

Lange's Metalmark Butterfly
(Apodemia mormo langei)

**5-Year Review:
Summary and Evaluation**



Photo Credit: M. Hayes

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U.S. Fish and Wildlife Service

San Francisco Bay-Delta Fish and Wildlife Office

Sacramento, California

5-YEAR REVIEW

Lange's Metalmark Butterfly (*Apodemia mormo langei*)

GENERAL INFORMATION:

Subspecies: *Apodemia mormo langei*

Date listed: June 1, 1976

FR citation(s): 41 FR 22041

Classification: Endangered species

BACKGROUND:

Most recent status review:

U.S. Fish and Wildlife Service. 2020. Five-Year Review: Lange's metalmark butterfly (*Apodemia mormo langei*). San Francisco Bay-Delta Fish and Wildlife Field Office. Sacramento, California. August 31, 2020. 30 pp.

FR notice citation announcing this status review:

U.S. Fish and Wildlife Service. 2024. (89 FR 83510); Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 59 Pacific southwest species; October 16, 2024.

ASSESSMENT:

Lange's metalmark butterfly (*Apodemia mormo langei*; Lange's metalmark) is a subspecies of Mormon metalmark butterfly (*Apodemia mormo*; Mormon metalmark). For a detailed review of Lange's metalmark, Mormon metalmark and the history of conservation efforts related to this butterfly, see Service (2020).

Lange's metalmark is a small butterfly typically with a wingspan of less than 1 inch. Lange's metalmark has only been definitively documented at Antioch Dunes National Wildlife Refuge (ADNWR), located between the south bank of the San Joaquin River and the city of Antioch in Contra Costa County, California. Lange's metalmark uses Antioch Dunes buckwheat (*Eriogonum nudum* var. *psycicola*) as its hostplant. This hostplant is only known to occur at ADNWR. In this review we consider one population of Lange's metalmark to be extant since the last 5-year review (Service 2020). This population occurs on the Sardis unit of ADNWR (Figure 1). Lange's metalmark used to occur on the Stamm unit of ADNWR but has not been documented there since 2010.

The main threats and stressors to this subspecies are (Service 2019, 2020): habitat loss from land conversion; habitat degradation due to the loss of the natural sand dune disturbance regime; invasive plant species; air particulate pollution from industrial operations; low population size; lack of multiple populations; wildfire; and possibly pesticide application and variability in climate trends. Wildfire is a substantial threat to any Lange's metalmarks that still occur at ADNWR. Last year (2024) there were at least 4 fires at ADNWR, several of which substantially impacted or destroyed high quality buckwheat stands known to have historically been used by Lange's metalmark.

Population Status and Trends:

The number of Lange's metalmarks observed during annual surveys has been declining since the late 1990's (Service 2020). In 2020, 7 butterflies were observed. In 2021, 16 butterflies were observed. In 2022, only 1 male was observed. In 2023 and 2024, no Lange's metalmarks were observed despite intensive searching.

Information acquired since the last status review:

The Service has continued to conduct annual Lange's metalmark surveys at ADNWR. In 2020, the Service also initiated a multi-year behavior study of Lange's metalmark, which provided detailed information on when and where Lange's metalmark occurred and the behaviors they exhibited (Service, unpublished data). This information included the relative time these butterflies spent basking, resting, batting their wings, flying, nectaring and engaging in other behaviors. A key unresolved question was whether male and female Lange's metalmarks were co-occurring at the same time and in close enough proximity to find mating partners. After collecting behavior data in 2020 and 2021, the Service concluded that males and females were occurring in the same place at approximately the same time in a way that facilitated finding mating partners. The Service has used these behavior data to refine current estimates of the probability of detecting individual butterflies, assuming they are available for detection (Hayes 2025). The Service currently estimates that individual detection probability using current intensive searching techniques is approximately 0.29 or higher (Service 2020; Hayes 2025), assuming a standardized search of hostplant patches. This means that if a given patch of buckwheat hostplant is searched intensively for 1 hour or more, there is estimated to be a 29% chance or greater of seeing any adult butterfly that is active in the area during the time searched.

Since 2020, the Service has been holding regular Antioch Dunes recovery meetings to help coordinate recovery efforts for endangered species at ADNWR. These meetings have consisted of both internal Service coordination meetings and meetings with external experts with interests and experience in conservation of Lange's metalmark at ADNWR. These meetings have regularly elicited new information and ideas related to recovery of Lange's metalmark.

