at *8 (quoting *Colo. River Cutthroat Trout v. Kempthorne,* 448 F. Supp. 2d 170, 176 (D.D.C. 2006)); *Morgenweck*, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A) (emphasis added)); *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, FWS erroneously applied "a more stringent standard" than that of the reasonable person). Accordingly, a petition does not need to establish that there is a high likelihood that a species is either endangered or threatened at the 90-day finding stage.

Moreover, as explained by the courts, FWS must give the "benefit of the doubt" to the petitioners – and thus the species:

> The 'may be warranted' standard . . . seems to require that in cases of . . . contradictory evidence, the [agency] must defer to information that supports petitioner's position. It would be wrong to discount the information submitted in a petition solely because other data might contradict it. At [the 90-day finding] stage, unless the [agency] has demonstrated the *unreliability* of information that supports the petition, that information cannot be dismissed out of hand.

*Kempthorne*, 2007 WL 163244, at *4 (emphasis added). In fact, the court in *Pritzker* determined that NMFS' expressed need for more conclusive information was itself sufficient to suggest a reasonable person "might conclude 'a review of the status of the species concerned' was warranted." 2014 WL 6946022, at *5. NMFS' failure to provide a positive 90-day finding and complete a status review was thus found to be arbitrary and capricious. 2014 WL 6946022, at *5-7.

### E. Best Available Scientific and Commercial Data

FWS is required to make an ESA listing determination for the Moth under the listing factors based exclusively on the best *available* scientific and commercial data. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). Therefore, FWS cannot deny listing merely because there is little information available, if the best *available* information indicates that the Moth is endangered or threatened under

any one, or any combination, of the five ESA listing factors.[1] This is particularly important during the 90-day review because, as noted above, FWS must make a positive 90-day finding and commence a status review when a "reasonable person" would conclude, based on the *available* evidence, that listing may be warranted. *See, e.g., Morgenweck*, 351 F. Supp. 2d at 1140-41; *Pritzker*, 2014 WL 6946022, at *5-7.

### 1. NatureServe

NatureServe is an independent scientific organization founded in 1994 to collect, summarize, and disseminate the best available scientific information on thousands of species throughout North America (*See* NatureServe, Undated at 1; NatureServe, Undated – 2 at 1-2). Its goal is to aid conservation decision-makers and the public by providing a readily available source of high quality scientific information so that conservation decisions can be well-informed and prioritized (NatureServe, Undated – 3 at 1). NatureServe is composed of more than 80 independent scientific organizations, with over 1,000 conservation professionals (NatureServe, Undated at 1). It is a well-respected source of scientific information and is widely acknowledged as a neutral forum providing unbiased scientific determinations. NatureServe provides information publicly on the internet through its NatureServe Explorer database (NatureServe, Undated – 2 at 1). This information, including species' extinction risk assessments, is periodically reviewed and updated with the input of hundreds of natural heritage program scientists and other collaborators to provide the public, conservation professionals, non-governmental organizations, and governmental agencies with the most current information on species and the threats that they face (*see* NatureServe, Undated – 2 at 1; NatureServe, Undated – 3 at 1).

If sufficient information on a species is available, NatureServe performs an extinction risk assessment based on explicit, objective criteria and assigns the species a Global Conservation Status Rank from G1 – G5, with G1 (the highest threat category) consisting of "Globally Critically Imperiled" species and G5 (the lowest threat category) consisting of species that are "Globally Secure" (NatureServe, Undated – 4 at 2). NatureServe also sometimes provides a national (United States and/or Canada), ranking between N1 – N5, with N1 (the highest threat category) consisting of "Nationally Critically Imperiled" species and N5 (the lowest threat category) consisting of species that are "Nationally Secure" (*see* NatureServe, Undated – 4 at 2). This system aims to provide a clear, objective framework for the classification of species according to their extinction risk (*see generally* NatureServe, Undated – 4).

These NatureServe categories are widely recognized, are relied on in a variety of scientific publications, and are used by numerous governmental and non-governmental organizations. In fact

[1] *See City of Las Vegas v. Lujan*, 891 F.2d 927, 933 (D.C. Cir. 1989) ("[Section 4] merely prohibits the Secretary from disregarding available scientific evidence that is in some way better than the evidence he relies on. Even if the available scientific and commercial data were inconclusive, he may – indeed must – still rely on it at this stage . . ."); *Trout Unlimited v. Lohn*, 645 F. Supp. 2d 929, 950 (D. Or. 2007) ("[T]he agency 'cannot ignore available biological information'" (quoting *Kern Co. Farm Bureau v. Allen*, 450 F.3d 1072, 1080-81 (9th Cir. 2006)); *In re Polar Bear Endangered Species Act Listing and 4(d) Rule Litigation*, 794 F. Supp. 2d 65, 106 (D.D.C. 2011) ("As this Court has observed, 'some degree of speculation and uncertainty is inherent in agency decisionmaking' and 'though the ESA should not be implemented 'haphazardly' . . . an agency need not stop in its tracks when it lacks sufficient information.'" (quoting *Oceana v. Evans*, 384 F. Supp. 2d 203, 219 (D.D.C. 2005)).

FWS itself regularly cites to NatureServe in its species profiles maintained on the Agency's website and has repeatedly described NatureServe as "a source for authoritative conservation information . . . provid[ing] in-depth information on rare and endangered species . . ." (*see, e.g.,* Fish and Wildlife Service, Undated at 4). NatureServe's species assessments and threat determinations reflect the best available science and are clearly the determinations of "reasonable persons," in fact, "reasonable scientists."

### 2. NatureServe's Assessment of the Patagonia Eyed Silkmoth

NatureServe has assessed the status of the Moth as "Globally Critically Imperiled," assigning it a rank of G1, and thereby indicating this species faces the highest possible risk of extinction in NatureServe's global species ranking system (NatureServe, 2007 at 1). Additionally, NatureServe has assessed the status of the Moth as "Nationally Critically Imperiled" in the United States, assigning it a rank of N1, and thereby indicating this species faces the highest possible risk of extinction in NatureServe's national species ranking system (NatureServe, 2007 at 1). The Patagonia Eyed Silkmoth received these rankings due to the threats it faces throughout its historic range and in the few areas where populations are currently thought to exist.[2] NatureServe also emphasized the lack of any regulatory protections for the Moth in its assessment (NatureServe, 2007 at 2). NatureServe's rankings of the Patagonia Eyed Silkmoth, standing alone, should be sufficient to convince a "reasonable person" that the species *may* warrant listing. Accordingly, it is certainly "practicable" for FWS to issue a positive, "substantial information" 90-day finding on this Petition within 90-days, and Petitioners expect FWS to do so in compliance with the ESA listing deadlines and standards discussed above.[3]

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[2] In fact, NatureServe stated that the limited number of Patagonia Eyed Silkmoth occurrences alone, estimated at 2-3 occurrences, merit listing the species as G1, but that the other threats that the species faces in fact increase its vulnerability past what is required for a G1 listing (NatureServe, 2007 at 1, 2). The Patagonia Eyed Silkmoth was initially assessed by NatureServe in 2000 with its status last reviewed in 2007 (NatureServe, 2007 at 1). Since that time, the species' range has been clarified and it is now more definitively known to live in 3 separate, disjunct populations (*see, e.g.,* Declaration of John Palting ("Palting Decl.") ¶ 6, at pages 4-5; Section III. D. Habitat and Range, *infra*). In addition, the threats to the species have continued or increased since 2007 (*see generally* Section IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING). Therefore, not only does the Moth merit listing as G1 based on its limited number of populations alone (the same number now as when it was assessed by NatureServe in 2007, just in different locations (*see* Palting Decl. ¶ 6, at pages 4-5)), but the ongoing or increasing threats to its existence elevate its vulnerability well above what is required for a G1 listing.

[3] This contention is bolstered by the fact that the scientist who is likely the world's leading expert on the Patagonia Eyed Silkmoth, John Palting, believes that it "is a species on the edge of extinction." (Palting Decl. ¶ 9, at page 7). The Declaration of John Palting has extensive information related to his expertise in entomology generally and his expertise on the Patagonia Eyed Silkmoth in particular. This Declaration is incorporated into this Petition by reference rather than restated in its entirety. Petitioners assert that this Declaration constitutes the best available science on the Moth and the threats it faces, and thus FWS should rely on it accordingly.

## III. SPECIES DESCRIPTION

### A. Common Name

This Petition will refer to *Automeris patagoniensis* by the common name "Patagonia Eyed Silkmoth," or simply as the "Moth," throughout (*see* AGFD, 2004 at 1; NatureServe, 2007 at 1).

### B. Taxonomy

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|---|---|
| Kingdom | *Animalia* |
| Phylum | *Mandibulata* |
| Class | *Insecta* |
| Order | *Lepidoptera* |
| Family | *Saturniidae* |
| Genus | *Automeris* |
| Species | *Patagonensis* |

**Figure 1.** Patagonia Eyed Silkmoth taxonomy (NatureServe, 2007 at 1).

This is a valid taxonomic species (*see* Palting Decl. ¶ 8, at page 6 (the Patagonia Eyed Silkmoth "became isolated as habitat changed in north central Sonora, [and] evolved into a distinct species."); Lemaire, *et al.*, 1992 at 123 ("The new species described here[, the Patagonia Eyed Silkmoth,] was first recognized as distinct from a specimen collected in 1989 by Jeffrey Slotten and Tom Kral along Harshaw Creek . . ."); Bailowitz & Palting, 2010 at 329, 334 (discussing the species in relation to related moths and also discussing the threats this species faces)).

While recognizing that it is a valid taxon, NatureServe, 2007 states that the Patagonia Eyed Silkmoth *may* only be a subspecies of *Automeris colenon* based solely on a single source (*see* NatureServe, 2007 at 1 (citing Tuskes, *et al.*, 1996)). Tuskes, *et al.*, 1996 indicates that the authors of that book were hesitant to attach taxonomic significance to polymorphic frequencies, which were used, in part, to differentiate the Patagonia Eyed Silkmoth and *Automeris colenon* (*see* Tuskes, *et al.*, 1996 at 155). The authors also appeared to think that the different Patagonia Eyed Silkmoth color morphs were merely geographic variations between U.S. and Mexican populations of *Automeris colenon* and were not indicative of a separate species (Tuskes, *et al.*, 1996 at 155).

Despite these doubts by Tuskes, *et al.* Lemaire, *et al.*, 1992 had substantial evidence for assigning the Patagonia Eyed Silkmoth to its own species. They found both differences in polymorphic frequencies and morphological differences between the Patagonia Eyed Silkmoth and *Automeris colenon* that were significant enough to differentiate the species. In the absence of genetic studies, such differences are well-accepted bases for species differentiation. The morphological differences include differing coloration and markings between the Patagonia Eyed Silkmoth and *Automeris colenon* as adults (Lemaire, *et al.*, 1992 at 128, 129, Table 1, Figures 1-10, 13-15) and as larvae until the end of the last instar, where they become more similar in color (Lemaire, *et al.*, 1992 at 125-129, Table 2). For example, Lemaire, *et al.*, 1992 at 123 states that the Patagonia Eyed Silkmoth, though similar to *Automeris colenon,* "can be distinguished by several characters, especially the straight lines on the underside hindwing . . ." Additionally, early instar Patagonia Eyed Silkmoth larvae are white or light green, whereas *Automeris colenon* larvae are dark reddish or black (Lemaire, *et al.*, 1992 at 125). During later instars, the white subspiracular band is twice as wide in the Patagonia Eyed Silkmoth as in

*Automeris colenon* and the Patagonia Eyed Silkmoth has one-third to one-half of the yellow pinacula that *Automeris colenon* has (Lemaire, *et al.*, 1992 at 125-27). "The absence of differences in genitalia is not significant in such closely allied species, considering the homogeneity of the structures in this group of *Automeris*." (Lemaire, *et al.*, 1992 at 129). Therefore, the Patagonia Eyed Silkmoth and *Automeris colenon*, although closely-related, are visibly distinct from each other at various life history stages and are considered separate species.

Moreover, in the nearly 20 years since Tuskes, *et al.*, 1996 was published, further study of the Patagonia Eyed Silkmoth, as described in the following paragraph, has provided additional evidence that the Moth is not conspecific with *Automeris colenon*, counter to Tuskes, *et al.*, 1996's hypothesis, and that it is in fact a distinct species.[4]

First, the Madrean Archipelago Biodiversity Assessment ("MABA") expeditions have since discovered Mexican populations of Patagonia Eyed Silkmoth that are distinct from *Automeris colenon*, thus supporting the taxonomic differentiation of the Patagonia Eyed Silkmoth and *Automeris colenon* in Mexico that Tuskes, *et al.*, 1996 were skeptical about (*see* Tuskes, *et al.*, 1996 at 155; Palting Decl. ¶¶ 7-8, at pages 5-6 (noting discoveries of Patagonia Eyed Silkmoth populations in Sonora, Mexico in 2010 and 2013 and still considering it to be a distinct species)). Second, the Patagonia Eyed Silkmoth occurs only in southern Arizona and northern Sonora, but the related *Automeris io* and *Automeris colenon* have no historically documented occurrences in this area of Sonora, with their only Sonoran occurrences being in "extreme southern Sonora (near Alamos on the Sinaloa border)" (Palting Decl. ¶ 7, at p. 5; *see also* Palting Decl. ¶ 5, at p. 3 ("The coloring and pattern of the adult Patagonia eyed silkmoth, especially the small size of the eyespot on the hindwing, is also strikingly different from *Automeris io*, and more similar to the Mexican species, *Automeris colenon*, which is also unknown from this region."). The failure to locate any of the related *Automeris* species in northern Sonora, even after the extensive MABA surveys were completed in this region (*see* Palting Decl. ¶ 7, at p. 5), supports the Moth's distinction from *Automeris colenon*. The available facts led John Palting to state that, although "[t]he exact evolutionary relationships of [the Patagonia Eyed Silkmoth] have yet to be elucidated through molecular phylogenetic studies, . . . it seems clear that this species is descended from either *Automeris io* or *Automeris colenon* and became isolated as habitat changed in north central Sonora, where [the Patagonia Eyed Silkmoth] evolved into a distinct species." (Palting Decl. ¶ 8, at p. 6).

Accordingly, the best available science indicates that the Patagonia Eyed Silkmoth is a separate and distinct species, and FWS should treat it as such. However, even if FWS determines that, counter to this evidence, the Patagonia Eyed Silkmoth is a subspecies of *Automeris colenon*, FWS should still list the Patagonia Eyed Silkmoth as an endangered, or alternatively as a threatened, subspecies under the ESA. *See* 16 U.S.C. § 1532(16) (defining the term species as including "any subspecies of fish or wildlife or plants . . .").

[4] This is in keeping with the 1992 determination made by the then leading authority on the family *Saturniidae* (Lemaire), to which the Patagonia Eyed Silkmoth belongs, along with two other *saturniid* experts, that the Patagonia Eyed Silkmoth is in fact a valid, new species, despite its noted similarities to *Automeris colenon* and *Automeris io* (Palting Decl. ¶ 5, at page 3 (citing Lemaire, *et al.*, 1992)).

### C. Physical Characteristics

Female Patagonia Eyed Silkmoths are larger than males (BMNA, Undated at 1). The species' upper side is orange to brownish orange, with the exception of an occasional yellow male, and the females' forewing is darker than its hindwing (BMNA, Undated at 1). The forewing of both sexes has faint post-median lines and the hindwing has a small white, gray, and black eyespot (BMNA, Undated at 1). It has a wingspan ranging from 2 ¼-2 ¾ inches (5.8-7 centimeters) (BMNA, Undated at 1). Larvae are large caterpillars with spines on their body (AGFD, 2004 at 1).

Lemaire, *et al.*, 1992 at 123-29, incorporated by reference rather than restated, provides a much more detailed description of the species (separated by sex), including at immature life history stages (not separated by sex).

