Thelypodium stenopetalum
slender-petaled mustard

5-Year Review:
Summary and Evaluation

Thelypodium stenopetalum (slender-petaled mustard)
Photo credit: Scott Eliason (USFS)

U.S. Fish and Wildlife Service
Carlsbad, CA

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5-YEAR REVIEW

Thelypodium stenopetalum (slender-petaled mustard)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed. Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

Thelypodium stenopetalum (slender-petaled mustard) is an herbaceous biennial in the Brassicaceae (mustard family) that is restricted to the moist alkaline meadows of the Big Bear Valley of San Bernardino County, California. *Thelypodium stenopetalum* was listed by the State of California as an endangered species in February 1982 and federally-listed as an endangered species in August 1984. At the time of listing, there were eight known occurrences of *T. stenopetalum* at four locations including near Erwin Lake, near Baldwin Lake, in Holcomb Valley, and the south shore of Big Bear Lake. Little information is available regarding the historical distribution of *T. stenopetalum*, but it is thought to have occurred throughout moist meadows of Big Bear Valley and it is currently extant at six occurrences in the Big Bear Valley. The primary threats at the time of listing were habitat loss and degradation due to urban development, off-road vehicle use, and cattle grazing.

Methodology Used to Complete This Review:

This review was prepared by Jennifer McCarthy at the Carlsbad Fish and Wildlife Office, following the Region 8 guidance issued in March 2008. We used information from the 1998 Recovery Plan, survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game (CDFG). The Recovery Plan and personal communications with species experts were our primary sources of information used to update the species' status and threats. We received no information from the public in response to our notice in the **Federal Register** initiating this 5-year review. This 5-year review contains updated

information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provides an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

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Federal Register (FR) Notice Citation Announcing Initiation of This Review:

A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 25, 2009 (USFWS, pp. 12878–12883). No information was received.

Listing History:

Federal Listing
FR Notice: 49 FR 34497 34500
Date of Final Listing Rule: August 31, 1984
Entity Listed: *Thelypodium stenopetalum* (slender-petaled mustard), a plant species.
Classification: Endangered

State Listing
Thelypodium stenopetalum was listed by the State of California as endangered in 1982.

Associated Rulemakings: None

Review History: No previous taxon-specific reviews of *Thelypodium stenopetalum* have been conducted.

Species' Recovery Priority Number at Start of 5-Year Review:

The recovery priority number for *Thelypodium stenopetalum* is 5C according to the Service's 2010 Recovery Data Call for the Carlsbad Fish and Wildlife Office, based on a 1–18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (USFWS 1983a, pp. 43098–43105; USFWS 1983b, p. 51985). This number indicates that the taxon is a species that faces a high degree of threat and has a low potential for recovery. The "C" indicates conflict with construction or other development projects or other forms of economic activity.

Recovery Plan or Outline:

Name of Plan
Recovery Plan for the Pedate Checkermallow (*Sidalcea pedata*) and Slender-Petaled Mustard (*Thelypodium stenopetalum*)

Date Issued
July 1998

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy:

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. Because the species under review is a plant the DPS policy is not applicable, and the application of the DPS policy to the species' listing is not addressed in this review.

Information on the Species and its Status:

Species Description

Thelypodium stenopetalum (slender-petaled mustard) is a glabrous (lacks hairs) biennial with simple stems, 30 to 80 centimeters (cm) (12 to 31 inches (in)) tall, with one to many branches per plant. The oblanceolate leaves (2 to 15 cm (1.6 to 5.9 in)) are thickish, purple-tinged, arranged in a basal rosette, and wither soon after blooming. The 2 to 5 cm (1.6 to 2 in) long stem leaves are sessile, arrowhead-shaped or auriculate-clasping at the base. The leaf margins are variably entire to few-toothed or shallowly lobed. The lavender to whitish flowers are borne in open, many-flowered racemes (inflorescence). The calyx (outermost group of floral parts) has a purplish tinge that gives the inflorescence a purple hue. The linear petals are 10 to 14 millimeters (0.4 to 0.6 in) long and crinkled at the base. The narrow, linear fruits are 3 to 5 cm (1 to 3 in) long.

Species Biology and Life History

Thelypodium stenopetalum is typically considered to be a biennial species, although this has not been verified (see Species-specific research section below) (Henderson 2003, p. 57), with individual plants completing their life cycle in 2 years. First year plants generally produce leaf rosettes only and rarely flower that year. Observations of *T. stenopetalum* during drier years have found that with less water the species can act as an annual and produce smaller flowers that fall off the plant earlier than during wet years (S. Eliason, U.S. Forest Service, pers. obs. 2010). Mature plants produce an inconspicuous flower stalk with flowers arranged in an open raceme in May or June; flowers may be present on the stalk through July. Pollination studies have not been

conducted on this species. No information is available on seed dispersal though it appears that the small seeds do not disperse very far from the parent plant (USFS 2000b, p. 41).

The larvae of the Andrew's marble butterfly (*Euchloe hyantis andrewsii*) (Krantz 1990, p. 24), a species endemic to the San Bernardino Mountains, has been observed feeding on native mustard species including *Thelypodium stenopetalum*. While the primary larval food source of Andrew's marble butterfly is identified as *Descurainia richardsonii* (mountain tansy mustard) (AMEC 2005, p. 6), the extent to which this butterfly utilizes *T. stenopetalum* and contributes to insect damage on *T. stenopetalum* plants is unknown as is the contribution to the survival of the butterfly from the plant (USFS 2000b, p. 42).

Habitat or Ecosystem

Thelypodium stenopetalum is primarily found on vernally moist alkaline meadows at elevations from 1,600 to 2,500 meters (m) (5,250 to 8,200 feet (ft)) in the Big Bear Valley, San Bernardino Mountains of California. Alkaline flats and lakeshores are also considered suitable habitat (USFS 2000b, p. 41). The geological history of the area as a Pleistocene lake bed has resulted in a high clay component in the soil that contributes to the formation of these moist meadows. The clay forms a barrier to percolation of surface water and creates favorable conditions to support moist to wet meadow species. The clay soils of these meadows are often saturated with surface water in the spring, but dry by July (Krantz 1980, p. 5). Community dominants are mostly low herbaceous species less than 0.5 m (1.6 ft) high (Krantz 1994, p. 100). Moist meadows are characterized by a shallow water table that is usually less than 0.6 m (2 ft) deep (Wood 1975, p. 30). Research indicates that moist meadow plant communities are groundwater dependent, but become precipitation dependent after the groundwater level drops below the rooting zone of the plants (Henderson 2003, p. 54; Elmore *et al.* 2006, p. 770).

All populations of *Thelypodium stenopetalum* are found on alkaline clays crossed by annually moist seeps and streams, indicating that soil hydrology is an important factor in determining distribution. *Thelypodium stenopetalum* is found towards the drier edges of moist meadows, or drier sparsely vegetated meadows that are dominated by *Artemisia rothrockii* (basin sagebrush) (USFS 2000b, p. 152; Krantz 1994, p. 100). *Thelypodium stenopetalum* plants are often seen growing up through *A. tridentata* (sagebrush) shrubs and may be as much as 1 m (3.3 ft) tall. These preferred areas are characterized by annual saturation of the soil, but not to the extent that denser, more water tolerant vegetation intrude.

