Anderson, Alison <alison_anderson@fws.gov>

Review of LMS Recovery Plan

1 message

Ken Osborne <euproserpinus@msn.com> Wed, Mar 30, 2016 at 10:31 AM
To: Alison Anderson <alison_anderson@fws.gov>

Hi Alison,

I reviewed this months ago and did not send you my comments.
I attach 1) an excel file showing how slight modifications of larval pupal mortality rates allow a stable population even without a summer brood; 2) scanned copy (only those pages with comments) of the Plan with my written comments.

I have only three significant comments.

1) Most important (under recovery strategy section), my view that creation of new hostplant complexes (locations with stands of *Horkelia*) are a critical component of recovery. This appears to be a missing aspect of the plan, and should be included because it would be so very easy to undertake and have such high prospects of enhancing the status of LMS within its range.

2) Cattle grazing is a Commercial use (Factor A) of land. The direct ingestion of LMS life stages and/or the alteration of hostplants beyond use for LMS are consequences of this commercial grazing. for your Recovery Plan, my view is that this process is wrongly attributed to predation (Factor C). Predation and disease are natural ecological processes under which LMS has evolved.

3) Related to #2 above, since predation and disease are natural ecological processes for LMS, I suggest that minimization of these "threats" as part of Delisting Criteria is misguided. As counterintuitive as this may look, the natural diseases and predators of LMS are, as part of the overarching LMS ecology, likely critical to LMS population health and critical to proper ecological settings for LMS population dynamics. Yes, of course this issue is valid if (and I think only if) the predatory actors are introduced or exotic species, but I have yet to see any real evidence of this in the field.

4) The Conceptual Population model suggests a critical role of the summer brood. I have long wondered about this because it evades me - How then, can *Pyrgus ruralis* in northern California be doing so well without summer broods? I have tinkered with the model (attached excel page) and found that with very slight adjustments of larval and pupal mortality (which after all remains unknown and is an educated guess for this model) the summer brood appears irrelevant to LMS population stability.

Respectfully submitted,

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2 attachments

LMS population model.xlsx
13K

Osborne comments on LMS Recovery Plan.pdf
4166K

Oshorne comments

3. Ensure population redundancy of Laguna Mountains skipper through documentation and reestablishment (where needed) of multiple resilient and genetically representative populations within its historical range.

Downlisting Criteria

1. On Palomar Mountain, an adequate amount of suitable habitat is protected and supports resilient populations in two Management Units (MUs) to ensure adequate redundancy and preserve the species' remaining genetic diversity. Resilience is demonstrated by an average summer to spring peak abundance ratio of 0.5 (representative of stable population growth) over at least 8 years (based on past data, a period of 8 years represents a population able to withstand fluctuations in population size) with evidence of reproduction for the last 2 years to allow for natural variation in population size. A population must be documented for 2 years (representing a reproducing population) in a third MU on Palomar Mountain. Reproduction is demonstrated by detection of a summer flight season (Factors A and E).

2. Off Palomar Mountain, another reproducing population is documented for 6 years which is considered persistent, but does not yet meet the definition of resilient (Factor E).

3. Disturbance is managed to optimize habitat successional stage and minimize direct and indirect impacts to Laguna Mountains skipper from grazing, fire, and succession in the three MUs that meet downlisting criterion 1 (Factors A and C).

Delisting Criteria

1. On Palomar Mountain, resilient populations are protected in three MUs. Another population is documented for 2 years (representing a reproducing population) in a fourth MU on Palomar Mountain. (Factors A and E).

2. Off Palomar Mountain an additional resilient population is protected in a MU (Factors A and E).

3. A climate-smart conservation plan is developed and implemented to adapt to and mitigate anticipated and observed climate change effects, including any changes in fire frequency and intensity, on otherwise resilient populations (Factors A and E).