In 2020, the head-starting and captive propagation program for Lange's metalmark at Moorpark College north of Los Angeles was discontinued due to the low density of Lange's metalmark at Antioch Dunes (Service 2020). Since then, the Service has been coordinating with the Peninsula Humane Society and the Larry Ellison Conservation Center for Wildlife Care in planning a possible future head-starting and captive propagation program for Mormon metalmark and potentially Lange's metalmark, contingent upon adequate population size.

In 2020 and 2021, the Service funded research and monitoring related to the impacts of fugitive dust generated by the Georgia-Pacific gypsum drywall plant in Antioch, which is located between the two ADNWR units. An air monitoring study (Spada 2021) conducted 6 months of air sampling using 30 passive sampling stations in upwind sampling locations at the Stamm unit and downwind sampling locations at the Sardis unit. The Stamm unit data suggested evidence of nearby industrial activities (such as airborne iron and zinc) and the Sardis unit data suggested a substantial contribution of airborne contaminants from the Georgia-Pacific drywall plant, as well as evidence of nearby industrial activities. Osborne and Longcore (2021) analyzed the influence

of gypsum dust on lepidoptera larvae growth rates and food consumption. This study concluded that fugitive dust from the Georgia-Pacific drywall plant has the potential to put downward pressure on the Lange's metalmark population through reduced growth and survival rates of larvae, and disruption of natural phenology patterns. Over the last 5 years the Georgia-Pacific gypsum drywall plant has worked to install structures that cover piles of gypsum material that are stored at the facility and are intended to reduce the amount of resulting dust deposited on the Sardis (east) unit of ADNWR.

Weiss (2021) conducted an evaluation of Mormon metalmark populations and habitat at selected locations near ADNWR, including at locations near Vallejo, at Morgan Territory Regional Preserve, Del Puerto Canyon, Black Diamond Mine Regional Park and on Mount Diablo. Weiss concluded that Del Puerto Canyon likely represented the closest match to ADNWR in terms of climate and ecological context, including hostplant availability. Service employees have also conducted field searches at some of these and other locations known to be occupied by Mormon metalmark (e.g., Del Puerto Canyon, Mount Diablo, the Vallejo site, and Goat Mountain).

Valle and Hayes (2021) compiled and analyzed Mormon metalmark species occurrence records from across the North American range of this species, including from western United States, north-western México, and south-western Canada. This analysis is ongoing and suggests that ADNWR is on the geographic edge of the Mormon metalmark distribution and may represent moderate quality habitat for the species relative to locations where Mormon metalmark has been observed in western North America.

De La Pascua and Hayes (2023) compiled data from weather stations near ADNWR and analyzed the potential influences of annual variations in climate on Lange's metalmark population size since the mid-1980s to the present. This analysis suggested that the prior year's population size and estimated population growth rate were the most important variables predicting a given year's population, followed by several climate variables including autumn temperatures and precipitation.

A Mormon or Lange's metalmark specimen was collected on September 2, 1972 at Jersey Island east of ADNWR with the collector name of "S. Sims" (McNally 2014). The specimen is housed in the University of California, Davis Bohart Museum of Entomology. In 2024, Service personnel contacted Steve Sims who indicated that he collected this specimen while working as a tomato pest monitor for a local agriculture producer. Sims was not able to recall the location on Jersey Island where he collected the specimen but speculated that there must have been naked stem buckwheat (*Eriogonum nudum*) nearby. Based on proximity to ADNWR, morphology and wing pattern, Sims concluded at the time that the specimen belonged to the Lange's metalmark subspecies. This record suggests that there may have been Mormon metalmark or Lange's metalmark that occurred on Jersey Island in the 1970's. To our knowledge a Mormon metalmark survey has never been conducted on Jersey Island.

McDonald and Shaffer (2025) are in the process of concluding a conservation genomics analysis of Lange's and Mormon metalmark butterfly as part of the California Conservation Genomics Project at University of California, Los Angeles (UCLA). The purpose of this study is to better understand the genetic relatedness of Lange's metalmark and nearby Mormon metalmark

populations, with the goal of providing useful information for a possible future Mormon metalmark head-starting and captive program. This information could also help inform a possible genetic rescue program in the future, if the Lange's metalmark population rebounds.

Johnson et al. (2025) initiated the development of a reference genome for Lange's metalmark using three dried Lange's metalmark specimens retained from the Lange's metalmark head-starting and captive propagation project at Moorpark College. The purpose of this project is to develop a full genome for this subspecies.