While soil hydrology plays an important role in the distribution of *Thelypodium stenopetalum*, a mosaic of moisture gradients has been observed at various *T. stenopetalum* occurrences such as along the margins of a relatively moist swell and on drier, alkaline flats around the margins of a dry lake bed (USFWS 1998, p. 21; USFS 2002, p. 115) indicating that soil hydrology alone is not the only limiting factor in determining suitable habitat. Specific soil characteristics such as soil alkalinity and clay content may be just as important in determining suitable habitat as soil moisture. When vernally moist meadows dry out in the summer, evaporates (salts and minerals) may collect at the surface of the saturated soils, creating salt scalds. These are vegetation free areas that may create opportunities for the establishment of other competing vegetation and provide a niche for plants such as *T. stenopetalum* that can tolerate such harsh conditions (Krantz

2008, p. 4). *Thelypodium stenopetalum* are particularly abundant in highly alkaline areas where salt accumulations preclude other meadow vegetation and grasses (Krantz 2008, p. 8). Further research regarding specific soil characteristics associated with *T. stenopetalum* is needed to better understand habitat requirements.

The moist to wet open meadows where *Thelypodium stenopetalum* occurs are at times interspersed with pebble plains, which is another rare habitat in the Big Bear Valley area. Pebble plains are areas where the clay soils are "paved" with sarapossa quartzite pebbles. These pebble plains provide habitat for a number of Big Bear endemics including, but not limited to: *Linanthus killipii* (Baldwin Lake linathus), *Mimulus exiguus* (small monkeyflower), *M. purpureus* (purple monkeyflower), *Castilleja lasiorhyncha* (Indian paintbrush), *Pyrrocoma uniflora* var. *gossypina* (plantain goldenweed), *Senecio bernardinus* (San Bernardino ragwort), and three other federally-endangered plant species — *Poa atropurpurea* (San Bernardino bluegrass), *Taraxacum californicum* (California taraxacum), and *Sidalcea pedata* (pedate checkermallow). At the time of listing, there remained only three locations in Big Bear where pebble plains and vernally moist meadows formed these habitat "mosaics" with their unique floral assemblages: Eagle Point on Big Bear Lake, Baldwin Lake, and Lower Holcomb Valley (Krantz 1981, p. 2).

Much of the former moist meadow habitat necessary for the continued existence of *Thelypodium stenopetalum* has been eliminated. Within the Big Bear and Holcomb Valleys, 91 percent of all meadow habitat has been lost since the turn of the century (USFS 2000b, p. 40). Current estimates suggest that there are fewer than 400 hectares (ha) (1,000 acres (ac)) remaining in these areas.

Spatial Distribution

The historical distribution of *Thelypodium stenopetalum* is not well known. It was believed to be more common around Big Bear Valley before its supporting habitat was eliminated by the construction and operation of Big Bear Dam in the 1890s, and subsequent residential and commercial development. The listing rule describes *T. stenopetalum* as being known from only four locations: the south shore of Big Bear Lake, near Baldwin Lake, Erwin Lake, and in Holcomb Valley; however, the listing rule does not provide a more specific occurrence distribution.

CNDDB has been a repository for information on the location and the status of rare taxa in California for over 30 years, including occurrences for *Thelypodium stenopetalum*. The data are chronologically and cumulatively recorded by localities that are assigned element occurrence (EO) reference numbers. The CNDDB currently recognizes 11 historical occurrences, all of which are found in one of the four locations described in the listing rule (CNDDB 2010). Using information from the CNDDB, it can be inferred that at the time of listing there were eight extant occurrences.

The occurrences at the Interlakken Shopping Center (EO 4) and at the southwest end of Erwin Lake (EO 5) have been extirpated since listing. The occurrence at the east end of Erwin Lake (EO 3) is within an area that has been subdivided, developed, and the habitat has become

severely degraded. *Thelypodium stenopetalum* has not been observed at the east end of Erwin Lake (EO 3) in recent years and may be extirpated (Eliason, pers. obs. 2010); however, it is considered extant until confirmation surveys have been completed. Currently, we consider there to be six extant occurrences of *T. stenopetalum* occupying less than 8.5 ha (21 ac) (Appendix 1). The location and distribution of extant *T. stenopetalum* occurrences are shown in Figure 1.

Abundance

The total area occupied by *Thelypodium stenopetalum* in 1998 was estimated to be 8.5 ha (21 ac) (USFWS 1998, p. iii). The two extirpated occurrences (EOs 4, 5) and observed declines at extant occurrences (EOs 3, 6, 7) suggest that the current total acreage of occupied habitat may be less than 8.5 ha (21 ac). Extant occurrences of *T. stenopetalum* vary in size from approximately 3.2 ha (8.0 ac) of occupied habitat to approximately 0.4 ha (1 ac). The highest recorded density was 11.3 plants per square meter, but this was reflective of a high proportion of seedlings (79 percent), most of which died by the end of the season. Average density for *T. stenopetalum* in 1980 was estimated at 5.94 plants per square meter. The biennial nature and population response to changes in precipitation of *T. stenopetalum* makes it difficult to obtain an accurate count and density estimate of plants. For example, monitoring at Belleville Meadow (EO 10) over 10 years showed that numbers of flowering plants fluctuate considerably relative to soil moisture and precipitation (between 500 and 75,000 individuals) (USFS 2000, p. 61). Because of the biennial nature of *T. stenopetalum*, these fluctuations in the number of flowering plants do not necessarily equate to population growth; therefore, discerning reliable population trends is difficult for *T. stenopetalum*. Anecdotal observations by Scott Eliason (U.S. Forest Service, Big Bear Ranger District) over the past several years suggest that populations at Belleville Meadow (EO 1) and the north shore of Baldwin Lake (EO 1) may be stable. The populations at the south shore of Baldwin Lake (EO 6) and Pan Hot Springs (EO 7) have demonstrated population declines (Krantz 2008, p. 2; Eliason, pers. obs. 2010), and small populations at Eagle Point (EO 2) occur in empty lots associated with existing home sites in a residential neighborhood, which we believe are the remnants of a once much larger population (USFWS 1998, p. 23).

Changes in Taxonomic Classification or Nomenclature

Neither the taxonomic classification nor the nomenclature of *Thelypodium stenopetalum* has changed since listing.

Genetics

No contemporary genetic analysis has been completed.

Persistence of a species in small populations suggest that loss of genetic variation, genetic drift, and potential inbreeding depression might occur over prolonged periods of time. See Factor E discussion below for analysis of these effects.