4. All potential Factor A and C threats have been investigated (for example hydrological modifications and groundwater removal, predation, and disease) to determine impacts and measures implemented to minimize threats in all MUs determined necessary to meet delisting criteria 1 and 2 (Factors A and C).

are these threats? (part of natural ecology)

Estimated Date and Cost of Recovery:

Date of recovery: 2045
Cost of recovery: $3,090,000 + TBD

The highest population growth under any plausible scenario should be realized when the summer to spring adult population ratio is largest. This ratio is a measure of potential annual population abundance in any scenario, and should reflect the quality of environmental conditions during spring growth and breeding. If there is a decrease in the quality of environmental conditions during the spring flight season, we would expect a reduced ratio and reduced corresponding summer peak adult abundance. This model illustrates the importance of summer brood production and that the summer brood's survival is likely critical for maintaining population resilience in bivoltine species (see also Faccoli and Stergulc 2006, pp. 62 and 63). Even a small portion of the spring brood can contribute substantially to adult population size the subsequent spring. In this example, only 4 percent of the spring brood develops to produce adults during the summer, but their offspring account for over 45 percent of the spring adult population the following year.

The conceptual model (Figure 4) identifies several drivers that should influence population abundance, such as host plant suitability, nectar and surface water availability, predation, temperature, mate availability, and development time. Because insect populations typically exhibit large fluctuations in abundance, "stability" is not a term typically used to characterize healthy population dynamics, but rather "resilient" populations are those that can reach relatively extreme lows without crashing and being extirpated. The best currently measureable indicator of resilience for the Laguna Mountain skipper is the detection of a summer flight season, because adult counts are not sufficient to estimate population size. The inability to detect adults during the summer indicates that the population is so small that mates would have difficulty finding each other, and a low summer to spring abundance ratio (approaching zero) is a strong indicator that abundance will decrease the subsequent year.

Further development and validation of this model with field and captive population dynamic values (such as larval survival) will expound on this relationship between spring and summer brood population sizes, and overall population growth potential. This information will in turn inform monitoring needs and thresholds for management actions.

