

Draft Recovery Plan for the Carson Wandering Skipper

(Pseudocopaeodes eunus obscurus)



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LITERATURE CITATION SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 2005. Draft recovery plan for the Carson wandering skipper (*Pseudocopaedes eunus obscurus*). U.S. Fish and Wildlife Service, Portland, Oregon. viii + 71 pages.

An electronic version of this recovery plan will also be made available at <http://www.r1.fws.gov/ecoservices/endangered/recovery/plans.html> and <http://endangered.fws.gov/recovery/index.html>.

Acknowledgments

This recovery plan was prepared by Marcy Haworth, Fish and Wildlife Biologist with the U.S. Fish and Wildlife Service, with input from species experts and stakeholders. We gratefully acknowledge the commitment and efforts of the following individuals in the recovery of the Carson wandering skipper. Without their assistance and participation during recovery team meetings, this document would not have been possible.

Mr. Donald Armentrout, Bureau of Land Management, Eagle Lake Office,
Susanville, California
Ms. Gail Bellenger, Nevada Department of Transportation, Carson City, Nevada
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Midvale, Utah
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Mr. Robert Pyle, Lassen Board of Supervisors, Susanville, California
Ms. Jeanne Ruefer, Washoe County Department of Water Resources, Reno,
Nevada
Ms. Sharon Stacey, California Department of Transportation, Redding, California
Mr. Dan Strait, U.S. Fish and Wildlife Service, California/Nevada Office,
Sacramento, California
Ms. Melani Tescher, Sierra Army Depot, Herlong, California
Mr. Ken Weaver, Natural Resources Conservation Service, Susanville, California

We would also like to thank the following individuals for their assistance in the development or preparation of this document:

Dr. Erica Fleishman, Stanford University, Stanford, California
Mr. Damian Higgins, U.S. Fish and Wildlife Service, Nevada Fish and Wildlife
Office, Reno, Nevada
Dr. Dennis Murphy, University of Nevada, Reno, Reno, Nevada
Dr. David Wright, Sacramento, California

Executive Summary

Current Species Status: The Carson wandering skipper (*Pseudocopaeodes eunus obscurus*) is a small butterfly in the subfamily Hesperinae (grass skippers). The species is federally listed as endangered. At the time of listing, only two extant populations were known, one in Washoe County, Nevada, and one in Lassen County, California. A third known population of the subspecies, from Carson City, Nevada, is considered extirpated as of 1998. In 2004, one additional population was located south of Carson City in Douglas County, Nevada, along the Carson River.

Habitat Requirements and Limiting Factors: Carson wandering skipper habitat is characterized as lowland grassland habitats on alkaline substrates. Occupied areas are located in a small region east of the Sierra Nevada in northwestern Nevada and northeastern California, and are characterized by an elevation of less than 1,524 meters (5,000 feet), the presence of *Distichlis spicata* (saltgrass) (Hickman 1993) and nectar sources in open areas near springs or water, and possible association with geothermal activity.

Threats to the subspecies include habitat destruction, degradation, and fragmentation due to urban and residential development, wetland habitat modification, agricultural practices, gas and geothermal development, and non-native plant invasion. Other threats include collecting, excessive livestock trampling/grazing, water exportation projects, road construction, recreation, pesticide drift, and inadequate regulatory mechanisms. This subspecies is also vulnerable to chance environmental or demographic events, to which small populations are particularly vulnerable. The combination of only three populations, small range, and restricted habitat makes the subspecies highly susceptible to extinction or extirpation from a significant portion of its range due to random events such as fire, drought, disease, or other occurrences (Shaffer 1981, 1987; Meffe and Carroll 1994).

Recovery Priority: The Carson wandering skipper has a recovery priority number of 3C. This ranking, determined in accordance with the Recovery Priority Criteria published in the Federal Register (U.S. Fish and Wildlife Service 1983), is based on a high degree of threat, high potential for recovery, and a taxonomic classification as a subspecies. Conflict with construction or development actions (urban, residential, and agricultural) may occur.

Recovery Goal: To recover the Carson wandering skipper to the point where it can be delisted.

Recovery Criteria: Downlisting of the Carson wandering skipper to a threatened status can be considered when the following criteria are met:

1) For the Lassen County, California, population/metapopulation **and** one of the two known Nevada populations (Washoe County or Douglas County) or a comparable newly discovered population, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Either population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance. In California, suitable habitat patches equivalent to 50 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance across the population/metapopulation.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the two populations in downlisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regards to habitat and land uses that may affect habitat quality including but not limited to development (urban, residential, water, gas and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

Delisting of the Carson wandering skipper can be considered when the following conditions are met:

1) For the Lassen County, California, population/metapopulation **and** both of the two known Nevada populations (Washoe County and Douglas County) or comparable newly discovered populations, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Each population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance. In California, suitable habitat patches equivalent to 75 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance across the population/metapopulation. Substantial landscape connectivity must exist among patches (i.e., land cover between most sites would be considered open space and not urban or suburban) in order to potentially facilitate movement of the Carson wandering skipper among patches.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the three populations in delisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regard to habitat and land

uses that may affect habitat quality, including but not limited to development (urban, residential, water, gas, and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

3) In addition to the populations in delisting criterion #1, for at least one additional Carson wandering skipper population or metapopulation that may be discovered or established within Carson wandering skipper historic range, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the population, unless we conclude (through intensive, comprehensive surveying) that additional populations or metapopulations do not exist and it would not be ecologically feasible to establish/reestablish one or more of them within Carson wandering skipper historic range.

4) *Lepidium latifolium* invasion into known and presumed suitable habitat for the Carson wandering skipper has been eliminated or reduced and managed to levels that do not pose a threat to the persistence of the Carson wandering skipper.

5) A long-term conservation plan and conservation agreements have been developed to guide management throughout the range of the Carson wandering skipper after it has been delisted.

6) A monitoring plan to cover a minimum of 5 years post-delisting of the Carson wandering skipper has been developed and is ready to be implemented to ensure the ongoing conservation of the species and the continuing effectiveness of management actions.

The criteria for downlisting and delisting of the Carson wandering skipper may change as more information becomes available.

Recovery Actions: Major actions needed for achieving recovery of the Carson wandering skipper are:

1. Manage existing populations and essential habitat on public and private lands to minimize threats.
2. Establish a research program to determine the ecological requirements and life history of the Carson wandering skipper, and develop a program to survey for additional populations and monitor existing populations and habitats for trends and threats.
3. Develop and implement an outreach program to keep local communities informed of the Carson wandering skipper's status and means to carry out recovery actions.

4. Evaluate progress of recovery, effectiveness of management and recovery actions, and revise management plans and recovery criteria as necessary.

Total Estimated Cost of Recovery (in \$1,000s): Details are found in the Implementation Schedule.

| YEAR | ACTION 1 | ACTION 2 | ACTION 3 | ACTION 4 | ACTION 5 |
|--------------|----------|----------|----------|----------|----------|
| 2006 | | 175 | 68.33 | 4 | |
| 2007 | 405 | 175 | 50 | 10 | |
| 2008 | 600 | 193.33 | 93.33 | 5 | |
| 2009 | 600 | 193.33 | 33 | | |
| 2010 | 615 | 193.33 | 58.33 | | 6 |
| 2011 | 600 | 100 | 25 | | |
| 2012 | 600 | 105 | 25 | 5 | |
| 2013 | 5 | 5 | 25 | 5 | |
| 2014 | | | 33 | | |
| 2015 | 10 | | 25 | | 5 |
| 2016 | 5 | | 25 | | |
| 2017 | | 50 | 25 | | |
| 2018 | | 50 | 25 | 5 | |
| 2019 | 5 | | 33 | 5 | |
| 2020 | 10 | | 25 | | 5 |
| 2021 | | | 25 | | |
| 2022 | | | 25 | 5 | |
| 2023 | | | 25 | 5 | |
| 2024 | | | 33 | | |
| 2025 | 10 | | 25 | | 5 |
| TOTAL | 3,465 | 1,240 | 702 | 49 | 21 |

The total estimated cost of recovering the Carson wandering skipper is \$5,477,000, plus additional costs that cannot be estimated at this time.

Date of Recovery: If surveying and habitat management efforts to eliminate threats are successful in allowing actions to be implemented as recommended and recovery criteria are met, downlisting could be considered in 2016. Delisting could be considered in 2026, if actions are implemented as recommended and recovery criteria are met.

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I. Background

A. STATUS OF THE SPECIES

The Carson wandering skipper (*Pseudocopaeodes eunus obscurus*) is a small butterfly in the subfamily Hesperinae (grass skippers). The species is federally listed as **endangered***. The Carson wandering skipper was given short-term protection under the Endangered Species Act of 1973, as amended, on November 29, 2001, when we published an emergency rule (U.S. Fish and Wildlife Service 2001a) to list the **species** as endangered. The emergency rule provided Federal protection to the Carson wandering skipper for 240 days, during which time we initiated the normal listing process for ensuring its long-term protection. A proposed rule to list the Carson wandering skipper was published in the Federal Register concurrently with the emergency listing (U.S. Fish and Wildlife Service 2001b). On August 7, 2002, we published a final rule listing the Carson wandering skipper as an endangered species (U.S. Fish and Wildlife Service 2002). **Critical habitat** has not been designated for this subspecies.

At the time of listing, only two **extant populations** were known, one in Washoe County in northwestern Nevada and one in Lassen County in northeastern California. A third known population of the **subspecies**, from Carson City, Nevada, is considered **extirpated** as of 1998. In 2004, one additional population was discovered and two single sightings of individual Carson wandering skippers occurred in Nevada. The new population was found south of Carson City in Douglas County along the Carson River. One of the single sightings occurred approximately 16 kilometers (10 miles) south of the previously known population in Washoe County. The second single sighting occurred south of Flanigan, Washoe County (Figure 1).

B. SPECIES DESCRIPTION AND TAXONOMY

The genus *Pseudocopaeodes* in the family Hesperidae (skippers) and subfamily Hesperinae (grass skippers) contains only one species, the alkali skipper or wandering skipper (*Pseudocopaeodes eunus*). The species *Pseudocopaeodes eunus* consists of five **subspecies**: the nominate subspecies *Pseudocopaeodes eunus eunus*, the alkali skipper or eunus skipper; *P. e. obscurus*, the Carson wandering skipper; *P. e. alinea*, the Ash Meadows alkali skipper; *P. e. flavus*, the Nevada alkali skipperling or yellow alkali skipper;

* A glossary has been provided as an appendix (Appendix B) to this plan. Words written in **bold type** within the text have been defined in the glossary.

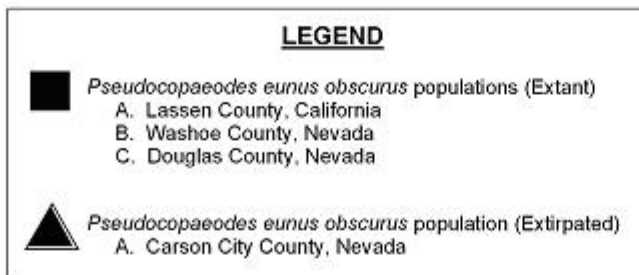


Figure 1. General locations of extant and extirpated populations of the Carson wandering skipper.

and an undescribed fifth subspecies found in 1998 (Brussard *et al.* 1999). Common names of subspecies reflect usage by New Mexico Department of Game and Fish (2000), The International Lepidoptera Survey (2004), and Nevada Natural Heritage Program (2004). *Pseudocopaeodes eunus obscurus*, the Carson wandering skipper, is locally distributed in grassland habitats on alkaline substrates in eastern California and western Nevada. *Pseudocopaeodes eunus alinea* is found in eastern desert areas of southern California and in southern Nevada; *P. e. eunus* is located in western desert areas of southern California; and *P. e. flavus* is found in western and central Nevada and the east slope of the Sierra Nevada in California. The undescribed fifth subspecies is found in Mono County, California (Brussard *et al.* 1999).

The Carson wandering skipper was first described by Austin and Emmel (1998). The **dorsal** ground color is dull, somewhat brownish orange. The **costal** area of the **forewing** is smudged with black. The **hind wing** is dusted rather heavily with black especially along the anal margin. The black terminal line on both wings is broad. **Veins** are blackened, and fringes of both wings are broadly dark gray proximally and whitish distally. The **ventral** surface is dull yellowish-orange and paler distally on forewing and all of hind wing. The forewing **apex** is grayish. Vein tips of the forewing are heavily blackened, and the veins of the hind wing are broadly outlined with dark gray, nearly filling **cells** anterior to M1 (medial vein 1) and posterior to CuA2 (anterior cubitus vein 2). The female's dorsal surface is similar to that of the male, as described above, but with heavier dusting on the **discal** area of the hind wing. The ventral surface is like that of the male. Males tend to average 13.1 millimeters (0.52 inches) in size (ranging from 12.0 to 13.9 millimeters (0.47 to 0.55 inches)). Females average 14.7 millimeters (0.58 inches) in size, and range from 13.4 to 15.6 millimeters (0.53 to 0.61 inches) (size is forewing length from base to apex).

The Carson wandering skipper can be distinguished from the other subspecies of *Pseudocopaeodes eunus* by a combination of several characteristics. The Carson wandering skipper is browner and less intensely orange on its dorsal surface, with thicker black coloring along the veins, outer margin, and on both **basal** surfaces; and it is duller, overall, with an expanse of bright yellow and orange ground color, especially on the ventral surface, interrupted by broadly darkened veins. Infrequently, specimens from other populations approach the less heavily marked extremes of the Carson wandering skipper. However, they do not give the impression of an insect with a dark ventral hind wing, and they lack the dark apex on the ventral forewing (Austin and Emmel 1998).

C. POPULATION TRENDS AND DISTRIBUTION

Historically, known population locations included the **type locality** found near the Carson Hot Springs in Carson City (formerly Ormsby County), Nevada, and one other site in Lassen County, California. When described in Austin and Emmel (1998), specimens from two additional sites, Dechambeau Hot Springs at Mono Lake (misspelled in publication as “Dechambean”) and Hot Springs, Mono County, California, were assigned, with uncertainty due to their small numbers, to the Carson wandering skipper subspecies. Based on 1998 surveys (Brussard *et al.* 1999), these Mono County specimens would be more appropriately assigned to the currently undescribed subspecies (George Austin, Nevada State Museum and Historical Society, pers. comm. 2001).

It is possible that a fairly large population of the subspecies occurred from the Carson Hot Springs site to the Carson River. Outflow from the springs likely supported a water table high enough to support *Distichlis spicata* (L.) Greene (saltgrass) (Hickman 1993), its larval food plant, and a variety of **nectar** sources. Urban development, water diversions, and wetland manipulations have eliminated most of the habitat in this area (Brussard 2000).