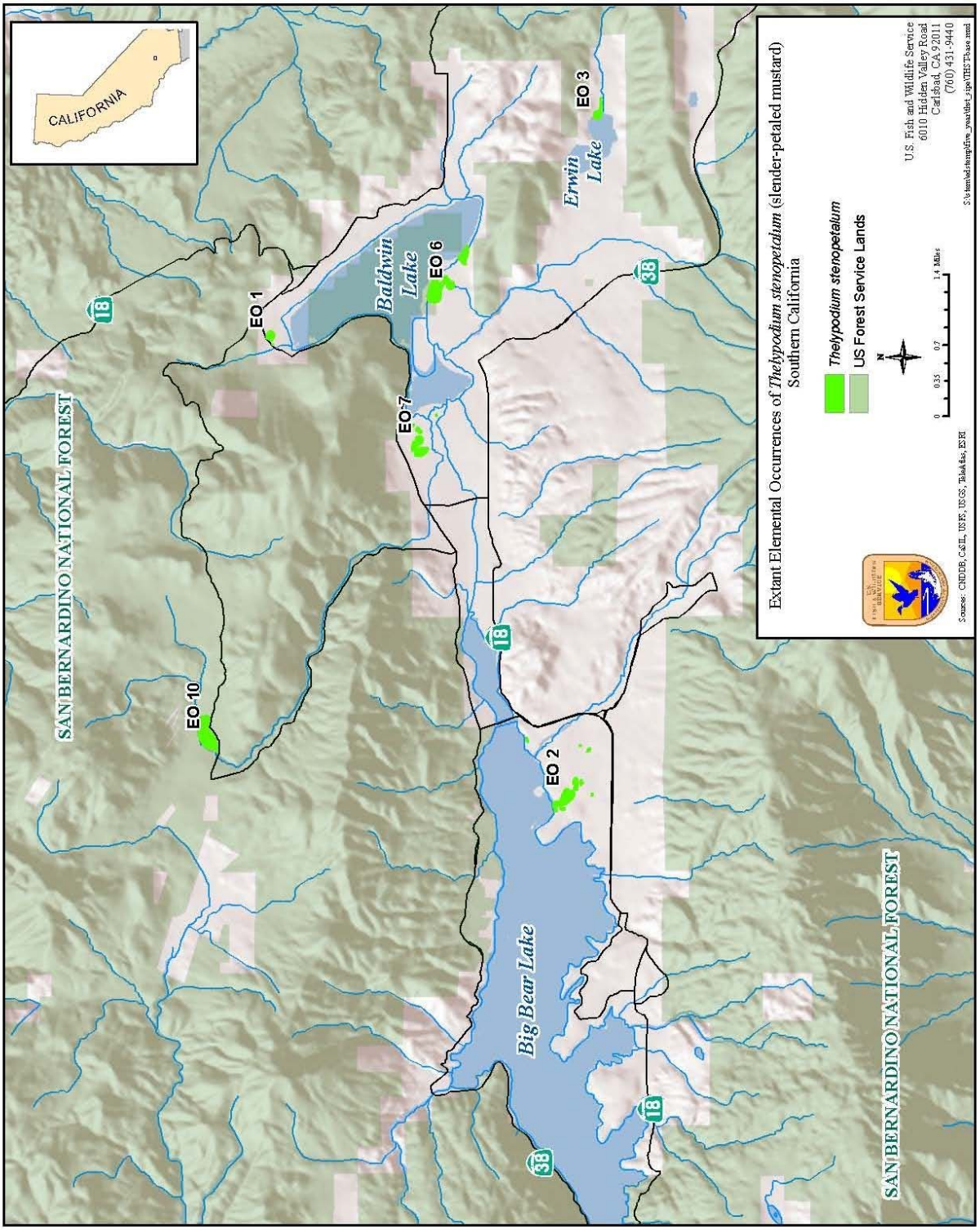

Figure 1: Distribution of *Thelypodium stenopetalum* (slender-petaled mustard) occurrences; prepared for 2011 5-year review.

Species-specific Research and/or Grant-supported Activities

The population response of *Thelypodium stenopetalum* to precipitation was investigated as part of a Master's thesis project conducted by Amy Lynne Henderson at California State University, Fullerton in 2003 (Henderson 2003). The study examined whether the total number of adult plants in Belleville Meadow (EO 10) was directly correlated with precipitation. Results supported a significant relationship between the total number of adult plants and 2-year precipitation, 2-year winter precipitation, 3-year precipitation, and 3-year winter precipitation. Henderson also found that contrary to published descriptions, *T. stenopetalum* may be a facultative biennial rather than an obligate biennial (Henderson 2003, p. 58).

Vulnerability Factors

Species may be vulnerable to threats for a variety of reasons. Primack (2006, p. 159) outlined the following five categories of species considered most vulnerable to extinction:

1) Species with very narrow geographical ranges,
2) species with only one or a few populations,
3) species in which population size is small (identified as one of the best predictors of species extinction rate),
4) species in which population size is declining, and
5) species which are hunted or harvested by people.

Evaluation of these categories relative to life history traits can be used to develop a vulnerability profile for *Thelypodium stenopetalum*. Fiedler and Ahouse (1992, p. 32) consider ecology, biotic competition, population dynamics, reproductive biology, and genetics among the factors affecting the rarity of a plant taxon, which would be reflected in categories two and three above. These traits may render the species more vulnerable to the threats discussed below and should be considered in developing management actions. We have identified the following vulnerability factors for *T. stenopetalum* include the following:

1) The species has a naturally discontinuous, narrow geographical range and is restricted to moist meadow habitat. *Thelypodium stenopetalum* is distributed on less than approximately 8.5 ha (21 ac) of moist meadow habitat in the Big Bear Valley.
2) The species is currently known from only six extant occurrences at four locations.
3) Some occurrences of *Thelypodium stenopetalum* contain only a few individuals.
4) Some populations may be considered stable, but others are declining.

Although life history and habitat specificity traits create natural limitations for *Thelypodium stenopetalum*, the threats described below in the five-factor analysis exacerbate the species' vulnerabilities described above.

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

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

The listing rule identified urban and commercial development and off-highway vehicle (OHV) activity as the main threats to habitat occupied by *Thelypodium stenopetalum* (USFWS 1984, p. 34498). Since listing, these threats have continued to impact *T. stenopetalum* habitat. We have also identified two new Factor A threats, alteration of hydrology and invasion by nonnative plants, which are described below.

Development

Development of the Big Bear Lake Reservoir (1884) and the Big Bear Dam (1911) destroyed almost all of the natural meadowland within Big Bear Valley. As a result, habitat occupied by *Thelypodium stenopetalum* was reduced from 2,800 ha (7,000 ac) to about 400 ha (1,000 ac) (USFWS 1984, p. 34498). This construction appears to have affected the extinction of some of the plants, which formerly grew in the valley (Parish 1917, p. 164) and likely eliminated some *T. stenopetalum* populations. Residential and commercial development led to the extirpation of three known historical occurrences of *T. stenopetalum* (EOs 8, 9, and 11) in the decades prior to listing (Appendix 1). At the time of listing, about 80 percent of the remaining *T. stenopetalum* habitat (approximately 400 ha (1,000 ac)) was considered vulnerable to development (USFWS 1984, p. 34499).

Since listing in 1984, habitat loss associated with development continues to be the predominant threat to *Thelypodium stenopetalum* and has contributed to two extirpations: Interlakken Shopping Center (EO 4) and south west of Erwin Lake (EO 5). In the 2000s, the Big Bear Valley experienced more residential construction than occurred in previous decades. The population in Big Bear Valley grew 14.1 percent from 2000 to 2007 (City of Big Bear Lake 2010, p. II-1) and this region is likely to experience continued growth over the next few decades (USFS 2002, p. 25). Over the past 20 years, occurrences on private lands have been either extirpated or disturbed. Virtually all known private land occurrences have shown some level of disturbance (USFS 2000b, p. 2). The Forest Service (2000, p. 2) suggests that "simply protecting the National Forest land occurrences will likely not be enough to ensure survival and recovery of these [in reference to the meadow species] species" and that "without aggressive conservation, recovery and restoration efforts, the federally-protected occurrences may not be enough to ensure long-term survival of these species."

The threat of development remains high because the majority of *Thelypodium stenopetalum* occurrences are on private land (four of six EOs). Impacts of development pressures on private land are evident at a number of occurrences: the subdivision and development of the land for the Hamilton Ranch Erwin Lake Estates at the east end of Erwin Lake (EO 3) has significantly impacted *T. stenopetalum* and its habitat, some *T. stenopetalum* habitat east of Eagle Point (EO 2 not in parcel K) has been lost to housing development, the occurrence at the south shore of

Baldwin Lake (EO 6) has been impacted by development, and the Belleville Meadow occurrence (EO 10) has been impacted by upstream development. The only *T. stenopetalum* occurrence that is considered fully protected from development impacts is at the north shore of Baldwin Lake (EO 1) on the Baldwin Lake Ecological Reserve (managed by CDFG), and residential construction activities are occurring adjacent to this reserve. There are no conservation measures in place that offer protection of these occurrences on private land from future development. The direct threat of development to *T. stenopetalum* therefore remains substantial and is currently impacting habitat at four of six extant occurrences (Appendix 1).