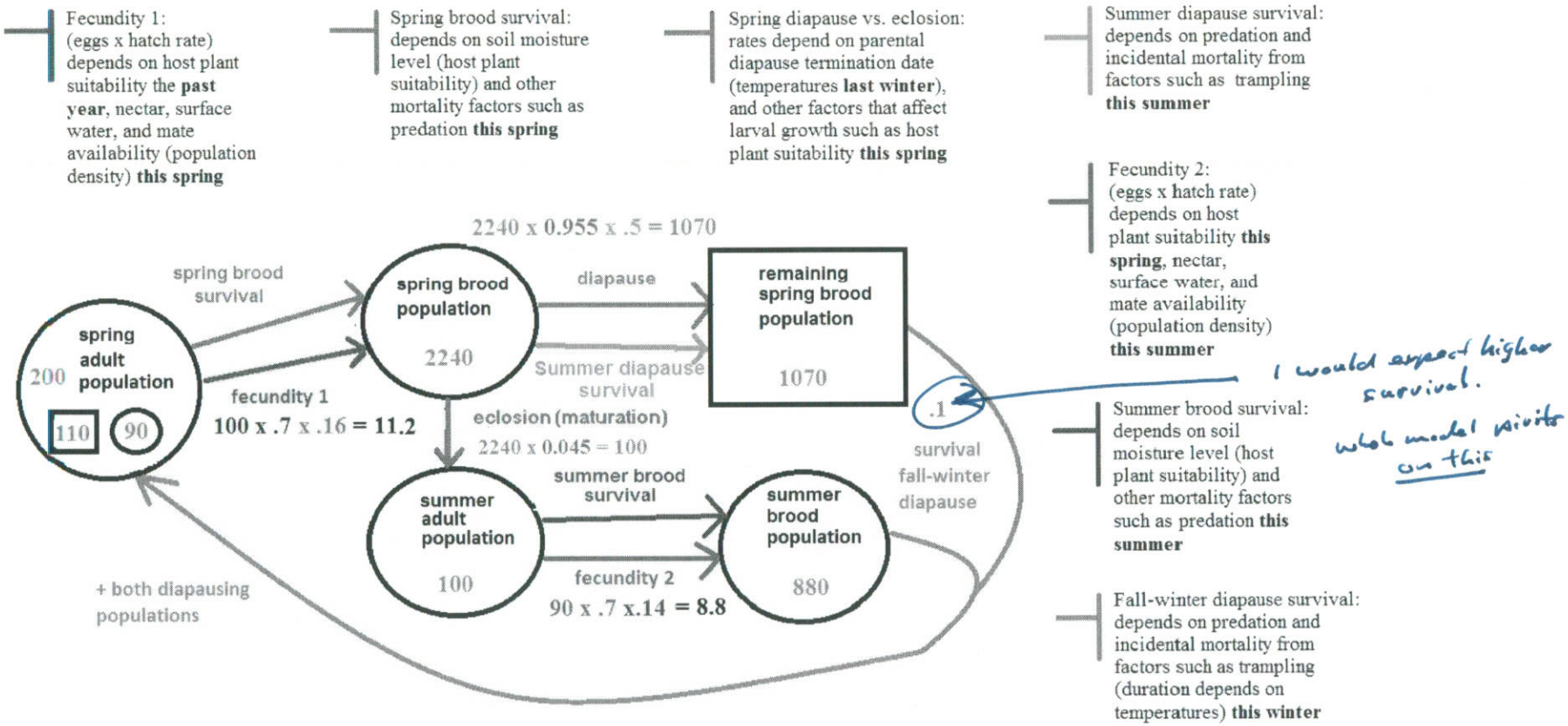

Figure 4. Life cycle and conceptual population model for the Laguna Mountains skipper. The majority of the spring brood enter diapause, while a smaller portion completes development to become the summer adult population. Hypothetical values are based on monitoring data that indicates a typical summer to spring peak abundance ratio of 0.5, which is assumed to represent stable replacement rate. Factors that may affect productivity throughout the season are illustrated on top and to the right with colored markers. Sources: Tashiro and Mitchell 1985; Levy 1994; Faulkner 2008; 2009; 2010a; 2011; 2012; 2013; Johnson *et al.* 2010; Greeney *et al.* 2010; The Butterfly Farm 2012; Longcore *et al.* 2014. Developed by A. Anderson, USFWS.

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. The final listing rule (Service 1997, pp. 2317–2320) identified the following threats to the Laguna Mountains skipper: range reduction and habitat destruction from overgrazing by domestic cattle, incidental predation by cattle, localized distribution and small population size, stochastic events, collection, vandalism, mortality due to recreational activities, displacement of host plant by nonnative species, fire, drought, localized distribution, and small population size. Existing protections at the time of listing described under Factor D were not considered sufficient absent listing under the Act. The most recent 5-year review for Laguna Mountains skipper (Service 2015, pp. 23–41) reported primary threats impacting the Laguna Mountains skipper as (in order by factor): habitat modification through cattle grazing and succession; climate change; incidental ingestion of immature life stages by cattle; and small isolated populations susceptible to events such as drought and fire. A detailed evaluation of all threats is included in the 2015 5-year review (Service 2015, pp. 23–41) and summarized below under each of the five factors and in Appendix II.

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

Current threats impacting Laguna Mountains skipper habitat include modification through cattle grazing, succession, and drought. Land use is also a minor threat. Climate change and surface and groundwater loss are potential threats of uncertain extent and magnitude.

Although grazing can be used as a positive management tool for Laguna Mountains skipper habitat, there can also be adverse impacts from inappropriate grazing management. Primary impacts from excessive cattle grazing on habitat include erosion of meadow structure that may cause drying and loss of soil and host plants (Osborne 2002, pp. 12 and 14; Osborne 2003, p. 16). Current information on habitat conditions and the lack of species-specific management agreements indicate the threat of habitat modification due to inappropriate cattle grazing is ongoing on Palomar Mountain in Dyche Valley (Pine Hills occurrence) and possibly upper French Valley (French Valley occurrence) (A. Anderson, 2014 and 2015 pers. obs.; USGS 2015).

Succession can also impact the habitat in locations where disturbances, such as fire and grazing, do not occur. For example, grazing has been excluded for decades in Upper Doane Valley and western Mendenhall Valley, resulting in apparent displacement of skipper host plants (Grant *et al.* 2009, p. 61; Marschalek 2014, p. 4; K. Winter, USFS, 2015, pers. comm.). Late-successional native plant species can reduce host plant suitability by shading and displacing host plants through competition. Impacts from nonnative plant invasion, which may also displace host plants, appears to be less of a threat than succession (L. Criley, USFS, 2015, pers. comm.), but early treatment of nonnative plants and ongoing management (for example grazing and controlled burns) may be needed to protect Laguna Mountains skipper habitat.