### D. Habitat and Range

The Moth's habitat is categorized as "Madrean Evergreen Woodland" (Lemaire, *et al.*, 1992 at 128). This habitat consists of mixed woodland oak species with several leguminous trees and shrubs, other shrub species, and a variety of grasses (Lemaire, *et al.*, 1992 at 128). When heavy summer rains occur, these woodlands can become quite lush (Lemaire, *et al.*, 1992 at 128). However, the Moth cannot inhabit much of the Madrean Evergreen Woodland in its range because of both historic and current livestock overgrazing (*see* Section III. E. Feeding, *infra*; Section IV. A. 1. Grazing, *infra*). This overgrazing has removed, and continues to remove, the native grasses that the Moth is completely dependent on during its larval stages and replace them with exotic grasses that the species cannot eat (*see* Section III. E. Feeding, *infra*; Section IV. A. 1. Grazing, *infra*). Therefore, the Moth's habitat is best described as Madrean Evergreen Woodland that has not been subjected to historic or current overgrazing and that still has an abundance of native grasses present.

The shortage of this habitat means that the Moth currently has a very restricted range (*see, e.g.,* Palting Decl. ¶¶ 4, 7, at pages 2, 5-6). It persists in a single location in the United States and two isolated, disjunct "sky islands"[5] in Sonora, Mexico (*see, e.g.,* Palting Decl. ¶ 8, at pages 6-7).[6] While the Moth's historical range was probably never very large, it is quite likely that, before the habitat between these currently persisting populations was overgrazed and altered to such an extent as to render it unsuitable, the Moth's populations were connected in a more widespread population or metapopulation running North-Northwest from northern Sonora and into southern Arizona (Palting Decl. ¶ 8, at page 7).

Palting's conclusion that the Moth's historic range was likely much larger than its current range is supported by the fact that "most or all" *Saturniidae* "are widespread in fairly dense populations rather

[5] The term "sky islands" refers to "mountain ranges that are isolated from each other by intervening valleys of grassland or desert. The valleys of this basin and range country act as barriers to the movement of certain woodland and forest species, somewhat like saltwater seas isolate plants and animals on oceanic islands . . ." (SIA, 2011 at 1).

[6] These are the only known populations despite extensive collecting and scientific study of moths from mountain ranges in Arizona and throughout Sonora, Mexico spanning at least 50 and 20-30 years respectively (*see* Palting Decl. ¶¶ 4, 6, at pages 2, 4-5). Early records from other localities were likely mislabeled, as to location, or represent extirpated populations (*see* Palting Decl. ¶ 6, at pages 4-5; Section III. D. 1. United States Population, *infra*; Section III. D. 2. Mexican Populations, *infra*).

than highly localized . . ." (NatureServe, 2007 at 3). The Moth likely had historic populations that covered hundreds of hectares to possibly over 100,000 hectares and that were several to many kilometers in at least one direction (*see* NatureServe, 2007 at 3). However, the Moth's current populations are much smaller, with the possible exception of the Sierra La Madera population, which covers at least part of a larger area containing suitable habitat (Palting Decl. ¶ 7, at page 5).

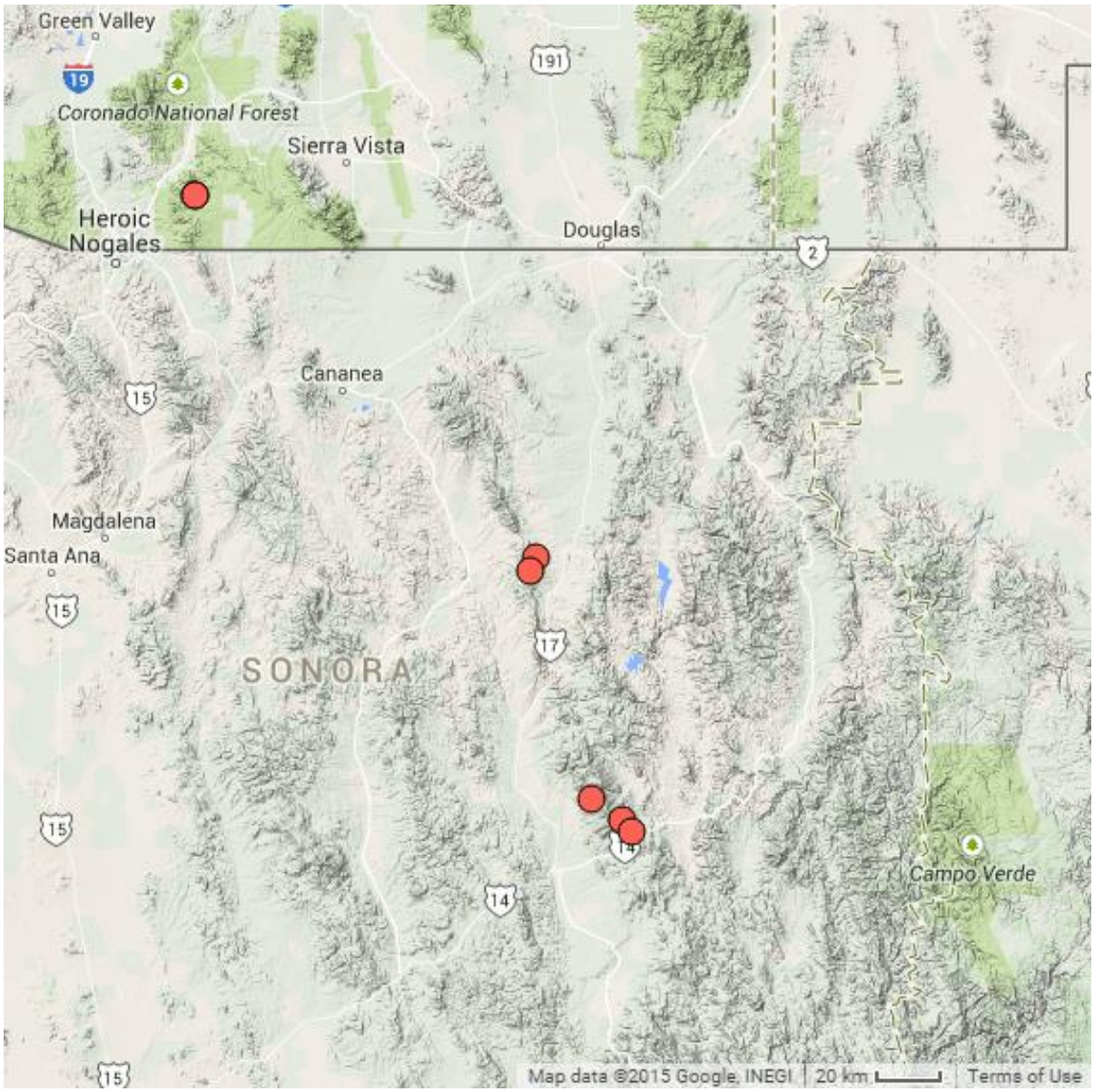


**Figure 2.** Red dots indicate all confirmed capture locations for the Patagonia Eyed Silkmoth: showing a single population in the United States (single red dot) and two populations in Mexico (clusters of red dots). The U.S.-Mexico Border is depicted by solid gray line (MABA, Undated at 1).

"[M]ost or all" *Saturniidae* "occupy a fairly distinct habitat type and stay within it," therefore, "habitat boundaries are often sharp and intervening terrain highly unsuitable (often low desert or developed land)." (NatureServe, 2007 at 3). As a result, all of the current Moth populations are likely disconnected, with a complete lack of metapopulation structure between them. NatureServe

explains that the separation distance[7] between populations across unsuitable habitat for this species is 4 kilometers (~2.5 miles) and that, when gaps of more than twice the unsuitable habitat range (8 kilometers or ~5 miles) are present in the same geographic features, the occupied habitats should not be treated as a metapopulation (NatureServe, 2007 at 3). NatureServe explains that the separation distance for populations across suitable habitat is 20 kilometers (~12.4 miles) (NatureServe, 2007 at 3). Figure 2, *supra*, shows that there is a gap of roughly 60 kilometers (~37.3 miles) between the two Mexican populations and 140 kilometers (~87 miles) between the U.S. population and the nearest Mexican population. Therefore, the distances between these populations are far too large to support a metapopulation, allow for gene flow, and/or allow for recolonization between the isolated populations, especially because the intervening lands are unsuitable Moth habitat (*see* Palting Decl. ¶¶ 8-9, at pages 7-8).

### 1. United States Population

The single U.S. Patagonia Eyed Silkmoth population is from the vicinity of the historic Harshaw town site in the Patagonia Mountains of Arizona ("Harshaw Population") (Palting Decl. ¶ 5, at page 3). However, its distribution is even more constrained than that, as Moths are never located far from the Harshaw Cemetery (Palting Decl. ¶ 8, at page 7). This is likely because the livestock exclosure erected around the Cemetery has largely prevented livestock from eating the Patagonia Eyed Silkmoth larvae as they feed on native grasses and from removing all of the native grasses that the species is completely reliant on during its larval stage (Palting Decl. ¶¶ 5, 8, at pages 3, 6-7). Petitioners' employees estimate that the fenced Cemetery is roughly 150 feet by 150 feet, making it 22,500 square feet, or less than half of an acre (an acre is 43,560 square feet). This means that the core of the Harshaw Population's range is similar in size to many suburban backyards. Additionally, there is evidence that trespass livestock gain access to the Cemetery and feed on the native grasses therein, thus compromising the security of even this small area of habitat (*see* Appendix 1: Pictures 1, 2). The Harshaw Population's remaining range in this area is represented by less than 5 miles (8 kilometers) of the valley along Harshaw Creek from approximately 4,400-5,100 feet (approximately 1,350-1,550 meters) in elevation (Lemaire, *et al.*, 1992 at 128; BMNA, Undated at 1).

In addition to the Harshaw Population, there is also a single 1972 record of the Patagonia Eyed Silkmoth credited to the Huachuca Mountains in Arizona (Lemaire, *et al.*, 1992 at 123, 128; Palting Decl. ¶ 6, at page 4). These mountains are located in Cochise County Arizona, roughly 20 miles (32 kilometers) east of the Harshaw Population (Lemaire, *et al.*, 1992 at 128). However, this specimen is likely mislabeled based on a number of factors (Lemaire, *et al.*, 1992 at 128; Palting Decl. ¶ 6, at page 4). First, specimens from the collector who gathered and labeled this specimen often contain questionable locality references (Lemaire, *et al.*, 1992 at 128). Second, old specimens such as this often are mislabeled (Palting Decl. ¶ 6, at page 4). Third, collectors often label specimens with the closest large mountain range, so, because the Huachuca Mountains are significantly larger than the nearby Patagonia Mountains, the 1972 Huachuca record may be a mislabeled specimen from the Harshaw Population (Palting Decl. ¶ 6, at page 4). Fourth, "[t]he Huachuca Mountains are one of the most intensively studied (biologically) ranges in Southeast Arizona, and despite this, there are no other records of this moth in the last half century from these mountains. More than a dozen entomologists actually live and collect on the flanks of the Huachuca Mountains year after year so it

[7] Separation is a measure of unoccupied habitat (or habitat of unknown occupancy) between a species' known occurrences that is great enough to effectively separate the known occurrences into separate populations (*see* http://explorer.natureserve.org/glossary/gloss_s.htm).

is unlikely that Patagonia eyed silkmoths in this area would be undiscovered considering the survey effort." (Palting Decl. ¶ 6, at p. 4; *see also* Lemaire, *et al.*, 1992 at 128 (noting that while the Huachuca Mountains contain some seemingly appropriate habitat, they have been extensively collected since the early 70's with no additional records). Therefore, the Huachuca specimen is either likely mislabeled or may be from a population that has been extirpated (*see* Palting Decl. ¶ 6, at p. 4; *see also* Lemaire, *et al.*, 1992 at 128). Regardless, because the Huachuca Mountains do not appear to presently support any Patagonia Eyed Silkmoths, much less a population, the only extant population of the species in the United States is the Harshaw Population.

**2. Mexican Populations**

Though the species was first identified in the United States, two more populations have been located in the Sonoran Mountains of the Sierra La Madera, near Moctezuma, and the Sierra La Purica, near Nacozari de Garcia (Palting Decl. ¶ 6, at p. 4). These populations were found as a result of extensive biodiversity surveys on sky islands in northern Sonora performed by MABA (Palting Decl. ¶ 7, at pages 5-6). "The Sierra La Madera is a sky island approximately 20 square miles in total area. This mountain is quite rugged and because it is somewhat protected from heavy livestock grazing by its topography, there are plenty of native grasses." (Palting Decl. ¶ 7, at page 5). The Patagonia Eyed Silkmoth has been found at several locations in this this sky island complex (Palting Decl. ¶ 7, at page 5). However, the Sierra La Purica population is much more restricted to a small area near the mountaintop known as "Las Antennas" (for the radio towers that are there) (Palting Decl. ¶ 7, at page 6). "Unlike the Sierra La Madera, this is a small range, heavily grazed in the lower portions, with a narrow 'crew-cut' like band of native grasses and pine trees at the very top of the mountain. Continued drought and habitat degradation on this small mountain is likely to extirpate the remaining native denizens (including the Patagonia eyed silkmoth) from this pine belt." (Palting Decl. ¶ 7, at page 6). Accordingly, while the Sierra La Purica population is part of the current range of the species, it may not be for long without additional protections (Palting Decl. ¶ 7, at page 6).

Similar to the Huachuca Mountains specimen in the United States, there is a single Patagonia Eyed Silkmoth record from Cananea, Sonora that has not been verified by subsequent collections (Palting Decl. ¶ 6, at pages 4-5). "Insect inventories of the Sierra de Ajos and other ranges near Cananea began in 1995, and have yet to produce another record of this species. The Cananea region is full of active mining operations and the integrity of much of the natural habitat in this region has been greatly altered by these operations, making it possible that the Cananea population has been locally extirpated." (Palting Decl. ¶ 6, at pages 4-5). Therefore, assuming that this single specimen was not mislabeled, it likely no longer represents an extant occurrence of the species.

**E. Feeding**

The Moth's unique larval feeding behavior led John Palting to conclude that "[t]he most striking difference between the Patagonia eyed silkmoth, *Automeris patagoniensis*, and other silkmoth species is that the larval stages of [the Patagonia Eyed Silkmoth] eat only certain native grasses (primarily *Bouteloua*, Sideoats Grama) unlike their polyphagous eastern *Automeris io* relatives, which eat a wide variety of plants, from corn (a grass) to trees. In captivity, [Patagonia Eyed Silkmoth] larvae also accepted a few other North American grasses (Bermuda and Bluestem) but rejected the common introduced African weed species that have taken over much of our North American rangeland." (Palting Decl. ¶ 5, at page 3; *see also* (Bailowitz & Palting, 2010 at 329 ("Although other *Automeris* have a wide distribution in Sonora associated with holm oaks, *A. patagoniensis* is known to feed

exclusively on grass (*Poaceae*) and is probably restricted by grazing to small areas where the larvae can feed without being molested by cattle.")[8]; (Bailowitz & Palting, 2010 at 334 ("The offspring of this moth has demonstrated that it only feeds on grass, and only certain native grasses, which clearly contrasts with its close relative, the widely distributed *Automeris io*, which feeds on a great variety of plants. Therefore, *A. patagoniensis* is very susceptible to disturbances caused by cattle grazing, as well as by clearings to establish pastures of buffel grass.")[9]; Lemaire, *et al.*, 1992 at 125, 127 (describing the Moth's refusal to eat exotic grasses and preference for Bermuda grass (*Cynodon dactylon* (*Poaceae*) and discussing observation of Patagonia Eyed Silkmoth larvae eating sideoats grama grass until pupation); Tuskes, *et al.*, 1996 at 156 (describing the Patagonia Eyed Silkmoth as only feeding on Poa and Bermuda grass species)). Accordingly, all of the available science indicates that Moth larvae require suitable, unaltered native grass areas to survive to adulthood.