Likewise, it is possible that more appropriate habitat once existed for the Carson wandering skipper between the existing populations in Lassen County, California, and Washoe County, Nevada (Peter Brussard, University of Nevada, Reno, pers. comm. 2001). Over time, habitat between these populations has become unsuitable and fragmented due to natural drying and human activities, and they may have become isolated from one another. The population locations are approximately 120 kilometers (75 miles) apart. While the dispersal capability of the Carson wandering skipper is unknown, it is unlikely that any current genetic exchange occurs between them because skippers, in general, seldom fly far (Scott 1986). Further surveys are needed to determine if the two single Carson wandering skipper sightings that occurred in Washoe County in 2004 indicate populations/metapopulations in these areas. The subspecies likely represents a remnant of a more widely distributed complex of populations in the western Lahontan basin (Brussard *et al.* 1999).

No information is available on historic population numbers of the Carson wandering skipper.

Surveys conducted in 1998 throughout potential, suitable habitat in Nevada and California found two new populations of Carson wandering skippers. Presence of the Carson wandering skipper is most easily determined by observing adults feeding on a nectar source and as such is reported as a **nectar site** location.

The distribution of the Carson wandering skipper population that may occur in the vicinity of that nectar site must eventually be determined. One nectar site was located in Warm Springs Valley, Washoe County, Nevada, and two nectar sites were located in Honey Lake Valley, Lassen County, California. The sites in Lassen County could be a rediscovery of the area where skippers were collected in the 1970s; however, the collection record is too vague to be certain (P. Brussard, pers. comm., 2001). The two nectar sites in Honey Lake Valley were located about 8 kilometers (5 miles) from one another. Other populations were not found in 2000 and 2001, despite additional, more limited attempts (P. Brussard, pers. comm. 2000; Rebecca Niell, University of Nevada-Reno, pers. comm. 2002).

Surveys in 2002 and 2003 located four other nectar sites; two of them were in close proximity to the two previously known nectar sites in Honey Lake Valley, California (R. Niell *in litt.* 2003, Earth Tech, Inc. 2003).

In 2004, several additional nectar sites were found in Honey Lake Valley, California (A. Hreha *in litt.* 2004a, 2004b; M. Sanford *in litt.* 2004a). Depending on the distances among these numerous nectar sites, the Carson wandering skipper in Honey Lake Valley may be comprised of one large population rather than a metapopulation. Further research is needed to determine the population structure in Honey Lake Valley, California.

One new population was found in Nevada along the Carson River in Douglas County in 2004 (Dennis Murphy, University of Nevada, Reno, pers. comm. 2004). Two single sightings of Carson wandering skipper individuals were made in Washoe County - one in Spanish Springs Valley and the other near Flanigan (Dennis Murphy, pers. comm. 2004; M. Sanford *in litt.* 2004b). To the best of our knowledge, only three populations are extant, one in Lassen County, California, and one each in Washoe County and Douglas Counties, Nevada. The two separate single Carson wandering skipper sightings in Washoe County observed in 2004 may or may not indicate a local population/metapopulation is present. Further research is needed in these areas.

1. Nevada

a) Carson City Site. The Carson wandering skipper was first collected in 1965 at a location north of U.S. Highway 50, Carson City (formerly Ormsby County), Nevada. Habitat at this site has been greatly modified over time, and most of it was destroyed by construction of a shopping center (Brussard *et al.* 1999). Several years later, an extension of the population was discovered north of the original location (Brussard *et al.* 1999). In the 1990s, additional urban development further reduced the remaining habitat, and the site is now completely surrounded by development.

The Carson City site was surveyed for the Carson wandering skipper by the University of Nevada, Reno from 1997 to 2001 (Table 1). Only five individuals (four males and one female) were observed during surveys in June 1997. One possible sighting of a Carson wandering skipper occurred at a project site in 1998 (Brussard *et al.* 1999). No individuals were observed at this site in 1999, 2000, or in 2001 (P. Brussard, pers. comm., 2000; R. Niell, pers. comm., 2001). In 2002, surveys were again conducted with no individuals observed (Marcy Haworth, U.S. Fish and Wildlife Service, pers. obs. 2002).

Habitat changes resulting from drainage manipulations for residential and commercial development are likely responsible for this probable extirpation (Brussard *et al.* 1999). Furthermore, construction of a freeway bypass will eliminate and fragment the remaining 5 hectares (12 acres) of unoccupied Carson wandering skipper habitat at this site. Construction began in 2002-03, and the freeway corridor is currently being graded (M. Haworth, pers. obs. 2004).

b) Douglas County (Carson River) Site. This nectar site, found and searched in 2004 (Table 1), occurs on Bureau of Land Management administered lands in Douglas County. The site is about 4 hectares (10 acres) in size. Additional habitat likely extends onto adjacent Nevada State lands and City of Incline Village lands. The entire habitat on the three properties combined is estimated at about 56.7 hectares (140 acres). Approximately nine Carson wandering skippers were observed but none were seen on nectar (R. Niell *in litt.* 2004).

Table 1. Occupied Carson wandering skipper nectar sites in Nevada, and dates of monitoring efforts since 1997.

| Site Name | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|--|------|------|------|------|------|------|------|------|------|
| Carson City | X | O | O | O | O | O | | | |
| Douglas County (Carson River) | | | | | | | | X | |
| Washoe County Site #1: Warm Springs Valley (BLM) | | X | | | X | X | X | X | |
| Washoe County Site #1: Warm Springs Valley (Private) | | X | | | | | | | |
| Washoe County Site #2: Flanigan | | | | | | | | X | |
| Washoe County Site # 3: Spanish Springs | | | | | | | | X | |

X site surveyed/searched and subspecies present
O site surveyed/searched and subspecies not present

c) Washoe County Site #1 (Warm Springs Valley). This site in Washoe County occurs on Bureau of Land Management and adjacent private lands (Table 1). The nectar site is estimated to include about 10 to 12 hectares (25 to 30 acres), with approximately half of the site occurring on Bureau of Land Management lands and half on private lands (Brussard *et al.* 1999). Because management activities differ between the public versus the private lands at this site, we report it as two nectar sites (Bureau of Land Management; Private). A few Carson wandering skippers were seen approximately 1.6 kilometers (1.0 mile) northeast of this site. This suggests the Carson wandering skipper may occur in small numbers elsewhere in the valley (Brussard *et al.* 1999). Surveys were not conducted in 1999 or 2000 at these nectar sites. In 2001, searches of this area were made to confirm the Carson wandering skipper's presence. Five individuals were found at the nectar site on Bureau of Land Management lands; private lands were not searched (Virginia Rivers, Truckee Meadows Community College, pers. comm. 2001). In 2002 and 2003, searches of the Bureau of Land Management nectar site were made to confirm the Carson wandering skipper's presence and 3 and approximately 15 individuals, respectively, were observed in 1 day (M. Haworth and W. Devaurs, Bureau of Land Management, pers. obs. 2002; M. Haworth and W. Devaurs, pers. obs. 2003). In 2004, one and three Carson wandering skippers were observed during 2 days of searching the Bureau of Land Management nectar site (M. Haworth, U.S. Fish and Wildlife Service, and C. Funari, Bureau of Land Management, pers. obs. 2004).

d) Washoe County Site #2 (single sighting). This nectar site was found in 2004 (Table 1). This site is located on private lands in Spanish Springs Valley. One male Carson wandering skipper was observed on nectar (D. Murphy *in litt.* 2004). Suitable habitat is estimated at approximately 16 hectares (40 acres). Additional Carson wandering skipper habitat may occur on adjacent private property.

e) Washoe County Site #3 (single sighting) A single male Carson wandering skipper was observed in 2004 (Table 1) along the southeastern boundary of an alkali flat south of Flanigan (M. Sanford *in litt.* 2004b).

2. California

The population/metapopulation in Honey Lake Valley in Lassen County, California appears to be larger than either of the two populations in Nevada. Numerous nectar sites have been located around Honey Lake during the period from 1998 to 2004. While it is not yet clear whether the Carson wandering skippers found around Honey Lake form a single population or a metapopulation, distances between the nearest nectar sites may be within the dispersal range of adults. As additional information is collected, the population structure in Honey Lake Valley should become evident.

The two nectar sites found in 1998 in Lassen County, California (Table 2), occurred on public lands managed by the California Department of Fish and Game (Site #1) and private lands (Site #2). In 1998, two individuals were observed on the public lands, while several individuals were observed at a nectar site less than 2 hectares (5 acres) in size on the private lands. These nectar sites are located approximately 8.0 kilometers (5.0 miles) from each other. Surveys were not conducted at these sites in 1999. Surveys were conducted in 2000, and, while several individuals were seen on the private property nectar site, none were seen on the public lands (P. Brussard, pers. comm., 2000). In 2001, searches were conducted to confirm the Carson wandering skipper's presence. A few Carson wandering skippers (three one day and four on another day) were observed on the private property nectar site, but again, none were observed on the public lands

Table 2. Occupied Carson wandering skipper nectar sites in Lassen County, California, and dates of monitoring efforts since 1997.

| Site Name | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|--|------|------|------|------|------|------|------|------|------|
| CDFG (#1) | | X | | O | O | X | | X | |
| Private (#2) | | X | | X | X | O | | | |
| Wendel Area (#3) | | | | | | X | | X | |
| Mapes Rd (#4) | | | | | | X | | | |
| The Island (#5) | | | | | | | X | X | |
| Cross Depot Access (#6) | | | | | | | X | X | |
| North Shore - Honey Lake Ranch (#7-8) | | | | | | | | X | |
| North Shore - Dakin Unit (#9-10) | | | | | | | | X | |
| East Shore - Wendel Hot Springs (#11-14) | | | | | | | | X | |
| East Shore - Amedee Hot Springs (#15-17) | | | | | | | | X | |
| Northern Shore Island (#18-22) | | | | | | | | X | |
| Western Shore Island (#23) | | | | | | | | X | |

X Site surveyed/searched and subspecies present

O Site surveyed/searched and subspecies not present

nectar site (V. Rivers, pers. comm. 2001). In 2002, no individuals were observed on the private property nectar site (M. Haworth, pers. obs. 2002, R. Niell *in litt.* 2003). In 2002, two individuals were seen on the California Department of Fish and Game public lands (S. Black *in litt.* 2002, M. Vaughn *in litt.* 2002, R. Niell *in litt.* 2003).

During surveys conducted in the Honey Lake Valley in 2002 and 2003 for specific proposed projects, four more nectar sites were found (Table 2). In 2002, a new nectar site (Site #3) was found near the Wendel Hot Springs area. On 4 different days, 1 to 20 individuals were seen on nectar. Also in 2002, three individuals were seen on Mapes Road (Site #4), approximately 3 miles west of the public/private site (P. Epanchin *in litt.* 2002). In 2003, Carson wandering skippers were observed on two parcels of lands (The Island [Site #5] and Cross Depot Access [Site #6]) that have been transferred to the Honey Lake Conservation Team for future deeding to the California State Lands Commission. The number of Carson wandering skippers observed nectaring ranged from 1 to

33 over 3 survey days at these 2 sites (Earth Tech Inc. 2003). In 2004, Sanford (*in litt.* 2004a) observed three Carson wandering skippers in the general area of the Cross Depot Access site (#6).

In June of 2004, employees of Michael Baker Jr., Inc., inventoried land around Honey Lake shoreline within the lake's boundary (meander) line. Forty areas were identified, based on data collected (nectar sources, *Distichlis* areas, elevation, soil alkalinity, nearby water sources, etc.), as potential Carson wandering skipper habitat to be surveyed for Carson wandering skipper presence during the flight season. As a result of this effort, 23 nectar sites for the Carson wandering skipper were found (A. Hreha *in litt.* 2004a, 2004b) in Honey Lake Valley, California. Most of the surveys occurred on lands immediately around the lake on former military lands, currently held by the Honey Lake Conservation Team. Other, more upland, areas were surveyed with permission from the landowners.

Due to the number of new occupied nectar sites found (17), we group them into 6 general areas around Honey Lake [North Shore (Honey Lake Ranch); North Shore (Dakin Unit); East Shore (Wendel Hot Springs); East Shore (Amedee Hot Springs); Northern Shore Island; Western Shore Island] for reporting purposes. Six of the individual nectar sites were located very near to nectar sites found previously in 2002 and 2003 (as indicated in Table 2), and 2004 information will be included under those previous locations to avoid double counting nectar sites; in 2004, between 7 and 37 Carson wandering skipper individuals were observed at these 6 nectar sites.

The six general areas where new nectar sites were found around Honey Lake during 2004 are discussed as follows:

- North Shore (Honey Lake Ranch). This general area includes two new nectar sites (#7 and #8) where one Carson wandering skipper individual was observed at each site. Land ownership included Honey Lake Conservation Team and private lands.
- North Shore (Dakin Unit). This general area includes 2 new nectar sites (#9 and #10) where 1 and 10 Carson wandering skipper individuals were observed respectively. Land ownership included Honey Lake Conservation Team, private, Bureau of Land Management, and state lands.

- East Shore (Wendel Hot Springs). This general area includes 4 new nectar sites (Sites #11 to #14) where between 1 and 186 Carson wandering skipper individuals were observed. Land ownership included Honey Lake Conservation Team, private, and Bureau of Land Management lands.
- East Shore (Amedee Hot Springs). This general area includes three new nectar sites (#15 to #17) where one Carson wandering skipper was observed at each site. Land ownership included Honey Lake Conservation Team and state lands.
- Northern Shore Island. This general area includes 5 new nectar sites (#18 to #22) where 1 to 25 Carson wandering skippers were observed. Land ownership included Honey Lake Conservation Team, private, and state lands.
- Western Shore Island. This general area includes one new nectar site (#23) where three Carson wandering skippers were observed. Land ownership included Honey Lake Conservation Team, private, and state lands.

D. LIFE HISTORY/ECOLOGY

Carson wandering skipper females lay their cream-colored eggs on *Distichlis spicata*, the larval host plant for the species (Garth and Tilden 1986, Scott 1986). *Distichlis spicata* is a common species in the *Atriplex-Sarcobatus* vegetation communities of the intermountain west and is widely distributed in lowland areas of now dry **pluvial** lakes. Different kinds of *Distichlis* communities exist, ranging from near-monotypic communities in meadow areas to understories in shrub dominated communities (Young *et al.* 1986). Some *Distichlis* communities have roots in contact with the ground water table while others rely on soil moisture from precipitation.

No other observations have been made of the early life stages of the Carson wandering skipper. However, the Carson wandering skipper's life cycle is likely similar to other species of Hesperinae. **Larvae** of the subfamily Hesperinae live in silked-leaf nests, and some species make their nests partially underground. Larvae of the subfamily Hesperinae are usually green or tan and have a dark head and black collar (Scott 1986). **Pupae** (intermediate stage between larvae and adult) generally rest in the nest, and larvae generally hibernate (Scott 1986). Minno (1994) described a last **instar** larva and a **pupa** of *Pseudocopaodes eunus*. These descriptions were based on one specimen each

collected in California. Some larvae may be able to extend their period of **diapause** for more than one season depending on the individual and environmental conditions (P. Brussard, pers. comm., 2001).