Drought was likely a contributing factor to the extirpation of the Laguna Mountains occurrences, (Appendix III), where rainfall was, and still is, typically lower than on Palomar Mountain

(Grant *et al.* 2009, p. 47; County of San Diego 2010, p. 113). Current climate conditions are not improved compared to when the Laguna Mountains skipper was extirpated from its namesake region. In 2014, the 4-year precipitation deficit was the greatest on record, equivalent to the loss of an entire average year of rainfall (NOAA 2014, pp. 1 and 7). State-wide, average January to September temperature in 2014 was the highest on record since 1895, culminating a steady upward trend since the late 1970s; only 4 years since 1977 have been below the 100 year mean (National Oceanic and Atmospheric Administration (NOAA) 2014, p. 4; Figure 7). On Palomar Mountain the average January to October temperature and the 4-year precipitation deficit were the highest ever recorded (NOAA 2014, pp. 1 and 7). In 2015 record high temperatures continued, as did below-average rainfall (CDWR 2015, p. 1). Given all we now know about the reliance of Laguna Mountains skipper populations on soil moisture and surface water availability, and vulnerability to grazing during periods of dry forage, we consider the current drought in California to be a threat throughout the subspecies' range.

Laguna Mountains skippers are sensitive to climate change because of their dependence on soil moisture levels and surface water availability, and because they currently inhabit a single mountaintop at maximum elevation, with no opportunity for range shift northward or upward in elevation. Comparison of the 1951-1980 mean and 1981-2009 mean annual climatic water deficit (CWD: potential minus actual evapotranspiration; a measure of soil moisture level and plant drought stress; California Basin Characterization Model (Lorraine and Alan Flint, 2014)), and consideration of Laguna Mountains skipper's dependence on habitat moisture availability strongly support that drying due to climate change was a contributing factor to subspecies' extirpation on Laguna Mountains. The California Basin Characterization Model indicates CWD was higher in the Laguna Mountains during the 30-year period when Laguna Mountains skippers declined and were extirpated, than it had been for the prior 30 years (Appendix III). There was likely a synergistic effect between increased drying of the habitat and increased grazing at the time, because as drought conditions reduce preferred annual forage plants, cattle are believed to more likely feed on the tops of the greener perennial host plants where summer brood larvae occur (Levy 1994, pp. 20 and 46; Pratt 1999, p. 27; Mattoni and Longcore 1998, p. 4). Also cattle grazing pressure was more intense (Brown 1991, p. 5; USFWS 2001, p. 5; K. Osborne pers. comm. 2015) and the climate was drier in Laguna Meadow (Grant *et al.* 2009, p. 47; County of San Diego 2010, p. 113) during the years leading up to Laguna Mountains skipper extirpation than they ever were in Mendenhall Valley where the subspecies persists. Grazing pressures in Laguna Meadow have since been reduced, but the subspecies was already extirpated.

Climate change model projections indicate climate could similarly affect habitat on Palomar Mountain and the Laguna Mountains over the next 60 years (Appendix III). Given their dependence on soil moisture and surface water availability, "driest" case CWD projections indicate drying may detrimentally affect habitat suitability. However, "wettest" case projections suggest CWD levels could improve over the next 30 years and then return to near current levels within 60 years. While there are opportunities for adaptation and a possibility of minimum effect, climate change is a potential threat to the Laguna Mountains skipper due to possible habitat drying, especially where grazing is not managed appropriately.

Conversion of even relatively small, occupied host-plant patches for land uses such as

agriculture, structure development, or water storage could also impact populations and is considered a minor threat. Occurrences lacking protection from such activities, based on the amount of habitat under private ownership with no conservation easements or other protective assurances, in order of vulnerability are: Pine Hills (Dyche and Will Valleys); French Valley (Upper French Valley); Mendenhall Valley (western half); and Doane Valley (Iron Springs).

Surface water, groundwater, and soil moisture levels are all affected by the water table in meadow habitats. Therefore, considering the dependence of Laguna Mountains skipper on established meadow hydrology, removal of groundwater via wells (Mattoni and Longcore 1998, p. 10) and diversion and storage of surface water for livestock (Grant *et al.* 2009, 24 and 26) are potential threats. Groundwater extraction for commercial drinking water is of concern on Palomar and in the Laguna Mountains because of the number of companies removing water and the apparent magnitude of withdrawals (Faulkner 2014, pers. comm.; Service 2015, Appendix IV). However, we cannot determine the magnitude of this threat at this time because we are not aware how these activities are affecting meadow water tables and, in turn, how they affect the Laguna Mountains skipper.