Finally, young Patagonia Eyed Silkmoth caterpillars feed in groups while older caterpillars take on a solitary feeding behavior (BMNA, Undated at 1). Although forage requirements for larvae appear to be quite specific (as discussed, *supra*), adults do not feed at all (BMNA, Undated at 1; AGFD, 2004 at 2).

### F. Reproduction and Lifespan

Information on the Moth's reproduction and lifespan is limited. One wild-caught female used to study the species' immature stages yielded 18 eggs (Lemaire, *et al.*, 1992 at 125). Most of these eggs hatched in 10-12 days, though at least one larvae subsequently died and several others "disappeared" (Lemaire, *et al.*, 1992 at 125). Specifically, of the original 18 eggs, scientists obtained a total of 11 pupae, and indicated that 7 of the 18 died or otherwise "disappeared" (Lemaire, *et al.*, 1992 at 125). Another female specimen from the Harshaw Population yielded 44 larvae, whose ultimate survival to adulthood is unclear (Tuskes, *et al.*, 1996 at 156).

Both male and female larvae undergo six instars averaging six days each, with the time periods increasing as the instars progress (Lemaire, *et al.*, 1992 at 125). There are both pink and green morphs as the species moves through these instars (Lemaire, *et al.*, 1992 at 125). Pupation occurs within a cocoon that is fortified with encrusted soil and debris and that is spun on the ground among dense grass (Lemaire, *et al.*, 1992 at 125). "Adults are reported from mid July to early August. Larvae are therefore probably mature around September to early October, to perhaps as late as November." (AGFD, 2004 at 2; *see also* NatureServe, 2007 at 3; Lemaire, *et al.*, 1992 at 128 (flight period from Mid-July to early August)). There is only one generation per year (Tuskes, *et al.*, 1996 at 157).

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[8] The original Spanish text reads "Aunque otros *Automeris* tienen una distribución amplia en Sonora asociados con encinos, *A. patagoniensis* se sabe que se alimenta exclusivamente de zacate (Poaceae) y probablemente está restringida por el pastoreo a áreas pequeñas donde las larvas puedan alimentarse sin ser molestadas por el ganado."

[9] The original Spanish text reads "La cría de esta palomilla ha demostrado que sólo se alimenta de zacates, y únicamente ciertos zacates nativos, lo que contrasta claramente con su pariente cercano y de distribución amplia *Automeris io*, que se alimenta de una gran variedad de plantas. Por lo tanto, *A. patagoniensis* es muy susceptible a las perturbaciones por el pastoreo del ganado, así como por los desmontes para establecer praderas de zacate buffel."

### G. Population Trend

Because the Moth was discovered and identified fairly recently, population trend information is necessarily lacking due to a lack of historic records. However, the best available information indicates that the species has experienced a large decline in both numbers and occupied acreage from historic levels, which eliminated its connected population or metapopulation structure, and that these declines are continuing (*see* Section III. D. Habitat and Range, *supra*). These ongoing declines led John Palting to state that, in his expert opinion, the Patagonia Eyed Silkmoth "is a species on the edge of extinction." (Palting Decl. ¶ 9, at page 7). Palting also added that the fact that the Harshaw Population exists at all, despite the threats it faces, "is a bit of a miracle." (Palting Decl. ¶ 9, at pages 7-8; *see also* Palting Decl. ¶ 7, at pages 5-6 (stating that threats to the Sierra La Purica population are likely to eliminate the Moth from that area in the foreseeable future as well)). In addition to declines in its current range and historical declines, the species may have also been lost in at least two additional populations in the very recent past, which would be a loss of 40% of the known populations since the species' recent discovery (*see* Palting Decl. ¶ 6, at pages 4-5 (discussing specimens credited to the Huachuca Mountains, Arizona and Cananea, Sonora, Mexico that may have come from now-extirpated populations)). These dramatic declines are alarming for a species with only a few small, isolated populations and will be discussed in further detail below.

#### 1. United States Population

The Patagonia Eyed Silkmoth is almost certainly currently limited to the single Harshaw Population in the United States (*see* Section III. D. Habitat and Range, *supra*). However, it was once likely a more widespread species in the United States that contracted into the relictual Harshaw Population largely as a result of grazing pressure (Palting Decl. ¶ 8, at pages 6-7). This is because the species is highly dependent on native grasses, and the introduction of exotic grasses to "improve" range fodder for livestock, and subsequent overgrazing of this region, probably eliminated other Moth populations and connectivity between historic populations. In fact, likely the only reason that the Harshaw Population has been able to survive is because of a livestock exclosure around the historic Harshaw Cemetery that has, at least partially, limited livestock grazing in this small habitat enclave (Palting Decl. ¶ 8, at pages 6-7). However, threats exist even within the Harshaw Cemetery both from trespass livestock and from rampant collection by moth collectors eager to get their hands on this rare "holy grail" moth (*see* Appendix 1: pictures 1, 2 (showing cow pies in the Cemetery); Palting Decl. ¶ 5, at pages 3-4). While population trend data is lacking, it is highly likely that these two threats are causing the Harshaw Population to continue to decline. Furthermore, because the remnant population is limited to such a tiny area, an increase in grazing or collection pressure, or any other threat causing localized impacts, could extirpate the Moth in a short time.

In addition to these impacts to the Harshaw Population, it is likely that the species historically had a much larger range, possibly beginning further North and running South-Southeast through northern Sonora in a continuous band, or at least exhibiting metapopulation structure (*see* Palting Decl. ¶ 8, at page 7). The Patagonia Eyed Silkmoth specimen that is currently identified as being from the Huachuca Mountains may be a representative of an extirpated portion of this metapopulation (*see* Lemaire, *et al.*, 1992 at 128; Palting Decl. ¶ 6, at page 4). If this is the case, then the Moth has already experienced population extirpations in addition to massive decreases in range, leaving the single, shrinking relictual Harshaw Population in the United States with no connectivity to the Mexican Moth populations. The remaining Harshaw Population is sparsely populated within its

limited area with researchers never being able to catch more than three Moths in one night and often being unable to catch any at all, even twenty years ago (Tuskes *et al.*, 1996 at 156).

### 2. Mexican Populations

The Moth's Mexican distribution is likely limited to two isolated populations in the Sonoran Mountains of the Sierra La Madera, near Moctezuma, and the Sierra La Purica, near Nacozari de Garcia (*see* Palting Decl. ¶ 6, at page 4). Both of these Mexican populations were likely part of the aforementioned connected population or metapopulation, but are now isolated. The Sierra La Purica population has since become increasingly restricted to a small area near the mountaintop known as "Las Antennas" (for the radio towers that are there) (Palting Decl. ¶ 7, at page 6). The remainder of the mountain is heavily grazed and the entire mountain has been subjected to ongoing drought (Palting Decl. ¶ 7, at page 6). These threats have almost certainly eliminated the population outside of the mountaintop area, have likely caused declines in the small patch that still contains suitable habitat, and are "likely to extirpate the remaining native denizens (including the Patagonia eyed silkmoth) from this pine belt." (*See* Palting Decl. ¶ 7, at page 6). The remaining area available to the Sierra La Madera population appears to have been subjected to lesser grazing pressure than the Sierra La Purica and may have thus experienced lower population declines after becoming isolated than the other two populations (the Harshaw and Sierra La Purica populations) (Palting Decl. ¶ 7, at page 5).

In addition to the two extant Mexican populations, there may have also recently been a third Mexican population from Cananea, Sonora that is known from a single specimen (Palting Decl. ¶ 6, at pages 4-5). However, extensive insect inventories around this area since 1995 have failed to locate the Moth (Palting Decl. ¶ 6, at pages 4-5). The extensive mining activity in this area has ruined much of the natural habitat and, together with other threats, has likely caused the extirpation of this population (assuming that it was not a collection mislabeling error, as discussed above) (*see* Section III. D. 2. Mexican Populations, *supra*; Palting Decl. ¶ 6, at pages 4-5).

### 3. Population Trend Summary

Based on the available information, the Patagonia Eyed Silkmoth is, and has been, experiencing extensive population declines. It is likely that the remaining three isolated populations were once part of a much larger, connected population or metapopulation that may have even extended further to the North and South of where the species is currently located. Extensive grazing and other impacts to the species' habitat have eliminated the connected population and have drastically reduced the suitable habitat available to the species where it remains. This ongoing habitat destruction has greatly reduced population numbers and likely caused localized extirpations. In addition to habitat loss, the remaining populations face a variety of other threats (discussed in detail, *infra*) that are also likely causing the species' numbers to shrink and/or populations to disappear. The possible recent extirpations of two Moth populations (the Huachuca and Cananea occurrences, assuming they were not collection errors (*see* Section III. D. Habitat and Range, *supra*)), suggest that similar threats could cause the remaining, isolated populations to vanish. Therefore, the Moth has experienced, and continues to experience, a declining population trend and a decline in occupied range.

## IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING

The Patagonia Eyed Silkmoth is threatened by all five ESA listing factors. *See* 16 U.S.C. § 1553(a)(1). As discussed in Section II. E. Best Available Scientific and Commercial Data, *supra*, FWS cannot deny listing merely because there is little information available if the best *available* information indicates that the Moth is threatened or endangered under any one, or any combination, of the five ESA listing factors. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). The following information represents the best available science regarding the Patagonia Eyed Silkmoth and shows that it warrants listing. *See* 16 U.S.C. § 1533(b)(3)(A). FWS should view these threats both individually and cumulatively when assessing the Moth's endangerment to determine whether the synergistic impact of these threats is greater than their individual additive impacts.

### A. The present or threatened destruction, modification, or curtailment of its habitat or range[10]

#### 1. Grazing[11]

As previously discussed, Patagonia Eyed Silkmoth larvae are entirely dependent on certain native grasses for their foraging needs (*see, e.g.,* Section III. E. Feeding, *supra*; Palting Decl. ¶ 5, at page 3; Lemaire, *et al.*, 1992 at 125, 127; Bailowitz & Palting, 2010 at 329, 334; Tuskes, *et al*, 1996 at 156). This dependence on native grasses makes the species exceptionally vulnerable to overgrazing by livestock and by the subsequent changes in amount and composition of forage that comes along with overgrazing. As explained by John Palting, "[w]ith its dependence on native grasses, *Automeris patagoniensis* was probably very susceptible to overgrazing by livestock in the last century." (Palting Decl. ¶ 8, at page 6).[12] Not only would livestock eat the native grasses just as they were becoming lush from summer rains, which is also when the larvae are hatching from eggs and needing to feed, but the "[i]ntroduction of exotic grasses in an effort to 'improve' range fodder probably also

[10] Note that, because the known Moth populations are geographically tiny and isolated, stochastic events such as fires should be considered serious threats to the species' habitat. This is because such a single stochastic event could completely wipe a population out by destroying its entire suitable habitat area. However, because stochastic events are also equally threatening to the Moth itself, and to reduce repetition in this Petition, stochastic events are treated primarily in Section IV. E. 2. a. Stochastic Events, *infra*. Despite this organizational arrangement, FWS should also consider stochastic events as a habitat related threat to the Moth.

[11] While grazing, livestock indiscriminately eat Moth larvae that are feeding on the grasses that the livestock consume. Accordingly, FWS should consider this aspect of grazing as a threat to the species' habitat. However, the consumption of the Moth's larvae by grazing livestock is treated exclusively as a predation threat in Section IV. C. Disease or Predation, *infra*, in order to avoid repetition.

[12] To the extent that U.S. Forest Service management of the Harshaw Population's habitat has decreased grazing pressure from historical levels, it has only done so incidentally. The Forest Service has not established any grazing exclosures or made any other land management designations or modified grazing practices specifically to protect the Moth. Therefore, any direct benefit to the species from its existence on Forest Service lands is minimal. Additionally, there is no evidence that grazing has decreased from historic levels in Mexico. Furthermore, even if grazing was decreased, or even halted, competition between the native grasses that the Moth relies on and the exotic grasses already introduced for, or increased by, grazing would continue to threaten the Moth.

negatively impacted *Automeris patagoniensis* without anyone knowing, as Lehmann Lovegrass, Bufflegrass and other invasive African species replaced the native grasses the moth relies on." (*See* Palting Decl. ¶ 8, at page 6; Bailowitz & Palting, 2010 at 334 ("The offspring of this moth has demonstrated that it only feeds on grass, and only certain native grasses, which clearly contrasts with its close relative, the widely distributed *Automeris io*, which feeds on a great variety of plants. Therefore, *A. patagoniensis* is very susceptible to disturbances caused by cattle grazing, as well as by clearings to establish pastures of buffel grass.")).[13]

This overgrazing threat is likely the primary reason that the historic connected Moth population or metapopulation, which would have filled in the space between the existing populations and possibly even continued further Northwest and/or Southeast, to contract into the tiny, isolated, relictual populations that exist today (*see* Palting Decl. ¶ 8, at pages 6-7). Entomologists, including John Palting, suspect that the only reason that the Harshaw Population has continued to exist in the face of the overgrazing threat that has persisted in this region for the last century is that the livestock exclosure erected around the Harshaw Cemetery has ameliorated overgrazing in this small area (Palting Decl. ¶ 8, at pages 6-7). Without this exclosure, Palting believes the Harshaw Population would likely have been extirpated before it was even discovered, just like all of the other U.S. Moth populations that formerly existed (*see* Palting Decl. ¶ 9, at pages 7-8). This is also why, even today, individuals from the Harshaw Population are never encountered very far away from the Cemetery, as there is simply a scarcity of suitable native grass habitat nearby (*see* Palting Decl. ¶ 8, at page 7). In fact, the Forest Service recognizes that, "[o]n the Coronado National Forest, there are more invasive plant and animal species in the grasslands than any other vegetation community, including Lehmann lovegrass (*Eragrostis lehmanniana*), weeping lovegrass (*Eragrostis curvula*)." (Forest Service, 2014 – 2 at 39 (citation omitted)). The Patagonia Eyed Silkmoth's populations in Mexico have also contracted to the few, limited areas in Mexico where native grass ecosystems persist because of their inaccessibility to livestock (Palting Decl. ¶ 8, at page 7; *see also* Bailowitz & Palting, 2010 at 329 (". . . *A. patagoniensis* is known to feed exclusively on grass (*Poaceae*) and is probably restricted by grazing to small areas where the larvae can feed without being molested by cattle.")).[14] The fertile plains separating the remaining Moth populations in Sonora have been "notoriously overgrazed and altered, and the moth was probably extirpated from these areas long ago." (Palting Decl. ¶ 8, at page 7). Furthermore, even where grazing has not entirely eliminated the remaining Moth populations, the moth's range continues to contract and threats to the species in its remaining range are apparent (*see* Appendix 1: pictures 1, 2 (showing cow pies in the Harshaw Cemetery despite its livestock exclosure); Palting Decl. ¶ 7, at page 6 (heavy grazing in portions of Sierra La Purica population's range have left only a small, narrow band of suitable grasses on the "Las Antennas" mountaintop that is somewhat protected from grazing)).

Even where grazing pressure has been lighter historically, there are no adequate regulatory mechanisms preventing grazing from increasing in the future as livestock producers seek

[13] The original Spanish text reads "La cría de esta palomilla ha demostrado que sólo se alimenta de zacates, y únicamente ciertos zacates nativos, lo que contrasta claramente con su pariente cercano y de distribución amplia *Automeris io*, que se alimenta de una gran variedad de plantas. Por lo tanto, *A. patagoniensis* es muy susceptible a las perturbaciones por el pastoreo del ganado, así como por los desmontes para establecer praderas de zacate buffel."