Carson wandering skippers may differ from other *Pseudocopaedes eunus* subspecies in producing only one **brood** per year during June to mid-July (Austin and Emmel 1998). The other subspecies may produce a second brood in late July to late September (Austin and Emmel 1998). During the 1998 surveys (Brussard *et al.* 1999), the formerly occupied Carson City site and the two occupied sites were visited again in August and September to look for second broods; none were found.

E. HABITAT CHARACTERISTICS/ECOSYSTEM

Little is known about the specific habitat requirements of the Carson wandering skipper beyond the similarities recognized among known locations of this subspecies. Based on observations of known, occupied sites, suitable habitat for the Carson wandering skipper in any given year has the following characteristics: elevation of less than 1,524 meters (5,000 feet); located east of the Sierra Nevada; and presence of green *Distichlis spicata* during March through June with a nectar source. Other characteristics may include possible geothermal activity and open areas near springs or water (Brussard *et al.* 1999).

There are no data in the literature on the micro-habitat requirements of the Carson wandering skipper (Brussard *et al.* 1999). However, it is likely that suitable larval habitat is related to the water table. Many *Distichlis* areas are inundated in the spring. During wet years, larval survival likely depends on *Distichlis* areas being above standing water. In dry years, survival is probably related to the timing of the host plant **senescence**. Therefore, **micro-topographic** variation is probably important for larval survival because it provides a greater variety of appropriate habitat over time (Brussard *et al.* 1999). Since the few historic collections of the Carson wandering skipper have been near hot springs, it is possible this subspecies may require the higher water table or ground temperatures associated with these areas to provide the appropriate temperatures for successful larval development (Brussard *et al.* 1999). However, more recent nectar sites are not located particularly close to geothermal springs. Larval development may not rely on appropriate temperatures but rather on the presence of good quality *Distichlis spicata* provided by any more permanent water source.

Adult Carson wandering skippers require nectar for food. For a *Distichlis* area to be appropriate habitat for the Carson wandering skipper, an appropriate

nectar source must be present and in bloom during the flight season. Few plants that can serve as nectar sources grow in the highly alkaline soils occupied by *Distichlis spicata*. Plant species known to be used by the Carson wandering skipper for nectar include *Thelypodium crispum* (thelypody), *Sisymbrium altissimum* (tumble mustard), *Pyrrocoma racemosus* (racemose golden-weed), *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Lotus corniculatus* (bird's foot trefoil)[†], *Cleomella parviflora* (slender cleomella), *Cleomella plocasperma* (small-flowered cleomella), *Heliotropium curassavicum* (heliotrope), *Potentilla* sp. (cinquefoil), and *Sesuvium verrucosum* (western sea purslane) (Brussard *et al.* 1999; R. Niell, pers. comm. 2003; D. Murphy *in litt.* 2004b; A. Hreha *in litt.* 2004a, 2004b). If alkaline-tolerant plant species are not present but there is a fresh-water source to support alkaline-intolerant nectar sources adjacent to the larval host plant, the area may provide suitable habitat (Brussard *et al.* 1999). Nectar sources depend on various environmental conditions and are likely to be transitory. Thus, nectar sites used by the Carson wandering skipper may change from year to year.

1. Nevada

a) Carson City Site. This site no longer supports the Carson wandering skipper as a result of surrounding development and habitat changes likely caused by drainage manipulations to accommodate this development. Most of the original habitat was destroyed by the construction of a shopping center. Subsequent urban development in the 1990's further reduced the remaining habitat to approximately 8.1 hectares (20 acres) (Brussard *et al.* 1999). While the site still supports *Distichlis spicata* and areas of native mustard, *Thelypodium crispum*, which served as the only nectar source at this site, the Carson wandering skipper has not been observed here since 1997. The elevation of this site is about 1,420 meters (4,660 feet). The Carson Hot Springs drainage currently meanders through this general area though portions of it have been modified due to development activities.

b) Douglas County (Carson River) Site. This site in Douglas County (Table 3) occurs on Bureau of Land Management administered lands, with additional habitat likely extending onto adjacent Nevada state lands and City of Incline Village lands. The potential nectar sources included *Lotus corniculatus* and the site is about 4 hectares (10 acres) in size. The entire habitat on the three

[†] Identification to species is possibly ambiguous, but *Lotus* occurrences are referred to as *Lotus corniculatus* in this recovery plan. According to The Jepson Manual (Hickman 1993), "In Europe, diploid *L. tenuis* Willd. is segregated [from *L. corniculatus*]; it seems indistinguishable in California."

Table 3. Currently and formerly occupied Carson wandering skipper sites in Nevada, with site characteristics.

| Site name | Found east of Sierra Nevada | Elevation less than 5,000 feet | Salt grass | Nectar | Microtopographic relief | Geo-thermal spring within 1.5 mile | Non geo-thermal spring within 1.5 mile | Other type of water source within 1.5 mile |
|-------------------------------|-----------------------------|--------------------------------|------------|--------|-------------------------|------------------------------------|--|--|
| Carson City | X | X | X | X | X | X | | |
| Douglas County | X | X | X | X | X | X | | X |
| Warm Springs Valley (BLM) | X | X | X | X | X | X | | |
| Warm Springs Valley (Private) | X | X | X | X | X | X | | |
| Flanigan | X | X | X | X | X | ? | ? | X |
| Spanish Springs | X | X | X | X | X | | | X |

properties is estimated at about 56.7 hectares (140 acres). The elevation is 1,420 meters (4,659 feet). *Distichlis spicata* occurs throughout the habitat and is interspersed with an overstory of *Artemisia* sp. (sagebrush), *Sarcobatus vermiculatus* (greasewood), and *Atriplex* sp. (saltbush). The density of *D. spicata* ranges from very sparse to fairly dense. There is an accumulation of salt on the soil surface. Hot springs are noted about 2.4 kilometers (1.5 miles) south of the site. The Carson River is located nearby, and the City of Incline Village lands support wetlands (R. Niell *in litt.* 2004).

The Bureau of Land Management portion of the site is dissected by a two track road. A second dirt road goes around the site. Evidence of recreational shooting was found on site (R. Neill *in litt.* 2004).

c) Washoe County Site # 1 (Warm Springs Valley). The first site in Washoe County occurs on Bureau of Land Management administered lands and adjacent private lands, thus reported as two nectar sites (Table 3). Both nectar sites combined are estimated to be about 10 to 12 hectares (25 to 30 acres), with approximately half occurring on Bureau of Land Management lands and half on private lands (Brussard *et al.* 1999). The nectar source (*Pyrrocoma racemosus*) is abundant, as is *Distichlis spicata*. The nectar sites are located at 1,290 meters (4,232.5 feet) in elevation. Springs are located within about 1.6 kilometers (1.0 mile) of the nectar sites.

d) Washoe County Site # 2 (single sighting). This second site is located on private lands in Spanish Springs Valley (Table 3). One male Carson wandering skipper was observed nectaring on *Cleomella plocasperma* (D. Murphy *in litt.* 2004). The nectar site where the Carson wandering skipper was seen was less than 2 hectares (5 acres) in size but this particular nectar source, along with other known nectar sources such as *Pyrrocoma racemosus*, *Lotus corniculatus*, and *Sisymbrium altissimum*, occurred in scattered areas over the property. Suitable habitat may also occur on adjacent lands. The site is located at 1,359 meters (4,460 feet) in elevation. A large, open water body occurs nearby, approximately 0.4 kilometer (0.25 mile) away. Springs occur between 6.4 and 12.9 kilometers (4 and 8 miles) away. This site is threatened by residential development. *Lepidium latifolium* (tall whitetop or perennial pepperweed) is invading adjacent lands. Future surveys are needed to determine if a population/metapopulation exists in this area.

e) Washoe County Site # 3 (single sighting). A single male Carson wandering skipper was sighted south of Flanigan along the southeastern boundary of an alkali flat at elevation 1,212 meters (3,975 feet) (M. Sanford *in litt.* 2004a, 2004b). The individual was observed on *Distichlis spicata*. The vegetation in the area was comprised of *D. spicata* and *Sarcobatus vermiculatus*, with some *Artemisia* sp. Nectar sources could have been *Chrysothamnus* sp. (rabbitbrush) or *Medicago sativa* (alfalfa). The nearest spring site was less than 1.6 kilometers (1 mile) away. The alkali flat was quite dry. Surveys are needed to determine if a population/metapopulation exists in this area.

2. California

Carson wandering skippers were observed at a total of 23 sites in the vicinity of Honey Lake from 1998 to 2004 (Table 4).

Table 4. Currently or formerly occupied Carson wandering skipper sites in Lassen County, California, with site characteristics.

| Site Name | Found east of Sierra Nevada | Elevation less than 5,000 feet | Salt grass | Nectar | Microtopographic relief | Geo thermal spring within 1.5 miles | Non geo thermal spring within 1.5 miles | Other water source within 1.5 miles |
|--|-----------------------------|--------------------------------|------------|--------|-------------------------|-------------------------------------|---|-------------------------------------|
| CDFG (#1) | X | X | X | X | X | X | | |
| Private (#2) | X | X | X | X | X | X | | |
| Wendel Area (#3) | X | X | X | X | X | X | | |
| Mapes Rd (#4) | X | X | X | X | X | ? | ? | ? |
| The Island (#5) | X | X | X | X | X | | | X |
| Cross Depot Access (#6) | X | X | X | X | X | | | X |
| North Shore - Honey Lake Ranch (#7-8) | X | X | X | X | X | | | X |
| North Shore – Dakin Unit (#9-10) | X | X | X | X | X | | | X |
| East Shore - Wendel Hot Springs (#11-14) | X | X | X | X | X | | | X |
| East Shore - Amedee Hot Springs (#15-17) | X | X | X | X | X | | | |
| Northern Shore Island (#18-22) | X | X | X | X | X | | | |
| Western Shore Island (#23) | X | X | X | X | X | | | |

a) Lassen County Sites # 1. The nectar sites found in 1998 occurred on public lands (one site) managed by California Department of Fish and Game and adjacent private lands (one site) (Brussard *et al.* 1999). Two females were observed on the public lands, one on *Lotus corniculatus*. *Distichlis spicata* is abundant in this area. The site is located at approximately 1,234 meters (4,050 feet) in elevation. Springs are known to be located within 2.4 kilometers (1.5 miles) of the site.

In 2002, Carson wandering skippers were again located on California Department of Fish and Game lands in this general area. One Carson wandering skipper was seen nectaring on *Cleomella parviflora* (R. Niell *in litt.* 2003). The *Distichlis* habitat in the immediate area was about 2 hectares (5 acres) in size. The site is at about 1,219 meters (4,000 feet) in elevation. Ditches provide a freshwater source on site. Another sighting on the California Department of Fish and Game lands was reported in 2002 (S. Black *in litt.* 2002, M. Vaughn *in litt.*

2002). A Carson wandering skipper was seen on a levee separating ponds created for waterfowl. The site's elevation is about 1,219 meters (4,000 feet).

In 2004, 13 Carson wandering skippers were observed on/near California Department of Fish and Game lands on *Heliotropium curassavicum* at approximately 1,222 meters (4,010 feet) in elevation (A. Hreha *in litt.* 2004a, 2004b). The nectar source *Sesuvium verrucosum* was also available. Water sources occur within 2.4 kilometers (1.5 miles) of the sighting.

b) Lassen County Site # 2. The second nectar site found in 1998 occurred on private lands with nectar covering less than 0.4 hectare (1 acre) in size. *Distichlis spicata* is abundant in this area, but the attraction appeared to be the nectar source, *Lotus corniculatus*. Eight individuals were observed during one particular visit in 1998 (Brussard *et al.* 1999). This site is located at approximately 1,234 meters (4,050 feet) in elevation. Springs occur within 2.4 kilometers (1.5 miles) of the site.

c) Lassen County Site # 3. This site, on the north side of Honey Lake (Wendel Area) is a nectar site consisting of several nectar sources (R. Niell *in litt.* 2003). Carson wandering skippers were seen nectaring on *Cleomella parviflora*, *Potentilla* sp., and *Lotus corniculatus*. As many as 15 to 20 individuals were seen on different days. The *Distichlis* habitat is about 10 acres in size. The site is located at approximately 1,219 meters (4,002 feet) in elevation. Springs are located on site.

In 2004, seven Carson wandering skipper individuals were observed on *Lotus corniculatus*, though *Cleomella parviflora* was also available, at elevation 1,228 meters (4,030 feet).

d) Lassen County Site # 4. In 2002, three Carson wandering skipper individuals were observed along Mapes Road on the north side of Honey Lake, nectaring on *Lotus corniculatus*. This area was near a culvert under the road, which created an artificial low, wet area (P. Epanchin *in litt.* 2002).

e) Lassen County Sites # 5. This site (The Island) was located in 2003 on the peninsula on the south side of Honey Lake. It included various sized nectar patches up to 40.5 hectares (100 acres) consisting of *Heliotropium curassavicum* and *Sisymbrium altissimum* (Earth Tech Inc. 2003). The *Distichlis* habitat was about 81 hectares (200 acres) in size. Numerous Carson wandering skippers were seen nectaring on *H. curassavicum*. The site's elevation is 1,213 meters (3,980 feet). Freshwater sources are located approximately 13 kilometers

(8 miles) away. Geothermal springs are located about 24 kilometers (15 miles) from the site.

In 2004, 37 and 7 Carson wandering skippers were observed at elevations 1,219 meters (4,000 feet) and 1,216.5 meters (3,991 feet), respectively (A. Hreha *in litt.* 2004b). Individuals were observed on *Heliotropium curassavicum* and *Sesuvium verrucosum*.

f) Lassen County Sites # 6. This site (Cross Depot Access), also found on the south side of Honey Lake in 2003, was located at about 1,211 meters (3,975 feet) in elevation. The *Distichlis* habitat is about 162 hectares (400 acres), and the nectar site was less than 0.2 hectare (0.5 acre). A few Carson wandering skippers were seen nectaring on *Heliotropium curassavicum*. Freshwater sources are located approximately 16 kilometers (10 miles) away. Geothermal springs are located more than 24 kilometers (15 miles) from the site (Earth Tech Inc. 2003).

In 2004, 7 and 14 Carson wandering skipper individuals were found at elevations of 1,218.6 meters (3,998 feet) and 1,211.9 meters (3,976 feet), respectively. Individuals were observed on *Heliotropium curassavicum* though *Sesuvium verrucosum* was also available (A. Hreha *in litt.* 2004a, 2004b).

In 2004, three Carson wandering skipper individuals were observed nectaring on *Heliotropium curassavicum* in this general area. *Sesuvium verrucosum* was also available (M. Sanford *in litt.* 2004a).

g) Lassen County Sites # 7-23. As stated earlier, numerous new nectar sites (17) were located around Honey Lake in 2004 and are grouped into 6 general areas for ease of reporting (A. Hreha *in litt.* 2004a, 2004b). A total of 394 Carson wandering skippers were observed during the 2004 survey season at these sites.