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Collection was considered a potential threat to the Laguna Mountains skipper and its habitat at the time of listing. However, there is no information to support that collection is impacting the Laguna Mountains skipper, and we do not consider it to be a threat at the current time.

Factor C: Disease or Predation

Direct mortality of immature life stages due to trampling and incidental ingestion by cattle was considered a threat at the time of listing, and continues to impact Laguna Mountains skipper at unquantified levels where grazing occurs; especially during the summer, fall, and winter. Larvae, and sometimes eggs and pupae, are located in the crowns of *Horkelia clevelandii*, plant parts that are commonly consumed by grazers (Levy 1994, p. 20; Mattoni and Longcore 1998, p. 4; Osborne 2008, p. 35). Trampling of host plants can also cause mortality during any Laguna Mountains skipper immature life stage. The threat of direct mortality due to cattle grazing appears currently most severe in Dyche Valley (Pine Hills occurrence), and proportionately less so in other grazed occupied meadows, depending on intensity and timing of grazing. Grazed areas in the French Valley and Pine Hills occurrences are not managed for Laguna Mountains skipper conservation. The impacts of incidental ingestion and trampling are likely greatest during dry years and seasons when other available forage is less abundant and perhaps less palatable than the perennial host plant *H. clevelandii* (Levy 1994, pp. 20 and 46; Mattoni and Longcore 1998, p. 4; Pratt 1999, p. 27). We believe there is likely a synergistic interaction under dry conditions between increased grazing pressure due to reduced forage quantity and quality for cattle and reduced skipper population growth due to reduced habitat quality, resulting in a greater combined impact to a Laguna Mountains skipper population than these factors normally have independently.

Move to Factor A. as directly related to Commercial use via cattle

Over the past several years, researchers have reported an increasing numbers of the nonnative seven spotted ladybird beetles (*Coccinella septempunctata*) in occupied and formerly occupied

Laguna Mountains skipper habitat (Faulkner 2009, pers. comm.; Grant *et al.* 2009, p. 25; A. Anderson, 2015, pers. obs.). Though not known to be a threat at the current time, other ladybird beetles have been reported to prey on the eggs and early instar larvae of other butterfly species (Sheppard *et al.* 2004, p. 2077).

During captive propagation the presence of the disease *Wolbachia sp.*, a proteobacteria, was detected in Laguna Mountains skippers collected from Mendenhall Valley on Palomar Mountain (Longcore *et al.* 2014, p. 11). *Wolbachia* has been reported to interfere with the reproduction of butterflies and other types of insects in a number of ways, including cytoplasmic incompatibility among infected and non-infected individuals (Werren 1997, p. 593; Nice *et al.* 2009, p. 3137). Longcore *et al.* (2014, p. 11) expressed concern that *Wolbachia* may have been responsible for the infertility of a wild adult female captured for rearing. However, *Wolbachia* is not considered to be a current threat to the Laguna Mountains skipper.

Factor D: Inadequacy of Existing Regulatory Mechanisms

In the listing rule, regulatory mechanisms thought to have some potential to protect the Laguna Mountains skipper included: (1) California Endangered Species Act (CESA), (2) California Environmental Quality Act (CEQA), (3) National Environmental Policy Act (NEPA), and (4) land acquisition and management by Federal, State, or local agencies, or by private groups and organization for the conservation of this subspecies (Service 1997, pp. 2318–2319).

The status of regulatory mechanisms and their adequacy for protection of the Laguna Mountains skipper remains largely unchanged since the time of listing. Several State and Federal mechanisms provide a conservation benefit to the Laguna Mountains skipper. However, the Act is the primary Federal law that provides protection for this species since its listing in 1997. Critical habitat was designated in 2006 both in the Laguna Mountains and on Palomar Mountain. Other Federal and State regulations provide discretionary protections for the subspecies, but do not guarantee protection for the subspecies absent its status under the Act (Service 2015, pp. 35–40). In the absence of the Act, other laws and regulations have limited ability to protect Laguna Mountains skipper throughout a substantial portion of the subspecies' range. Therefore we continue to work with private landowners and State and Federal agencies, in particular California Department of Parks and Recreation (CDPR), California Department of Fish and Wildlife (CDFW), and United States Forest Service (USFS) to implement actions to reduce ongoing threats and recover this subspecies. For additional information related to regulatory mechanisms see the 2015 5-year review (Service 2015, pp. 35–40).

Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence

The listing rule indicated that restricted range, localized distribution, and small population size make Laguna Mountains skippers more vulnerable to the effects of habitat loss, degradation and fragmentation, and stochastic events (Service 1997, p. 2318). The 2015 5-year review again identified small population size as a threat, as well as the potential impacts from fire.

The threat to Laguna Mountains skipper posed by small population size and isolation has significantly increased since the time of listing due to loss of the Laguna Meadow and Crouch

Valley occurrences. The remaining Laguna Mountains skipper populations are relatively small and susceptible to stochastic events, which may result in extirpation of additional populations. Small population size also increases the probability of extinction of the subspecies due to difficulty finding mates, loss of genetic diversity, and lack of colonists to repopulate habitat patches (Allee 1931, pp. 246 and 247). Low genetic diversity may decrease a species' ability to adapt to changing environmental conditions. Genetically homogenous populations may therefore be more at risk and less able to recover from environmental or demographic variability (such as drought and fire events) compared to large diverse populations. Therefore, the extremely restricted range and localized distribution make the Laguna Mountains skipper more vulnerable to extirpation by environmental events.

At the time of listing the Laguna Mountains skipper was thought to occur in fire-adapted ecosystems, but it was noted that a large fire could eliminate affected populations (Service 1997, p. 2319). This characterization has not changed, however we know more now about positive effects from fire activity, including reduced fuel loads and maintenance of early successional stage (Service 2015, p. 41). Grant *et al.* (2009, p. 10) expressed concern that "a single high intensity conflagration fueled by Santa Ana katabatic winds [carries high density air from a higher elevation down a slope under the force of gravity] could potentially drive the species to extinction..." Other fire-adapted species that typically survive burns have been extirpated from portions of their range (for example, Quino checkerspot butterfly; Service 2003, p. 30), and catastrophic wildfire is known to be a threat to small, isolated butterfly populations (Healy and Wassens 2008, p. 13). Therefore, while not considered as significant a threat as in 2009 (Grant *et al.* 2009, p. 10; Service 2015, p. 41), wildfire does pose a rangewide threat with potential to extirpate populations.

II. RECOVERY PROGRAM

This section describes the Laguna Mountains skipper recovery program by outlining a strategy, identifying where recovery will occur (management units), defining the recovery goal and objectives, and delineating criteria to reclassify the subspecies as threatened (downlist the subspecies) and subsequently to remove the Laguna Mountains skipper from the list of threatened and endangered species (delist the subspecies).

A. Recovery Strategy

The most pressing threats to Laguna Mountains skipper are range reduction and vulnerability due to small population size and isolation. Resilient populations, of sufficient size, are necessary to withstand natural stochastic events (extremes of otherwise normal conditions that temporarily reduce population size). Redundant populations are necessary to withstand catastrophic events (unpredictable rare events that may cause population extirpation). Both are needed to preserve populations with genetic composition representative of historical diversity (genes likely to be required for survival under current and future ecological states) and withstand climate-change driven increased vulnerability to grazing pressure and loss of habitat suitability. Therefore, the highest priorities for recovery are: management of grazing to balance positive and negative impacts; captive propagation and reintroduction; modeling of population growth; climate change adaptation and mitigation planning; and monitoring to ensure each Laguna Mountains skipper population is resilient and genetically representative. Further research is necessary to better understand the species life history, refine grazing management practices so that they are economically feasible and desirable to ranchers, and address uncertainties regarding disease and predation. Recovery of the Laguna Mountains skipper will especially benefit from the involvement of stakeholders and partners in all applicable actions. Increasing the number of resilient populations, increasing the extent of occupied habitat, and maintaining genetic diversity are needed to help with the continued survival of this endangered species.

Management Units

Laguna Mountains skipper management units (MUs) are geographic areas defined by property parcels with a unique set of land owners or managers that encompass meadow habitats currently supporting, or that formerly supported, one of the six occurrences (Figures 2 and 3; Table 1). Each MU has the potential to support an independent and resilient population, but may require unique management actions to ameliorate threats.

Palomar Mountain

Palomar Mountain is occupied and divided into four MUs (Figure 2):

- Doane Valley Management Unit: Includes Lower French Valley, Lower Doane Valley, Upper Doane Valley, and Iron Springs. The majority of meadow habitat in this unit is owned and managed by the California Department of Parks and Recreation. Iron Springs is privately owned.