[14] The original Spanish text reads ". . . *A. patagoniensis* se sabe que se alimenta exclusivamente de zacate (Poaceae) y probablemente está restringida por el pastoreo a áreas pequeñas donde las larvas puedan alimentarse sin ser molestadas por el ganado."

unexploited resources – particularly in Mexico, and thus grazing threatens the Moth in these places as well (*see* Section IV. D. 1. Mexican Biodiversity Reserves, *infra*). This is possible even where livestock grazing exclosures exist as these exclosures can be breached, either intentionally or as a result of normal failure, with livestock subsequently entering this habitat and damaging it, or even destroying it entirely (Appendix 1: pictures 1, 2 (showing cow pies in the Harshaw Cemetery despite its livestock exclosure)). Furthermore, even where livestock do not entirely remove the native grasses that the Moth needs, they will often deposit exotic grass seeds from their coats or dung. This allows exotic grasses to proliferate and outcompete native grasses, especially because livestock preferentially graze on native grasses to the exclusion of introduced grasses, thereby changing the vegetative communities in these areas. Accordingly, even limited livestock grazing reduces and threatens the remaining native grass communities and thereby decreases the amount of suitable Moth habitat (*see also* AGFD, 2004 at 2 (including invasive weeds replacing host plants as a threat to the species); NatureServe, 2007 at 2 (same); Bailowitz & Palting, 2010 at 334 (species susceptible to clearing of land to establish buffel grass)).

### 2. Mining

Mining operations pose an additional threat to Moth habitat throughout the species' range, and in particular to the Harshaw Population, which faces an imminent threat from planned and foreseeable mining.[15] As previously discussed, the Harshaw Cemetery is the heart of the Moth's habitat in the Patagonia Mountains (Palting Decl. ¶ 8, at pages 6-7 (the species is never located far from the Cemetery)). The Harshaw Population's remaining suitable habitat is represented by less than 5 miles (8 kilometers) of the valley along Harshaw Creek from approximately 4,400-5,100 feet in elevation (approximately 1,350-1,550 meters) (Lemaire, *et al.*, 1992 at 128; BMNA, Undated at 1). At least two proposed mining projects in this area (the Hermosa Project and the Sunnyside Project) pose both direct and indirect threats to the species' habitat via impacts from mine construction and operations, and even total elimination of the species' habitat as it becomes incorporated into the mines' open pits or is buried under tailings piles and mine-related facilities (*see* Figure 3, *infra*; Figure 4, *infra*; Figure 6, *infra*). In fact, PARA employees have seen mining claim stakes *within* the Harshaw Cemetery itself, and the Cemetery is clearly covered by the Hermosa Project mining claims (*see* Figure 3, *infra*; Figure 5, *infra*). There is also a patented mining claim that goes right up to Harshaw Creek directly opposite the Harshaw Cemetery (*see* Figure 3, *infra*; Figure 4, *infra*; Figure 5, *infra*;

[15] Petitioners do not have specific knowledge of new planned mining activities threatening the Mexican Moth populations, although historic and existing mines have certainly reduced the species' available habitat in Mexico (*see* Palting Decl. ¶ 6, at pages 4-5 ("The Cananea region is full of active mining operations and the integrity of much of the natural habitat in this region has been greatly altered by these operations, making it possible that the Cananea population has been locally extirpated."); Smithsonian Institute, Undated at 9 ("Open pit mining for copper, gold and other metals in many parts of this highly mineralized region poses a continuing major threat. Air pollution from smelters (such as at Cananea and Nacozari in northeastern Sonora) is likewise threatening and has been linked to the serious decline of the Tarahumara frog.") (citation omitted)). Additionally, environmental impacts from mining in Mexico appear to be poorly regulated and there do not seem to be adequate regulatory mechanisms to prevent mining from damaging Moth habitat in the future. As a result, potential mining threats to the Sierra La Madera and Sierra La Purica populations will be treated in Section IV. D. 1. Mexican Biodiversity Reserves, *infra*. However, FWS should also consider any mining threat that is applicable to the Mexican Moth populations as an additional habitat threat.

Figure 6, *infra*). In addition, all, or nearly all, of the rest of the Harshaw Population's potentially suitable habitat is included within the Sunnyside and Hermosa Projects' mine plans (*compare* Section III. D. Habitat and Range, *supra*; Figure 3, *infra*).

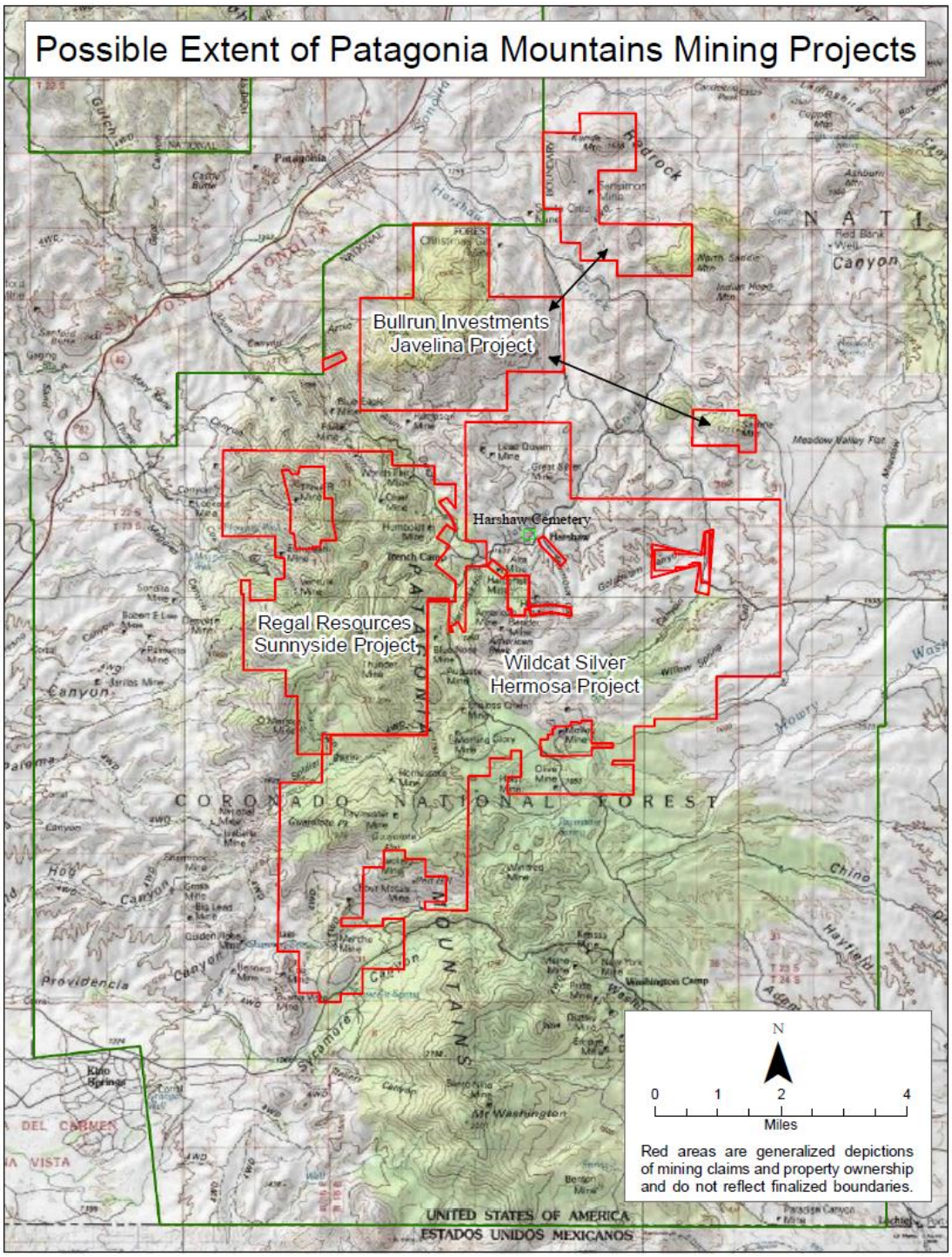


**Figure 3.** Map compiled by PARA from records showing mining claims for the Sunnyside, Hermosa, and Javelina mining projects (outlined in red), the Coronado National Forest (outlined in dark green), and the small Harshaw Cemetery (outlined in bright green towards the center of the map) (PARA, 2015).

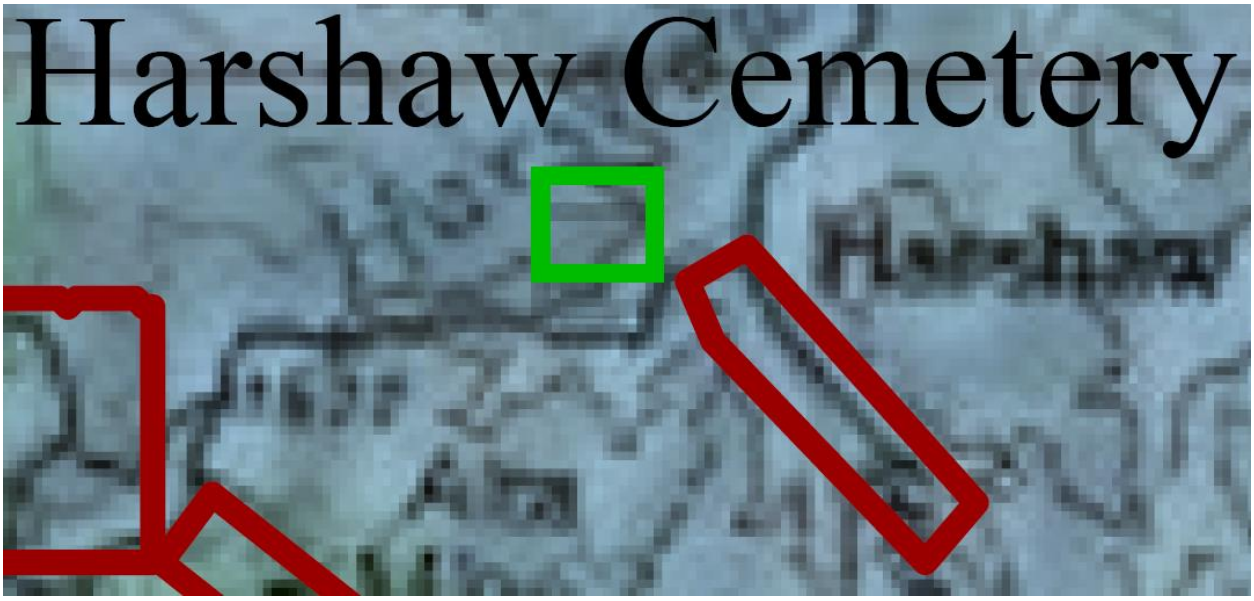


**Figure 4.** Enlarged Map showing that the Harshaw Cemetery (outlined in bright green) and much of Harshaw Creek running alongside it (black line traveling between the Cemetery and one of the patented mining claims (outlined in red)) are within the footprint for the Hermosa Project and are right next to an already-patented mining claim (PARA, 2015).

Mining may have already extirpated a Mexican population of Patagonia Eyed Silkmoths that may have lived near Cananea, Sonora by ruining the species' habitat (Palting Decl. ¶ 6, at page 5). Therefore, there is historical evidence that mining practices and/or mining pose threats of sufficient magnitude to exterminate the species in localized areas. Mining often eliminates or damages streams and adjacent areas, which appear to be important in creating the species' habitat (based on the species persistence in the Harshaw Creek drainage) (*see* Figure 4, *infra*). However, most importantly, it appears likely that the entirety of the Moth's known habitat in the Harshaw Creek area may become a mining pit, tailings pile, or be used for related mining facilities. These planned events will clearly remove all suitable habitat where mine activities overlap with Moth habitat and will likely have spillover effects on any remaining nearby habitat. Accordingly, even if some of the species' current suitable habitat is left outside the planned mine footprints, the spillover effects of the mining operations could render the habitat unsuitable, or even more fragmented and isolated, and eliminate the Harshaw Population.

### a. The Hermosa Project

The Hermosa Project is currently in the exploratory drilling phase as Arizona Minerals Inc., which is 80% owned by Wildcat Silver (Wildcat, 2015),[16] is exploring mineral deposits within patented and unpatented mining claims in the Patagonia Mountains (Wildcat, 2013 – 2 at 1; *see also* figure 5, *infra* (indicating the boundaries of the Hermosa Project and the patented and unpatented mining claims therein); Forest Service, 2014 – 2 at 1 ("The Plan of Operations is to conduct site characterization activities on unpatented mining claims . . . as part of ongoing feasibility studies of the Hermosa

[16] To avoid confusion, the remainder of this Petition will refer to both Arizona Minerals Inc. and Wildcat Silver as "Wildcat."

mineral deposit.")).[17] "The purpose of the [current drilling activity] is to allow [Wildcat] to gather necessary information related to further characterizing their mineral resource (exploration) . . ." (Forest Service, 2014 – 2 at 1). In short, Wildcat is pursuing its exploratory drilling to prove valuable mineral resources exist in order to solicit investment funding to construct its massive planned open pit mining operation (*see* Figure 6, *infra* (delineating the proposed pit location and additional high interest mining sites where the original pit would likely be expanded or new pits would likely be dug).

Wildcat has recently increased its 2007 estimate of resources available from the Hermosa Project and currently estimates

> a proven and probable reserve of 145 million ounces of silver and 7.2 billion pounds of manganese, which is included in a measured and indicated resource of 245 million ounces of silver and 10.3 billion pounds of manganese. In addition, the inferred resource contains 50 million ounces of silver and 1.2 billion pounds of manganese.

(Wildcat, 2015 at 1). Wildcat defines a "proven mineral reserve" as the "economically mineable" portion of the minerals in the area (Wildcat, 2014 at 7). "Hermosa's pre-feasibility study estimates annual production of over 12 million ounces of silver for the first five years of production and 110 million pounds of electrolytic manganese metal (EMM) over an 18 year mine life, at industry low cash costs . . ." (Wildcat, 2015 at 1). "Hermosa is expected to be one of the *largest* silver producers and the *only* [electrolytic manganese metal ("EMM")] producer in the (sic) North America" (Wildcat, 2015 – 2 at 1 (emphasis added)). Wildcat expects to invest capital costs in the mine of $835,000,000, which it expects to recoup in 2.8 years with mine life extending an additional 15.2 years after that (*see* Wildcat, 2015 – 2 at 1). Wildcat states that the Hermosa Project is the seventh largest undeveloped primary silver deposit *in the entire world* (*see* Wildcat, 2015 – 2 at 2). In support of its effort to finance this mine, Wildcat recently announced a high grade ore body at the Hermosa Project site, which Wildcat describes as the "best encountered" in the five years that they have been drilling at the Project site (Miller, 2015 at 1). Wildcat intends to continue to explore lands in the Hermosa Project footprint via drilling to prove up the resources on the site and move forward with its plan to extensively mine there (Miller, 2015 at 1). Accordingly, these announcements indicate that Wildcat intends to mine this area extensively and expects such mining to be lucrative. By any standard, it is certainly foreseeable that this proposed project is likely to become an extremely large mine, characterized by an extremely large and expanding pit, and accompanied by other significant land disturbance (including tailings piles and mine facilities).

[17] Note that patenting of a mining claim is not necessary to mine it (Forest Service, 2014 at 1). Patenting provides an ownership right to the land, which is not necessary to mine and remove minerals (*see* Forest Service, 2014 at 1). As such, mining is likely to proceed, and indeed is intended by the mining companies to proceed, in both patented and unpatented claims within the Hermosa Project area (*compare, e.g.,* Figure 5, *infra* (showing patented (the minority) and unpatented (the majority) mining claims in the Hermosa Project footprint); Figure 6, *infra* (showing the location of the proposed Hermosa Project pit and other high potential sites for mining, all of which include at least some, or all, unpatented claims)).