- North Shore (Honey Lake Ranch). Two nectar sites (Sites #7 and #8) were found at elevations of 1,209.8 meters and 1,213 meters (3,969 and 3,980 feet), respectively. Nectar sites were less than 2.0 hectares (5 acres) to 4.0 hectares (10 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum*, *Lotus corniculatus*, and *Sisymbrium altissimum* were also available as nectar sources. The *Distichlis* habitat was between 8 and 12 hectares (20 and 30 acres) in size at the sites. Water sources were 0.8 to 1.6 kilometers (0.5 to 1 mile) away.

- North Shore (Dakin Unit). Two nectar sites (Sites #9 and #10) were found at elevations of 1,213 meters (3,980 feet) and 1,214 meters (3,984 feet) in this area and were less than 2.0 hectares (5 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum*, *Lotus corniculatus*, *Sisymbrium altissimum*, and *Sesuvium verrucosum* were also available as nectar sources. Nearby *Distichlis* habitat was between 16.2 and 101.2 hectares (40 and 250 acres) in size. Water sources were within 1.6 kilometers (1 mile) of these sites.
- East Shore (Wendel Hot Springs). Four nectar sites (Sites #11 to #14) were included in this general area and were found between 1,213.7 and 1,221.6 meters (3,982 and 4,008 feet) in elevation. Nectar sites were between 2.0 hectares (5 acres) and 16.2 hectares (40 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum*, *Sesuvium verrucosum*, and *Lotus corniculatus*, *Cleomella parviflora*, was also available as a nectar source. The *Distichlis* habitat was between less than 2.0 and 97.1 hectares (5 and 240 acres) in size at these sites. Water sources were between 0.8 and 1.6 kilometers (0.5 and 1.5 miles) away.
- East Shore (Amedee Hot Springs). The three nectar sites (Sites #15 to #17) found in this general area were located between 1,212 and 1,216 meters (3,975 and 3,990 feet) in elevation. Nectar sites were between less than 2 hectares (5 acres) and 8.1 hectares (20 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum*, *Sesuvium verrucosum* was also available as a nectar source. The *Distichlis* habitat was between 12 and 47 hectares (30 and 115 acres) in size. A water source was 0.3 kilometers (0.2 miles) away from one site but between 3.2 and 4.8 kilometers (2.0 and 3.0 miles) away from the other two sites.
- Northern Shore Island. The five nectar sites (#18 to #22) were found between 1,212.8 and 1,214.9 meters (3,979 and 3,986 feet) in elevation. Nectar sites were from less than 2.0 hectares to about 26.3 hectares (5 acres to 65 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum* and *Sesuvium verrucosum*, *Lotus corniculatus*, *Cleomella parviflora*, and *Sisymbrium altissimum* were also available as nectar sources. The *Distichlis* habitat was between 14.2 and 76.9 hectares (35 and 190 acres) in size. Water sources were between 3.2 and 8.0 kilometers (2 and 5 miles) away.

- Western Shore Island. This nectar site (#23) was found at an elevation of 1,219.2 meters (4,000 feet). The nectar site was less than 2.0 hectares (5 acres) in size. While Carson wandering skippers were observed nectaring on *Heliotropium curassavicum*, *Lotus corniculatus* was also available as a nectar source. The *Distichlis* habitat was about 16.2 hectares (40 acres) in size. Water sources were between 6.8 and 7.2 kilometers (4.2 and 4.5 miles) away.

F. REASONS FOR LISTING/THREATS

Species are placed on the List of Endangered and Threatened Wildlife and Plants based on one or more of the five listing factors for Federal listing of a species in section 4(a)(1) of the Endangered Species Act. The five listing factors are: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) Over-utilization for commercial, recreation, scientific, or educational purposes; (3) Disease or predation; (4) The inadequacy of existing regulatory mechanisms; and (5) Other natural or manmade factors affecting its continued existence. On August 7, 2002, we published a final rule listing the Carson wandering skipper as an endangered species (U.S. Fish and Wildlife Service 2002).

Although the Carson wandering skipper is thought to have been historically rare, it is likely to have been more widespread in the past. Only three populations are currently known to exist. At the time of listing the following threats were discussed: habitat destruction, degradation, and fragmentation due to urban and residential development; wetland habitat modification; agricultural practices (such as excessive livestock grazing); gas and geothermal development; and non-native plant invasion. Other threats include collecting, livestock trampling, water exportation projects, road construction, recreation, pesticide drift, and lack of state regulatory mechanisms for the protection of insects. Extinction could occur from naturally occurring events or other threats due to the small, isolated nature of the known populations.

1. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Adult Carson wandering skippers have not been observed at the Carson City site since 1997. The Carson wandering skipper has likely been extirpated from this site due to development and habitat changes resulting from drainage manipulations for residential and commercial development (Brussard *et al.* 1999).

Adjacent lands surrounding this site will continue to be developed for commercial and residential use.

The remaining unoccupied habitat at the Carson City site also will be fragmented or destroyed by construction of a freeway bypass and associated flood control facilities by the Nevada Department of Transportation. The alignment will impact approximately 2.4 hectares (6 acres) of previously occupied habitat and about 8 hectares (20 acres) of the potential habitat remaining at both areas north and south of U.S. 50 (P. Frost *in litt.* 1998). Construction activities began in 2002-2003, and the freeway corridor is currently being graded (M. Haworth, pers. obs. 2004).

Residential development is occurring in the vicinity of the Washoe County population. Urban development is occurring in the vicinity of the Lassen County population. Increases in domestic wells could impact the water table in the area, resulting in changes to the *Distichlis* community in these valleys. As these areas become more populated, fragmentation and degradation of the Carson wandering skipper's habitat is expected to increase due to development.

Until 2001, grazing practices on Bureau of Land Management-administered lands at the Washoe County site allowed for a November to March grazing season. While this season of use avoids adverse impacts to adult Carson wandering skipper nectar sources and *Distichlis spicata* during spring and summer, high livestock densities can cause larval mortality through trampling during the winter. On adjacent private lands, cattle densities and timing are not regulated, and cattle have access to nectar sources during the Carson wandering skipper's flight season. Cattle also have access to the Lassen County site; however, it is unknown at this time what type of management is being implemented. As stated earlier, timing of use and densities of livestock can affect the availability of nectar sources and *Distichlis spicata*, as well as larval survival.

Implementation of proposed large scale water exportation projects could result in the lowering of the water table in Warm Springs or Honey Lake Valleys. This may cause the loss of a significant portion of the *Distichlis* community upon which the Carson wandering skipper population in these areas depends.

As development increases near known sites, there may be a potential for increases in recreational activities, such as off-highway vehicle use. This use is likely to occur both on public and private lands as these areas becomes more developed. Recreational use at the Carson City population may have contributed

to the possible extirpation of that population through habitat destruction and fragmentation.

A proposed gas and geothermal development permit has been issued near the Lassen County population. The Carson wandering skipper may be associated with geothermal areas, and the resulting hydrologic and ground disturbances caused by exploratory drilling may affect the subspecies and its habitat.

At the Lassen County population, *Lepidium latifolium* is of concern. *Lepidium latifolium* is a perennial native to Europe and Asia that grows in disturbed sites, wet areas, ditches, roadsides, and cropland. It is very competitive, and the species can occur in dense patches that become near-monoculture sites (Young *et al.* 1995). Spreading roots and numerous seeds make this plant difficult to control (Stoddard *et al.* 1996). Beginning in 2000, this nonnative species began to encroach onto the nectar site on the private property in California and has become established in patches of *Lotus corniculatus*, this site's nectar source. By 2002, a portion of this nectar site had been eliminated due to *Lepidium latifolium* invasion. In Lassen County, *Lepidium latifolium* has become widely established (Howard 2000). To date, Carson wandering skippers have not been observed nectaring on *Lepidium latifolium*.

Pesticide use can be a potential threat to the Carson wandering skipper. Pesticides used to control pests could affect the Carson wandering skipper if used in close proximity or through pesticide drift.

2. Over-Utilization for Commercial, Recreation, Scientific, or Educational Purposes

The known populations of Carson wandering skipper that remain could face strong pressure from collectors. Since some of the nectar sites occur near public roadsides, the subspecies is easily accessible, and the limited number and distribution of these populations make this subspecies vulnerable to collectors. Collecting of the Carson wandering skipper at the Carson City site over several years may have contributed to the extirpation of that population. To date, there are no known cases of collecting causing a population extirpation.

3. Disease or Predation

There also may be some threat from predation, parasitism, or disease; however, these threats have not been determined.

4. The Inadequacy of Existing Regulatory Mechanisms

The Carson wandering skipper occurs on Federal, State, and private lands. The California Department of Fish and Game is unable to protect insects under its current regulations (P. Bontadelli *in litt.* 1990). The Nevada Division of Wildlife is unable to protect insects under its current regulations (Nevada Revised Statutes 1999).

5. Other Natural or Manmade Factors Affecting its Continued Existence

The apparent low numbers of the Carson wandering skipper make it vulnerable to risks associated with small, restricted populations. This subspecies is susceptible to **extinction** as a result of naturally occurring **stochastic** environmental or demographic events because the Carson wandering skipper occurs at only three known isolated locations and in fairly small numbers. These events could be wildfire, increase in disease or predation, or severe weather events such as flooding. Additionally, random demographic effects (e.g., skewed sex ratios) and loss of genetic variability may result in individuals and populations being less able to cope with environmental change and could cause the loss of one or both of the populations. In addition, the loss of habitat compromises the ability of the Carson wandering skipper to disperse. Populations remain isolated with no opportunity to migrate or recolonize if conditions become unfavorable.

G. CONSERVATION MEASURES

Conservation measures include scientific studies, laws that provide protection, and other activities that affect the conservation of the Carson wandering skipper.

1. Federal Protection

Section 6 of the Endangered Species Act provides for Cooperative Agreements between us and state wildlife agencies that have approved conservation management programs for listed species. To date no one has applied for section 6 funds for conservation of the Carson wandering skipper.

Section 7(a) of the Endangered Species Act requires Federal agencies to evaluate their actions with respect to any species that is proposed to be listed or is listed as endangered or threatened, and with respect to its critical habitat, if any is being designated. Federal agencies are required to confer with us informally on

any action that is likely to jeopardize the continued existence of a proposed species, or result in destruction or adverse modification of proposed critical habitat. If a species is subsequently listed, section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species, or to destroy or adversely modify its critical habitat. If a Federal agency action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with us. Section 7(a)(1) requires that these agencies use their authorities to further the conservation of listed species. Several informal consultations have been conducted in Nevada and California since the Carson wandering skipper's listing. These have included construction of a Federal Correctional Institute, Department of Defense ordnance and explosive response actions, land transfers to Lassen County, Herlong, and the Honey Lake Conservation Team, and Caltrans construction of a wetlands mitigation bank in California, as well as several recreational events on Bureau of Land Management lands in Nevada.

Section 9 of the Endangered Species Act makes it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or attempt any such conduct), import or export, transport in interstate or foreign commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Regulations further define harm to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harassment consists of intentional or negligent actions that create the likelihood of injury to listed species to such an extent to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding, or sheltering.

Section 10 of the Endangered Species Act provides for the issue of two types of permits. These permits authorize actions that would otherwise be prohibited under section 9. Such permits are available for scientific purposes or to enhance the propagation or survival of the listed species [10(a)(1)(A)] and for incidental take in connection with otherwise lawful activities [10(a)(1)(B)]. To date, one section 10(a)(1)(A) permit request involving the Carson wandering skipper has been reviewed and a permit issued. In addition, a section 10(b)(1)(B) permit is in the process of being prepared due to planned residential development activities in Nevada.

Some protection is afforded to the Carson wandering skipper on lands administered by the Bureau of Land Management at the Washoe County site due to their commitment to assist in the conservation of this subspecies through a Cooperative Agreement. This Cooperative Agreement was signed by us, Nevada Department of Transportation, the Federal Highway Administration, and the Bureau of Land Management in October 1999. Since then the Bureau of Land Management has designated 98 hectares (243 acres) of their lands at the Washoe County site as an Area of Critical Environmental Concern. This designation allows the Bureau of Land Management discretion in determining actions that can occur within this area (Bureau of Land Management 2001). However, these protections only cover a portion of Carson wandering skipper habitat in the area and are insufficient to protect the species throughout the site due to adjacent private land ownership.

2. State Protection

Although California State laws may provide a measure of protection to this subspecies, these laws are not adequate to protect the Carson wandering skipper and ensure its long-term survival. California Environmental Quality Act pertains to projects on non-Federal lands and requires that a project proponent publicly disclose the potential environmental impacts of proposed projects. Section 15065 of the California Environmental Quality Act Guidelines requires a “finding of significance” if a project has the potential to “reduce the number or restrict the range of a rare or endangered plant or animal” including those that are eligible for listing under the California Endangered Species Act. However, under the California Environmental Quality Act, where overriding social and economic considerations can be demonstrated, a project may go forward despite significant adverse impacts to a species.

H. RECOVERY STRATEGY

Due to the restricted range of this subspecies and its vulnerability, a priority for **recovery** is to manage and maintain the remaining populations and the habitats on which they occur; threats must be effectively counteracted to assure the persistence of populations. Threats to habitat may be addressed through such means as land acquisition from willing sellers, conservation agreements, management agreements, or by other means.

Very little is understood about the ecological, life history, or population structure of the Carson wandering skipper. A good understanding of these parameters is needed to protect fully the subspecies from extinction. Research is

essential in making scientifically based conservation decisions. A research program that targets the life history and habitat requirements of the Carson wandering skipper is necessary. Additional research needs to be conducted to provide a better understanding of the subspecies' demographics and whether or not the Carson wandering skipper occurs as **local populations** at a **local scale** or as **metapopulations** at a **metapopulation scale** (Hanski and Gilpin 1991). Annual monitoring of the known populations with appropriate, consistent methods is essential to better understand normal population fluctuations, trends, and movement into or out of changing habitats. Monitoring should be applied during a sufficient period of time (20 years) to address the variability of environmental conditions that may be experienced by the Carson wandering skipper. Surveys are needed in potential habitats to determine the distribution of known populations or the presence of additional populations. As more information becomes available, areas that support adequate amount of suitable habitat will be evaluated as possible reintroduction sites. Delisting of the Carson wandering skipper could be based, in part, on the discovery or establishment of one or more additional populations or metapopulations located elsewhere within its range. However, we may determine that locating or establishing one or more additional populations or metapopulations elsewhere within its range is not feasible.

Viable populations or metapopulations must be perpetuated throughout the Carson wandering skipper's geographic range in California and Nevada. This can be accomplished by maintaining extant populations or metapopulations throughout its range, and improving and stabilizing those populations or metapopulations that are less secure such that they are large enough to be viable. Monitoring and **adaptive management** should protect areas against threats, maintain suitable habitat over time, and identify appropriate responses to any declines.