Off-Highway Vehicles (OHVs)

The listing rule indicated that OHV activity eliminated colonies and damaged *Thelypodium stenopetalum* habitat (USFWS 1984, p. 34499). In 2000, a review by the Forest Service found that approximately 1.1 miles (1.7 kilometers) (1.3 ha (3 ac)) of unauthorized roads bisect or are adjacent to known occupied meadow plant occurrences and that the unauthorized network of roads allow for an "unknown, though likely high, level of random and on-going impacts to threatened/endangered meadow plant habitat" (USFS 2000b, p. 99). Unauthorized routes are closed when they are found; however, illegal OHV use continues to impact moist meadow habitat by altering hydrology, compacting soil, and degrading habitat.

Controlling OHV use within *Thelypodium stenopetalum* habitat has been difficult because much of the activity is either on private land or is unauthorized. Occurrences at the north and south shores of Baldwin Lake (EOs 1, 6) are particularly vulnerable to OHV use. At the south shore of Baldwin Lake (EO 6), OHV trails bisect the *T. stenopetalum* occurrence, connecting private land to the shoreline (USFS 2000b, p. 62). Fencing that may have provided protection to the occurrence at the north shore of Baldwin Lake (EO 1)—at the side of State Route 18, which could prevent unauthorized OHVs from entering—has been knocked down or has fallen down due to heavy snow drifts (Eliason, pers. obs. 2010). In 2010, the Forest Service placed boulders at the entrance of these roads to preclude OHV activity, which appears to be successful in reducing this threat on Forest Service lands (Eliason, pers. obs. 2010). At Belleville Meadow (EO 10), OHV activity in unauthorized areas has been observed on a closed road that bisects the area (USFS 2000b, p. 62) and has caused devegetation and alteration of surface hydrology in some areas (USFS 2005, p. 37). The Forest Service has closed and rehabilitated unauthorized roads at this occurrence (USFWS 2005, p. 220). Despite fencing and barriers, unauthorized OHV use still occurs at Belleville Meadow (USFWS 2005, p. 37). Currently, we believe OHV activity is negatively impacting *T. stenopetalum* rangewide.

Alteration of Hydrology

Thelypodium stenopetalum is susceptible to changes of the natural hydrological conditions within its habitat due to its apparent dependence on soil moisture (USFS 2000b, p. 37). Alteration of hydrology poses a threat to all *T. stenopetalum* occurrences (Eliason, pers. obs. 2010). Alteration of drainages and swales, depletion of groundwater, and conversion of drainages to flood control channels all have the potential to significantly impact populations of *T. stenopetalum*. In extreme cases, alteration of hydrology may result in the dewatering of the habitat by lowering the water table (USFS 2000b, p. 43). An increase in residential development

and the subsequent installation of a large number of private wells has the potential to lower the water table and thereby alter the hydrology of moist meadow habitat (Krantz 1979, p. iv; Eliason, pers. obs. 2010). Additionally, development, roads, and OHV activity may alter the hydrology of an area by creating gullies, which can cut off the water supply to a meadow aquifer downstream by intercepting, concentrating, and diverting runoff (USFS 2002 p. 22).

Alteration of soil hydrology or existing drainage patterns may have impacted several *Thelypodium stenopetalum* occurrences including Eagle Point (EO 2) and the north shore of Baldwin Lake (EO 1). At each of these locations, efforts were made to prevent hydrology-related impacts to the habitat and to the species. For instance, CDFG's purchase of private land containing the watershed for the north shore of the Baldwin Lake occurrence (EO 1; Baldwin Lake Ecological Reserve) in 1992 has helped to maintain natural hydrologic patterns. The Pan Hot Springs occurrence (EO 7) is found on deed restricted land; however, the water source for the habitat is not included in the deed restriction. Without control of water availability, the plants and their habitat at this occurrence remain threatened (USFS 2002, p. 25).

While protection measures have lessened the threat of altered hydrology at several occurrences, it remains a rangewide threat to five of six extant occurrences (Appendix 1).

Invasive Nonnative Plants

Since listing, invasive nonnative plants have been identified as a threat to five of six *Thelypodium stenopetalum* occurrences (Appendix 1). Nonnative species of grasses and forbs invade many plant communities often as an indirect result of habitat disturbance (Vitousek *et al.* 1997, p. 1). Development, roads, and other threats that disturb moist meadow habitat allow invasive nonnative plants to occupy and replace *T. stenopetalum*, and may decrease the amount of soil nutrients available to co-existing *T. stenopetalum* and eliminate natural pollinators (Levine *et al.* 2003, p. 777). Nonnative grasses may impact *T. stenopetalum* habitat by decreasing community water availability, which is often mediated by the displacement of species that use more water (Levine *et al.* 2003, p. 778). Invasion by nonnative grasses, may make it more difficult for *T. stenopetalum* to thrive because these grasses have a highly diffuse root system that is well positioned in the soil horizon to remove moisture that otherwise could support seedlings of *T. stenopetalum* (Levine *et al.* 2003, p. 778). Additionally, dead grasses may create a mat or thatch that impedes or prevents seedlings from becoming established.

Thinopyrum intermedium (previously *Elytrigia intermedia)* (intermediate wheatgrass) has been identified as a threat to occurrences at the north and south shores of Baldwin Lake (EOs 1, 6), East of Eagle point (EO 2), Erwin meadows (EO 3), and in the south end of Pan Hot Springs (EO 7) (Eliason pers. comm. 2011). *Thinopyrum intermedium* invades *T. stenopetalum* habitat and outcompetes it for space. It also produces a thatch that *T. stenopetalum* seedlings cannot penetrate. Control methods, such as burning or mowing, have proven ineffective because the grass is a perennial that returns in subsequent years (Eliason pers. obs. 2010).

Summary of Factor A

In summary, the most significant ongoing threat to *Thelypodium stenopetalum* continues to be development on private lands (four of six occurrences are potentially impacted). Two occurrences have been extirpated since listing as a result of development (EOs 4, 5). The occurrence at the north shore of Baldwin Lake (EO 1) is the only occurrence considered fully protected. While fencing, signage, and barriers have been installed at several occurrences, unauthorized OHV activity continues to impact *T. stenopetalum* habitat throughout its range. Alterations of hydrology and invasion by nonnative species have also been identified as new rangewide threats since listing. Conservation efforts focused on ameliorating Factor A threats on private lands may be critical to prevent extirpation.

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

Overutilization for commercial purposes was not known to be a factor in the 1984 final listing rule (USFWS 1984, p. 48136). Overutilization for any purpose does not appear to be a threat at this time.

FACTOR C: Disease or Predation

The listing rule indicated that, historically, cattle grazing in the Big Bear Valley likely affected the species composition of many of the meadow areas formerly supporting *Thelypodium stenopetalum* and that the few remaining colonies may still be adversely impacted by from cattle grazing (USFWS 1984, p. 34499). Since listing, we have determined that cattle grazing is no longer a threat, although grazing by burros and horses has impacted *T. stenopetalum.* In early 1997, a population of wild burros, estimated to be 117 animals, inhabited the Big Bear Valley and Baldwin Lake area. That same year, 77 of the burros were removed and those remaining are now prevented from entering habitat occupied by *T. stenopetalum* (USFS 2002, p. 18). Based on the best information available, we found no evidence that burro grazing poses a threat to the species at this time.