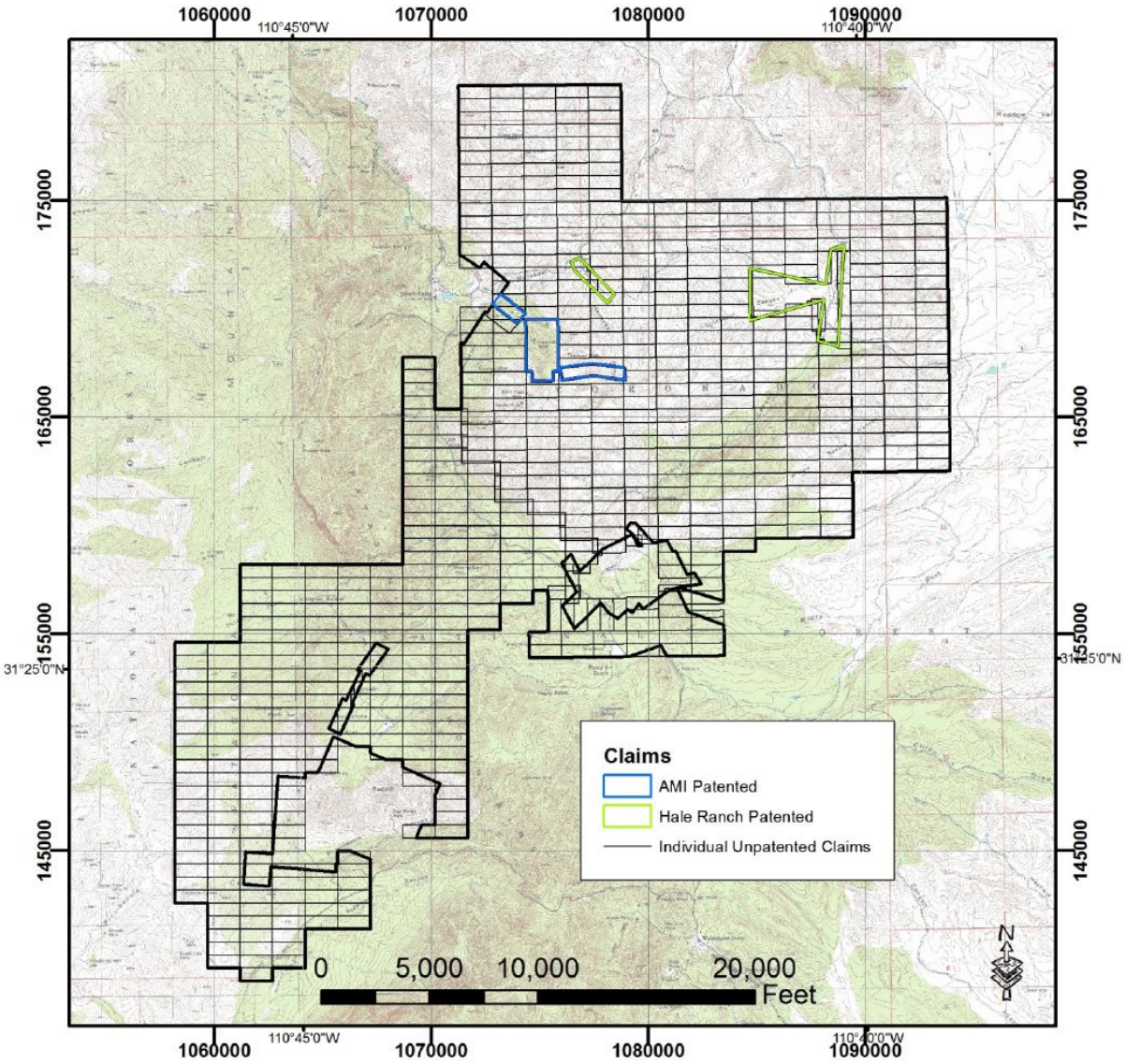


**Figure 5.** Hermosa Claims Status Map, the Harshaw Cemetery is just Northwest of the western Hale Ranch patented claim and nearly touches it (Wildcat, 2014 at 29).

"Primary access to the proposed Project Area will generally be gained from Harshaw Road . . ." and Harshaw Creek is within the project area (Wildcat, 2013 – 2 at 5, 8). The claims clearly overlap the Harshaw Cemetery (*compare* Figure 3, *supra*; Figure 4, *supra*; Figure 5, *supra*) and PARA employees have in fact seen claim stakes within the Harshaw Cemetery itself. The main pit and four of the high potential targets for later development are all within roughly one mile of the Harshaw Cemetery (*compare* Figure 3, *supra*; Figure 6, *infra*). Regardless, even if the Cemetery remained untouched by mining, it would be too small and isolated by mining construction and operations to support a long-term, viable population of Moths (Petitioners' employees estimate that the fenced Cemetery is roughly 150 feet by 150 feet, making it 22,500 square feet, or less than half of an acre (an acre is 43,560 square feet)) and would also likely be subject to direct and indirect effects from its proximity to the mining activity. In addition to impacting the Cemetery, the main pit and several other high potential targets for future development come within a mile of, or indeed overlap, Harshaw Creek (*compare* Figure 4, *supra*; Figure 6, *supra*). Wildcat's current exploratory drilling has occurred, and/or

will imminently occur, as close as about ¼ mile from the Harshaw Cemetery, with multiple other exploratory drilling projects occurring, and/or imminently expected, on Harshaw Creek or in its drainage (*see* Appendix 2 (mapping characterization sites for the Hermosa Project where drilling has occurred or is planned); *see also generally* Wildcat, 2015 – 4 (discussing drilling that has already been completed for the Hermosa Project)). This is further evidence that Wildcat intends to develop in these and nearby areas.

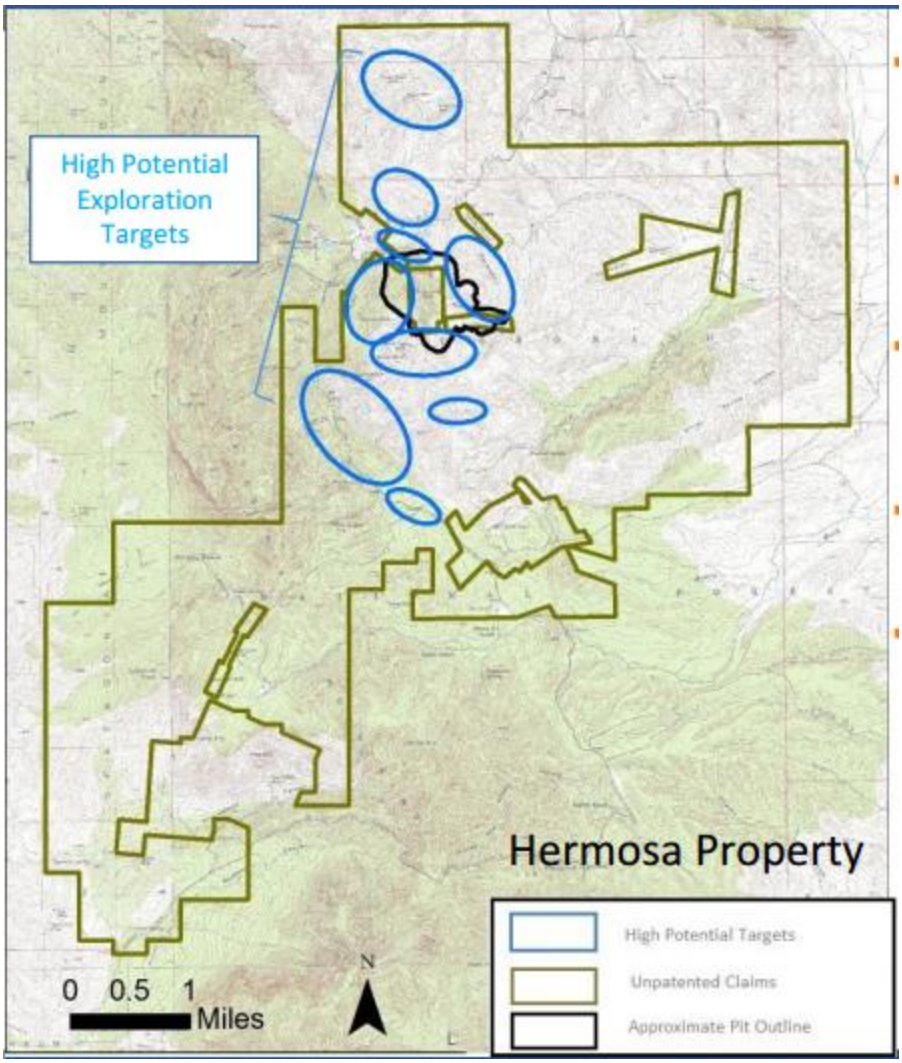


**Figure 6.** Map indicating the initial pit location and high potential expansion sites for mining in the Hermosa Project (Wildcat, 2015 – 3 at 23).

Wildcat intends to both develop, and expand beyond, the initial pit in its mining endeavors (*see, e.g.,* Wildcat, 2015 – 3 at 23). Wildcat states that it owns 100% of the property covered by the Hermosa Project (Wildcat, 2015 at 1). Wildcat further characterizes this area as a "mining friendly jurisdiction." (Wildcat, 2015 – 3 at 25). Considering these factors, and the potentially tremendous profits that Wildcat stands to make from the Hermosa Project, Wildcat will certainly aggressively pursue mining at this location on a large scale. This mining will physically destroy much of the Harshaw Population's known occupied and suitable habitat, including most or all of its most important occupied habitat, will harm or destroy the species' remaining suitable habitat that exists

outside of the mine's immediate footprint, and will likely degrade or render that habitat unsuitable to the species.

One example of Moth habitat degradation that would be caused by the Hermosa Project, but that would occur outside of the Hermosa Project's immediate footprint, is that the hot lights required to drill seven days a week and 24 hours per day will act as giant moth collecting lights that will concentrate the Moth and harm those individuals that get too close to them (*see* Forest Service, 2014 – 2 at 11 ("Exploration, hydrogeological, and geotechnical drillings may be conducted up to seven days per week for 24 hours per day."); *see also* Wildcat, 2013 – 2 at 27; Forest Service, 2014 – 2 at 31, 80). Therefore, to the extent that drilling or mining operations overlap the time period that adult Patagonia Eyed Silkmoths are present in the area, the lights required for these activities will degrade the species' habitat that is near those activities. The Forest Service also recognizes that the risk of transporting new invasive plant species into the Hermosa Project area is "high" and that the risk of spreading existing invasive plant species is also "high" (Forest Service, 2014 – 2 at 42). This is because the heavy equipment that will be used for the Hermosa Project is transported from other areas and may transport the invasive species from those areas into the Project area (Forest Service, 2014 – 2 at 42). The Forest Service recognizes that these invasive species can spread beyond the immediate Hermosa Project footprint, especially to nearby areas (Forest Service, 2014 – 2 at 42). The Forest Service explains that

> Ground-disturbing activity can facilitate the spread and establishment of invasive plants, especially in areas of exposed soil. Once established, these invasive species may eliminate native vegetation and associated plant and wildlife habitats. They also create a fuel-bed that may accelerate fire return intervals. Use and maintenance of travel routes, construction of new [temporary access roads], and development of drill pads would provide opportunities for introduction spread, and establishment of invasive plants.

(Forest Service, 2014 – 2 at 42). Invasive plant species are a very serious threat to the Moth that has removed, and continues to remove, much of the species' habitat (*see* Section IV. A. 1. Grazing, *supra*; Section III. E. Feeding, *supra*). The introduction of new invasive species and the spread of existing invasive species will further reduce the native vegetation that the Moth requires and will destroy even more of the species' habitat. Additionally, application of herbicides is part of the mitigation plan for addressing this invasive species risk (Forest Service, 2014 – 2 at 88). However, the use of herbicides would be yet another threat to the Moth. For example, herbicide spraying in Mexican sky islands "has caused extensive but undocumented and unstudied damage to the native vegetation and flora, . . . threatens unique relict populations of tropical species . . . [, and] may be responsible for reduction in populations" of another *saturniid* moth, *Rothschildia cincta*, there (Smithsonian Institute, Undated at 9). Therefore, to the extent that invasive species infestations are treated with herbicides, this will likely reduce the quality of the Patagonia Eyed Silkmoth's habitat in those areas and may even cause direct mortality to individuals. As a result, the many foreseeable harms from the Hermosa Project represent a serious habitat-related threat to the Harshaw Population; the Moth's only remaining population in the United States.

**b. Sunnyside**

The Sunnyside Project, owned by Regal Resources ("Regal"), is located to the west of the Harshaw Cemetery (*see* Figure 3, *supra*). "Regal employees and contractors would access the project area from

the town of Patagonia by way of Harshaw Road . . .” (Forest Service, 2015 at 2). Regal describes the Sunnyside Project as its “100% owned flagship copper exploration project.” (Regal Resources, 2011 at 1). “The property consists of 295 claims totaling approximately 5,900 acres ([22 square kilometers or ~9.2 square miles]) containing several areas with [exploratory] drilling completed . . . Four main targets (and several secondary targets) were identified [in the Sunnyside Project area] by geologic mapping and core drilling conducted from 1952 through 1992.” (Regal Resources, 2011 at 1). The purpose of Regal’s new planned exploratory drilling is “to explore for locatable minerals.” (Forest Service, 2015 at 1). Regal has stated that “[t]he results generated by the data compilation and historical drill core re-logging and sampling program recently completed by Regal at the Sunnyside Project are sufficiently encouraging to warrant a significant exploration program.” (Regal Resources, 2011 at 4). Regal hopes to obtain significant amounts of copper, molybdenum, and silver from the Sunnyside project (*see generally* Regal Resources, 2011). Regal plans to mine these mineral resources by creating an open pit mine (*see* Regal Resources, 2011 at 4-5). Regal appears to be certain that the porphyry, chalcocite and skarn targets (*see* Figure, 7, *infra*) are sufficiently promising that further drill testing is warranted (*see* Regal Resources, 2011 at 4). Regal also plans to conduct additional drilling “to explore for additional targets on the Property” and thereby find other areas within the Sunnyside footprint to mine (Regal Resources, 2011 at 5; *see also generally* Forest Service, 2015). In sum, development of the Sunnyside mine at this location is entirely foreseeable.

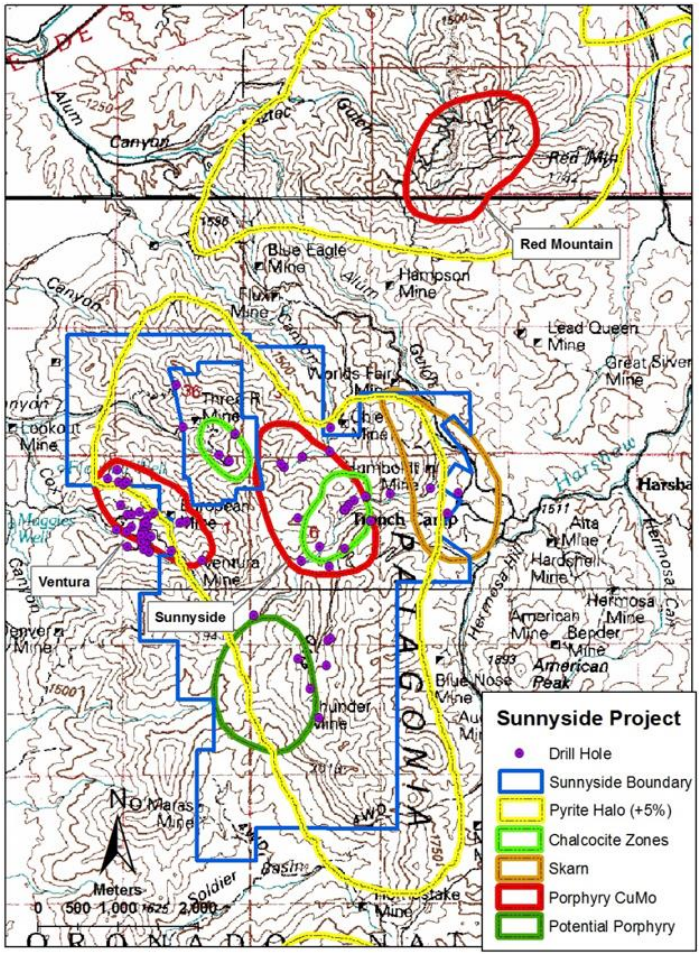


**Figure 7.** Map of the Sunnyside Mine, note Harshaw Creek directly to the East (Regal Resources, 2011 at 1).

Through both its statements and actions, Regal has made its intention to undertake significant mining operations in the direct vicinity of Harshaw Creek clear. Not only would this potentially remove Patagonia Eyed Silkmoth habitat directly as that habitat is consumed by pits, tailings piles, and by the other ground-disturbing activities that take place incident to mining, but it will also cause impacts to the species' habitat that occurs outside of these directly disturbed areas that will likely render that habitat unsuitable to the species.