Because of the natural fluctuation of butterfly abundance due to various factors, using numbers of individuals as a recovery criterion is inappropriate. This also applies to identifying a required minimum population size. Due to the difficulties associating numbers of populations or numbers of individuals within each population with recovery success for invertebrates, the amount of suitable habitat and its occupancy is recommended (D. Murphy, University of Nevada, Reno, and E. Fleischman, Stanford University, pers. comm. 2004) as a feasible means of expressing recovery criteria. Some habitat/landscape characteristics known or suspected to be associated with Carson wandering skipper occupancy include green *Distichlis spicata* for larval feeding at the appropriate time of year, nectar sources for adult feeding at the appropriate time of year, and presence of

springs or other water sources for larval host plant/nectar establishment. It is reasonable to presume that a site with these characteristics is suitable for Carson wandering skipper. The definitive measure of habitat suitability is occupation by and persistence of a species over time. For the purposes of this plan, “known suitable habitat” equates with “occupancy” of the habitat by the Carson wandering skipper, and “presumed suitable habitat” has Carson wandering skipper habitat characteristics, but occupancy has not been determined. It will become important to clarify known and presumed suitable **habitat patches** and opportunities for managing these areas for the benefit of the Carson wandering skipper. At this time it is not known how many presumed habitat patches exist or where they are located. The spatial extent of suitable habitat patches, distances between them, and the extent of suitable migration corridors are also not currently known.

Four categories of suitable habitat patches can be identified: 1) known suitable habitat that is currently managed or can be managed for the Carson wandering skipper; 2) known suitable habitat that is not currently managed or cannot be managed for the Carson wandering skipper; 3) presumed suitable habitat that is currently managed or can be managed for the benefit of the Carson wandering skipper; and 4) presumed suitable habitat that is not currently managed or cannot be managed for the Carson wandering skipper.

Within the three known populations/metapopulations in Nevada and California, known suitable habitat exists that is managed or can be managed for the benefit of the Carson wandering skipper (the Bureau of Land Management site in Warm Springs Valley, Washoe County, Nevada [1 nectar site]; the California Department of Fish and Game site in Lassen County, California [1 nectar site]; the Carson River site in Douglas County, Nevada (1 nectar site); and the Honey Lake Conservation Team/California State Lands Commission lands in Lassen County, California [19 nectar sites]). Some currently known suitable habitat also exists that is not being managed or cannot be managed for the Carson wandering skipper (the private site in Warm Springs Valley, Washoe County, Nevada [1 nectar site]; and in Lassen County, California, Site #2 [Private; 1 nectar site], Site #3 [Wendel area, 1 nectar site], and Site #4 [Mapes Road, 1 nectar site]).

The California population/metapopulation appears to be larger in size and covers a greater land base than the Nevada populations. As such it will be necessary to ensure appropriate management of known suitable habitat patches for the Carson wandering skipper in perpetuity. In addition, the possible influence of varying Honey Lake levels on population size must be determined for the population/metapopulation. Surveys conducted in 2004 occurred primarily within

the lake's boundary (meander) line and numerous nectar sites were located. During these surveys, Honey Lake was dry. During wet years, it is possible that some nectar sites and *Distichlis* acreage used by the Carson wandering skipper will be inundated by rising lake levels. As a result, this population/metapopulation may experience greater fluctuations in the number of individuals based on the availability of nectar sites for adults and the amount of *Distichlis spicata* available for larvae. Dry years may offer an opportunity for population/metapopulation increases or expansion while wet years may cause declines or contraction. Long-term monitoring should help clarify the effects of lake level. Management of nectar sites in more upland areas around Honey Lake to eliminate threats may be essential to the long-term persistence of this subspecies in California.

Recovery of the Carson wandering skipper can be based, in part, on the number of known suitable habitat patches being managed for the species. Increasing the number of known suitable habitat patches managed for the Carson wandering skipper from the other categories would be beneficial, and appropriate management for a number of these known suitable habitat patches would need to be ensured in perpetuity for downlisting or delisting of the Carson wandering skipper to occur. The occupancy of these sites needs to be documented over time because they may not be used every year. Priority for appropriate management of these areas will be given to known or suspected source patches.

The support and participation of numerous stakeholders will be necessary for the recovery of the Carson wandering skipper in California and Nevada. The Carson wandering skipper has been found on public (Federal and State) and private lands. As indicated in section II.C (Recovery Narrative) below, many opportunities are available for becoming involved in the recovery of the Carson wandering skipper.

A post-delisting monitoring plan will be developed and implemented for a minimum period of 5 years to ensure recovery.

II. Recovery

A. RECOVERY OBJECTIVES AND CRITERIA

1. Recovery Objectives

The primary objective of this recovery plan is to prevent the extinction of the subspecies and to ensure that existing populations or metapopulations are protected from threats for the foreseeable future, thereby perpetuating viable populations or metapopulations of the Carson wandering skipper throughout its former **range**. The secondary objective is to allow for reclassification and eventually delisting of this subspecies. This plan is intended to guide willing participants in achieving these objectives. If additional populations or metapopulations are found, if appropriate management to counteract threats is ensured in perpetuity for a large amount of the known suitable habitat, if the numbers of the known populations increase naturally or through propagation coupled with augmentation, if reintroduction/introduction efforts are successful, and if threats are eliminated or reduced, the Carson wandering skipper may be considered for delisting in 20 years. While knowledge of the current status of the Carson wandering skipper and its range-wide distribution is limited, the following criteria for downlisting and delisting are based on the best available information. These criteria may be revised and further quantified as additional information from research and monitoring becomes available in the future.

2. Recovery Criteria

Downlisting of the Carson wandering skipper to a threatened status can be considered when the following criteria are met:

1) For the Lassen County, California, population/metapopulation **and** one of the two known Nevada populations (Washoe County or Douglas County) or a comparable newly discovered population, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Either population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance. In California, suitable habitat patches equivalent to 50 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance across the population/metapopulation.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the two populations in downlisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regards to habitat and land uses that may affect habitat quality including but not limited to development (urban, residential, water, gas and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

Delisting of the Carson wandering skipper can be considered when the following conditions are met:

1) For the Lassen County, California, population/metapopulation **and** both of the two known Nevada populations (Washoe County and Douglas County) or comparable newly discovered populations, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Each population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance. In California, suitable habitat patches equivalent to 75 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance across the population/metapopulation. Substantial landscape connectivity must exist among patches (i.e., land cover between most sites would be considered open space and not urban or suburban) in order to potentially facilitate movement of the Carson wandering skipper among patches.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the three populations in delisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regard to habitat and land uses that may affect habitat quality, including but not limited to development (urban, residential, water, gas, and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

3) In addition to the populations in delisting criterion #1, for at least one additional Carson wandering skipper population or metapopulation that may be discovered or established within Carson wandering skipper historic range, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the population, unless we conclude (through intensive, comprehensive surveying) that additional populations or metapopulations do not exist and it would not be ecologically feasible to establish/reestablish one or more of them within Carson wandering skipper historic range.

4) *Lepidium latifolium* invasion into known and presumed suitable habitat for the Carson wandering skipper has been eliminated or reduced and managed to levels that do not pose a threat to the persistence of the Carson wandering skipper.

5) A long-term conservation plan and conservation agreements have been developed to guide management throughout the range of the Carson wandering skipper after it has been delisted.

6) A monitoring plan to cover a minimum of 5 years post-delisting of the Carson wandering skipper has been developed and is ready to be implemented to ensure the ongoing conservation of the species and the continuing effectiveness of management actions.

Prior to implementation of any action in this plan, the lead Federal agency must comply with all applicable provisions of the National Environmental Policy Act and the Endangered Species Act. All necessary Federal, State, and local permits or authorizations must be obtained. These recovery criteria were designed to provide a basis for consideration of downlisting and delisting, but not for automatic downlisting or delisting. Before delisting occurs, we must determine that the five listing factors no longer are present or continue to adversely affect the listed species. The final decision regarding delisting will be made only after a thorough review of all relevant information.

B. STEP-DOWN OUTLINE FOR RECOVERY ACTIONS

1. Manage existing populations and essential habitat on public and private lands to minimize threats
 - 1.1 Identify and map known occupied sites, especially those of suspected source populations.
 - 1.2 Establish appropriate long-term management of known occupied sites, especially those of suspected source populations.
 - 1.3 Identify and map spring sites essential to the Carson wandering skipper.
 - 1.4 Establish appropriate long-term management of essential spring sites.
 - 1.5 Support mapping of *Lepidium latifolium* by Federal, State, local agencies, and other interested parties.
 - 1.6 Support control of *Lepidium latifolium* by Federal, State, local agencies, and other interested parties.

- 1.7 Support monitoring of *Lepidium latifolium* by Federal, State, local agencies, and other interested parties.
- 1.8 Work with interested landowners, University of California Cooperative Extension, and other interested parties to control *Lepidium latifolium* at occupied and potential sites.
- 1.9 Work with interested landowners of occupied sites to develop livestock grazing management plans to enhance habitat conditions for the Carson wandering skipper.
- 1.10 Coordinate with Federal, State, and local agencies to address issues of large scale ground water pumping to ensure adverse impacts to the Carson wandering skipper do not occur.
- 1.11 Work with non-Federal public and private interests (local landowners, agricultural interests, geothermal development interests, water developers, etc.) on a voluntary basis to develop and implement safe harbor agreements, conservation agreements, habitat conservation plans, or other programs (such as Partners for Fish and Wildlife and Farm Bill conservation programs) to protect, restore, enhance, and manage existing populations and habitat as well as potential habitat of the Carson wandering skipper.
- 1.12 Coordinate with State wildlife resource agencies (California Department of Fish and Game; Nevada Department of Wildlife) to provide Federal section 6 funds to be used by the states to carry out species recovery actions.
- 1.13 Coordinate with Bureau of Land Management to acquire additional habitat and water rights from a willing seller at the Washoe County, Nevada, site.
- 1.14 Seek to acquire additional occupied or potential habitat from willing sellers, when possible, through fee acquisitions.
- 1.15 Conduct Endangered Species Act section 7 consultations with various Federal agencies (Bureau of Land Management, Federal Highway Administration, Department of Defense, Department of Justice, Army Corps of Engineers, Animal and Plant Health Inspection Service, and Natural Resource Conservation Service) or their designated agents as appropriate to protect Carson wandering skipper populations and enhance Carson wandering skipper habitat.
- 1.16 Coordinate with the Army Corps of Engineers to avoid, minimize, or compensate for impacts to *Distichlis* and wetland habitat in relation to section 404 of the Clean Water Act activities.

- 1.17 Coordinate with Caltrans and California Department of Fish and Game regarding implementation of the Honey Lake Mitigation Bank in consideration of the Carson wandering skipper.
 - 1.18 Coordinate with the Honey Lake Conservation Team/California State Land Commission on the management of their lands adjacent to Honey Lake in consideration of the Carson wandering skipper.
2. Establish a research program to determine the ecological requirements and life history of the Carson wandering skipper, and develop a program to survey for additional populations and monitor existing populations and habitats for trends and threats.
- 2.1 Develop and implement a program to survey for additional populations (a survey protocol for proposed projects has been developed).
 - 2.2 Develop and implement a monitoring program for known populations and habitat for trends and threats.
 - 2.3 Better understand ecological (including specific habitat needs) and life history requirements of the Carson wandering skipper.
 - 2.4 Determine population structure and dispersal distance of Carson wandering skipper in Honey Lake and Warm Springs Valleys and at the Douglas County site.
 - 2.5 Determine the relationship between livestock grazing and the Carson wandering skipper and its habitat.
 - 2.6 Develop a hydrologic model to understand the relationship between surface and groundwater resources better in Honey Lake and Warm Springs Valleys and at the Douglas County site.
 - 2.7 Develop techniques for captive propagation with possible introduction/reintroduction to unoccupied, suitable sites.
 - 2.8 Develop techniques for Carson wandering skipper habitat creation and enhancement.
3. Develop and implement an outreach program to keep local communities informed of the Carson wandering skipper's status and means to carry out recovery actions.
- 3.1 Create a web site to provide information on the species and the recovery process with the opportunity for the public to comment on the draft recovery plan.
 - 3.2 Prepare general information for the public.

- 3.3 Use and develop kiosks at appropriate sites such as California Department of Fish and Game management areas, Honey Lake Conservation Team/California State Lands Commission lands, and California Department of Transportation Safety Roadside Rest Areas for educational material distribution.
 - 3.4 Encourage Resource Conservation Districts and cooperative extension to provide technical assistance to landowners to further land management activities to assist in Carson wandering skipper recovery.
 - 3.5 Foster community involvement and educational opportunities with schools, scouts, 4H, and other groups to assist in Carson wandering skipper recovery.
 - 3.6 Identify landowners willing to assist in the recovery of the Carson wandering skipper.
- 4. Evaluate progress of recovery, effectiveness of management and recovery actions, and revise management plans and recovery criteria as necessary.
 - 4.1 Revise the recovery plan as appropriate at 5-year intervals.
 - 4.2 Hold periodic meetings to encourage information sharing.

C. RECOVERY NARRATIVE OUTLINE FOR ACTIONS ADDRESSING THREATS

1. Manage existing populations and essential habitat on public and private lands to minimize threats. Only three populations of Carson wandering skipper are currently known to exist. Protection and management of these populations are essential to the subspecies' survival.

- 1.1 Identify and map known occupied sites, especially those of suspected source populations. Identify known, occupied sites of Carson wandering skipper habitat that occur on Federal, State, and private property, and obtain spatial coordinates of sites using GPS (global positioning systems). Access permission must be obtained to conduct surveys.
- 1.2 Establish appropriate long-term management of known occupied sites, especially those of suspected source populations. Known, occupied sites of Carson wandering skipper habitat occur on Federal, State, and private property. Because of the low number of known sites, ensuring appropriate management of these areas to

minimize threats, through such means as acquisition from willing sellers, conservation agreements, management agreements, or other means, is important to the survival of the subspecies. Those sites that are believed to provide habitat for source populations especially need protection. Access permission must be obtained to conduct surveys.

- 1.3 Identify and map spring sites essential to the Carson wandering skipper. Because of the close association of Carson wandering skipper with *Distichlis spicata*, and the influence of springs on *D. spicata* quality and availability of nectar plants, identification of spring habitats is likely important to Carson wandering skipper survival and recovery. Spatial coordinates of spring sites can be obtained using GPS. Access permission must be obtained to conduct surveys.
- 1.4 Establish appropriate long-term management of essential spring sites. Because of the close association of the Carson wandering skipper with *Distichlis spicata*, and the influence of springs on *D. spicata* quality and availability of nectar plants, spring habitats are likely important to Carson wandering skipper survival and recovery. Appropriate management of those areas within/near occupied Carson wandering skipper habitat needs to be ensured through various means such as acquisition from willing sellers, conservation agreements, management agreements, or other means. Access permission must be obtained to conduct surveys.
- 1.5 Support mapping of *Lepidium latifolium* by Federal, State, local agencies, and other interested parties. Aggressive plant species invasions, such as by *L. latifolium*, can be a threat to the Carson wandering skipper by out-competing other plant species, particularly nectar plants, required by the Carson wandering skipper. The first line of defense from invasive species is prevention; when that fails, early detection and a rapid response can prevent further infestation. This action would provide support (funds and personnel) to local entities such as the Lassen County Special Weed Action Team, University of California Cooperative Extension, and other interested parties to map *L. latifolium* in and around areas known to be used by the Carson wandering skipper. Additional support may also be provided for the mapping of *L. latifolium* in areas where potential Carson wandering skipper

habitat could be threatened by this invasive species. Refer to recovery actions 1.6, 1.7 and 1.8.