Since the time of listing, horse grazing and pasturing activities have been identified as threats that are impacting occurrences at Pan Hot Springs (EO 7), the south shore of Baldwin Lake (EO 6), and the east end of Erwin Lake (EO 3). Voluntary landowner agreements resulted in the relocation of equestrian activities away from rare plant habitat at Pan Hot Springs. These efforts were successful and recovery of *Thelypodium stenopetalum* populations has been observed at this location (USFS 2002, p. 19). Horse grazing and pasturing activities remain a threat at the east end of Erwin Lake (EO 3) and south Baldwin Lake (EO 6). These occurrences are on private lands and there is no formal protection in place to control this threat.

As described in the species biology, Andrew's marble butterfly feed on members of Brassicaceae (mustard family) including *Thelypodium stenopetalum.* The extent that feeding by Andrew's marble butterfly impacts *T. stenopetalum* populations is unknown. Further research is necessary to determine the status of this threat.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time *Thelypodium stenopetalum* was listed as endangered under the Act, it was already listed as endangered under the California Endangered Species Act (CESA). Our listing rule stated that listing by the State of California does not provide sufficient protection to ensure survival of the species in its natural habitat, as it principally addresses salvage of plants when there is a change in land use and restrictions on trade (USFWS 1984, p. 34499). No Federal regulatory mechanisms that might provide for the conservation of *T. stenopetalum* were described in our listing other than reference to the general benefits of listing under the Act. The following discussion describes State, Federal, and local laws and regulations relevant to conservation of *T. stenopetalum*.

State Protections

State laws potentially providing protection to *Thelypodium stenopetalum* include CESA, Native Plant Protection Act (NPPA), California Environmental Quality Act (CEQA), and the Natural Communities Conservation Planning (NCCP) Act enacted in 1991.

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA)

Protections have been afforded to *Thelypodium stenopetalum* since the species was listed as endangered by the State in 1982. Both the NPPA and CESA include prohibitions forbidding the "take" of State-listed species (Chapter 10, Section 1908 and Chapter 1.5, Section 2080, CFG code). With regard to prohibitions of unauthorized take under NPPA, landowners are exempt from this prohibition for plants to be taken in the process of habitat modification. Where landowners are notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify CDFG 10 days in advance of changing land use in order to allow salvage of listed plants. Sections 2081(b) and (c) of CESA allow CDFG to issue incidental take permits for State-listed threatened and endangered species if:

1) The authorized take is incidental to an otherwise lawful activity;
2) the impacts of the authorized take are minimized and fully mitigated;
3) the measures required to minimize and fully mitigate the impacts of the authorized take are roughly proportional in extent to the impact of the taking of the species, maintain the applicant's objectives to the greatest extent possible, and are capable of successful implementation;
4) adequate funding is provided to implement the required minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures; and
5) issuance of the permit will not jeopardize the continued existence of a State-listed species.

Protections for *Thelypodium stenopetalum* afforded under CESA and NPPA may be lessened as a result of enforcement of a local weed abatement requirement of the County of San Bernardino, as described in the Local Agencies (San Bernardino County Land Use/Fire Hazard Abatement Division) section below.

California Environmental Quality Act (CEQA)

CEQA is the principal statute mandating environmental assessment of projects in California. The purpose of CEQA is to evaluate whether a proposed project may have an adverse effect on the environment and, if so, to determine whether that effect can be reduced or eliminated by pursuing an alternative course of action or through mitigation. CEQA applies to projects proposed to be undertaken or requiring approval by State and local public agencies (*http://www.ceres.ca.gov/topic/env_law/ceqa/summary.html*). CEQA requires disclosure of potential environmental impacts and a determination of "significant" if a project has the potential to reduce the number or restrict the range of a rare or endangered plant, including *Thelypodium stenopetalum*; however, projects may move forward if there is a statement of overriding consideration. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

The Natural Community Conservation Planning (NCCP) Act

The NCCP program is a cooperative effort between the State of California and numerous private and public partners with the goal of protecting habitats and species. An NCCP program identifies and provides for the regional or area-wide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. The program began in 1991 under the State's NCCP Act (CFG Code 2800–2835). The primary objective of the NCCP program is to conserve natural communities at the ecosystem scale while accommodating compatible land uses (*http://www.dfg.ca.gov/nccp/*). Regional NCCPs provide protection to federally-listed species by conserving native habitats upon which the species depend. Many NCCPs are developed in conjunction with Habitat Conservation Plans (HCPs) prepared pursuant to the Act. *Thelypodium stenopetalum* does not occur on lands with an HCP.

California Department of Fish and Game (CDFG)

Lake or Streambed Alteration Agreement

The CDFG Code at section 1602 requires notification by any person, business, State, or local government agency, or utility that proposes an activity that will: 1) Substantially divert or obstruct the natural flow of any river, stream or lake; 2) substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake or; 3) deposit or dispose of debris, waste, or any other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake. This notification applies to any work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. This includes ephemeral streams, desert washes, and waterways with subsurface flows. It may also apply to work undertaken within the flood plain of a body of water. If CDFG determines that the activity may substantially adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement will be prepared. The agreement includes reasonable conditions necessary to protect those resources and must comply with CEQA. This CDFG requirement may afford protections

to the State listed *Thelypodium stenopetalum* in the intermittent waterways and shallow flood plain associated with Big Bear Lake and Baldwin Lake occurrences.

Baldwin Lake Ecological Reserve

The CDFG owns and conserves 55 ha (138 ac) of sensitive habitat on the north shore of Baldwin Lake (EO 1). This is considered the only fully protected occurrence of *Thelypodium stenopetalum*. Most of this land, which was originally purchased by The Nature Conservancy and transferred to CDFG in 1986, is now designated as the Baldwin Lake Ecological Reserve (Reserve). The Reserve includes 1 ha (3 ac) of wet meadow habitat supporting *T. stenopetalum*. A management plan and "Operations and Maintenance Schedule" for the Reserve and adjacent lands were completed in August 1989 pursuant to a cooperative endeavor involving CDFG, The Nature Conservancy, and the Forest Service. Management actions include rerouting of trails to avoid rare plant habitat, installation of fencing along State Highway 18 to limit access, and surveying in 2000 (no significant changes to habitat were noted) (USFS 2000, pp. 32–33). Additionally, the Friends of the Forest (the official interpretive association of the Big Bear Service District) renovated an abandoned building in the Reserve in 1992 for use as a visitor center, which provided information on endangered and threatened species in Big Bear Valley, including *T. stenopetalum*. Management actions appear to be successful, as the *T. stenopetalum* occurrence seems to be stable here.

Federal Protections

National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) (42 U.S.C. 4371 *et seq*.) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigations that could offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be reduced to a level of insignificance, only that impacts be assessed and the analysis disclosed to the public.

Clean Water Act (CWA)

Under section 404, the U.S. Army Corps of Engineers (Corps) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the Corps' criteria of hydric soils, hydrology (either sufficient annual flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands) (USFWS 1988). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act (CWA), NEPA, and the Act. These reviews require consideration of impacts to listed species and their habitats, and recommendations for mitigation of significant impacts. Big Bear Lake is considered a jurisdictional wetland; however

the ephemeral drainages where *Thelypodium stenopetalum* occurrences are found require a significant nexus determination. In response to the recent Supreme Court decisions, the Corps and the U.S. Environmental Protection Agency have recently released a memorandum providing guidelines for determining jurisdiction under the CWA. This guidance indicates that wetlands adjacent to navigable-in-fact waters of the United States are subject to regulation under the CWA, as are non-adjacent wetlands that are shown to have a significant nexus to navigable waters. The guidelines provide for a case-by-case determination of a "significant nexus" standard. No jurisdictional determination has been made on Baldwin Lake and its tributaries (Gerry Salas, U.S. Army Corps of Engineers, pers. comm. 2011).

