Arenaria paludicola
(Marsh Sandwort)

5-Year Review:
Summary and Evaluation

Photo by Dieter Wilken

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

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5-YEAR REVIEW
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1. GENERAL INFORMATION

1.1. Introduction:

Arenaria paludicola is an herbaceous perennial in the Caryophyllaceae (pink family). It has trailing stems that can be up to 39 inches (in) (1 meter (m)) long and are often supported by surrounding vegetation. *Arenaria paludicola* has small, white flowers that are borne singly on long stalks arising from the leaf axils (point of leaf attachment to the stem). This plant can also reproduce asexually. It can produce adventitious roots on the trailing stems that come in contact with suitable conditions. It generally blooms from May to August.

1.2. Reviewers:

Lead Region: Region 8, California/Nevada Operations Office

Contact name(s) and phone numbers: Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, (916) 414-6464; Jenness McBride, Fish and Wildlife Biologist, (916) 414-6613

Lead Field Office: Ventura Fish and Wildlife Office

Contact name(s) and phone numbers: Mark A. Elvin, Biologist, (805) 644-1766 ext. 258; Connie Rutherford, Listing and Recovery Coordinator, (805) 644-1766 ext. 306.

Cooperating Field Office: Carlsbad Fish and Wildlife Office; Gary Wallace, Ph.D., Botanist, (760) 431-9440.

1.3. Methodology used to complete the review:

This review was prepared by Ventura Fish and Wildlife Office staff. We reviewed the information in our files regarding *Arenaria paludicola* including all relevant scientific papers, survey reports, and letters to and from the U.S. Fish and Wildlife Service (Service). We spoke with botanical experts and knowledgeable individuals regarding new information that has been acquired since its listing as well as any other pertinent information. We also spoke with knowledgeable individuals who have expertise with the species within the geographic region where the species occurs, familiarity with the principles of conservation biology, and/or knowledge of wetlands ecosystems and their associated nutrient cycles. We incorporated all comments and information from our files and the public into our review as appropriate. We received no public comments in response to our Federal Register (FR) notice initiating a request for information on this species (see section I.C.1, below).

1.4. Background:

FR Notice citation announcing initiation of this review: We published a notice in the Federal Register announcing the initiation of the 5-year review for *Arenaria paludicola* and 57 other species on February 14, 2007 (72 FR 7064). This notice initiated a 60-day request for information period which closed on April 16, 2007.

1.4.1. Listing history

Original Listing
FR notice: 58 FR 41378
Date listed: August 3, 1993
Entity listed: *Arenaria paludicola* (marsh sandwort); a plant species
Classification: Endangered

1.4.2. Associated rulemakings

There have been no associated federal rulemakings for *Arenaria paludicola*.

1.4.3. Review History

No formal status review has been conducted since the original listing of the species. Informal status reviews have been conducted on an irregular basis, and information was incorporated into the draft and final recovery plans, prepared in 1997 and 1998.

1.4.4. Species' Recovery Priority Number at start of 5-year review

The recovery priority number for *Arenaria paludicola* prior to initiating this review was 5. This indicates that it is a full species with a high degree of threat and a low recovery potential. The species is assigned a low recovery potential because the biological and ecological limiting factors are poorly understood, the threats to the species existence are poorly understood and are pervasive and difficult to alleviate. Intensive management is needed and there is an uncertain probability of success or it is not known if the techniques will be successful.

1.4.5. Recovery Plan or Outline

Name of plan or outline: Recovery Plan for Marsh Sandwort (*Arenaria paludicola*) and Gambel's Watercress (*Rorippa* [*Nasturtium*] *gambelii*).

Date issued: September 28, 1998

Dates of previous revisions, if applicable: There have been no revisions to this plan.

2. REVIEW ANALYSIS

2.1. 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 of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

2.2. Recovery Criteria

2.2.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X__ Yes

____ No

2.2.2. Adequacy of recovery criteria.

2.2.2.1. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

____ Yes
__X__ No. Population demographics and threats have changed since the time of listing (see 2.2.3 below).

2.2.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information (for threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here):

Although the recovery criteria in this recovery plan were not implicitly based on the threats, the threats identified in the listing rule will have been addressed if the criteria are met. Many of the recovery tasks in this recovery plan address specific threats that were identified in the listing rule.

