Lilium occidentale
(Western lily)

5-Year Review:
Summary and Evaluation

Photograph utilized courtesy David Imper, Arcata FWO

U.S. Fish and Wildlife Service
Arcata Field Office
Arcata, California

January 2009

5-YEAR REVIEW
Lilium occidentale (Western lily)

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 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 (or since the most recent 5-year review). 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 Endangered Species 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 Endangered Species Act that includes public review and comment.

Species Overview:

Lilium occidentale (western lily) is an attractive perennial member of the Liliaceae (lily family), which dies back to an underground bulb in the winter. It is restricted to a narrow strip along the immediate Pacific coast between Coos Bay, Oregon, and Eureka, California (Figure 1), where it occupies a variety of early successional habitats, including freshwater wetlands, coastal prairie and scrub, and the edges of Sitka spruce forest. It occurs in one of two soil conditions: mineral soils that possess an impermeable layer that serves to maintain moisture late into the growing season; or organic marsh soils in which a fluctuating water table exposes the bulb during a critical portion of the growing season. The species is especially attractive to deer and small mammal browsers, which limit the reproductive output of the plant at many sites. It also appears well adapted to moderate levels of ungulate grazing and fire, both of which were undoubtedly important historical factors in maintaining its habitat across the range. Seedling and juvenile stage plants can survive in shade, in some cases for long periods, if adequate moisture is available. Reproductive plants require relatively open conditions (Bencie and Kalt 2007, Imper 1997, Schultz 1989).

Methodology used to complete the review:

This review was conducted by the Arcata Fish and Wildlife Office (Arcata FWO) following the Region 8 guidance issued in March 2008. We used information from the *Lilium occidentale* recovery plan (Service 1998) and contained in our files, relevant information provided by other agencies and experts, and the California Natural Diversity Database (CNDDB 2008) maintained