Endangered Species Act of 1973, as amended (Act)

Since listing, the Act is the primary Federal law that may provide protection for *Thelypodium stenopetalum*. The Service's responsibilities include administering the Act, including sections 7, 9, and 10. Section 7(a)(2) of the Act requires Federal agencies, including the Service to ensure that actions they fund, authorize, or carry out do not "jeopardize" a listed species or result in the "destruction or adverse modification" of habitat in areas designated by the Service to be "critical." Critical habitat has not been proposed for this taxon. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 C.F.R. § 402.02).

Under Section 9(a)(2) of the Act, with respect to endangered plant taxa, it is unlawful to remove and reduce to possession (i.e., collect) any such taxon from areas under Federal jurisdiction; maliciously damage or destroy any such taxon on any such area; or remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any law or regulation of any state or in the course of any violation of a state criminal trespass law.

Section 10(a)(1)(A) of the Act contains provisions for collection of plants or plant parts for scientific purposes or to enhance the propagation and survival of the species. Under section 10(a)(1)(B) of the Act, the Service may issue "incidental take" (take is defined in section 3(18) of the Act) permits for listed animal species to non-Federal applicants. Take and therefore incidental take protections are not extended to plants.

National Forest Management Act (NFMA)

The National Forest Management Act (NFMA) (36 C.F.R. 219.20(b)(i)) has required USFS to incorporate standards and guidelines into Land and Resource Management Plans, including provisions to support and manage plant and animal communities for diversity and for the long-term, rangewide viability of native species. The Forest Service recently released a proposed planning rule for National Forest System Land management planning, including preparation of its Land and Resource Management Plans, which is likely to change future management of listed species, particularly rare plant occurrences, on National Forests (76 FR 8480; February 14, 2011).

The most recently revised Land and Resource Management Plans for the four southern California national forests within the San Bernardino District includes strategic direction in the form of land use zoning and standards (USFS 2005). The land use zoning and standards indicate that, for projects under the plans, new activities will be neutral or beneficial to *Thelypodium stenopetalum* and expansion of existing facilities or new facilities will focus recreational use away from *T. stenopetalum* habitat. Exceptions were included for fuel abatement activities ("fuel treatments") in wildland-urban interface areas and to allow for projects with short-term effects but long-term benefits (USFWS 2005, p. 15). However, projects could be proposed outside of the scope of the Plans that may still impact the species.

Meadow Habitat Management Guide

In 2002, the San Bernardino National Forest completed the Meadow Habitat Management Guide (USFS 2002). This guide updates the status of *Thelypodium stenopetalum* on Forest Service land and on private lands and describes location-specific management strategies to promote the recovery of this species. Management direction and prescriptions are based on existing laws, regulations, and USFS policy (USFS 2002, p. 1). On Forest Service land occupied by *T. stenopetalum*, examples of recommended management actions include: monitoring for *T. stenopetalum*, monitoring for nonnatives along trails and roads, and rerouting of roads and limiting accessibility. On private lands, recommended management actions include cooperating with land owners (i.e., CDFG, City of Big Bear Lake, or cabin owners) to conserve meadow habitat or discourage impacts (USFS 2002, pp. 29–70). Thus far, the occurrence at Pan Hot Springs (EO 7) is the only occurrence on private land where this recommended action has been implemented, and cooperating with land owners has led to the relocation of horse pasturing activities away from *T. stenopetalum* (see Factor C for further discussion).

Local Agencies

<u>San Bernardino County Land Use/Fire Hazard Abatement Division</u>

The San Bernardino County Land Use/Fire Hazard Abatement Division inspects open area parcels, homes that have a significant amount of tall weeds, and responds to complaints regarding weeds. Species identified as weeds are not specified in the San Bernardino County code; however, there is no discrimination for rare plants growing on the identified properties (Codified Ordinances of the County of San Bernardino 2010, 23.0304). If the Code Enforcement Office determines a property could be a fire hazard, residents may receive a weed abatement order in the mail. Because mowing is conducted by private owners who wish to remove weeds under the weed abatement program (see Factor E discussion), occurrences of *Thelypodium stenopetalum* within these areas may be impacted. To resolve this conflict, the City of Big Bear Lake suggested that there should be exceptions when rare plants are present, though these have not yet been adopted by San Bernardino County (Eliason, pers. obs. 2010).

City of Big Bear Lake

The City of Big Bear Lake General Plan, completed in 1983, includes a Conservation Element that recognizes the significance of rare plant populations within the city boundaries. Populations of *Thelypodium stenopetalum* are designated on a "Rare Plant Habitat Map" within the Conservation Element.

The City of Big Bear Lake received a deed restriction for 2.8 ha (7.0 ac) of rare plant habitat at Eagle Point often referred to as “Lot K” (EO 2). This parcel contains populations of *Thelypodium stenopetalum*. The deed restriction on this property, which is still owned by the developers of an adjacent housing development, was granted to the City of Big Bear Lake as mitigation for project impacts. Although these lands are considered conserved, there are currently no management provisions in place here.

Big Bear City Community Services District

Thelypodium stenopetalum occurs on property at Pan Hot Springs (EO 7) owned and managed by the Big Bear Community Services District. This parcel includes 20 ha (50 ac) of sensitive meadow and wetland habitat. Approximately 4 ha (10 ac) of the property has been set aside as a rare plant preserve. This area is covered by a Big Bear Community Services District deed restriction that requires protection of the rare plant populations and habitat and is managed following guidelines and directives outlined in the Pan Hot Springs Management Plan (Krantz 2008). This protection agreement was designed in consultation with the Service, Corps, and The Nature Conservancy personnel.

Factor D Summary

In summary, the Act is the primary Federal law that has provided protection for *Thelypodium stenopetalum* since its listing as endangered in 1984. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for *T. stenopetalum* absent its status under the Act. There are also unresolved conflicts between State protections afforded under CESA and NPPA and county weed abatement provisions. Therefore, we believe that State and other Federal laws and regulations have limited ability to protect the species in absence of the Act. Two of the six extant *T. stenopetalum* occurrences are however, afforded protection through local agencies by protecting land to conserve rare plant populations. Inadequacies in provisions or implementation in regulatory mechanisms are not considered threats to the species, although these inadequacies may permit or precipitate actual threats that are described under Factors A, B, C, and E.

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

The listing rule did not identify any other natural or manmade threats impacting *Thelypodium stenopetalum’s* continued existence. Since listing, several new threats under Factor E have been identified and include: recreational activities, fire suppression, reduced populations, and climate change and drought.

Recreational Activities

Impacts associated with recreational activities have been identified as a rangewide threat to *Thelypodium stenopetalum* (Appendix 1). Recreational activities include, but are not limited to: hiking, dispersed camping, fishing, horse riding, mountain biking, and dog walking. The primary impact from recreational activities is trampling, which can crush and kill individual plants. Additional impacts include soil compaction, devegetation, escaped campfire threats, introduction or spread of nonnative species, and burial of plants with litter (USFS 2002, p. 23). Fencing and signage indicating the presence of sensitive species have proven effective at reducing the threat of recreational activities at the north and south shore of Baldwin Lake (EOs 1, 6). Moderate success has also been made in educating the public and heightening the awareness of the need for the protection and recovery of *T. stenopetalum* and numerous other listed and rare species in the vicinity of Big Bear Lake. The Big Bear Discovery Center at San Bernardino National Forest regularly presents public education programs on a variety of subjects, including threatened and endangered species (USFS 2000b, p. 80).