The status of *Arenaria paludicola* at the time of listing, at the completion of the Recovery Plan, and at the time of this review, is so critical, that the main objective for this plant is to prevent its extinction. We developed only downlisting criteria for *A. paludicola* due to its critical status and our lack of knowledge regarding it and its ecosystem (i.e., ecology,

population and reproductive biology, population status and distribution). We have not yet developed delisting criteria.

The recovery plan contains the following downlisting criteria (Service 1998):

Arenaria paludicola can be considered for downlisting when:
1) "[N]ew plants are established so that there are at least 5 populations of at least 500 individuals each" (addresses Factors A, D, and E). This criterion has not been met. While the intent of this criterion may be appropriate, we do not think that it is practical and may not be attainable. We are assembling a Scientific Recovery Implementation Team to help us make a more accurate determination regarding the number of populations and individuals that are necessary to recover this species.

2) "[S]ome of these populations occur in permanently protected habitats in Black Lake Canyon and the dune lakes area" (addresses Factors A, D, and E). This criterion has not been met. While the intent of this criterion may be appropriate, we do not think that it is attainable in the near future. Plants were reintroduced into Black Lake Canyon (Mazer et al., in litt., 2000) as a recovery task, only to become extirpated later (California Natural Diversity Data Base (CNDDB) 2007, California Native Plant Society (CNPS) 2007).

3) "[S]ome of the populations must be in other areas of suitable habitat within the species' historical range in the United States" (addresses Factors A, D, and E). This criterion has not been met. We believe this criterion is adequate and appropriate with respect to the recovery of the species.

4) "[T]he [introduced] populations remain viable for at least 5 years" (addresses Factor E). This criterion has not been met. We believe this criterion is appropriate with respect to the downlisting of the species.

2.3. Updated Information and Current Species Status

2.3.1. Biology and Habitat

- Abundance:

  At the time of listing in 1993, there was only one known, extant population of *Arenaria paludicola*, and it was in Black Lake Canyon in southwestern San Luis Obispo County. *Arenaria paludicola* was considered to have been extirpated from eight other populations along the Pacific coast ranging from Washington to southern California. The only known population at the time of listing, at Black Lake Canyon, was declining, which prompted the Service to determine that there was good cause for the listing rule to take effect immediately upon publication (Service 1993).

  Naturally occurring plants were last seen in Black Lake Canyon in 1994 after a recorded declining trend since 1985 (CNDDB 2007). *Arenaria paludicola* was reintroduced into Black Lake Canyon at three places: one in 1995 (with one plant

from one clone) and two in 1998 (with three plants from one clone in April and 12 plants from one clone in May). The decline of *A. paludicola* at these three sites was recorded with the last observation occurring on November 11, 1999 (CNDDB 2007; Mazer et al., in litt., 2000). *Arenaria paludicola* is now considered to be extirpated from Black Lake Canyon (CNDDB 2007; Mazer et al., in litt., 2000). In order to improve the success of recovery activities for *A. paludicola*, we need more information regarding the conditions in Black Lake Canyon. We need to determine what caused the re-introductions to fail and disappear before we expend additional efforts to introduce *A. paludicola* into Black Lake Canyon again. We are proceeding with introductions into other secured locations in the Pismo Dunes area.

Since it was listed, *Arenaria paludicola* was rediscovered at Oso Flaco Lake in 1998 with this site now being the only known extant, wild population for this species (CNDDB 2007). There has been a recorded decline in this population with 85 individuals that were reported in 1998 and only 25 individuals in 2005. There has also been a recorded decline in the amount of suitable habitat at this site between 2005 and late 2006, possibly due to biostimulation (a state when vegetation is more robust, taller, thicker, and overgrown, which is correlated with nutrient loads) (CNDDB 2007).