- 1.6 Support control of *Lepidium latifolium* by federal, state, local agencies, and other interested parties. This action would provide support (funds and personnel) to local entities such as the Lassen County Special Weed Action Team, University of California Cooperative Extension, and other interested parties to control *L. latifolium* in and around areas known to be used by Carson wandering skipper. Additional support may also be provided for the control of *L. latifolium* in areas where potential Carson wandering skipper habitat could be threatened by this invasive species. To date, Carson wandering skippers have not been seen nectaring on *L. latifolium*; consequently, at this time appropriately planned and implemented control efforts are not considered to be detrimental to Carson wandering skipper. Refer to recovery actions 1.5, 1.7 and 1.8.
- 1.7 Support monitoring of *Lepidium latifolium* by Federal, State, local agencies, and other interested parties. This action would provide support (funds and personnel) to local entities such as the Lassen County Special Weed Action Team, University of California Cooperative Extension, and other interested parties to monitor *L. latifolium* in and around areas known to be used by Carson wandering skipper. Additional support may also be provided for the monitoring of *L. latifolium* in areas where potential Carson wandering skipper habitat could be threatened by this invasive species. Refer to recovery actions 1.5, 1.6 and 1.8.
- 1.8 Work with interested landowners, University of California Cooperative Extension, and other interested parties to control *Lepidium latifolium* at occupied and potential sites. Invasions of *L. latifolium* into areas containing *Distichlis spicata* and/or nectar plants have resulted in loss of occupied and potential habitats, and continued invasions are likely to result in greater losses of appropriate habitats and the conversion and degradation of lowland grassland habitats. Opportunities exist for landowners to conduct habitat improvement projects, manage livestock grazing, control weeds, and engage in other actions to reduce the coverage of *L. latifolium* and to prevent it from invading new sites. Technical assistance and/or program funds to help interested landowners

conduct those kinds of activities are available from us, the University of California Cooperative Extension, U.S. Department of Agriculture, and other agencies and organizations. Landowners who are concerned about the effects of *L. latifolium* on the Carson wandering skipper or on the land in general, and who wish to engage in projects to remove *L. latifolium*, are encouraged to contact their local agency or extension office to begin that effort. Likewise, agency and extension service staff are encouraged to outreach to landowners to inform them about land and habitat degradation from *L. latifolium* invasions and to provide technical assistance and funds toward control and elimination of *L. latifolium* from affected lands. Refer to recovery actions 1.5, 1.6 and 1.7.

- 1.9 Work with interested landowners of occupied sites to develop livestock grazing management plans to enhance habitat conditions for the Carson wandering skipper. Landowners of occupied sites need to be informed about the Endangered Species Act and the associated legal requirements and assistance programs available. Educational material on the Carson wandering skipper needs to be distributed to landowners. Landowners should be notified of any financial assistance available to implement programs. We, the landowner, and other involved agencies should form working partnerships with the University of California Cooperative Extension (Livestock Farm Advisor) and Natural Resource Conservation Service (Range Specialist) to develop a mutually agreeable livestock grazing management plan to enhance habitat conditions for the Carson wandering skipper and at the same time continue to provide a viable livestock operation. Grazing guidelines must be developed to provide an economically sound business for the landowner of occupied sites. These management plans would be developed in association with the research discussed in recovery action 2.5.
- 1.10 Coordinate with Federal, State, and local agencies to address issues of large scale ground water pumping to ensure adverse impacts to the Carson wandering skipper do not occur. Groundwater extractions in sensitive habitat for the Carson wandering skipper may have the effect of reducing or eliminating spring discharges supporting the vegetation that appears to provide necessary habitat elements. It is recommended that we work closely with Federal,

State and local water management and purveyor agencies in California and Nevada to evaluate the effects of groundwater level declines associated with municipal and agricultural groundwater extraction in Honey Lake and Warm Springs Valleys. Proposed evaluations include an inventory of existing wells and water rights, anticipated future groundwater development potential based upon water rights, assessment of geological and hydrological conditions, and development of numerical groundwater flow models to assess the surface effects of groundwater extraction. Monitoring of vegetation and the Carson wandering skipper needs to occur in association with commencement of pumping.

- 1.11 Work with non-Federal public and private interests (local landowners, agricultural interests, geothermal development interests, water developers, etc) on a voluntary basis to develop and implement safe harbor agreements, conservation agreements, habitat conservation plans, or other programs (such as Partners for Fish and Wildlife and Farm Bill conservation programs) to protect, restore, enhance, and manage existing populations and habitat as well as potential habitat of the Carson wandering skipper. Opportunities for Carson wandering skipper recovery on private and non-Federal public lands should be investigated on a willing/interested landowner basis on suitable lands/areas. Landowners should be informed of the various opportunities available through safe harbor agreements and habitat conservation plans. Funding sources include, but are not limited to, Partners for Fish and Wildlife, Safe Harbor Agreements, Endangered Species Landowner Incentive Program, the Natural Resource Conservation Service's Wildlife Habitat Improvement Project funds, etc. Refer to recovery action 3.6.
- 1.12 Coordinate with State wildlife resource agencies (California Department of Fish and Game, California Parks and Recreation Department, and Nevada Department of Wildlife) to provide Federal section 6 funds to be used by the States to carry out species recovery actions. Opportunities for Carson wandering skipper recovery on State lands should be investigated. Land managers should be informed of the opportunities and funding sources available through Endangered Species Act section 6 grants.

- 1.13 Coordinate with Bureau of Land Management staff to acquire additional habitat and water rights from a willing seller at the Washoe County, Nevada, and site. The Bureau of Land Management Carson City Field Office is attempting to acquire 80 acres of occupied habitat along with ground water rights to sustain that habitat. This parcel is adjacent to, and would become part of the Bureau of Land Management's Carson Wandering Skipper Area of Critical Environmental Concern. Southern Nevada Public Lands Management Act and /or Land and Water Conservation Fund appropriations could be used to finalize the transactions with willing sellers. If acquired, a management plan would be developed. A site-specific management plan to address habitat management needs and threats to the population or habitat would be developed. The plan should include goals, strategies, funding sources, time line, and incorporate adaptive management. Additional areas are being investigated for acquisition, along with water rights, from other willing sellers in the area.
- 1.14 Seek to acquire additional occupied or potential habitat from willing sellers, when possible, through fee acquisitions. Occupied and potential habitats could be acquired from willing sellers throughout the Carson wandering skipper's range, with first preference to fee acquisitions. Where appropriate, conservation agreements could be acquired from willing sellers to ensure habitat is managed to prevent threats from disturbance or development. Funding sources could include Southern Nevada Public Lands Management Act, Land and Water Conservation Fund, agency appropriations, donations or grants. Future management of acquired fee title lands would be directed toward Carson wandering skipper conservation and restoration in accordance with the acquiring agency's or organization's mission.
- 1.15 Conduct Endangered Species Act section 7 consultations with various Federal agencies (Bureau of Land Management, Federal Highway Administration, Department of Defense, Department of Justice, Army Corps of Engineers, Natural Resource Conservation Service, and Animal and Plant Health Inspection Service) or their designated agents as appropriate to protect and enhance Carson wandering skipper populations and habitat. We will conduct section 7 consultations with various Federal agencies or their designated agents on projects affecting the Carson wandering

skipper throughout its range to ensure these projects do not jeopardize its continued existence.

- 1.16 Coordinate with the Army Corps of Engineers to avoid, minimize, or compensate for impacts to *Distichlis* and wetland habitats in relation to section 404 of the Clean Water Act activities. We will coordinate with the U.S. Army Corps of Engineers when a permit is required to reduce proposed project impacts to wetland and *Distichlis* habitats through section 404 of the Clean Water Act. Where impacts to these habitats cannot be avoided, mitigation should be required.

- 1.17 Coordinate with Caltrans and California Department of Fish and Game regarding implementation of the Honey Lake Mitigation Bank in consideration of the Carson wandering skipper. A wetlands mitigation bank located adjacent to existing California Department of Fish and Game lands is being established near the Lassen County site. This parcel of 121 hectares (300 acres) of land has been recently grazed and farmed. The bank is intended to create a minimum of 37 hectares (92 acres) of emergent wetlands at this site to mitigate for wetland losses in sagebrush scrub and juniper woodland habitats due to road construction in Lassen and Modoc Counties and in the eastern portion of Plumas County. This bank will be managed by the California Department of Fish and Game (California Department of Transportation and California Department of Fish and Game 1998). Long-term maintenance of the wetlands will follow the terms and conditions of the Honey Lake Wildlife Area Management Plan (Holmes and Novick 1993, California Department of Transportation 2002). The Honey Lake Wildlife Area Management Plan (Holmes and Novick 1993) is scheduled to be updated. This plan allows for providing suitable habitat and protecting threatened and endangered species. Opportunities to pursue Carson wandering skipper recovery at the bank site should be explored.

- 1.18 Coordinate with the Honey Lake Conservation Team/California State Lands Commission on the management of their lands adjacent to Honey Lake in consideration of the Carson wandering skipper. The Honey Lake Conservation Team is a consortium of two non-profit natural resource conservation organizations (The Trust for Public Lands, the Center for Urban Watershed Renewal)

and two natural resource consulting firms (The Bioengineering Group, Inc., and Michael Baker, Jr., Inc.), that have been selected to receive the Honey Lake property from the Department of Defense. The Honey Lake Conservation Team will hold title to the lands until transferred to the State of California which is currently expected to occur in late 2005. To assume the Department of Defense's obligations regarding Honey Lake, the Department of Defense has committed to providing the Team with \$8,650,000. Of this sum, \$1,000,000 will be spent for studying, understanding, promoting, and enhancing the Carson wandering skipper and its habitats. This will include the development of a Carson wandering skipper Conservation Strategy and a Honey Lake Management Plan for these lands. This group will work with other parties as appropriate in managing these transferred lands in consideration of the Carson wandering skipper.

2. Establish a research program to determine the ecological requirements and life history of the Carson wandering skipper, and develop a program to survey for additional populations and monitor existing populations and habitats for trends and threats. The current understanding of the biology and ecology of the Carson wandering skipper is limited. A better understanding of habitat requirements, behavior, and population dynamics is necessary to support effective recovery recommendations. Research is needed to determine the best techniques for propagation and/or introduction/reintroduction into suitable habitats if selected as a conservation strategy. This strategy should be used only as a last resort and not in place of protecting existing populations.
 - 2.1 Develop and implement a program to survey for additional populations. Although *Distichlis* areas in northwestern Nevada and northeastern California have been surveyed to varying degrees since 1999, there is still a possibility that additional populations may exist. Areas in Lassen County, California, and Washoe and Douglas Counties, Nevada, identified as having soils that support *Distichlis spicata* should be mapped and then searched during the flight season. Additional populations also may be found if more access to private land becomes available (access permission must be obtained). Unfortunately, satellite imagery, aerial photographs, and vegetation maps have not been particularly useful in locating Carson wandering skipper populations or habitat to date.

Survey guidelines to determine presence or absence became available prior to the 2002 Carson wandering skipper flight season. The survey guidelines may be obtained from either the Nevada Fish and Wildlife Office in Reno, Nevada or from the Sacramento Fish and Wildlife Office in Sacramento, California. Survey guidelines should be obtained annually because the methods are subject to change as additional information is gathered over time (U.S. Fish and Wildlife Service 2004).

- 2.2 Develop and implement a monitoring program for known populations and habitat for trends and threats. Annual monitoring of Carson wandering skipper populations is needed to track their status and progress towards recovery. Parameters for population and habitat trends needs to be selected, methods and techniques need to be determined, and a plan developed and implemented. Population trends in invertebrates are very difficult to determine, since normal annual variation in numbers may span two to three orders of magnitude. It is highly unlikely that standard capture-mark-release-recapture techniques can be used successfully to obtain quantitative estimates of Carson wandering skipper population sizes. Individuals are difficult to capture and too small to handle without damaging them. Furthermore, their relative rarity and unknown dispersal tendencies make the likelihood of obtaining enough recaptures for meaningful estimates remote at best. Brussard *et al.* (1999) attempted to obtain estimates of relative population numbers using the Pollard (1977) walking transect technique. However, the variance in transect counts was so large that the attempt was unsuccessful. The application of qualitative descriptors is probably the most reliable method of monitoring Carson wandering skipper populations. The descriptors used by Brussard *et al.* (1999) were: *abundant* (usually observed in large numbers), *common* (usually observed but not in large numbers), *fairly common* (usually observed but in small numbers or not always observed), *uncommon* (occasionally observed) and *rare* (a single sighting). We have developed survey guidelines for the Carson wandering skipper (U.S. Fish and Wildlife Service 2004). These guidelines provide categories for the number of individuals seen: low (1-10 individual seen per day); medium (11-30 individuals seen per day); and high (31-100 or more individuals seen per day). Inter-annual trends in these descriptors/ranges, along with maps showing occupied and

unoccupied localities, should give reasonable insight into population trends in the Carson wandering skipper. Properly established photo points and verbal descriptions should provide adequate documentation of habitat trends. Reporting requirements of various environmental laws should provide information on land-use changes that might adversely impact the Carson wandering skipper.

Monitoring methods should be applied consistently during a sufficient period of time (20 years). This period of time is needed to include the variability of environmental conditions experienced by the Carson wandering skipper.

Data will be gathered according to methods outlined in the monitoring plan. Any new threats to the Carson wandering skipper should be identified. Copies of monitoring reports should be provided to us so review and assessment of the status of populations and habitat can be made. This information will be maintained in a database developed by our Nevada Fish and Wildlife Office in Reno, Nevada.

2.3 Better understand ecological (including specific habitat needs) and life history requirements of the Carson wandering skipper. Raising individuals from egg to adult in the laboratory is important to determine: (1) whether the larvae spin webs, (2) how many larvae can co-exist and ultimately develop on a single *Distichlis spicata* plant, and (3) if the species can re-enter diapause under adverse conditions. Once this information is known, careful field studies may produce more information on larval ecology. See recovery actions 2.2 and 2.4.

2.4 Determine population structure and dispersal distances of the Carson wandering skipper at Honey Lake and Warm Springs Valleys and at the Douglas County sites. Understanding the structure of Carson wandering skipper populations is necessary for recovery. Populations could be independent demographic and genetic units with little or no dispersal among them (island model); the populations could have independent dynamics but sufficient dispersal among them to recolonize after extinction events (metapopulation model), or movement among habitat patches may be extensive enough that dynamics are essentially correlated

(single population model). Each of these population structures would require a different management approach. Because it is probably infeasible to determine dispersal distances with any precision and to make accurate estimates of population size in the Carson wandering skipper (see recovery action 2.2), an incidence-function approach is probably the most appropriate method for determining population structure. All nectar sites where the Carson wandering skipper has been found need to be mapped accurately; these sites need to be visited every year to determine the presence or absence of individuals. Over time, these data will allow estimation of annual colonization and extinction rates. These probabilities, plus the spatial arrangement of habitat patches and the distances among them, should provide insight into whether or not patch dynamics are synchronous or asynchronous and if asynchronous dynamics are correlated with distance.