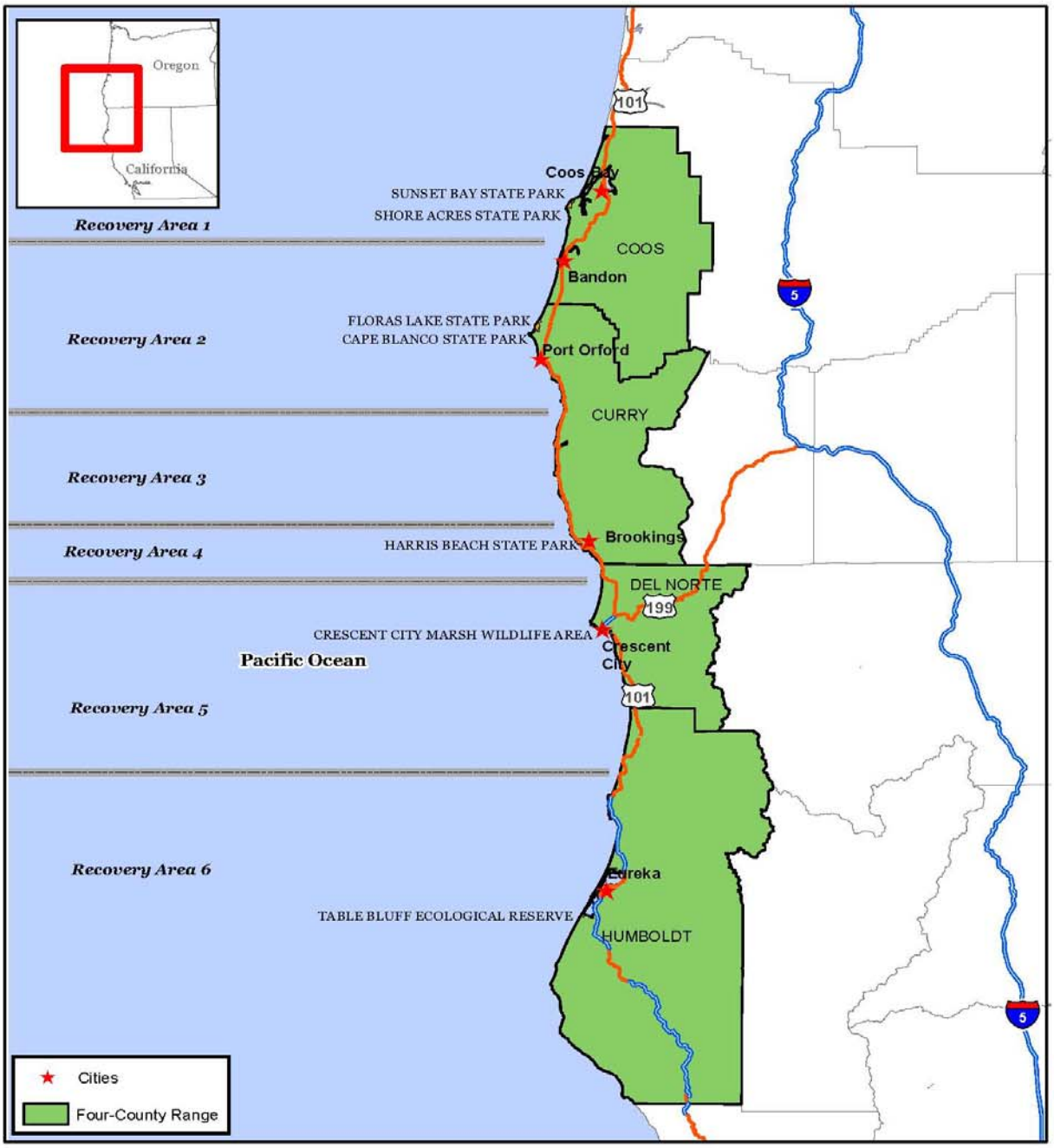
U.S. Fish & Wildlife Service

Arcata Fish and Wildlife Office

Humboldt County, California

Figure 1. ***Lilium occidentale*** (Western Lily) Range Map

Prepared for the 2008 5-year Status Review



0 20 40 80 Miles

0 35 70 140 Kilometers

N

UTM ZONE 10
NAD 83

Produced in the Arcata Fish and Wildlife Office
Arcata, California
Map Date: 9/15/08
File: westernLily_rangeMap.mxd

by the California Department of Fish and Game (CDFG), and the Oregon Natural Heritage Databank (ONRHD 2008), maintained by the Oregon Natural Heritage Program. The recovery plan, data in our files, and unpublished monitoring and research reports were our primary sources of information used to update the species' status and threats. 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 or since the last 5-year review. We focus on current threats to the species that are attributable to the Endangered Species Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide 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:

Lead Regional Office: Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, Region 8, California and Nevada; (916) 414-6464.

Lead Field Office: David Imper, Arcata Fish and Wildlife Office (707)822-7201.

Cooperating Field Offices: Liz Kelly, Newport, Oregon Fish and Wildlife Office (541) 867-4558; Sam Friedman, Roseburg, Oregon Fish and Wildlife Office (541) 957 3474.

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 5, 2008 (73 Federal Register 11945). No comments were received in response to the notice. The Service received one response to the notice, which we have considered in preparing this 5-year review.

Listing History:

Original Listing (Service 1994)
FR Notice: 59 Federal Register 42171
Date of Final Listing Rule: August 17, 1994
Entity Listed: *Lilium occidentale* (species)
Classification: Endangered

State Listing: *Lilium occidentale* (western lily) was listed by the State of California as endangered in 1982, and by the State of Oregon as endangered in 1989.

Associated Rulemakings: None

Review History: No status reviews or other documents that contain a five-factor analysis and conclusion have been conducted since the taxon was listed.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Lilium occidentale* is 2 according to the Service's 2008 Recovery Data Call for the Arcata FWO, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a species that faces a high degree of threat, and has a high potential for recovery.

Recovery Plan or Outline:

Name of Plan or Outline: Final Recovery Plan for the Endangered Western Lily (*Lilium occidentale*)
Date Issued: March 31, 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 Endangered Species 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 further in this review.

Information on the Species and its Status:

Principle Research Efforts to Date
Lilium occidentale has been the focus of great interest over the past 100 years, perhaps due to its great beauty and interesting habitat, and the importance of genus *Lilium* to the horticultural trade. Not long after the species was described (Purdy 1897), accounts of the species and in some cases specific locations began to appear in lily trade journals (e.g., Vollmer 1934, Purdy 1935). In the late 1970's, Orel Ballantyne conducted limited investigation of pollen grain structure, chemotaxonomy, and morphological variation in *L. occidentale*, and the first range-wide assessment of the species (Ballantyne 1980). Stewart Schultz conducted extensive research focused at Bastendorff Bog, Coos County, Oregon, in the late 1980's (Schultz 1986). He also studied morphological variation across the range (Shultz 1987) and conducted a more thorough range-wide assessment (Schultz *in litt.* 1988, 1989). From the early 1980's to the present, David Imper has conducted research on the species and its habitat, initially for sites in Humboldt County, California, and later range wide (e.g., Imper *et al.* 1987, Imper 1997). The management plan for the Table Bluff Ecological Reserve in Humboldt County (Imper *et al*. 1987) contained a review of the *L. occidentale* literature to date. Also in the late 1980's, Mark Skinner investigated the reproductive biology of the California species of *Lilium*, including extensive field and greenhouse studies on *L. occidentale* (Skinner 1988). In the 1990's, Bruce Rittenhouse monitored many of the Oregon sites (e.g., Rittenhouse 1994, 1995, 1999, 2000). Between 2001 and 2005, Robin Bencie and others have conducted extensive monitoring and life history research on *L. occidentale*, primarily focused on the two largest populations in California, the

Table Bluff Ecological Reserve, and the Crescent City Marsh Wildlife Area in Del Norte County (e.g., Bencie and Wear 2003, Bencie and Kalt 2007).

Species Biology and Life History

Lilium occidentale, a perennial species in the family Liliaceae, dies back each year, and over-winters as a short, unbranched, rhizomatous underground stem (referred to as a bulb). Seed germination is hypogeal, meaning the cotyledon or seed leaf stays beneath the surface of the ground. A bulb scale is formed in the fall, and the first true (or epicotylar) leaf emerges the following spring). Depending on environmental conditions, some individuals in a population will normally begin to emerge between mid-March and mid-May. The date by which all multiple-leaved plants have emerged can vary substantially, ranging from late April, to mid-July in cases where a high water table exists (Imper unpubl. data 2008). Seedlings and small juvenile plants produce a single above-ground leaf, while multiple-leaved plants commonly reach a height of 3 to 5 feet (maximum 7 feet). Leaves grow along the unbranched above-ground stem, ranging from 0.35-0.75 inches wide by 3.1-10.6 inches long (range in population means, from Schultz *in litt.* 1988). Leaves are distributed singly or in up to 9 whorls (range in population means for number of whorls 0.03 to 4.7 [Schultz *in litt.* 1988]) along the shoot. Populations of non-flowering individuals may persist for many years under closed forest canopies (Imper *et al*. 1987).

Like other lilies, *Lilium occidentale* has hermaphroditic flowers (producing both pollen and seeds). *Lilium occidentale* appears relatively unique within the genus in being able to produce abundant self-pollinated seed (Skinner 1988). Hummingbirds are the primary pollinator of *L. occidentale*, but bees and other insects may also transfer pollen (Skinner 1988, Schultz 1989). Reproductive plants usually produce 1-3, but up to 25 pendant flowers (Imper *et al*. 1987). The nodding flowers are crimson red, sometimes deep orange, on the outer portions with yellow to green centers in the shape of a star and with purple spots. The six petals (actually "tepals", look-alike petals) are 1.8-2.4 inches long (Schultz *in litt.* 1988) and strongly recurved (curved backwards). Between May and July the green buds turn red for 3-5 days, open over a period of about 1-2 days, and the nodding flowers last for 7-10 days. After the floral parts have fallen, the pedicels (flower stalks) become erect within a week and capsules enlarge to maturity over a period of 40-50 days. Natural seed set in a sample of 35 capsules at Bastendorff Bog, Hauser Bog, and Shore Acres ranged from 0 to 204 seeds per capsule with a mean of 132 seeds (Schultz 1989). Seeds are primarily dispersed by wind and gravity, mostly within a 13-foot radius (Skinner 1988). The species reproduces primarily by seed, but asexual reproduction is possible from detached bulb scales. Dead, above-ground shoots may persist for one or more years in protected sites. In cultivation, plants may flower in as little as 3 years (Skinner 1988); in the wild plants may live for 25 years or more (Imper *et al*. 1987).

Lilium occidentale can be distinguished from most other species of *Lilium* by its pendent red flowers, yellow to green centers, highly reflexed tepals, non-spreading stamens, and closely unbranched rhizomatous bulb. When viewed from their open end, the flowers give the appearance of a golden star because the yellow basal portion comes to a point toward the midline of each tepal. The primary distinguishing characteristic of this species is the presentation of the stamens and style, which remain nearly straight, compared to all other orange or red flowered *Lilium* in California and Oregon, in which the stamens and usually style curve outward.