- Distribution

Arenaria paludicola has been documented as occurring along the Pacific coast from central-western Washington to southern California (CNDDB 2007, Consortium of California Herbaria 2007, California Academy of Sciences Herbaria 2007). It has been documented from ten sites (or populations) in six general areas along the Pacific coast. *Arenaria paludicola* is considered to be extirpated in Washington, only being known there from one collection in Pierce County, Washington, in "swamps near Tacoma" on September 21, 1896 (*J.B. Flett 262* (WS, GH)) (Kennison, in litt., 1980; Gamon, in litt., 1991; Washington Flora Checklist 2007). Several other plant collections from Washington have been reported to be and misidentified as *Arenaria paludicola*, but were determined to be *Stellaria borealis* subsp. *sitchana* (Kennison, in litt., 1980; Gamon, in litt., 1991). Only one collection from Washington, *Flett 262*, has been confirmed to be *Arenaria paludicola*. Interestingly, there are no *A. paludicola* collections from Oregon (California Academy of Sciences Herbaria 2007, Oregon State University Herbarium 2007, Oregon Plant Atlas 2007). In California, historical populations are known from five areas: San Francisco Bay (Crissy Field, San Francisco County), Santa Cruz (Scotts Valley, Santa Cruz County), Guadalupe-Nipomo Dunes (Black Lake, Black Lake Canyon, Jack Lake, Oso Flaco Lake, Twin Lake, Pismo Beach, San Luis Obispo County), Los Angeles basin (Los Angeles County), and along the Santa Ana River (vicinity of San Bernardino, San Bernardino County). At the time of listing in 1993, the only known extant population was in Black Lake Canyon. Currently, there is only one known, extant wild population, at Oso Flaco Lake, and one, extant, introduced population, at Sweet Springs Marsh on the southern edge of Morro Bay.

During the public comment period for the Draft recovery plan for *Arenaria paludicola* and *Rorippa* [*Nasturtium*] *gambelii*, the Service was notified of a report of *A. paludicola* from Zempoala Lakes, Zempoala Lakes National Park, Morelos, Mexico, southwest of Mexico City (Service 1998). Since then, we have become aware of a number of collections from central southern Mexico and Guatemala that are housed in several herbaria in Mexico and the United States (Conabio 2007). These specimens were collected from montane valleys above 2,500 m (8,200 feet (ft)) in central and southern Mexico and Guatemala that are more than 2,400 kilometers (1,500 miles (mi)) to the south-southeast of the southernmost location in California (Conabio 2007; Rich Rabeler, Research Museum Collection Manager, Assistant Research Scientist (Vascular Plants), University of Michigan Herbarium, pers. comm. 2007).

The plants on most of the herbarium sheets show some characteristics that are consistent with *A. paludicola*. Dr. Richard Rabeler and Dr. Ron Hartman (Curator of the Rocky Mountain Herbarium, University of Wyoming, Laramie), who are coauthors for the *Arenaria* treatment in the Flora of North America north of Mexico and are working on the *Arenaria* treatment for the second edition of The Jepson Manual: Higher plants of California, have tentatively identified some/most of these as *A. paludicola* (Rich Rabeler, electronic mail, 2007). They have subsequently requested a loan of the *A. paludicola* specimens from three Mexican herbaria and will analyze them and compare them to specimens from California and Washington. Both Dr. Rabeler and Dr. Jim Solomon (Curator of the Missouri Botanical Garden Herbarium) noted two things: 1) the considerable separation between the coastal plants along the Pacific Ocean between Washington and California and the montane plants from Mexico and Guatemala (more than 1,500 mi) and 2) the differences in habitat and elevations (more than 2,000 m) between these two locations (Dr. Jim Solomon, pers. comm. 2007; Dr. Rich Rabeler, pers. comm. 2007).

Beaman (1979) wrote that the putative *Arenaria paludicola* plants in the Valley of Mexico may be extirpated due to their restricted habitat and the apparent lack of any collections after 1907.