- French Valley Management Unit: Includes Upper French Valley, Palomar Observatory Trail, and Palomar Observatory Meadows. Meadow habitat in this unit is primarily privately owned, with some USFS and California Institute of Technology-owned land.
- Mendenhall Valley Management Unit: Includes the Observatory Campground and Mendenhall Valley. Meadow habitat in this unit is owned by a number of private landowners and the USFS.
- Pine Hills Management Unit: Includes Jeff Valley, Dyche Valley, and Will Valley. Meadow habitat in this unit is primarily privately owned; Jeff Valley and much non-meadow habitat areas are owned by the USFS.

Laguna Mountains

The Laguna Mountains are considered unoccupied and divided into two MUs (Figure 3):

- Laguna Meadow Management Unit: Includes Big Laguna Lake, El Prado Meadow, Laguna Campground, Horse Heaven Group Camp, Boiling Spring Ravine, and Agua Dulce Campground. Meadow habitat in this unit is primarily owned by the USFS, with some private land. Chico Ravine
- Crouch Valley Management Unit: Includes Meadows Kiosk and Joy Meadow. Meadow habitat in this management unit is primarily privately owned, with some USFS holdings.

Other Potential Management Unit Areas

Introduction of Laguna Mountains skipper may be possible in an additional area within its historical range in the Cuyamaca Mountains.

- The Cuyamaca Mountains: Includes Cuyamaca Meadow and Green Valley. Meadow habitat in this potential unit is primarily owned by the California Department of Parks and Recreation, with some private ownership.

B. Recovery Goal and Objectives

The goal of this recovery plan is to control or reduce threats to the Laguna Mountains skipper to the extent the subspecies no longer requires protections afforded by the Act and therefore, warrants delisting. To achieve this goal, the recovery plan's objectives are to:

(1) Further develop the population ecology model to advance our ability to model population viability of Laguna Mountains skipper and inform management practices.

(2) Increase abundance and ensure long-term persistence of Laguna Mountains skipper through reduction and management of threats to the subspecies and its habitat throughout its current range; and

(3) Ensure population redundancy of Laguna Mountains skipper through documentation and reestablishment (where needed) of multiple resilient and genetically representative populations within its historical range.

in addition to reestablishment need establishment of new host stands at sites within each MU.

C. Recovery Criteria

An endangered species is defined in the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting or delisting, we consider whether it meets either of these definitions. A recovered (or conserved) species is one that no longer meets the Act's definitions of threatened or endangered due to amelioration of threats. Determining whether a species should be downlisted or delisted requires consideration of the same five threat categories considered when the species was listed, specified in section 4(a)(1) of the Act.

Recovery criteria are conditions that, when met, indicate a species may warrant downlisting or delisting. Thus, recovery criteria are mileposts that measure progress toward recovery. These recovery criteria are our best assessment at this time of what needs to be completed so that the species may subsequently be removed from the list of threatened and endangered species. Because our understanding of species' vulnerability to threats is likely to change as more is learned, a status review may indicate downlisting or delisting is warranted before all recovery criteria are met. Conversely, it is possible that recovery criteria could be met and a status review could indicate that reclassification is not warranted; for example, a new threat is identified that was not addressed by the recovery criteria.

Laguna Mountains skipper recovery is not defined in terms of absolute numbers of individuals, but by the number of resilient populations protected and sustained via natural processes and ongoing management. The recovery criteria presented below represent our best estimate for measuring when impacts from current threats have been sufficiently reduced such that the recovery objectives have been met. Downlisting and delisting will be considered for the Laguna Mountains skipper when the following conditions have been met.

Downlisting Criteria

1. On Palomar Mountain, an adequate amount of suitable habitat is protected and supports resilient populations in two MUs to ensure adequate redundancy and preserve the species' remaining genetic diversity. Resilience is demonstrated by an average summer to spring peak abundance ratio of 0.5 (representative of stable population growth) over at least 8 years (based on past data, a period of 8 years represents a population able to withstand fluctuations in population size) with evidence of reproduction for the last 2 years to allow for natural variation in population size. A population must be documented for 2 years (representing a reproducing population) in a third MU on Palomar Mountain. Reproduction is demonstrated by detection of a summer flight season (Factors A and E).