Recent research on aspects of *Lilium occidentale* biology indicated some of the problems associated with detecting and inventorying for the species, its potential susceptibility to future threats, and methods for conserving the species.

An intensive investigation of *Lilium occidentale* life history, habitat characteristics, impacts of browsing and livestock grazing, and methods for maintaining its habitat was conducted at the Table Bluff Ecological Reserve and the Crescent City Marsh Wildlife Area from 1998-2005 (Bencie and Kalt 2007). That study found as little as 38 percent of the plants emerging in any one year, based on a thorough inventory of all plants down to an inch tall or less that remained visible until the peak flowering period when inventories are typically conducted. Because all reproductive plants are often browsed by mid-season (Imper, unpubl. data 2008), detection of this species can be difficult.

The same study indicated the species is very sensitive to some aspects of climate. The populations at the Table Bluff Ecological Reserve and the Crescent City Marsh Wildlife Area, although both located in California, probably represent the extremes across the range of the species with respect to soils, hydrology, and life history. In general, populations of *Lilium occidentale* farther north emerge later, and flower later than the populations at the south end of the range in Humboldt County. *Lilium occidentale* habitat at Table Bluff Ecological Reserve, although subject to a seasonally high water table, is drier and soils are warmer than at the Crescent City Marsh Wildlife Area, which is generally inundated for long periods during the winter and spring (Imper, unpubl. data 2008). Spring soil temperatures at roughly the depth of *L. occidentale* bulbs, averaged 4 degrees F. cooler at the Crescent City Marsh Wildlife Area than the Table Bluff Ecological Reserve (Bencie and Imper 2003a), suggesting that temperature (influenced by high groundwater at the Crescent City Marsh Wildlife Area) is a controlling factor for emergence.

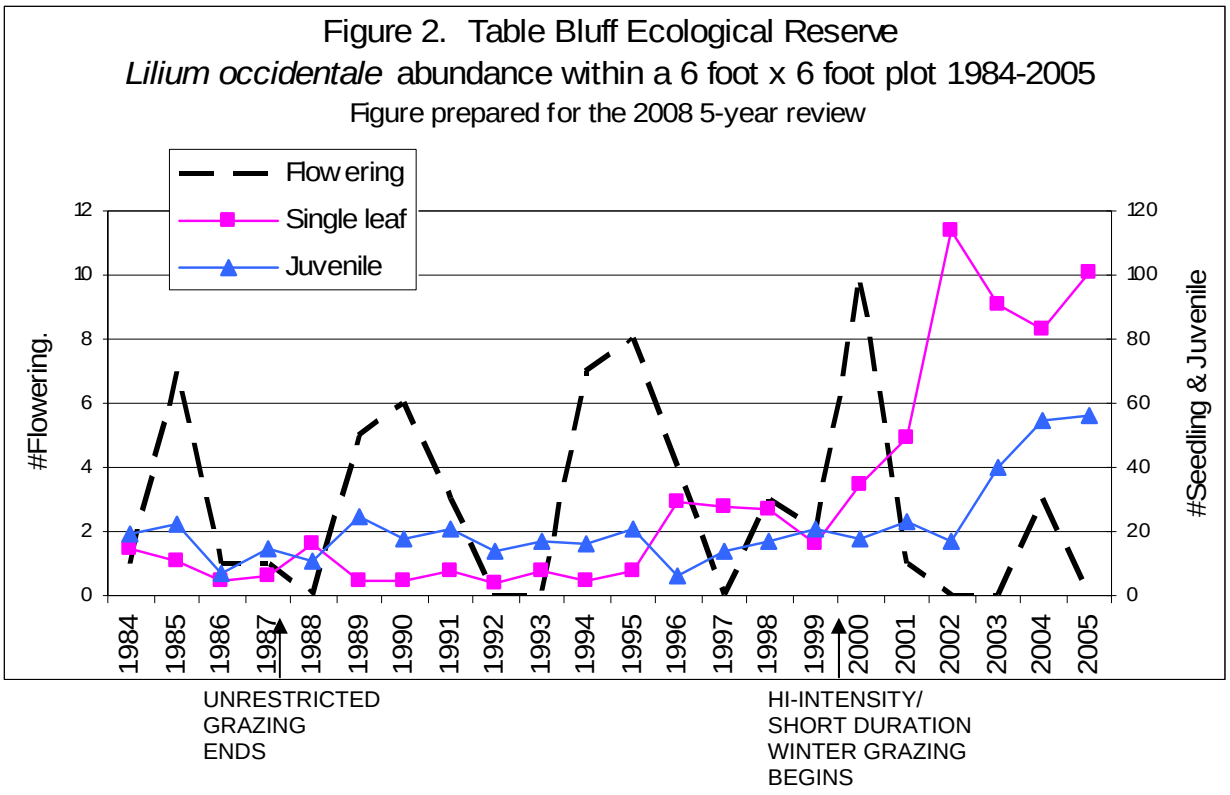
Reproductive phenology (e.g., the relation between climate and floral timing) also varies significantly across the range, and has been suggested as one factor indicating the existence of two forms within the species. However, research at the Table Bluff Ecological Reserve suggests spring air temperatures may explain most of the variation in floral timing across the range of the species. Regression analysis was used to predict the proportion of the reproductive population in fruiting stage on a given date at the Table Bluff Ecological Reserve using various climate variables (Bencie and Imper 2003b). Ninety-one percent of the variation in number of plants in fruit on the day of the census between 1988 and 2002 was explained by the previous mean spring air temperature and number of spring heating degree days. That data also indicated, on average, the floral timing was delayed approximately 4 days per degree F. cooler spring air temperature. Data collected between 1998 and 2002 indicated flowering at the Crescent City Marsh Wildlife Area was delayed approximately 3 weeks compared to the Table Bluff Ecological Reserve, again correlated with differences in air and soil temperatures (Bencie and Imper 2003b).