- Habitat Characteristics:

Arenaria paludicola is a coastal species that was historically known to occur in marshes and other perennially mesic areas (i.e., streams, creeks) from central Washington (Pierce County) to southern California (Los Angeles County). Relatively little is known about the conditions at the historical locations while *A. paludicola* was present, because there is little information on the herbarium specimens. In Santa Cruz, *A. paludicola* was reported to grow in swampy ground with *Oenanthe sarmentosa, Lupinus polyphyllus* var. *grandiflorus*, and other mesic or riparian plants (California Academy of Sciences Herbaria 2007). In the dunes lakes area of San Luis Obispo County, it has been reported to grow with dense mats of reeds (*Juncus* spp.), cattails (*Typha* sp.), bur-reed (*Sparganium* sp.), and bulrush (*Scirpus* spp.) (California Academy of Sciences Herbaria 2007, University of California Herbarium 2007).

Chesnut (1998) describes the Oso Flaco Lake habitat as a "…peat substrate formed in a *Sparganium* [sp.], *Carex cusickii* and *Typha* sp. marsh. Plants trail up *C. cusickii* tussocks." Currently, it is believed that its primary habitat consists of boggy areas in freshwater marshes and swamps below 170 m (560 ft) in elevation (Consortium of California Herbaria 2007; California Academy of Sciences Herbaria 2007; Kennison, in litt., 1980; Gamon, in litt., 1991; CNDDB 2007; Skinner and Pavlik 1994; CNPS 2001; Hartman 1993; Hartman et al. 2005; University of California Herbarium 2007).

The plants that have tentatively been identified as *Arenaria paludicola* from Mexico and Guatemala have been described as growing as an emergent plant at the edge of lakes (presumably in marshy areas) and in humid grasslands/meadows and in swamps/marshes/bogs in mountain valleys above 2,500 m (Beaman 1979, Conabio 2007, Missouri Botanic Garden Herbarium 2007). We have not been able to determine the status and quality of the *A. paludicola* habitat and populations in Mexico and Guatemala.

- Changes in Habitat Conditions:

As a whole, marsh habitat along the Pacific coast continues to decrease both in quantity and quality. These changes are attributed primarily to increased development, erosion and sedimentation, and non-native plants (CNPS 2001, 2007; CNDDB 2007).

Black Lake Canyon

The conditions in Black Lake Canyon have changed considerably since the listing. Several new development projects have been built in the Black Lake Canyon watershed and upstream of the historic populations. Most notable are: 1) the Cypress Ridge Golf Course and development, 2) Black Lake Canyon Golf Course, and 3) the expansion of the Greenhart Farms nursery production facility (Airphoto USA Inc. 2000, Airphoto USA Inc. 2003, CNDDB 2007, Google Earth 2007 (image taken April 2006)). Since these developments have been built, the hydrologic patterns within Black Lake Canyon have changed. The subsurface recharge has decreased due to groundwater pumping to partially supply the developments (Land Conservancy of San Luis Obispo County, in litt., 1992; Chipping, in litt., 1994). At the same time, surface flows into Black Lake Canyon have increased in quantity and now include higher levels of herbicides, pesticides, and fertilizers (Land Conservancy of San Luis Obispo County, in litt., 1992; Chipping, in litt., 1994).

Vegetation in the Black Lake Canyon watershed is denser and more overgrown now than it was in the early 1990s (Anuja Parikh and Nathan Gale, pers. comm. 2007; Mark A. Elvin, Connie Rutherford, and John Chesnut, pers. obs., September 28, 2005; Mazer et al., in litt., 2000; Airphoto USA Inc. 2000; Airphoto USA Inc. 2003; CNDDB 2007; Google Earth 2007; Land Conservancy of San Luis Obispo County, in litt., 1992). While vegetation changes naturally over time in dynamic systems such as some riparian habitats, the vegetation changes in Black Lake Canyon are consistent with biostimulation (Dodds et al. 1998).

Additionally, *Eucalyptus* (eucalyptus) trees surround much of the canyon and cover much of the watershed of Black Lake Canyon. Because eucalyptus trees consume large amounts of water, they have contributed to lowering the water table in the canyon bottom (Chipping, in litt., 1994). In 1996, approximately 2.5 acres of eucalyptus were removed with an unknown effect to the water table in the canyon (Land Conservancy, in litt., 1992). However, dozens of acres of eucalyptus still remain in the Black Lake Canyon watershed (Airphoto USA Inc. 2000; Airphoto USA Inc. 2003; Google Earth 2007; Mark A. Elvin, Connie Rutherford, and John Chesnut, pers. obs., September 28, 2005).