Information on both daily and long-distance movements would be useful for determining population structure, habitat requirements and connectivity, and restoration opportunities. Unfortunately, this information will be extremely difficult to obtain. Because of the difficulties with using capture-mark-release-recapture studies on the Carson wandering skipper (see recovery action 2.2) this approach cannot be used. One possibility is to use a surrogate such as one of the other subspecies of *Pseudocopaeodes eunus* to determine dispersal distances. Another possibility is to place concentrations of nectar sources at increasing distances from known areas of adult concentration and monitoring their use to determine movements.

- 2.5 Determine the relationship between livestock grazing and the Carson wandering skipper and its habitat. Livestock grazing is a major agricultural activity in Carson wandering skipper habitat areas. Excessive livestock grazing is a potential threat to the species through reduction in the availability of nectar sources and *Distichlis spicata*, trampling, ground compaction, and increases in weeds. Currently there is no information on what level of grazing and type of grazing management enhances or degrades habitats for the Carson wandering skipper. Differences in animal stocking rates (number and type of livestock per acre), and management (grazing early season, late season, year-long, high intensity/short duration, etc.) may improve, degrade, or have no significant effect

on the quality of habitats for the Carson wandering skipper in grazed areas. Universities, agricultural extension offices, government agencies, and non-governmental organizations, Farm Bureaus, Cattlemen's Associations, and others should support research on the types of grazing management that are most beneficial or detrimental to the Carson wandering skipper through the use of a surrogate. Livestock operators can use this information to determine what type and level of grazing can improve their lands for the Carson wandering skipper and which are least likely to result in conflicts between the Carson wandering skipper and livestock grazing. This research would be applied to the development of grazing management plans as encouraged in recovery action 1.9.

- 2.6 Develop a hydrologic model to understand the relationship between surface and groundwater resources better in Honey Lake and Warm Springs Valleys and at the Douglas County site. Habitat requirements of the Carson wandering skipper include the presence of *Distichlis spicata*, which usually grows in areas where the water table is near the surface. Since it is likely that suitable Carson wandering skipper habitat is related to water table elevation, a numerical groundwater model should be constructed to evaluate the interactions between surface and groundwater. Activities include an inventory of current groundwater extraction wells and pumping records, mapping spring locations, placement of monitoring wells for measurement of water level fluctuations, conducting aquifer tests to ascertain the effects of groundwater extraction on spring discharge, and collection of water quality data to attempt to correlate the presence of geothermal water with Carson wandering skipper habitat. These data can be incorporated into a numerical model used to evaluate the effects of groundwater fluctuations on spring discharge and shallow water table.
- 2.7 Develop techniques for captive propagation with possible introduction/reintroduction to unoccupied, suitable sites. While many butterfly species have been raised in captivity, rearing them on a scale large enough for a successful introduction/reintroduction program is difficult and expensive. Inducing individuals to mate is often a limiting factor to continuous rearing. Hand pairing is often used, but the technique is tedious, impractical for rearing large numbers of individuals, and probably results in unwanted artificial

selection. Successful introduction/reintroduction of the Carson wandering skipper is also highly problematic because we know so little about its ecological requirements. Success with recovery action 2.3 could facilitate the development of these techniques, but captive propagation and introduction/reintroduction as a conservation strategy only should be used as a last resort.

2.8 Develop techniques for habitat creation and enhancement. Since it is highly likely that the Carson wandering skipper requires *Distichlis spicata* with succulent, green leaves from March through June to complete its life cycle, adding enough water to *D. spicata* areas to keep the plants green should enhance larval habitat considerably. This could be done on a small scale with shallow wells and low-flow solar or wind-powered pumps. A predictable supply of water also would facilitate the availability of suitable nectar sources for adult Carson wandering skippers. The plants and the butterflies will very likely establish on enhanced sites on their own.

3. Develop and implement an outreach program to keep local communities informed of the Carson wandering skipper's status and means to carry out recovery actions. Increasing public awareness of the Carson wandering skipper will assist efforts to protect and recover this subspecies.

3.1 Create a web site to provide information on the subspecies and the recovery process with the opportunity for the public to comment on the draft recovery plan. A website will be created to provide information on the Carson wandering skipper and the recovery process. An opportunity to provide comments on the draft recovery plan will be provided to the public, and information about the comment submittal process will be outlined on the web site.

3.2 Prepare general information for the public. Prepare and distribute regional/local information on Carson wandering skipper protection and recovery. Prepare brochures or fact sheets that describe the plight of the listed subspecies, its value and role in the environment, the importance of its habitats and the efforts being undertaken for its recovery. Public outreach also needs to include warnings to lepidopterists and other insect collectors that taking of specimens would be in violation of the Endangered Species Act, which provides both criminal and civil penalties. Information

related to recreational activities and possible impacts to the Carson wandering skipper and its habitat should be included. Brochures or fact sheets would be distributed to affected landowners, schools, and other community facilities. Outreach methods could also involve working with the media, displaying exhibits at community centers, preparing school lesson plans, etc.

- 3.3 Use and develop kiosks at appropriate sites such as California Department of Fish and Game management areas, Honey Lake Conservation Team/California State Lands Commission lands, and California Department of Transportation Safety Roadside Rest Areas for educational material distribution. Education and outreach activities can be important tools in the recovery of threatened or endangered species, especially for little known invertebrate species such as the Carson wandering skipper. Educational programs encourage conservation and proper management. This action would make available to the public brochures that included a discussion of the importance of the subspecies to the region (i.e. federally listed, restricted range, unique to the area) and other educational materials at local California Department of Fish and Game Management Areas and California Department of Transportation Safety Roadside Rest Areas kiosks.
- 3.4 Encourage Resource Conservation Districts and cooperative extension to provide technical assistance to landowners to further land management activities to assist in Carson wandering skipper recovery. There are a variety of threats to the Carson wandering skipper that are linked to various activities on both public and private lands. There are agencies that are available to provide land management and/or pest management recommendations to assist private landowners in the reduction of these threats and the recovery of the Carson wandering skipper. These include the Honey Lake Valley Resources Conservation District, the Natural Resources Conservation Service, University of California Cooperative Extension advisors, University of Nevada Reno Cooperative Extension Service advisors, and the Lassen County Agricultural Commissioner.
- 3.5 Foster community involvement and educational opportunities with schools, scouts, 4H, and other groups to assist in Carson wandering

skipper recovery. An important component in the recovery of a species is community involvement. Schools, parents and teachers, youth groups, and other volunteer organizations are involved throughout California and Nevada in projects to restore fish and wildlife habitats on private lands and elsewhere. These activities have the dual purpose of educating the public about habitats and the species that use them while restoring and improving lands for fish and wildlife, including threatened and endangered species. In some cases schools have “adopted” a threatened or endangered species as a mascot, worked to learn about the species, and have come to take a personal stake in its survival. The result is that fears surrounding the species and its associated regulatory restrictions are lessened, the species gains habitat and public support, and prospects for recovery are enhanced. We, other Federal, State, and local agencies, and others are urged to reach out to a variety of schools and volunteer organizations to assist them in developing educational programs about the Carson wandering skipper and its life history and habitat needs, and to encourage schools and volunteer organizations to become involved in activities that foster the long-term survival of this attractive and very interesting species.

3.6 Identify landowners with suitable habitat willing to assist in the recovery of the Carson wandering skipper. Contact will be made with landowners having suitable Carson wandering skipper habitat to inquire about their interest in participating in the recovery of the Carson wandering skipper. Their assistance is important in the success of Carson wandering skipper recovery. Agencies will work with participants on a voluntary basis to provide technical assistance and inform participants of funding opportunities available. It is important to let private landowners make their own decisions and determine the level of participation they are willing to make. Also refer to recovery actions 1.11., 3.2, and 3.4.

4. Evaluate progress of recovery, effectiveness of management and recovery actions, and revise management plans and recovery criteria as necessary.

4.1 Revise the recovery plan as appropriate at 5-year intervals. The plan will need to be updated/revise at intervals to reflect current conditions and to incorporate new research findings. This may occur at 5-year intervals.

- 4.2 Hold periodic meetings to encourage information sharing. It is important to be able to share information regarding research, habitat management techniques, monitoring, and adaptive management efforts. Recovery partners and other interested parties should be involved. These meetings could be held when sufficient information has been gathered, possibly every 3 to 5 years.

III. Implementation Schedule

The Implementation Schedule that follows lists the actions and estimated costs for the recovery program for the Carson wandering skipper. It is a guide for meeting the recovery goals outlined in this plan. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. When more than one party has been identified the proposed lead party is indicated by an asterisk (*). The listing of a party in the Implementation Schedule does not require, nor imply a requirement, that the identified party has agreed to implement the action(s) or to secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and is therefore considered a necessary action for the overall coordinated effort to recover the Carson wandering skipper. Also, section 7(a)(1) of the Endangered Species Act directs all federal agencies to utilize their authorities in furtherance of the purposes of the Endangered Species Act by carrying out programs for the conservation of threatened and endangered species.

A. Key to Recovery Action Priority Numbers

Action priorities are set according to the following standards:

- Priority 1: Those actions that must be taken to prevent extinction or to prevent the species from declining irreversibly;
- Priority 2: Those actions that must be taken to prevent a significant decline in species populations/habitat quality or some other significant negative impact short of extinction; and
- Priority 3: All other actions necessary to provide for full recovery of the species.

B. Codes used in the Implementation Schedule

Continual: Action will be implemented on a periodic basis once begun.

Ongoing: Action is currently being implemented and will continue until no longer necessary for recovery.

TBD: To be determined

* Primary responsible party: a party likely to take the lead, or have an especially large role in implementing a recovery action.

C. Key to Acronyms in Implementation Schedule

| | |
|----------|--|
| ACIN | Academic Institutions |
| APHIS | Animal and Plant Health Inspection Service |
| BLM | Bureau of Land Management |
| Caltrans | California Department of Transportation |
| COE | Army Corps of Engineers |
| CDFG | California Department of Fish and Game |
| CSLC | California Division of State Lands Commission |
| FWS | Fish and Wildlife Service |
| HLCT | Honey Lake Conservation Team |
| NDOT | Nevada Department of Transportation |
| NRCS | Natural Resources Conservation Service |
| SWAT | Lassen County Special Weed Action Team |
| UCCE | University of California Cooperative Extension |
| UNR | University of Nevada Reno |
| USDA | U.S. Department of Agriculture |
| WCDWR | Washoe County Department of Water Resources |

Implementation Schedule for the Carson Wandering Skipper Draft Recovery Plan

| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|---|--------------------------|------------------------------------|----------------------------------|-----------------------|-------|-----------------------|-------|----------|------------------------------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 1 | 1.1 | Identify and map known occupied sites, especially those of suspected source populations | 2 | FWS CDFG UNR BLM HLCT | 2 2 2 2 2 | 1 1 1 1 1 | | 1 1 1 1 1 | | | |
| 1 | 1.2 | Establish appropriate long-term management of occupied sites, especially those of suspected source populations | TBD | FWS CDFG BLM Landowners | TBD | | | | | | |
| 1 | 1.3 | Identify and map spring sites essential to the Carson wandering skipper | 2 | FWS CDFG UNR BLM HLCT | 2 2 2 2 2 | 1 1 1 1 1 | | 1 1 1 1 1 | | | |
| 1 | 1.4 | Establish appropriate long-term management of essential spring sites | TBD | FWS CDFG BLM Landowners | TBD | | | | | | |
| 1 | 1.8 | Work with interested landowners, UCCE, and other interested parties to control <i>Lepidium latifolium</i> at occupied and potential sites | Ongoing | SWAT UCCE NRCS Landowners | -- | | | | | | Cost within existing budgets |

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| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|---|--------------------------|---|----------------------------------|--------------------------|-----------------------|--------------------------|-----------------------|--------------------------|-------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 1 | 1.11 | Work with non-Federal interests to develop and implement Safe Harbor agreements, conservation agreements, habitat conservation plans, or other programs to protect, restore, enhance, and manage existing Carson wandering skipper populations and habitat as well as potential habitat | 5 | FWS* Landowners | 25 | | 5 | | | 5 | |
| 1 | 1.13 | Coordinate with BLM to acquire additional habitat and water rights from a willing seller at the Washoe County, Nevada, site | 1 | BLM | 400 | | 400 | | | | |
| 1 | 2.1 | Develop and implement a program to survey for additional populations | 3 | FWS* UNR/ACIN BLM CDFG | 25 25 25 25 | 8.3 8.3 8.3 8.3 | | 8.3 8.3 8.3 8.3 | | 8.3 8.3 8.3 8.3 | |
| 1 | 2.2 | Develop and implement a monitoring program for known populations and habitat for trends and threats | 20 | FWS* UNR/ACIN BLM CDFG HLCT | 100 100 100 100 100 | 5 5 5 5 5 | 5 5 5 5 5 | 5 5 5 5 5 | 5 5 5 5 5 | 5 5 5 5 5 | |

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| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|---|--------------------------|--|----------------------------------|-------|------------------------------|------------------------------|--------------------------|--------------------------|-------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 1 | 2.3 | Better understand ecological (including specific habitat needs) and life history requirements of the Carson wandering skipper | 2 | FWS* UNR/ACIN BLM CDFG HLCT/CSLC | 150 | 75 | 75 | | | | |
| 1 | 2.4 | Determine population structure and dispersal distance of Carson wandering skipper in Honey Lake and Warm Springs Valleys and at the Douglas County site | 3 | FWS* UNR/ACIN BLM CDFG HLCT/CSLC | 250 | | | 83.3 | 83.3 | 83.3 | |
| 1 | 3.6 | Identify landowners willing to assist in the recovery of Carson wandering skipper | 1 | FWS* BLM NRCS | 1 1 1 | | 1 1 1 | | | | |
| 2 | 1.5 | Support mapping of <i>Lepidium latifolium</i> by Federal, State, local agencies, and other interested parties | 2 | SWAT* UCCE NRCS HLCT | 12.5 12.5 12.5 12.5 | | 6.25 6.25 6.25 6.25 | 6.25 6.25 6.25 6.25 | | | |
| 2 | 1.6 | Support control of <i>Lepidium latifolium</i> by Federal, State local agencies, and other interested parties | Ongoing | SWAT UCCE NRCS Landowners | 750 750 750 750 | | | 150 150 150 150 | 150 150 150 150 | 150 150 150 150 | |