Fire Suppression Measures

Implementation of fire suppression measures has been identified as a threat at four of six extant *Thelypodium stenopetalum* occurrences. The San Bernardino County Land Use/Fire Hazard Abatement Division (see Factor D discussion) requires that owners must remove weeds and grasses in areas where this vegetation acts as a fuel that may pose a fire threat. Weeds and grasses are described by the County of San Bernardino generally as annuals that grow and dry out each year, and they did not discriminate for rare plants (County of San Bernardino 2010a, 2010b). Weed and grass removal generally involves mowing, which damages or destroys individual *T. stenopetalum* plants. If removal activities are conducted before or during *T. stenopetalum* flowering and fruit development, the plants reproductive output and germination may be significantly impacted.

Reduced Populations

Fragmentation and isolation can adversely impact small populations of plants that are already reduced in distribution such as *Thelypodium stenopetalum* resulting in increased vulnerability to extirpation (Barrett and Kohn 1991, pp. 3–30). These effects may be the result of several factors, including small areas of suitable habitat, local extirpations, or ongoing natural or artificial factors limiting establishment and survival of the taxon.

The small number of *Thelypodium stenopetalum* occurrences is a concern because it increases the possibility that impacts from urban development or other activities near moist meadow habitat could destroy all or a significant portion of the species' population. *Thelypodium stenopetalum* is distributed on less than 8.5 ha (21 ac) of moist meadow habitat (USFWS 1998, p. iii). Stochastic events outside the natural range of frequency and severity (such as floods, fires, contamination, or drought) can substantially reduce or eliminate species such as *T. stenopetalum* with a restricted range and small population, and increase the likelihood of extinction (Lande 1993, p. 912).

Genetic effects may further influence population demography via inbreeding depression and genetic drift (Barrett and Kohn 1991, pp. 3–30; Menges 1991, pp. 58–61). Allee (1931, pp. 17–50) suggested small, single populations are vulnerable to extirpation when opportunities for reproduction diminish because of reduced opportunity of individuals to reproduce (Allee effect or depensation) (Courchamp *et al*. 2008, pp. vi–216). Stephens *et al*. (1999, pp. 185–190), Dennis (2002, pp. 389–401) and Courchamp *et al*. (2008, pp. vi–216) suggest that the Allee effect is a density-dependent event that is inversely related to population size.

Climate Change and Drought

Soil hydrology is likely a limiting factor in the distribution of *Thelypodium stenopetalum* in moist meadows. Currently, altered hydrology is a rangewide threat to *T. stenopetalum*, and may be exacerbated by climate change. There is a broad consensus among scientists that the earth is in a warming trend caused by anthropogenic greenhouse gases such as carbon dioxide (IPCC 2007). Climate models are beginning to examine what will happen in localized regions such as southern California, and many scientists believe warmer, wetter winters and warmer, drier summers will occur within the next century as well as an increase in extreme temperature events (e.g., Field *et al*. 1999, pp. 2–3, 20; Christensen *et al.* 2007, p. 891). Climate-related changes in California have been documented (Croke *et al*. 1998, pp. 2128, 2130; Breashears *et al*. 2005, p. 15144, McMullen 2009, p.41, Dominquez *et al*. 2010, p. 500). Predictions for California indicate prolonged drought and other climate-related changes will continue in the future (Field *et al*. 1999, pp. 8–10; Lenihan *et al*. 2003, p. 1667; Hayhoe *et al*. 2004, p. 12422; Breashears *et al.* 2005, p. 15144; Seager *et al*. 2007, p. 1181; IPCC 2007, p. 9). The impacts on species like *T. stenopetalum* that depend on specific hydrological regimes may be more severe.

In a changing climate, conditions could change in a way that would allow both native and nonnative plants to invade the habitat where *Thelypodium stenopetalum* occurs. Five factors associated with a changing climate may affect the long-term viability of *T. stenopetalum* occurrences in its current habitat configuration:

1) Drier conditions may result in less suitable moist meadow habitat, a lower percent germination and smaller population sizes, fewer and less reliable recovery cycles of abundant individuals;
2) higher temperatures may inhibit germination, dry out meadows, affect pollinator services;
3) a shift in the timing and nature of the annual precipitation may favor nonnative species or increase erosion and summer drought;
4) the timing of pollinator life-cycles may become out-of-sync with timing of flowering *Thelypodium stenopetalum*; and
5) drier conditions may result in increased fire frequency, making the ecosystems in which *Thelypodium stenopetalum* currently grows more vulnerable to the threats of subsequent erosion and nonnative/native plant invasion.

While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species (including *Thelypodium stenopetalum*) or sites at this time. It

seems likely that *T. stenopetalum*, a species restricted to montane meadows in a single small portion of a mountain range found on particular soils with particular hydrological needs, would be threatened rangewide by any differences in climatic regimes brought on by changes to the climate. A changing climate with spatial and temporal shifting of temperature and precipitation may cause this species specific adaptations to climate to work against its survival. A changing climate may also provide advantages to other native and nonnative plant species. Sharing information between scientists, land managers, and decision makers will increase our ability to address these threats. Increasing the success with which we address current threats to *T. stenopetalum* will increase our success of handling the uncertain effects of future climate change.

Summary of Factor E

Since listing, recreational activities, fire suppression, reduced, fragmented, or isolated populations, and climate change have been identified as rangewide threats to *Thelypodium stenopetalum*. Numerous recreational activities can crush or damage plants or degrade habitat. While fencing and signage has been installed to reduce the impacts of such activities in *T. stenopetalum* habitat, unauthorized trespass still occurs. Landowner agreements and educational efforts to raise awareness may be beneficial in reducing this threat on private lands. Mowing as a means of fire suppression may pose a substantial threat to *T. stenopetalum* on private lands. *Thelypodium stenopetalum* populations have been fragmented and isolated and are at risk of extirpation from stochastic events or genetic effects associated with its small population size. Because *T. stenopetalum* is limited by specific hydrological regimes, the species is likely threatened by climate change and drought events, which may alter its habitat to a point that it is no longer suitable. As a result of the persistence of impacts associated with recreation, fire suppression, small population size, and potentially climate change, Factor E threats continue to threaten *T. stenopetalum* with extinction throughout its range.

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, states, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The primary objective of the recovery plan for *Sidalcea pedata* and *Thelypodium stenopetalum* was "to enable the reclassification to threatened and ultimately delist the two species by providing written guidance on protecting and maintaining sufficient populations and habitat (USFWS 1998, p. 34)." Although recovery criteria were developed for the two plant species, the criteria were not threat-based, as addressing ecosystem function and integrity was the modus for recovery plans developed during the 1990s (Clark *et al.* 2002, pp. 1510–1519). Additionally, the criteria to assess recovery of *T. stenopetalum* do not reflect the most current information available. Overall, little progress has been made toward satisfying the recovery criteria.

Recovery criteria focused on reclassification from endangered to threatened were listed as:

1) *Six populations of Thelypodium stenopetalum and adjacent suitable habitat are fully protected through land management agreements, land ownership by resource agency or conservation organization, conservation easement, or other permanent means of protection.*
2) *Populations are stable or increasing with allowances for natural fluctuations.*

Since listing, conservation measures have been put into place that allow for at least partial protection of three *Thelypodium stenopetalum* occurrences. The occurrence at the north shore of Baldwin Lake (EO 1) is the only population of *T. stenopetalum* that is considered fully protected (USFWS 2005, p. 208); however, even this population is impacted by recreational activities and illegal trespass. Voluntary landowner agreements have lessened the impact associated with horses (pasturing activities) at Pan Hot Springs (EO 7). The Belleville Meadow occurrence (EO 10) and part of the south shore Baldwin Lake occurrence (EO 6) are found on San Bernardino National Forest lands and are conserved and managed through actions contained in the Forest Service's Land and Resource Management Plan and the Meadow Habitat Management Guide. Two other extant occurrences receive partial protection. Part of the occurrence at Eagle Point (parcel K, EO 2) is found on privately owned, deed restricted land governed by the City of Big Bear Lake and has been set aside as a rare plant preserve as mitigation for Eagle Point development. The Pan Hot Springs occurrence (EO 7) is found, in part, on land owned by Big Bear City's Community Services District and receives partial protection through management actions identified in the Pan Hot Springs Meadow Habitat Management Plan (Krantz 2008).