Oso Flaco Lake

The habitat at Oso Flaco Lake has been recorded as declining in quality and quantity (CNDDB 2007). The vegetation here recently has become thicker, denser, and more overgrown than Airphoto USA Inc. 2000; Airphoto USA Inc. 2003; Mark A. Elvin, Connie Rutherford, and John Chesnut, pers. obs., September 28, 2005; CNDDB 2007; Google Earth 2007). Indirect effects from urbanization and development, as well as agricultural operations upstream from the lake have added to the decline in quality of this marsh and swamp habitat (i.e., increases in nutrients, type conversion of habitat, biostimulation) (Service 1993; Chesnut, in litt., 1998; Airphoto USA Inc. 2000; Airphoto USA Inc. 2003; Land Conservancy of San Luis Obispo County, in litt., 1992; California State Water Resources Control Board 2006a; California State Water Resources Control Board 2006b; Central Coast Ambient Monitoring Program 2002). The changes in vegetation at Oso Flaco Lake are also consistent with biostimulation (Dodds et al. 1998).

- Description and Taxonomy:

  No changes in taxonomic classification or nomenclature have been proposed for *Arenaria paludicola* since this name was established in 1894 (Abrams 1944; Hartman 1993; Hoover 1970; Jepson 1923; Hartman et al. 2005; Munz 1959, 1974; Robinson 1894; Smith 1998).

- Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

  Mazer et al. (in litt., 2000) conducted a preliminary survey of genetic variation in *Arenaria paludicola* from the Oso Flaco and Black Lake Canyon populations. They concluded that plants in the Oso Flaco population differed genetically from plants in the Black Lake Canyon population. They also determined that there was genetic variation between clumps of plants at Oso Flaco Lake and suggested that it is likely that each clump is genetically unique, however, some clumps could be genetically identical (which is consistent with the ability for this plant to root at the nodes of the stem and reproduce asexually) (Mazer et al., in litt., 2000). Based on this information, recovery efforts for this species should maintain distinct clonal lineages in a propagation program for future reintroductions or introductions. Additional

studies that analyze genetic variation between and within populations are recommended to help us determine the best recovery strategy for this species.

- Recovery Efforts:

  Introduction/reintroduction Efforts
  Due to the loss of so many historical populations of *Arenaria paludicola,* the Service has supported, and continues to support, efforts to reintroduce this species to historically occupied locations that have suitable habitat and to introduce it to additional sites with suitable habitat within its historical range. *Arenaria paludicola* has been (re-)introduced to three field locations: 1) Black Lake Canyon (three sites within the canyon), 2) Nipomo Native Garden (in the Black Lake Canyon watershed), and 3) Sweet Springs Marsh (at Morro Bay, San Luis Obispo County).

  All three *Arenaria paludicola* reintroduction efforts in Black Lake Canyon (one in 1995 and two in 1998) have failed, with *A. paludicola* last being observed in the canyon in 1999 (CNDDB 2007; Mazer et al., in litt., 2000). *Arenaria paludicola* was introduced to a site at Nipomo Native Garden in 2002 (15 plants from the one remaining Black Lake Canyon clone) and 2003 (10 additional plants of the same clone) within a newly created wetland habitat (Vierheilig, in litt., 2002, 2003). The plants thrived for a short period of time despite being grazed by rabbits. All of the plants eventually died, possibly due to a fungal infection in 2004 (Vierheilig, in litt., 2004). *Arenaria paludicola* was introduced to Sweet Springs Marsh, an Audubon Preserve beside Morro Bay, in 2003 (20 plants from the one remaining Black Lake Canyon clone). The plants here appear to be doing well with 16 plants remaining. They cover an area approximately 7 m (22 to 23 ft) across (John Nowak, botanical consultant, pers. comm., 2007).