The threats to the Moth's habitat that would be caused by the Sunnyside Project, but that would occur outside of the Sunnyside Project's immediate footprint, are essentially identical to those discussed in Section IV. A. 2. a. The Hermosa Project, *supra*. This projects are very similar and both occur very near to each other, and very near to the Harshaw Population (*see* Figure 3, *supra*). Like the Hermosa Project, the Sunnyside Project will cause degradation of the Moth's habitat outside of its immediate footprint because the hot lights required to drill seven days a week and 24 hours per day will act as giant moth collecting lights that will concentrate the Moth and harm those individuals that get too close to them (*see* Forest Service, 2014 – 3 at 4 ("Drilling may be conducted 24-hours-a-day."); *see also* Forest Service, 2014 – 3 at 11, 12, 16, 19, 21 (discussing necessity of using lights to drill at night)). Therefore, to the extent that drilling or mining operations overlap the time period that adult Patagonia Eyed Silkmoths are present in the area, the lights required for these activities will degrade the species' habitat that is near those activities. The Forest Service also recognizes the risk of transporting new invasive plant species into the Sunnyside Project area and of encouraging the spread of those invasive plant species that already exist (*see* Forest Service, 2015 at 5). For the similar, and indeed adjacent, Hermosa Project (*see* Figure 3, *supra*), the Forest Service recognized that the threat of introducing new invasive plant species is "high" and that the risk of spreading existing invasive plant species is also "high" (Forest Service, 2014 – 2 at 42). Therefore, due to the nearly identical character and location of these two projects, the likelihood of these threats occurring at the Sunnyside Project should also be assumed to be high. This is because the heavy equipment that will be used at the Sunnyside Project is transported from other areas and may transport the invasive species from those areas into the Sunnyside Project area; the same as with the Hermosa Project (*see* Forest Service, 2014 – 2 at 42). The Forest Service recognizes that invasive plant species can spread beyond immediate project footprints, especially to nearby areas (*see* Forest Service, 2014 – 2 at 42). The Forest Service explains that

> Ground-disturbing activity can facilitate the spread and establishment of invasive plants, especially in areas of exposed soil. Once established, these invasive species may eliminate native vegetation and associated plant and wildlife habitats. They also create a fuel-bed that may accelerate fire return intervals. Use and maintenance of travel routes, construction of new [temporary access roads], and development of drill pads . . . provide opportunities for introduction spread, and establishment of invasive plants.

(Forest Service, 2014 – 2 at 42). Invasive plant species are a very serious threat that has removed, and continues to remove, much of the Moth's habitat (*see* Section IV. A. 1. Grazing, *supra*; Section III. E. Feeding, *supra*). The introduction of new invasive species and the spread of existing invasive species will further reduce the native vegetation that the Moth requires and will destroy even more of the species' habitat. Additionally, and like the Hermosa Project, application of herbicides is part of the mitigation plan for addressing this invasive species risk for the Sunnyside Project (Forest Service, 2015 at 5). As discussed above, the use of herbicides would be yet another threat to the Moth and has already harmed a similar *saturniid* moth in the Mexican sky islands (*see* Smithsonian

Institute, Undated at 9). Therefore, to the extent that invasive species infestations are treated with herbicides at Sunnyside, this will likely reduce the quality of the Patagonia Eyed Silkmoth's habitat in those areas and may even cause direct mortality to individuals. As a result, the many foreseeable harms from the Sunnyside Project represent a serious habitat-related threat to the Harshaw Population; the Moth's only remaining population in the United States.

### 3. Climate Change

The National Climate Assessment ("NCA"), created by a team of over 300 experts from the public and private sector and guided by a 60-member National Climate Assessment and Development Advisory Committee (NCA, 2014 at iv), states that "[t]he Southwest is the hottest and driest region in the United States . . . [and that it] is expected to get hotter and, in its southern half, significantly drier." (NCA, 2014 at 463). The Southwest is also one of the fastest warming regions in the world and parts have already warmed more than 2 degrees Fahrenheit relative to average 20th century temperatures (*see* NCA, 2014 at 464; SIA, 2011 – 2 at 6). Under a growing global emissions scenario, temperatures in this region may rise 2.5 to 5.5 degrees Fahrenheit by 2041-2070 and by 5.5 to 9.5 degrees Fahrenheit by 2070-2099, with the greatest increases in summer and fall (NCA, 2014 at 464). Between 1991 and 2006 alone, the mean annual temperature rose 1.9 degrees Fahrenheit in Arizona (SIA, 2011 – 2 at 6 (citation omitted)). This region is already experiencing fewer cold air outbreaks and more heat waves, with summertime heat waves expected to get longer and hotter (NCA, 2014 at 464). These issues will impact all of the Moth's populations in southern Arizona and northern Sonora.

"This warming has contributed to increases in wildfire activity, changes in the timing of species' lifecycle events, and ecological changes in habitats. To further complicate matters, climate changes are interacting with other stressors such as decades-long drought, human land use, habitat fragmentation, and complex ecosystem interactions to create measurable and sometimes drastic changes in the region." (SIA, 2011 – 2 at 6; *see also* NCA, 2014 at 464 ("There is mounting evidence that the combination of human-caused temperature increases and recent drought has influenced widespread tree mortality, increased fire occurrence and area burned, and forest insect outbreaks.") (citations omitted)). As a result, climate change has been described as "the most significant long-term threat to ecosystems" in the sky island region (*see* SIA, 2011 – 2 at 6; *see also* SIA, Undated at 1). Furthermore, "[d]isruptions in the amount, timing, and intensity of precipitation combined with increased temperatures and fires events are already having considerable visible impacts on species, ecological systems and ecosystem service delivery." (SIA, Undated at 1). Therefore, climate change represents both a current and future threat to every remaining Moth population and to their remaining habitat.

#### a. Wildfire

> Increased warming due to climate change, drought, insect infestations, and accumulation of woody fuels and non-native grasses make the Southwest vulnerable to increased wildfire. Climate outweighed other factors in determining burned area in the western U.S. from 1916 to 2003, a finding confirmed by 3000-year long reconstructions of southwestern fire history.

(NCA, 2014 at 468). "There has [already] been a four-fold increase in the annual number of major wildfires [in Western forests] and a six-fold increase in the area of forest burned compared with the

period 1970-1986." (SIA, 2011 – 2 at 6; *see also* NCA, 2014 at 468). Fires in Mexico and Arizona have been at all-time highs with the most intense fire years and largest fires in modern history being recorded in recent years (SIA, 2011 – 2 at 6). "Numerous fire models project more wildfire as climate change continues. [In fact, m]odels project a *doubling* of burned area in the southern Rockies . . ." (NCA, 2014 at 468 (emphasis added)).

In addition to higher temperatures and more extreme aridity, increased available fuel load due to increased tree death and the spread of invasive species, all exacerbated by climate change, are causing these wildfire increases. The NCA explains,

> Drought and increased temperatures due to climate change have caused extensive tree death across the Southwest. In addition, winter warming due to climate change has exacerbated bark beetle outbreaks by allowing more beetles, which normally die in cold weather, to survive and reproduce. Wildfire and bark beetles killed trees across 20% of Arizona and New Mexico forests from 1984 to 2008.
>
> Historical and projected climate change makes two-fifths (40%) of the region vulnerable to these shifts of major vegetation types or biomes; notably threatened are the . . . sky islands of Arizona.

(NCA, 2014 at 468 (citations omitted)). In addition to changing species composition, this tree death leaves additional fuel for fires, and "[invasive species] also create a fuel-bed that may accelerate fire return intervals." (*see* Forest Service, 2014 – 2 at 42). As discussed below, climate change will increase the prevalence of these invasive species, which will in turn increase fire risk in the region (*see* Section IV. A. 3. d. Increased Abundance of Invasive Species, *infra*). Therefore, the increases in temperature and aridity in this region will exacerbate the high wildfire risk that already exists via several vectors and will increase the likelihood that the few isolated Moth populations will be wiped out in their entirety, or have significant amounts of their remaining suitable habitat destroyed by catastrophic wildfire.

### b. Habitat Ascent and Sky Islands

As the climate warms, habitat of species endemic to the sky islands will shrink as suitable climate conditions shift up slope. Some species may become extinct when there is no higher elevation into which species may retreat, or if the higher elevation areas are composed only of unsuitable habitat (*see* SIA, 2011 – 2 at 6). This aspect of climate change in the Desert Southwest will eliminate these habitats in the same way that a rising sea level would eliminate a low-lying island. These fragile sky island ecosystems are isolated because the surrounding lowlands are inhospitable to many of the species that live on the mountains.

The NCA discusses how a warming climate will affect high elevation islands in Hawaii ("high islands") by explaining,

> Land-based . . . species that exist in high-elevation ecosystems in high islands . . . are especially vulnerable [to climate change]. Existing climate zones on high islands are

> generally projected to shift upslope in response to climate change.[18] The ability of native species to adapt to shifting habitats will be affected by ecosystem discontinuity and fragmentation, as well as the survival or extinction of pollinators and seed dispersers. Some (perhaps many) invasive plant species will have a competitive edge over native species, as they disproportionately benefit from increased carbon dioxide, disturbances from extreme weather and climate events, and an ability to invade higher elevation habitats as climates warm.

(NCA, 2014 at 543).

This trend is already apparent in the sky island region with studies indicating that 15% of flowers surveyed now bloom as much as 1,000 feet higher than they did 20 years ago and that native species' ranges generally are shifting pole-ward and higher in elevation (*see* SIA, 2011 – 2 at 6). The Sierra La Purica population of Patagonia Eyed Silkmoths is demonstrating this trend, having become isolated and limited to a small band of habitat at the top of the mountain with nowhere else to go (*see* Palting Decl. ¶ 7, at page 6). Moreover, this population is already experiencing severe drought, which will worsen as warming increases; this may destroy the last remaining forest there, along with the local Moth population (*see* Palting Decl. ¶¶ 7, 9, at pages 6, 8). Therefore, this shifting of the Moth's suitable habitat to higher elevations will cause threats to the species as it literally shifts the species' required climatic conditions above the mountaintops that the species inhabits and as it allows the conditions, and better adapted lower-elevation species, from unsuitable lower elevation lands to encroach into the few areas where the Moth remains. A vanishing Moth population is unlikely to be able to survive by colonizing new habitat because the species is known to be a poor disperser (*see* Section IV. 3. C. Limited Practical Substitute Habitat, *infra*; Section III. D. Habitat and Range, *supra* (discussing short separation distances across both suitable and unsuitable habitat)).

### c. Limited Practical Substitute Habitat

While some species are better able to travel pole-ward or up in elevation to escape rapidly-rising temperatures, *saturniidae* are particularly poorly suited to travel long distances and pioneer areas outside of their larval homes, even if suitable habitat does exist in relative proximity (SIA, 2011 – 2 at 14). Because they lack functional mouthparts and have short adult lifespans, they cannot feed while they move and will necessarily only be able to cover limited distances in their short lifetimes (SIA, 2011 – 2 at 14).[19] This inability to travel great distances is exacerbated where, as here, patches of potentially suitable habitat are separated by large expanses of unsuitable habitat (*see* Section IV. E. 2. Rarity, Constrained Range, and Stochastic Events, *infra*). The NCA noted that "[t]he ability of native species to adapt to shifting habitats will be affected by ecosystem discontinuity and fragmentation. . ." (NCA, 2014 at 543). Therefore, the Moth's inability to travel to new areas to avoid the effects of climate change, both because of its own physical limitations and because of the shortage of suitable habitat nearby, means that the threats to the species' present range are even more pressing.

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[18] Fire also encourages an upslope shifting of vegetation, which could exacerbate this retreat of suitable habitat where fire is present (*see* NCA, 2014 at 468; *see also* Section IV. A. 3. a. Wildfire, *supra* (explaining that wildfire is likely to increase in this region)).

[19] This lack of functional mouthparts and short adult lifespan should also be considered when assessing threats to the Moth under Section IV. E. Other Natural or Manmade Factors Affecting its Continued Existence, *infra*.

### d. Increased Abundance of Invasive Species

Some, perhaps many, invasive plant species will benefit from climate change in a number of ways that will allow them to outcompete native grasses and increase their range and their dominance over native vegetation (NCA, 2014 at 543). This is threatens the Moth because it is completely reliant on native grasses for forage and cannot eat invasive plants (*see* Section III. E. Feeding, *supra*). First, at least some invasive species "disproportionately benefit from increased carbon dioxide" as compared to native species (NCA, 2014 at 543). As humans release more carbon dioxide, this will increasingly benefit invasive species over native species. Second, as discussed in Section IV. A. 3. b. Habitat Ascent and Sky Islands, *supra*, climate change will enable invasive species "to invade higher elevation habitats as climates warm." (NCA, 2014 at 543). "For example, cold-intolerant species (e.g., [buffel grass]) adapted to warmer environments are likely to benefit from the shift in temperature probability distribution, expanding their suitable range north and upward in elevation in the absence of other drivers." (Abatzoglou & Kolden, 2011 at 475 (citation omitted); *see also* Abatzoglou & Kolden, 2011 at 472 ("warming across the Southwest over the 20th century . . . has extended the length of the frostfree season, therein increasing climatically suitable ranges for cold-intolerant species such as [buffel grass]."") (internal citation omitted)). The Moth cannot eat buffel grass and will therefore lose habitat where it becomes dominated by buffel grass to the exclusion of native grasses (*see* Section III. E. Feeding, *supra*; Section IV. A. 1. Grazing, *supra*). Because buffel grass is already common in the Moth's habitat, and because buffel grass plantings are ongoing, this threat is of imminent concern (*see, e.g.,* Smithsonian Institute, Undated at 9). Third, "while precipitation variability is inherent in the Southwest, a significant increase in coolseason (November–March) precipitation variability over the past half century . . . may be responsible for assisting the colonization of invasive annual grasses . . ." (Abatzoglou & Kolden, 2011 at 472). "For the warm southern deserts, increased aridity and drought frequency may provide an additional edge to drought-adapted nonnative grasses, as it will likely increase native woody vegetation stress and mortality and will likely favor opportunistic winter annual grasses capable of capitalizing on the more sporadic precipitation typical of drought periods." (Abatzoglou & Kolden, 2011 at 475 (internal citations omitted)). Fourth,

> Wildfire is a catalyst that promotes invasion through a positive feedback process. This process is characterized by the accumulation of an abundant seed bank of invasive annual grass species, a wildfire removing the native perennial species, and increases in fine fuel loading and fuel connectivity following landscape conversion to invasive grasses that, in turn, increase fire frequency and inhibit the regeneration of native species ill adapted to fire.