RECOVERY CRITERIA:

Service (2019) articulated downlisting and delisting criteria for Lange's metalmark. To be considered for downlisting to threatened based on these criteria, the subspecies would need three populations at separate, managed locations with a 15-year moving median of 2,600 individuals and a minimum effective population size of 50.

CONCLUSIONS:

A core consideration in evaluating downlisting or delisting was the current resiliency, redundancy, and representation of the subspecies (Smith et al. 2018). Resiliency is the ability of Lange's metalmark to continue to maintain viable populations when exposed to environmental and demographic stochasticity, such as those associated with typical variation in climate and weather conditions at Antioch Dunes, and in the reproductive and survival rates of the butterflies in the various populations. Redundancy is the ability of Lange's metalmark to withstand catastrophic events that have the potential to cause the extinction of one or more populations, but that would not be expected to cause the extinction of the subspecies, so long as there are multiple populations distributed in geographic space with suitable distance among populations. Representation is the ability of Lange's metalmark to adapt to changes in environmental conditions that might plausibly occur at Antioch Dunes and nearby locations. The Service assumed that genetic diversity and/or diversity among populations that are physiologically or behaviorally adapted to a variety of environmental conditions at Antioch Dunes would improve the viability of the subspecies.

In developing recovery criteria for Lange's metalmark, the Service (2019) placed an emphasis on establishing downlisting and delisting criteria that would promote relatively high resilience, redundancy, and representation for this subspecies. Downlisting criteria specify that there should be three separate populations of Lange's metalmark with 15-year moving median population of 2,600 individuals and a minimum effective population size of 50 with a stable or increasing population growth rate.

The Service concludes that these criteria have not been met. After reviewing the best available scientific information, we conclude that Lange's metalmark remains an endangered species. The evaluation of threats affecting the species under the factors in 4(a)(1) of the Endangered Species Act and analysis of the status of the species in our 2020 status review remains an accurate reflection of the current status of Lange's metalmark.

FUTURE RECOMMENDATIONS:

Proposed work related to Lange’s metalmark could include: continuing annual Lange’s metalmark surveys (the Service has already planned surveys for the August and September flight season of 2025); developing a probabilistic approach to determining the likelihood that Lange’s metalmark is extirpated from individual buckwheat stands and ADNWR units; expanding survey areas to include all Antioch Dunes buckwheat stands on the Sardis and Stamm units; finalizing the genomics project in process at the California Conservation Genomics Project at UCLA; scouting Jersey Island and other nearby locations for suitable habitat for Mormon metalmark; monitoring gypsum dust deposition from the Georgia-Pacific facility and other industrial contaminants; and continuing coordination with the Peninsula Humane Society and the Larry Ellison Conservation Center for Wildlife Care in planning a possible future head-starting and captive propagation program.

FIELD OFFICE APPROVAL:

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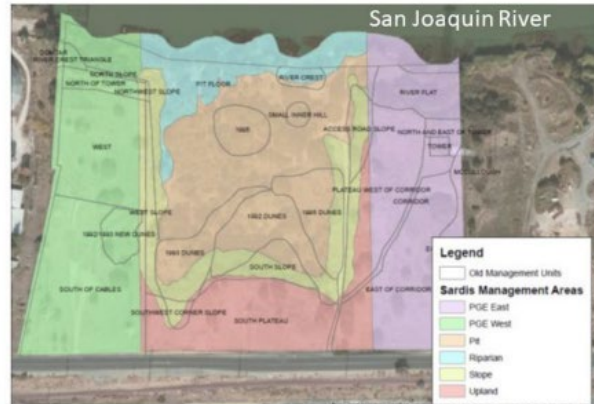
Map A - California



Map B - Antioch Dunes NWR



Map C - Stamm Unit



Map D - Sardis Unit

Figure 1. Maps of the location of Antioch Dunes National Wildlife Refuge and the Stamm and Sardis Units of the Refuge. Map A shows the approximate location of the Refuge (black star) in the state of California; Map B shows the Stamm and Sardis Units of the Refuge relative to the adjacent city of Antioch, California and the San Joaquin River (blue color); Map C shows a detail of the Stamm Unit; and Map D shows a detail of the Sardis Unit. Management subunits in Maps C and D are indicated by color and thin lines. Maps C and D created by W. Chan, San Francisco Bay National Wildlife Refuge Complex.

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