  We are currently working to reintroduce/introduce *Arenaria paludicola* to additional sites within its historical range in California. Plants are being propagated at the Santa Barbara Botanic Garden and the University of California, Irvine, Arboretum for this effort. Eventually, we would also like to reintroduce *A. paludicola* to the historical location in Washington.

  Conservation/Preservation Efforts
  As part of an effort to achieve the second recovery criterion, portions of Black Lake Canyon have been acquired and are preserved either through conservation easements or ownership by conservation organizations (Bob Hill, Conservation Director, Land Conservancy of San Luis Obispo County, in litt., 2007, CNDDB 2007). *Arenaria paludicola* is not presently known to occur in Black Lake Canyon. Additionally, some eucalyptus trees were removed from various portions of Black Lake Canyon as a recovery project for *Arenaria paludicola* (Service 1996; J. Langford, Land Conservancy of San Luis Obispo County, in litt., 1997).

2.3.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1. Present or threatened destruction, modification or curtailment of its habitat or range (Factor A):

In the final rule to list the species under Factor A (Service 1993), we stated that threats to the continued existence of *Arenaria paludicola* consisted of habitat modification by conversion of marsh habitat to mesic upland habitats that support grass- and shrub-dominated plant communities, increased sedimentation caused by urbanization, and alteration of the hydrological regime. Since the listing of this plant, the Service developed and finalized a recovery plan that includes this species (Service 1998); however, these threats to the species have not diminished.

There continues to be both a loss and degradation of habitat due to development/urbanization and a conversion of marsh habitat due to the collateral, but indirect, effects from development/urbanization. Some of this habitat loss occurs in watersheds that are classified as impaired by the Regional Water Quality Control Board for excessive amounts of nitrogen and other nutrients (California State Water Resources Control Board 2006a). The vegetation in these watersheds exhibits excessive growth that is consistent with biostimulation and eutrophication (a state in which the total nitrogen is >1.5 milligrams/liter and/or the total phosphorus is >0.075 milligrams/liter within an aquatic system) (California State Water Resources Control Board 2006a, California State Water Resources Control Board 2006b, Central Coast Ambient Monitoring Program 2002, Dodds et. al. 1998).

Most of the historical occurrences and their surrounding areas are urbanized and/or indirectly impacted by urbanization, which has further limited this species' ability to colonize adjacent suitable habitat. These conditions also limit sites and opportunities for successful introductions and reintroductions.

2.3.2.2. Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):

Under Factor B in the final listing document (Service 1993), overutilization was not known to be a factor/threat to this species (i.e., *Arenaria paludicola* was not known to be sought after by collectors), but the species was thought to be vulnerable to this threat because of its limited distribution. There are no data to indicate that this is currently a threat.

2.3.2.3. Disease or predation (Factor C):

Under Factor C in the final listing document in 1993, we stated that disease or predation was not known to be a threat to this species (Service 1993). Herbivory has been noted on plants at the native occurrence at Oso Flaco Lake (Mark A. Elvin pers. obs., December 21, 2005). Herbivory does not appear to be an issue at the introduced

population at Sweet Springs Marsh population (J. Nowak, pers. comm. 2007). Herbivory has been evident on outplanted individuals at Nipomo Native Gardens (Vierheilig, in litt. 2003), and on plants under propagation at University of California, Irvine (UCI) Arboretum (Barry Nerhus, pers. comm., undergraduate researcher, UCI, 2006). While this plant may be able to withstand some herbivory, herbivory may cause a reduction in its reproductive success due to the loss of flowers and the correlated reduction in the production of seeds. The extent of this threat is not known, but the herbivory of even a few flowers may have a significant effect on the long-term survival of *Arenaria paludicola* because there are so few individuals and only one known population remaining in the wild.

2.3.2.4. Inadequacy of existing regulatory mechanisms (Factor D):

Under Factor D in the listing document (Service 1993), we noted that *Arenaria paludicola* received some protections because it was listed as endangered in 1990 under the Native Plant Protection Act (chapter 1.5 section 1900 et seq. of the Fish and Game Code) and the California Endangered Species Act (chapter 1.5 section 2050 et seq.) (Morey, in litt., 1990). We also noted that, even though both statutes prohibit "take", there are exemptions. After a landowner has been notified that a state-listed plant grows on his or her property, State law requires only that the landowner notify the agency "at least ten days in advance of changing the land use to allow salvage of such plant" (chapter 1.5 section 1913). State law requires State agencies to consult with the Service regarding projects that may potentially affect federally listed plants, thereby conferring a certain measure of protection for populations located on State Parks property.