(Abatzoglou & Kolden, 2011 at 472-73 (citation omitted)). Considering the increases in fire that this region has already experienced, coupled with the projected increases that are expected in the near future, this feedback loop is certain to exacerbate the invasive species problem in this region in the future (*see* Section IV. A. 3. a. Wildfire, *supra*; *see also* Abatzoglou & Kolden, 2011 at 476 ("Projected increases in the frequency and onset of extreme fire danger across the region will likely dramatically increase mortality rates of native species less adapted to wildfire . . ."")). Therefore, climate change will allow invasive grasses to further outcompete native grasses and will thereby remove the Moth's only forage, destroying the suitability of its habitat.

### e. Climate Change Overall Impact

These, and other, negative impacts of climate change on the Patagonia Eyed Silkmoth's habitat are reasonably foreseeable for each of the three populations that compose the Moth's entire known occupied habitat, even if climate change is seriously reduced beyond its predicted trend. Because the Moth will have limited opportunity to seek out higher elevations, and little or no ability to seek out new habitat that is separated from current populations by any substantial distance, destruction of presently-occupied habitat will likely mean extirpation of the Moth population that relies on it. In addition, fires will increase in frequency and severity in the sky island region removing even more habitat. Therefore, climate change represents a serious present and future threat to the Moth's remaining habitat.

## B. Overutilization for Commercial, Recreational, Scientific or Educational Purposes

The Patagonia Eyed Silkmoth is a beautiful species with striking markings (*see, e.g.,* Lemaire, *et al.*, 1992). Therefore, when moth collectors heard that this new species was unprotected and available for capture in the United States, the hunt was on (*see* Palting Decl. ¶ 5, at pages 3-4). "The Patagonia eyed silkmoth became a much sought-after 'holy grail' for insect collectors, and every summer since the moth's description, the sleepy Harshaw town site has been lit up with insect-collecting lights." (Palting Decl. ¶ 5, at pages 3-4). The Moth is nocturnal (NatureServe, 2007 at 3), which makes it susceptible to capture using lights to lure it in (Palting Decl. ¶ 5, at page 4; Tuskes, *et al.*, 1996 at 156; Lemaire, *et al.*, 1992 at 123 (discussing recorded capture of 34 males and one female using ultraviolet and mercury vapor lights in July of 1990 and 1991 alone)), and its virtual seclusion in the tiny Harshaw Cemetery makes it fairly easy to locate (*see* Palting Decl. ¶ 8, at page 7).

This collection threat is driven both by individual and scientific curiosity and by an international market that provides a financial incentive to capture and remove as many Patagonia Eyed Silkmoths as possible. As detailed below, both mounted Moth specimens and Moth larvae are available for sale on the internet from Europe, the United States, and elsewhere throughout the world. Some collectors charge large sums of money for these mounted specimens and larvae and some simply give them away, free of charge, to other interested moth collectors (*see* Insect Collector, Undated at 1 (selling a mounted Moth specimen for €75.00 (approximately $81.77 as of May 27, 2015)); Bugmaniac, 2015 at 1 (selling 10 mounted Moth specimens for €39.96 each, on sale (approximately $43.57 as of May 27, 2015), with a usual price of €49.95 (approximately $54.45 as of May 27, 2015)); Lepidoptera Breeders Association, 2015 at 1 (selling 10 Moth pupae for £7.45 (approximately $11.44 as of May 27, 2015)); Ovogram, 2015 at 2 (offering free Moth ova delivered throughout the world from "international community" members, with Patagonia Eyed Silkmoth ova shared as recently as July 2014)). Furthermore, the market for live pupae that individuals can rear themselves likely causes disproportionate targeting of females for eggs, which would be unsustainable where it occurs. Regardless, this international demand is sure to cause ongoing removals as long as the Moth remains unprotected by the ESA and may even cause the species' extinction in the wild.

In addition to this recreational and commercial capture, from the discovery of the species (and identification of the Harshaw Population) on August 2, 1989, dozens of moths, including at least several females with fertile eggs, were captured by scientists and removed from the Harshaw Population in a period of just a few years (*see* Lemaire, *et al.*, 1992 at 123, 125, 127; Tuskes, *et al.*, 1996 at 156). This collection for scientific purposes is likely to continue as scientists remain

interested in the species and is almost certainly an unsustainable collection threat to such a limited population subject to so many cumulative threats.[20]

### C. Disease or Predation

In addition to destroying or degrading the Moth's habitat, grazing also presents a "predation" threat to the Patagonia Eyed Silkmoth. This is because the Moth's "larvae would be hatching from eggs just as the grasses became lush from summer rains, and the [livestock] probably ate the larvae along with the grasses." (Palting Decl. ¶ 8, at page 6; Bailowitz & Palting, 2010 at 329 (stating that the species "is probably restricted by grazing to small areas where the larvae can feed without being molested by [livestock].")).[21] This unintentional predation is likely exacerbated by the fact that, during the evening and early morning hours, larvae are fully exposed and feed near the terminal ends of the grass species that they eat (*see* Tuskes, *et al.*, 1996 at 156). This would leave the Moth highly susceptible to unintentional predation at those times. When they are not at the terminal ends of host grasses, during the day and when they are cocoons, the larval Moths are instead towards the base of the host plant, but remain susceptible to trampling by livestock (*see* Tuskes, *et al.*, 1996 at 156-57). Therefore, because grazing appears to occur throughout the Moth's remaining habitat to varying degrees (*see, e.g.,* Appendix 1: Pictures 1, 2 (cow pies in the Harshaw Cemetery); Section IV. D. 1. a. Sierra La Madera Population, *infra* (discussing grazing threat to Sierra La Madera population); Section IV. D. 1. b. Sierra La Purica Population, *infra* (discussing grazing threats to the species)), predation from livestock grazing, and not just habitat degradation from grazing, should be considered as a threat to the Moth.[22]

### D. The Inadequacy of Existing Regulatory Mechanisms

#### 1. Mexican Biodiversity Reserves

Both the Sierra La Madera and Sierra La Purica Moth populations are within areas afforded some protection by the Comisión Nacional de Áreas Naturales Protegidas ("CONANP"). However, the degree of management and protection that the Moth receives as a result of this protection is suspect. The Smithsonian Institute has stated that, "[u]nfortunately, conservation efforts [in Mexico] suffer from acute underfunding and resultant neglect. Although several areas in northwestern Mexico have a special conservation status,[ which would include the habitat of the two Mexican Patagonia Eyed Silkmoth populations,] enforcement of environmental policy and protection of natural areas has been lax or nonexistent." (Smithsonian Institute, Undated at 11). Therefore, although Petitioners applaud the Mexican government's moves towards conserving these areas, the Biodiversity Reserve designations currently represent inadequate regulatory mechanisms to protect the Moth.

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[20] There is very limited information on collection from the two Mexican populations. However, due to their isolation and other threats, any collection from these populations would be concerning, especially collection from the extremely limited, and possibly unviable, Sierra La Purica population (*see* Palting Decl. ¶ 7, at page 6).

[21] The original Spanish reads "*A. patagoniensis* . . . probablemente está restringida por el pastoreo a áreas pequeñas donde las larvas puedan alimentarse sin ser molestadas por el ganado."

[22] Captive rearing has also shown that low-feeding larvae are susceptible to predation by ants (Tuskes, *et al.*, 1996 at 157).

In addition, to the extent that these Biodiversity Reserve designations do effectively protect the species in situ from day-to-day threats, they will not enable the species to expand its range, or to repopulate extirpated locations, as the areas between the populations are separated by unsuitable habitat. John Palting explained this problem by saying that, because the remaining relictual populations are now quite disjunct, "it is likely that if the moth's populations at any of the three remaining localities were destroyed,[ by a stochastic event for example,] it would be impossible for the moth to repopulate these localities – as the moth would have historically been able to do when the species' population was more widespread and connected." (Palting Decl. ¶ 8, at page 7). The Patagonia Eyed Silkmoth populations are effectively trapped in their current habitat, which makes them particularly susceptible to stochastic events and other localized threats that can have devastating effects on isolated populations.[23]

This concern over localized impacts is heightened because the region that these two Mexican populations live in is subject to a number of environmental threats that could cause harm to the Moth where they overlap its range. First, this region has become an important marijuana and opium poppy cultivation location (Smithsonian Institute, Undated at 8-9). This has led to clearing land for illicit growing operations and to law enforcement herbicide spraying to eradicate these illegal crops (Smithsonian Institute, Undated at 9). "Aerial spraying of herbicides by law enforcement agencies has caused extensive but undocumented and unstudied damage to the native vegetation and flora, . . . threatens unique relict populations of tropical species . . . [, and] may be responsible for reduction in populations" of another *saturniid* moth, *Rothschildia cincta* (Smithsonian Institute, Undated at 9). Replacement of native grasses with any other crops would remove the Patagonia Eyed Silkmoths only forage source (*see* Section III. E. Feeding, *supra*), and aerial spraying to kill illegal crops would likely be a serious threat to *saturniid* moth species like the Patagonia Eyed Silkmoth where it occurred in or near the species' habitat (*see* Palting Decl. ¶ 5, at page 3 (indicating that the Patagonia Eyed Silkmoth is also a *saturniid* species)). Second, "[o]pen pit mining for copper, gold and other metals in many parts of this highly mineralized region poses a continuing major threat. Air pollution from smelters (such as at Cananea and Nacozari in northeastern Sonora) is likewise threatening and has been linked to the serious decline of the Tarahumara frog." (Smithsonian Institute, Undated at 9 (citation omitted)). If mining were to expand into, or even near, the Patagonia Eyed Silkmoth's remaining habitat, it would likely eliminate the affected populations (*see* Section IV. A. 2. Mining, *supra*). Additionally, one Patagonia Eyed Silkmoth population may have been extirpated by environmental degradation from mining near Cananea, and the Sierra La Purica population is located near Nacozari, where a smelter already exists, indicating that the threat from these mining and smelting activities to the species is real and imminent (*see* Palting Decl. ¶¶ 6-7, at pages 4-6; Smithsonian Institute, Undated at 9). Third, "[t]he most serious cause of desertification (defined as the reduction in species richness or diversity) in desert and subtropical regions in northwestern Mexico is replacement of the native vegetation with buffel grass (*Pennisetum ciliare*) for cattlegrazing. In Sonora, more than 5000 km$^2$ have been cleared and a government goal calls for as much as 60,000 additional km$^2$ to be cleared and planted with this species." (Smithsonian Institute, Undated at 9 (citation omitted)). Because the Patagonia Eyed Silkmoth refuses to eat buffel grass, anywhere that such plantings occur will necessarily be rendered unsuitable habitat for the species (*see* Section III. E. Feeding, *supra*; Section IV. A. 1. Grazing, *supra*). This is particularly concerning as buffel grass and other invasive plant species will increasingly outcompete native grasses in this region as climate change progresses and will spread beyond the areas where they have been planted (*see* Section IV. A. 3. d. Increased Abundance of Invasive Species, *supra*). Fourth, livestock grazing

[23] Stochastic events will be discussed further in Section IV. E. 2. Stochastic Events, *infra*.

poses a predation threat to the species where it overlaps the Moth's occupied habitat (*see* Section IV. C. Disease or Predation, *supra*). Finally, deforestation also continues to be a problem in this region (Smithsonian Institute, Undated at 10). Because the Patagonia Eyed Silkmoth is dependent on oak woodland areas, ongoing deforestation would remove the habitat necessary to sustain the species (Lemaire, *et al.*, 1992 at 128) and thus poses a threat. Because the existing Mexican Biodiversity Reserves do not adequately address these threats, they are an inadequate regulatory mechanism to protect the Moth, and the Moth remains threatened by the absence of effective regulatory measures.

**a. Sierra La Madera Population**

The Sierra La Madera population "has some degree of protection in a [CONANP] preserve that covers the entire top of that mountain range" called Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe ("Ajos-Bavispe") (Palting Decl. ¶ 9, at page 8). However, as described in Section IV. D. 1. Mexican Biodiversity Reserves, *supra*, the protection that the Moth actually receives from living in Ajos-Bavispe is inadequate.

Additionally, 11.67% of Ajos-Bavispe is Federal land and 88.32% is private property (Avila & Jacobs, 2008 at 3). This preponderance of private land indicates that the ongoing conservation of these lands is at least somewhat at the whim of the private property owners. The area covered by Ajos-Bavispe was historically subject to mining and timber harvest, which changed the vegetative communities in the area and has left ongoing water quality issues (*see* Avila & Jacobs, 2008 at 3, 4). While mining has been of limited scope in at least some of the areas comprising the Ajos-Bavispe, "the geology of the range and the proximity to the large mines at Cananea suggest potential mineral exploitation in the future." (Fishbein, *et al.*, 1995 at 130). This is particularly true on the private property in this area.

Plant communities appear to be highly variable in Ajos-Bavispe, as they are in other sky island areas (*see* Avila & Jacobs, 2008 at 4-5). This variability indicates that suitable Patagonia Eyed Silkmoth habitat likely occurs in pockets. A major factor influencing vegetation in this area has been frequent fires (Fishbein, *et al.*, 1995 at 130). "Especially in the last century, fires have dramatically altered the appearance and composition of vegetation." (Fishbein, *et al.*, 1995 at 130). In addition to alteration of vegetation, "a catastrophic fire at critical times of the year, either when [Patagonia Eyed Silkmoth] adults, eggs or larvae are out, could completely erase the moth" from this location (Palting Decl. ¶ 8, at page 7). This is especially so where the species is limited to certain smaller areas of habitat that could be wiped out even more easily.[24] Wildfire is likely to increase in this area as climate change progresses and will therefore become an even more serious problem (*see* Section IV. A. 3. a. Wildfire, *supra*).

The mountains in the Ajos-Bavispe are also subject to grazing. "The lower elevations are readily accessible to cattle and are utilized as rangelands. The steepest high-elevation canyons and some lower elevation cliffs are inaccessible to livestock. In 1993, some riparian areas [in the Ajos-Bavispe] showed evidence of the cumulative impacts of intensive grazing. Overgrazed clumps of grass were very sparse and large stands of weedy native (e.g. *Croton texensis*) and non-native (e.g. *Nicotiana glauca*) species formed dense and extensive patches." (Fishbein, *et al.*, 1995 at 130). As discussed in Section IV. D. 1. Mexican Biodiversity Reserves, invasive grass species remove the Patagonia Eyed Silkmoths only forage and livestock grazing subjects the species to threats from loss of habitat and

[24] This is also treated in Section IV. E. 2. Stochastic Events, *infra*.

predation (*see also* Section III. E. Feeding, *supra*; Section IV. A. 1. Grazing, *supra*; Section IV. C. Disease or Predation, *supra*). Climate change will increase the ability of the invasive grass species to invade additional Moth habitat, and, therefore, this threat is likely to increase in the foreseeable future (*see* Section IV. A. 3. d. Increased Abundance of Invasive Species, *supra*). Therefore, continued grazing and other threats are ongoing in this area despite its inclusion in the Ajos-Bavispe Biodiversity Reserve.

### b. Sierra La Purica Population

John Palting explained that "[t]he La Purica mountaintop is also protected by [CONANP], but this particular locality is highly susceptible to climate shifts, and if the climate does get any drier, the narrow band of forest left on La Purica may be destroyed by drought along with the moth." (Palting Decl. ¶ 9, at page 8). Palting further explained that, "[c]ontinued drought and habitat degradation on this small mountain is likely to extirpate the remaining native denizens (including the Patagonia eyed silkmoth) from this pine belt." (Palting Decl. ¶ 7, at page 6). A biodiversity reserve cannot stop a drought and climate change. Therefore, the Moth's location in this reserve is inadequate to protect against these related threats. Furthermore, the habitat degradation that Palting mentions is in large part due to heavy grazing pressure on the lower portion of the mountain (Palting Decl. ¶ 7, at page 6). Therefore, it appears that, despite CONANP's protection, grazing, one of the most serious threats to the Moth, is unchecked in the Moth's Sierra La Purica habitat (*see* Section IV. A. 1. Grazing, *supra*; Section IV. C. Disease or Predation, *supra*). In addition, there is extensive mining nearby that has already caused harm to other species (Smithsonian Institute, Undated at 9 (citation omitted)). This mining is likely impacting the Moth and the expansion of mining operations even closer to the Moth's remaining habitat here is reasonably foreseeable. While this Biodiversity Reserve may be "protected," largely as a "paper" enterprise, it is clear that the existing regulations are insufficient to protect the Moth against several of the threats that are most imminently threatening it with extinction.