Implementation Schedule for the Carson Wandering Skipper Draft Recovery Plan

| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments |
|--------------------------|------------------------|--|--------------------------|---|----------------------------------|-------|-------|--------------------------|--------------------------|-------------------------------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | |
| 2 | 1.7 | Support monitoring of <i>Lepidium latifolium</i> by federal, state, local agencies, and other interested parties | Continual | SWAT UCCE NRCS HLCT | 8 8 8 8 | | | | 2 2 2 2 | |
| 2 | 1.12 | Coordinate with State wildlife resource agencies to provide Federal section 6 funds to be used by the states to carry out species recovery actions | Continual | FWS* CDFG NDOW | TBD | | | | | |
| 2 | 1.14 | Seek to acquire additional occupied or potential habitat from willing sellers, when possible, through fee acquisitions | Continual | TBD | TBD | | | | | |
| 2 | 1.15 | Conduct Endangered Species Act section 7 consultations to protect and enhance Carson wandering skipper populations and habitat | Ongoing | FWS* BLM, FHWA, DOD, DOJ, COE, NRCS, APHIS | -- | | | | | Costs within existing budgets |
| 2 | 2.5 | Determine the relationship between livestock grazing and the Carson wandering skipper and its habitat | 3 | UCCE NRCS ACIN Ag Agencies | 7.5 7.5 7.5 7.5 | | | 2.5 2.5 2.5 2.5 | 2.5 2.5 2.5 2.5 | |

Implementation Schedule for the Carson Wandering Skipper Draft Recovery Plan

| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|--|--------------------------|---|----------------------------------|-------|-------|-------|-------|----------|-------------------------------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 2 | 3.4 | Encourage Resource Conservation Districts and cooperative extension to provide technical assistance to landowners to further land management activities to assist in Carson wandering skipper recovery | Continual | Federal/State Agencies | -- | | | | | | Costs within existing budgets |
| 3 | 1.9 | Work with interested landowners of occupied sites to develop livestock grazing management plans to enhance habitat conditions for the Carson wandering skipper | 2 | FWS UCCE NRCS BLM Ag Agencies Landowners | 10 | | | | | | |
| 3 | 1.10 | Coordinate with federal, state, and local agencies to address issues of large scale ground water pumping to ensure adverse impacts to the Carson wandering skipper do not occur | Ongoing | WCDWR | -- | | | | | | Costs within existing budgets |

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| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|--|--------------------------|--------------------------|----------------------------------|-------|-------|-------|-------|----------|-------------------------------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 3 | 1.16 | Coordinate with the COE to avoid, minimize, or compensate for impacts to <i>Distichlis</i> and wetland habitat in relation to section 404 of the Clean Water Act activities | Ongoing | COE* FWS | -- | | | | | | Costs within existing budgets |
| 3 | 1.17 | Coordinate with Caltrans and CDFG regarding implementation of the Honey Lake Mitigation Bank in consideration of the Carson wandering skipper | Ongoing | FWS CDFG* Caltrans | -- | | | | | | Costs within existing budgets |
| 3 | 1.18 | Coordinate with the Honey Lake Conservation Team/California State Land Commission on the management of their lands adjacent to Honey Lake in consideration of the Carson wandering skipper | 5 | FWS* BLM CDFG | -- | | | | | | Costs within existing budgets |

Implementation Schedule for the Carson Wandering Skipper Draft Recovery Plan

| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|--|--------------------------|-----------------------------------|----------------------------------|-------|-------|-------|-------|-----------------------|---|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 3 | 2.6 | Develop a hydrologic model to understand the relationship between surface and groundwater resources better in Honey Lake and Warm Springs Valleys and at the Douglas County site | 7 | WCDWR | 700 | 100 | 100 | 100 | 100 | 100 | |
| 3 | 2.7 | Develop techniques for captive propagation with possible introduction/reintroduction to unoccupied, suitable sites | 2 | FWS* UNR/ACIN | 100 | | | | | | Costs for technique development. Need for augmentation to be assessed; partners not identified at this time |
| 3 | 2.8 | Develop techniques for Carson wandering skipper habitat creation and enhancement. | 4 | FWS BLM UNR NRCS CDFG | 8 8 8 8 8 | | | | | 2 2 2 2 2 | |

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| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|--------------------------|------------------------|--|--------------------------|-------------------------------------|----------------------------------|-------|-----------------------|------------------|-------|----------|-------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 3 | 3.1 | Create a web site to provide information on the species and the recovery process with the opportunity for the public to comment on the draft recovery plan | 1 | FWS | 1 | 1 | | | | | |
| 3 | 3.2 | Prepare general information for the public | 1 | FWS | 3 | 3 | | | | | |
| 3 | 3.3 | Use and develop kiosks at appropriate sites for educational material distribution | 1 | Caltrans CDFG HSLT CSLC | 2 | | 2 | | | | |
| 3 | 3.5 | Foster community involvement and educational opportunities with schools, scouts, 4H, and other groups to assist in Carson wandering skipper recovery | Continual | FWS* BLM NRCS UCCE CDFG | 8 8 8 8 8 | | 1 1 1 1 1 | 1 1 1 1 | | | |
| 3 | 4.1 | Revise the recovery plan as appropriate at 5-year intervals | Periodic | FWS | 20 | | | | | 5 | |

Implementation Schedule for the Carson Wandering Skipper Draft Recovery Plan

| Recovery Action Priority | Recovery Action Number | Recovery Action Description | Recovery Action Duration | Responsible Parties | Cost Estimate (in \$1,000 units) | | | | | Comments | |
|---|------------------------|---|--------------------------|---------------------|----------------------------------|-------|-------|-------|-------|----------|-------|
| | | | | | Total Costs | FY 06 | FY 07 | FY 08 | FY 09 | | FY 10 |
| 3 | 4.2 | Hold periodic meetings to encourage information sharing | Continual | FWS | 1 | | | | | 1 | |
| Total estimated cost of recovery over 20 years: \$5,477,000 | | | | | | | | | | | |

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Appendix A. Summary Of Threats And Recommended Recovery Actions

| Listing Factor | Threat | Recovery Criteria | Recovery Action Numbers |
|----------------|--|------------------------|---|
| A | Development (urban, residential, road) | A(1,2) B(1,2,3,5,6) | 1.1; 1.2; 1.3; 1.4; 1.11; 1.13; 1.14; 1.15; 2.8; 3.1; 3.2; 3.5; 3.6; 4.1; 4.2 |
| A | Wetland loss | A(1,2) B(1,2,3,5,6) | 1.2; 1.4; 1.10; 1.11; 1.12; 1.13; 1.14; 1.16; 1.17; 1.17; 2.8; 3.1; 3.2; 3.3; 3.4; 3.5; 3.6; 4.1; 4.2 |
| A | Agricultural practices | A(1,2) B(1,2,3,5,6) | 1.2; 1.4; 1.5; 1.6; 1.7; 1.8; 1.9; 1.10; 1.11; 1.12; 1.16; 2.5; 2.8; 3.1; 3.2; 3.4; 3.5; 3.6; 4.1 |
| A | Gas and geothermal development | A(1,2) B(1,2,3,5,6) | 1.1; 1.2; 1.11; 1.14; 1.15; 2.3; 2.8; 3.1; 3.2; 3.4; 3.5; 3.6; 4.1; 4.2 |
| A | Nonnative plant invasion | B(4,5,6) | 1.5; 1.6; 1.7; 1.8; 1.9; 1.11; 1.12; 1.15; 1.16; 1.17; 1.18; 2.8; 3.1; 3.2; 3.3; 3.4; 3.5; 3.6; 4.1; 4.2 |
| A | Water exportation | A(1,2) B(1,2,3,5,6) | 1.3; 1.4; 1.8; 1.9; 1.10; 1.11; 1.12; 1.15; 1.16; 1.17; 2.6; 3.1; 3.2; 3.3; 3.4; 3.5; 3.6; 4.1; 4.2 |
| B | Collection | A(1,2) B(1,2,3,5,6) | 1.2; 3.1; 3.2; 3.3; 3.5; 4.2 |
| B | Recreation | A(1,2) B(1,2,3,5,6) | 1.2; 1.4; 1.11; 1.12; 1.13; 1.14; 1.15; 1.16; 1.17; 1.18; 3.1; 3.2; 3.3; 3.4; 3.5; 4.1; 4.2 |
| C | Disease, predation | N/A | N/A |
| D | Inadequate regulatory mechanisms | N/A | Beyond scope of recovery plan, would require legislation changes |
| E | Use of pesticides/insecticides | A(1,2) B(1,2,3,5,6) | 1.6; 1.8; 1.11; 1.12; 1.13; 1.17; 1.18; 3.1; 3.2; 3.3; 3.4; 3.5; 3.6; 4.1; 4.2 |
| E | Stochastic events | A(1,2) B(1,2,3) | 1.2; 1.4; 1.9; 1.10; 1.11; 1.12; 1.13; 1.14; 1.16; 1.17; 1.18; 2.1; 2.2; 2.3; 2.4; 2.5; 2.7; 2.8; 3.4; 3.5; 3.6 |

Listing Factors:

- A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range
- B. Overutilization for Commercial, Recreational, Scientific, Educational Purposes
- C. Disease or Predation (no known diseases; predation not known to be a threat at this time)
- D. The Inadequacy of Existing Regulatory Mechanisms
- E. Other Natural or Manmade Factors Affecting Its Continued Existence

Recovery Criteria

A. Downlisting criteria

1) For the Lassen County, California, population/metapopulation **and** one of the two known Nevada populations (Washoe County or Douglas County) or a comparable newly discovered population, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Either population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance. In California, suitable habitat patches equivalent to 50 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence with no downward trend in abundance across the population/metapopulation.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the two populations in downlisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regards to habitat and land uses that may affect habitat quality including but not limited to development (urban, residential, water, gas and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

B. Downlisting criteria

1) For the Lassen County, California, population/metapopulation **and** both of the two known Nevada populations (Washoe County and Douglas County) or comparable newly discovered populations, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the populations. Each population in Nevada must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance. In California, suitable habitat patches equivalent to 75 percent or more of the currently known suitable habitat patches must be managed to effectively address threats, and each of these habitat patches must have been occupied for 6 years out of the most recent 10-year sequence after downlisting criteria are met, with no downward trend in abundance across the population/metapopulation. Substantial landscape connectivity must exist among patches (i.e., land cover between most sites would be considered open space and not urban or suburban) in order to potentially facilitate movement of the Carson wandering skipper among patches.

2) Adaptive management plans have been developed and implemented with adequate long-term funding, either individually or comprehensively, for the three populations in delisting criterion #1. These plans must address appropriate management for the Carson wandering skipper with regard to habitat and land uses that may affect habitat quality, including but not limited to development (urban, residential, water, gas, and geothermal), livestock grazing, recreation, invasive plant control, pesticide use, and public education.

3) In addition to the populations in delisting criterion #1, for at least one additional Carson wandering skipper population or metapopulation that may be discovered or established within Carson wandering skipper historic range, management has been established in perpetuity to effectively address threats to the species and ensure persistence of the population, unless we conclude (through intensive, comprehensive surveying) that additional populations or metapopulations do not exist and it would not be ecologically feasible to establish/reestablish one or more of them within Carson wandering skipper historic range.

4) *Lepidium latifolium* invasion into known and presumed suitable habitat for the Carson wandering skipper has been eliminated or reduced and managed to levels that do not pose a threat to the persistence of the Carson wandering skipper.

5) A long-term conservation plan and conservation agreements have been developed to guide management throughout the range of the Carson wandering skipper after it has been delisted.

6) A monitoring plan to cover a minimum of 5 years post-delisting of the Carson wandering skipper has been developed and is ready to be implemented to ensure the ongoing conservation of the species and the continuing effectiveness of management actions.

Appendix B. Glossary Of Terms Used In The Recovery Plan

| | |
|----------------------------|---|
| adaptive management | a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices. |
| apex | on the wing near its tip |
| basal | on the wing near its base |
| broods | generations per year |
| cell | any area between wing veins in an insect; each cell is designated by the vein in front of it |
| costal | side of the wing toward the body |
| critical habitat | the specific areas within the geographical area currently occupied by a species, at the time of listing, on which are found physical and biological features essential to the conservation of the species and that may require special management considerations or protections, and specific areas outside of the geographic area occupied by a species at the time of listing upon determination by the Secretary that such areas are essential for the conservation of the species |
| diapause | a natural state of suspended development at any life stage |
| discal | an area in the center of a butterfly wing |
| dorsal | the upper surface |
| endangered | any species which is in danger of extinction throughout all or a significant portion of its range |
| extant | in existence |
| extinction | complete disappearance or death of a species throughout its entire range |

| | |
|------------------------------|---|
| extirpation | the disappearance of a species from a portion of its range |
| forewing | the front wing of a butterfly |
| habitat patch | a discrete geographic area containing habitat/landscape characteristics associated with Carson wandering skipper occupancy, such as green <i>Distichlis spicata</i> , nectar sources, and springs or other water sources. At this time it is not known how many presumed suitable habitat patches exist or where they are located. The spatial extent of suitable habitat patches, distances between them, and the extent of suitable migration corridors are also not currently known. |
| HCP | Habitat Conservation Plan. A plan developed for land management to meet federal requirements for obtaining an incidental take permit pursuant to section 10(a) of the Endangered Species Act of 1973, as amended. |
| hind wing | the rear wing of a butterfly |
| instar | a stage between molts during the development of a larval insect |
| larva (plural larvae) | the immature and wingless form (caterpillar) that hatches from the egg of a holometabolous insect. It will eventually transform into a pupa before reaching adulthood |
| local scale | the scale at which individuals move and interact with each other in the course of their routine feeding and breeding activities |
| local population | set of individuals which all interact with each other with a high probability |
| metapopulation | set of local populations which interact via individuals moving among populations |
| metapopulation scale | the scale at which individuals infrequently move from one place (populations) to another, typically across habitat types which are not suitable for their feeding and breeding activities, and often with substantial risk of failing to locate another suitable habitat patch in which to settle |
| micro-topographic | pertaining to slight irregularities of a land surface |

| | |
|----------------------------|---|
| nectar | sugar secretion of a plant. It attracts insects and birds which pollinate the plant flower |
| nectar sites | areas where the adult Carson wandering skipper has been observed feeding on flowering plants. Carson wandering skippers are most readily observed when nectaring on plants during their flight season. These areas vary in size and offer a food resource but may or may not provide the other necessary life history requirements of the Carson wandering skipper. |
| occupied habitat | areas utilized for breeding, feeding, and shelter and adjoining dispersal corridors |
| pluvial | formed by the action of rainfall |
| population | a group of individuals in a locality that interbreed when mature |
| protect | to guard against loss; i.e., effectively counteracting threats to assure the persistence of a population. Carson wandering skipper habitat may be protected through such means as land acquisition from willing sellers, conservation agreements, management agreements, or by other means. |
| pupa (plural pupae) | stage between larva and adult |
| range | geographic area occupied by a species or subspecies |
| recovery | improvement in the status of a listed species to the point where listing is no longer appropriate under the criteria established in the Endangered Species Act |
| senescence | aging |
| species | as defined by the Endangered Species Act, a species includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species or vertebrate fish or wildlife which interbreeds when mature |
| subspecies | a geographical subdivision of a species |
| stochastic | random or chance variables |

| | |
|----------------------|--|
| threatened | any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range |
| type locality | the locality where the specimen from which a species was named was collected |
| vein | any of the riblike structures that form the framework of an insect's wing |
| ventral | the bottom surface |

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December 2005