At the time of listing, we discussed that the County of San Luis Obispo had designated Black Lake Canyon as a Sensitive Resource Area (SRA). An enhancement management plan has been prepared (Land Conservancy of San Luis Obispo County 1992); however, the plan has never been adopted by the County and therefore potential benefits to sensitive resources that would result from management guidelines have not been realized. Our current analysis of protections afforded by local regulations remains the same as that at the time of listing.

Under section 404, the U.S. Army Corps of Engineers (Corps or USACE) 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). At the time of listing we noted that if the fill is less than 1 acre in size, no permit was necessary, and if the fill is between 1 and 10 acres in size, a Nationwide Permit Number 26 is issued by default within 20 days unless it is determined that an individual permit is required. In general, the term "wetland" refers to areas meeting the Corps's 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). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act, National Environmental Policy Act, and

Endangered Species Act. These reviews require consideration of impacts to listed species and their habitats, and recommendations for mitigation of significant impacts.

The Corps interprets "the waters of the United States" expansively to include not only traditional navigable waters and wetlands, but also other defined waters that are adjacent or hydrologically connected to traditional navigable waters. However, recent Supreme Court rulings have called into question this definition. On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld this interpretation as it applied to two cases involving "isolated" wetlands. Currently, Corps regulatory oversight of such wetlands (e.g., vernal pools) is in doubt because of their "isolated" nature. In response to the Supreme Court decision, the Corps and the U.S. Environmental Protection Agency (USEPA) have recently released a memorandum providing guidelines for determining jurisdiction under the Clean Water Act. The guidelines provide for a case-by-case determination of a "significant nexus" standard that may protect some, but not all, isolated wetland habitat (USEPA and USACE 2007). The overall effect of the new permit guidelines on loss of isolated wetlands, such as vernal pool habitat, is not known at this time. At the time of listing, we determined that since there was little to no regulation of fill in the range of *Arenaria paludicola*, the protections under section 404 were inadequate; although the Corps' implementation of these regulations has changed since then, there has been no change in the level of protections afforded to *A. paludicola* under section 404.

Since the time of listing, the Service has conducted one consultation (for the Forest Service) that included *Arenaria paludicola* (Service 2000). There are no completed Habitat Conservation Plans (HCP) that include *A. paludicola* as a covered species. *Arenaria paludicola* is being considered as a covered species in a draft HCP for the Oceano Dunes State Vehicular Recreation Area.

2.3.2.5. Other natural or manmade factors affecting its continued existence:

Under Factor E, we noted that there were potential threats to the existence of *Arenaria paludicola* from: 1) eucalyptus trees, 2) stochastic (i.e., random) extirpation/extinction events due to the small size and isolation of the remaining population, and 3) other manmade factors (Service 1993).

Threats to *Arenaria paludicola* from *Eucalyptus* trees included altering *A. paludicola* habitat by increasing the amount of shade, reducing the local water availability, and possibly introducing organic compounds that inhibit growth of other species into the surrounding substrate (Morey, in litt., 1990; Land Conservancy of San Luis Obispo County, in litt., 1992).

At this time we also determined that *Arenaria paludicola* was threatened with stochastic (i.e., random) extirpation/extinction events due to the small size and isolation of the remaining populations. The limited gene pool (Mazer et al. 2000) may depress reproductive vigor, or a single human-caused or natural environmental disturbance (e.g., flood, drought, disease) could cause the extinction of this species.