## 2. No Protection in the United States

The Patagonia Eyed Silkmoth receives no formal Federal protections, no protection by the state of Arizona (the only U.S. state it inhabits), and no other protective status (*see* AGFD, 2004 at 2). This complete lack of protection is one of the primary threats to the species recognized by NatureServe and is ongoing despite the Arizona Game and Fish Department's determination that "all populations should be monitored and conserved." (NatureServe, 2007 at 2 (threats); AGFD, 2004 at 2 (conservation and monitoring recommendation)).

While at least some of the Harshaw Population's habitat occurs in the Coronado National Forest (*see* Figure 3, *supra*), where grazing and other impacts are managed to some degree, the U.S. Forest Service ("USFS") has not put any specific protections in place for the species. The Moth is not included in USFS's list of sensitive species and does not appear to receive any particularized consideration (*see* Forest Service, 2013 at 544 (categorizing the Moth's status as "other," not as protected in any way)). To the extent that USFS's management of the lands that the Moth's Harshaw Population relies on has decreased overall grazing pressure, USFS has not targeted any grazing reductions to benefit the Moth's habitat. Additionally, USFS has not made any land management designations or altered any management practices to protect the Moth. Therefore, any benefit to the species from its existence on these USFS lands is minimal. Furthermore, even if grazing were to decrease or even cease entirely, encroachment by exotic grasses introduced for or by

grazing would continue to threaten the Moth even after the livestock were no longer physically present and climate change will facilitate such encroachment. (*see* Section IV. A. 3. d. Increased Abundance of Invasive Species, *supra*).

In addition, the Harshaw Population is in fact subject to a variety of threats in this habitat that USFS is not preventing – including grazing, mining,[25] and collecting – and to a variety of threats that USFS is incapable of preventing – including climate change (*see generally* Section IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING). Therefore, any limited protection that the Harshaw Population arguably receives by virtue of being present on USFS-managed lands is inadequate to protect the Moth.

### E. Other Natural or Manmade Factors Affecting its Continued Existence

#### 1. Extinction Vortex

As the remaining Patagonia Eyed Silkmoth populations continue to shrink, they will begin to enter what is called an extinction vortex. An extinction vortex is the point at which "[e]nvironmental, demographic and genetic factors can interact and reinforce each other in a downward spiral" increasing the likelihood that a species or a population of a species will become extinct in the short term (*see* Blomqvist, *et al.*, 2010 at 1). Because at least the Harshaw Population and the Sierra La Purica population have been reduced to very low numbers, they are likely approaching an extinction vortex. This increases the urgency of protecting all of the Moth's populations to avoid further reduction of the species' range and genetic diversity.

#### 2. Rarity, Constrained Range, and Stochastic Events

The Patagonia Eyed Silkmoth's rarity and constrained range present additional threats to the species' continued existence. There was probably once a connected Patagonia Eyed Silkmoth population or metapopulation, but it has since broken down into three isolated populations (*see* Section III. D. Habitat and Range, *supra*). It is highly likely that these individual populations will never reconnect (without human assistance) because they are separated by vast tracts of unsuitable habitat and the Moth has a relatively limited ability to travel over such unsuitable habitat (*see* Section III. D. Habitat and Range, *supra*; NatureServe, 2007 at 3 (stating that the species' separation distance across unsuitable habitat is only 4 kilometers (~2.5 miles)); Palting Decl. ¶ 8, at page 7 ("it is likely that if the moth's populations at any of the three remaining localities were destroyed, it would be impossible for the moth to repopulate these localities - as the moth would have historically been able to do when the species population was more widespread and connected.")). Additionally, the Moth is unlikely to colonize outside of its present occupied range as the specific habitat that it requires is largely lacking in the surrounding landscape. Accordingly, the Moth's rarity and constrained and shrinking range, combined with foreseeable stochastic events, threaten the species and increase its susceptibility to extinction.

[25] Indeed, as discussed in Section IV. A. 2. Mining, *supra*, USFS is in the process of permitting the Moth's habitat for large-scale mining operations that will completely destroy it.

### a. Stochastic Events

While there is evidence that the Patagonia Eyed Silkmoth's remaining populations are in decline, a potentially more concerning fact is that the three relatively-small, unconnected populations are the only known Patagonia Eyed Silkmoth populations in the world (*see* AGFD, 2004 at 2 (listing few populations as one of the primary threats to the species); NatureServe, 2007 at 1, 2 (same)). Given its geographically constrained populations in small, isolated areas, the Moth is vulnerable to stochastic events, like habitat destruction and adverse modification from grazing, replacement of native grasses, fire, localized drought, mining, herbicide spraying, logging, air pollution, clearing land for illegal drug growing operations, and other such threats. Even a short term increase in grazing pressure or a single large fire, for example, could easily wipe out one of the Patagonia Eyed Silkmoth populations before action could be taken to protect the species. This vulnerability to localized threats that is inherent in the species' small number of populations and limited pockets of habitat represents an additional threat to the Moth. In reference to this threat, John Palting stated that "[t]he susceptibility of these small populations is alarming; a catastrophic fire at critical times of the year, either when the adults, eggs or larvae are out, could completely erase the moth from any of these remaining localities." (Palting Decl. ¶ 8, at page 7).

### b. Inbreeding

Inbreeding represents a significant threat to small populations. For example, in reference to the Sisi snail (*Ostodes strigatus*), FWS noted that

> Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change.

(Fish and Wildlife Service, 2012 at 5).

Bumblebee studies have determined that inbreeding and reduced genetic diversity can also lead to a reduction in adult longevity and fecundity (Darvill, *et al.*, 2006 at 608) and decreased immunocompetence and higher susceptibility to parasites (*see generally* Whitehorn, *et al.*, 2011; Whitehorn, *et al.*, 2014). Like these other invertebrates, the Moth likely experiences similar negative impacts when subjected to inbreeding. Therefore, the reduction of genetic diversity inherent in small, isolated populations such as those currently existing for the Patagonia Eyed Silkmoth, may cause the remaining populations to become less fit and more prone to extinction.

### 3. Synergistic Effects

The synergistic effects of aforementioned threats could conspire to cause the extinction of the Patagonia Eyed Silkmoth. "Like interactions within species assemblages, synergies among stressors form self-reinforcing mechanisms that hasten the dynamics of extinction." (Brook, *et al.*, 2008 at 457 (internal citations omitted)).

The combination of threats to the Patagonia Eyed Silkmoth and its habitat could cause a greater and faster reduction in the remaining populations than might be expected from simply the additive impacts of the threats. "[H]abitat loss can cause some extinctions directly by removing all

individuals over a short period of time, but it can also be indirectly responsible for lagged extinctions by facilitating invasions, improving hunter access, eliminating [forage], altering biophysical conditions and increasing inbreeding depression. Together, these interacting and self-reinforcing systematic and stochastic processes play a dominant role in driving the dynamics of population trajectories as extinction is approached." (Brook, *et al.*, 2008 at 453 (internal citations omitted)).

The Patagonia Eyed Silkmoth is at increased risk of extinction because it presently exists at a low population density and exhibits significant specialization in native grasses. "Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet." (Brook, *et al.*, 2008 at 455 (internal citations omitted)). Therefore, the synergistic impacts of multiple threats to the Patagonia Eyed Silkmoth increase its risk of extinction.

## V. CRITICAL HABITAT

This Petition requests that FWS designate critical habitat for the Moth in the United States concurrently with a final ESA listing. *See* 16 U.S.C. § 1533(b)(6)(C). The critical habitat designation should include all areas most important to the Patagonia Eyed Silkmoth's survival and recovery. *See* 16 U.S.C. § 1532(5)(A) (defining critical habitat to include both occupied and unoccupied habitat that is "essential for the *conservation* of the species.") (emphasis added); 16 U.S.C. § 1532(3) (defining "conservation" as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are longer necessary."). The definitions of the terms "critical habitat" and "conservation" indicate that, in designating critical habitat, FWS must consider the species' ultimate recovery, and not just survival, as a primary purpose of critical habitat designation. Accordingly, the critical habitat designation for the Moth should include all of the area currently or potentially inhabited by the Harshaw Population, as described in Section III. D. 1. United States Population, *supra*, and a sufficient amount of other potentially suitable habitat in the Patagonia Mountains area, or elsewhere in the U.S. sky islands (possibly in the Huachuca Mountains where it may have previously lived for example (*see* Section III. D. 1. United States Population, *supra*)), to allow the species to recover from its endangered, or threatened, status.

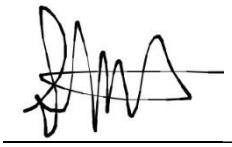
## VI. CONCLUSION

The Patagonia Eyed Silkmoth merits listing as an endangered, or alternatively as a threatened, species under the ESA. The Moth is likely decreasing in its remaining three small, isolated populations and has experienced a vast contraction from its probable historic range. It continues to face overwhelming threats to its habitat from grazing, mining, climate change, and other stressors. It is being extensively collected for recreational, commercial, and scientific purposes in numbers that may exceed sustainable levels to satisfy collectors' and scientists' curiosity and international demand. There is little doubt that wherever livestock gain access to the Moth's habitat, they eat the species' larvae, remove their native grass forage, and introduce inedible exotic grasses. The few existing regulatory protections for the Moth are inadequate to protect it, and harm caused by the above threats is exacerbated by the species' rarity, constrained range, and susceptibility to stochastic events. Petitioners therefore request that FWS list the Patagonia Eyed Silkmoth throughout its range as an endangered, or alternatively as a threatened, species under the ESA. However, should FWS initially determine that threats to the Moth pose an extinction risk in some part of its range only, Petitioners

request that FWS specifically analyze whether that portion of its range meets the SPR requirements such that the species should be listed under the ESA. Finally, should FWS list the species under the ESA, Petitioners request that FWS concurrently designate critical habitat for the species in the United States as required by law.

Thank you for your time and attention to this Petition. We look forward to hearing from you shortly. If you have any questions or need additional information, please feel free to write or call.

Sincerely,



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# APPENDIX 1

Photographs Relevant to Showing the Character of the Harshaw Cemetery and Surrounding Areas of Patagonia Eyed Silkmoth Habitat

**All Photos Taken April 2, 2015**

**Picture 1.** Cow pies in Harshaw Cemetery (April 2, 2015).

**Picture 2.** More cow pies in Harshaw Cemetery (April 2, 2015).

**Picture 3.** Gramma grass in Harshaw Cemetery (April 2, 2015).

**Picture 4.** More gramma grass in Harshaw Cemetery (April 2, 2015).

**Picture 5.** More gramma grass in Harshaw Cemetery (April 2, 2015).

**Picture 6.** View from Harshaw Cemetery to the parking lot. (April 2, 2015).


**Picture 7.** Harshaw Cemetery fence (April 2, 2015).

**Picture 8.** Harshaw Cemetery fence (additional view) (April 2, 2015).

**Picture 9.** Harshaw Cemetery fence (additional view) (April 2, 2015).

**Picture 10.** Harshaw Cemetery fence (additional view) (April 2, 2015).

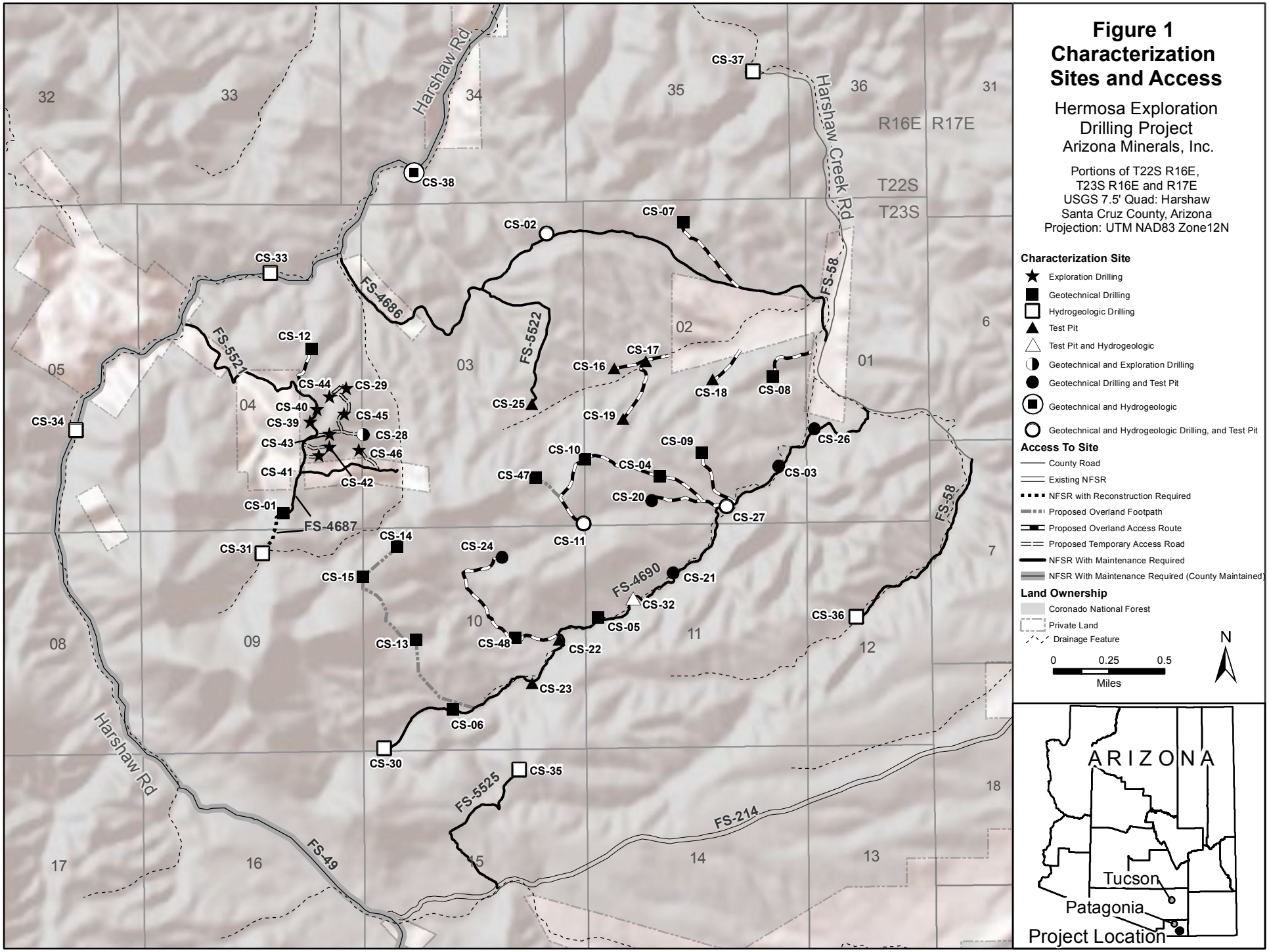
**Picture 11.** Harshaw Cemetery fence (additional view) (April 2, 2015).


**Picture 12.** Harshaw Riparian Exclosure (April 2, 2015).


**Picture 13.** Harshaw townsite Forest Service Road 4686 (April 2, 2015).

# APPENDIX 2

Characterization Sites and Access to Those Sites
for the Hermosa Project(Wildcat, 2013).




August 19, 2013