Four of the six extant occurrences are located, in part, on private land and receive no formal protection. Development on private land remains the predominant threat to *Thelypodium stenopetalum.* As the majority of occurrences receive no protection, the conservation efforts described above are not enough to meet reclassification criterion 1 for *T. stenopetalum* from endangered to threatened status.

The populations of *Thelypodium stenopetalum* are declining overall, with extirpation of two occurrences (EOs 4 and 5) since listing. All occurrences are impacted by multiple threats and though some populations are presumed extant, surveys are needed to verify their status (e.g., east end of Erwin Lake (EO 3)). Surveys are necessary to determine the status of all occurrences on private land, but observations in the field suggest that *T. stenopetalum* are not increasing and may be declining; therefore, reclassification criterion 2 has not been met.

Overall, while some steps have been made in achieving recovery, progress towards reclassifying and eventually delisting *Thelypodium stenopetalum* has been largely unsuccessful and there are indications—such as two extirpations, and the significant habitat degradation at the south shores of Baldwin Lake (EO 6)—that *T. stenopetalum* is facing a greater threat of extirpation than at the time of listing. The recovery plan was not threats-based; consequently, action items necessary to meet the plan's recovery criteria are insufficient to reduce or eliminate the threats identified in the five factor analysis and recover the species.

IV. SYNTHESIS

Thelypodium stenopetalum and other obligate moist meadow or pebble plain species are conservation dependent, because their habitat occurs within natural areas with unique hydrological conditions that are also vulnerable to development pressures. Historically, 91 percent of moist meadow habitat has been lost development in Big Bear Valley (USFS 2000b, p. 46). Residential construction on private land and population growth has continued since listing and contributed to the extirpation of two *T. stenopetalum* occurrences. All of the threats identified at listing as well as newly identified threats currently impact *T. stenopetalum* and its habitat.

The original threats that led to listing of *Thelypodium stenopetalum* include loss of habitat from development and OHV use. Since listing, additional threats have been identified: alteration of hydrology, invasion by nonnative plants, grazing by horses, recreational activities, fire suppression, reduced, isolated, or fragmented populations, and climate change and drought. Protections afforded by the Act, and corresponding cooperative endeavors with private landowners and local and State governments, have helped to reduce impacts of OHV use and recreational activities. Development on private land continues to be the predominant threat to *T. stenopetalum*. Cooperation with private landowners regarding recovery and restoration efforts is critical to the persistence to the species.

Since listing, *Thelypodium stenopetalum* has persisted in six of eight occurrences throughout its range. The species is dependent on unique moist meadow habitat and the anticipated effects of climate change and drought events may represent a significant threat to the long-term retention, recovery efforts, or facilitate extinction of the species. The status of *T. stenopetalum* as endangered is appropriate due to the suite of current threats, which affect its short and long-term existence. The direct and indirect effects of increased development and urbanization include: (1) loss and degradation of habitat, and associated alteration of hydrological regimes of moist meadow landscapes; (2) increased displacement by invasive nonnative plants; (3) continued incidental OHV impacts; and (4) continued recreational activities. Reductions in population distributions resulting from increased fragmentation and isolation of extant occurrences make this species increasingly vulnerable to stochastic events and genetic effects associated with small population size. Many of the persisting threats to this taxon are considered rangewide, including alteration in hydrology, recreational activities, small population size, and drought and climate change. Therefore, we find that *T. stenopetalum* still meets the definition of endangered and do not recommend a change in status at this time.

V. RESULTS

Recommended Listing Action:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reason for delisting according to 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X_ No Change

New Recovery Priority Number and Brief Rationale: No Change

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1) Work with partners, in particular private landowners, to help conserve *Thelypodium stenopetalum*. Identify opportunities through the Service's Partners for Fish and Wildlife Programs to implement conservation opportunities on private lands.

2) Conduct monitoring to inventory actual occurrences and update the status of *Thelypodium stenopetalum* occurrences throughout the species range. While the occurrence on the east end of Erwin Lake (EO3) is presumed extant, surveys should occur because they have not been conducted at this species location for many years.

3) Conduct research on life history characteristics (e.g., pollination studies) and more specific habitat requirements. This information may be used for unoccupied habitat identification and potential reintroduction experiments.

4) Establish a seed bank focusing first on small, isolated populations that have the greatest potential to become extirpated.

5) Work with the State and San Bernardino County to resolve conflicts with the weed abatement plan.

6) Develop a threats-based recovery outline to guide conservation actions for the species.

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Appendix 1. Occurrence table for of *Thelypodium stenopetalum* (slender-petaled mustard) occurrences; prepared for 2011 5-year review.

Area	EO	Location	Owner	Extant at listing	Current status	Current Threats	Current Conservation
Baldwin Lake	1	North shore of Baldwin Lake (Baldwin Lake Ecological Reserve)	CDFG own 50 ha (125 ac) within the Reserve; adjacent land is Forest Service and private	Yes	Extant	A: Development (Upstream), OHV use, nonnatives	Fully protected occurrence and managed by CDFG
	6	South shore of Baldwin Lake	Private, Wildhaven Ranch	Yes	Extant	A: Development, OHV use, altered hydrology, nonnatives C: Grazing E: Recreation activities, fire suppression	
	7	Pan Hot Springs (Southwest end of Baldwin Lake)	City of Big Bear/ Private	Yes	Extant	A: OHV use, altered hydrology, nonnatives C: Grazing E: Recreation activities, fire suppression	Pan Hot Springs Meadow HMP/ no formal protection
Holcomb Valley	10	Belleville Meadow	USFS	Yes	Extant	A: OHV use, altered hydrology E: Recreation activities	Managed by the U.S. Forest Service

Area	EO	Location	Owner	Extant at listing	Current status	Current Threats	Current Conservation
Erwin Lake	3	East end of Erwin Lake	Private (the Hamilton Ranch Lake Erwin Estates)	Yes	Presumed extant	A; Development, OHV use, altered hydrology, nonnatives C: Grazing E: Recreation activities, fire suppression	No formal protection
	5	South west of Erwin Lake	Private (the Hamilton Ranch Lake Erwin Estates)	Yes	Extirpated		
Big Bear Lake Fragments	2	East of Eagle Point	Fee ownership by private party with conservation easement to City of Big Bear Lake	Yes	Extant	A: Development, OHV use, altered hydrology, nonnatives E: Recreation activities, fire suppression	Parcel K under conservation easement
	4	Interlakken Shopping Center	Privately owned	Yes	Extirpated		
	8	Margin of Big Bear Lake at east end on south side, west of Big Bear City	Owned by Big Bear City Community Services District	No	Extirpated		

Area	EO	Location	Owner	Extant at listing	Current status	Current Threats	Current Conservation
	9	Near Big Bear Post Office and mouth of Pine Knot drainage		No	Extirpated		
	11	Big Bear Valley Golf Course and Moonridge Meadows.		No	Extirpated		

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

***Thelypodium stenopetalum* (Slender-petaled mustard)**

Current Classification: 5C

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
X No change needed

Review Conducted By: Carlsbad Fish and Wildlife Office

FIELD OFFICE APPROVAL:

ACTING **Lead Field Supervisor, U.S. Fish and Wildlife Service**

Approve _____ Date MAR 10 2011

Scott A. Sobiech