Small populations are threatened by inbreeding depression (Ellstrand and Elam 1993). Small populations can have significantly lower germination rates than larger populations of the same species due to high levels of homozygosity (Menges 1991). An increase in urban development has reduced the range of this species considerably. Increasing development in the area will likely increase threats from stochastic events. Indirect effects from urbanization in the watershed include changes in hydrology, changes in vegetation, and an increase in nonnative species. The effects of competition with nonnative species is most problematic immediately adjacent to urban areas and in habitat that has been isolated or fragmented by development (Alberts et al. 1993). These factors may not be enough to threaten the survival of *A. paludicola* independently, but taking into account its limited range, the cumulative and synergistic effects of all of these factors combined could be a threat to the survival and recovery of *A. paludicola*. Threats identified, since the time of listing, that are discussed above under Factor A include excessive amounts of nitrogen and other nutrients in watersheds that either currently support or historically supported *A. paludicola*. This has a direct effect on the vegetation in these watersheds that results in excessive growth that is consistent with biostimulation and eutrophication. These effects will likely increase threats from stochastic events.

2.4. Synthesis:

Arenaria paludicola continues to have a high degree of threat and a low recovery potential. The threats are pervasive, poorly understood, and therefore difficult to alleviate. The biological and ecological limiting factors for this species are poorly understood. Intensive management is needed to recover *A. paludicola*.

Arenaria paludicola has one known, remaining wild population. At the time of listing *Arenaria paludicola* was known from one wild population. This population is considered to be extirpated. Currently, it is known from one wild population, which is different from the one known at the time of listing. This population is declining. It is on protected (conserved) lands, but it continues to face a number of threats. There have been three attempts to introduce this species back into suitable habitat within its historical range, two of which have failed. The surviving introduced population, at Sweet Springs Marsh, is on protected (conserved) lands and appears to be stable. While none of the recovery criteria have been met, we are working to introduce this plant to several sites on protected lands within its historical range.

Plants have been collected in central Mexico and Guatemala that have been tentatively identified as *Arenaria paludicola*. Experts are currently analyzing these specimens to determine whether or not they are *A. paludicola*. We have not been able to determine the status and quality of the habitat in Mexico or Guatemala. This species remains in danger of extinction throughout all or a significant portion of its range. Therefore, we recommend that *A. paludicola* remain listed as endangered with no change in status.

3. 3.0 RESULTS

3.1. Recommended Classification

____ Downlist to Threatened

____ Uplist to Endangered

____ Delist (Indicate reasons for delisting per 50 CFR 424.11):

__X__ No change is needed

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1) Work with the California Department of Parks and Recreation and other stakeholders to implement site-specific management activities in the immediate future to alleviate threats and prevent the loss of the last, known remaining wild population (at Oso Flaco Lake).

2) Work with others to establish several new populations in the near future to reduce the risk of extinction to *Arenaria paludicola* and maintain *ex situ* stock at two or more institutions.

3) Assemble a scientific recovery implementation team to assist us in determining a scientifically sound plan to reintroduce and introduce *Arenaria paludicola* to sites within its historical range in California.

4) Work with the Regional Water Quality Control Board to determine nutrient levels in the watersheds which have supported *Arenaria paludicola* in the recent past (particularly Black Lake Canyon and Oso Flaco), and work with local landowners and stakeholders to alleviate (and remove) any threats to *A. paludicola* that are associated with water quality.

5) Conduct a genetic analysis to determine the extent of variation within and between *Arenaria paludicola* populations to help determine an appropriate recovery and reintroduction strategy.

6) Survey historical *Arenaria paludicola* sites for potential extant occurrences and to identify suitable sites for reintroductions and survey areas in southern and central California and near Tacoma in Washington State for potential new *A. paludicola* occurrences and to identify suitable sites for introductions.

7) Modify downlisting criterion number 4 ("[T]he [introduced] populations remain viable for at least 5 years") to viable onsite reproduction for more than one generation (i.e., a second, or "f2" generation) has been confirmed.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Marsh Sandwort (*Arenaria paludicola*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened

____ Uplist to Endangered

____ Delist

__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

Review Conducted By: Mark Elvin

FIELD OFFICE APPROVAL:

Field Supervisor, Fish and Wildlife Service

Approve Diane L Noda Date 7/2/08

REGIONAL OFFICE APPROVAL:

Regional Director, Fish and Wildlife Service

Approve Acting ROBERT D. WILLIAMS Date 7/10/08