The relationship between plant emergence, water level, and population trends at the Crescent City Marsh Wildlife Area suggest particular sensitivity of the species to inundation during the growing season. Although the species often occurs in fens that are flooded for periods in the winter and spring, the species does not appear to tolerate year-round inundation. Delayed

emergence of *Lilium occidentale* at the Crescent City Marsh Wildlife Area, in some cases into July when the plant normally flowers, was correlated with high water conditions remaining in the marsh until late June or July (Bencie and Kalt 2007). The extended period that groundwater remained above the plant bulbs is suspected to have caused as high as 50 percent mortality in the population (discussed in the Five-Factor Analysis, Factor A, below). The Hauser Bog population, also inundated for periods of the year, provided more evidence of its sensitivity to inundation. Plants growing within Hauser Bog consistently occur within an elevation band of only 6 inches, situated on mounds approximately 9 inches above the floor of the fen (Imper, unpubl. data 2008). The very uniform, lower elevation of the plant bulbs suggests the duration of high water is likely an important factor controlling the local distribution of *L. occidentale*.

At the same time, there is abundant evidence indicating the species requires available soil moisture late into the growing season. At the two driest sites on Table Bluff, population fluctuations were correlated with variation in annual rainfall, and seasonal growth patterns were directly correlated with soil moisture levels (Imper 1993, 1994; McRae and Imper 1993, 1994). In general, field monitoring and greenhouse propagation efforts over many years have confirmed a sensitivity of this species to desiccation, particularly in the seedling stage (Imper 2001; Imper and Sawyer 1991, 1992a, 1993, 1994). This and other evidence suggests that even a minor alteration of site hydrology that results in either extending the period bulbs are under water, or causes the soils to dry out earlier in the season, could have a significant impact on *L. occidentale*.

Other research at the Humboldt County sites suggests the species may be well-adapted to certain conditions related to livestock grazing. Abundant *Lilium occidentale* individuals were observed rooted in cattle feces, evidence the seed passed through the cow (Imper 1992a, 1995a). Presumably, the resulting seed bed is conducive to seedling growth and establishment in a microsite temporarily free from competition and with plentiful nutrients. Monitoring at the Table Bluff Ecological Reserve also found significantly higher density of *L. occidentale* seedlings within cattle trails compared to adjacent habitat. Those results suggested its germination and early survival were enhanced by the exposed mineral soil conditions, a more favorable moisture regime, and/or the direct effects of foot traffic which served to break through the ground vegetation layer and "plant" the seed (Imper and Sawyer 2001). Research conducted at the Table Bluff Ecological Reserve suggested reintroduction of seasonal grazing in winter 1998-99 led to a significant increase in seedling and juvenile stage plants (Figure 2; Imper, unpubl. data 2008). The apparent decline in reproductive plants suggested in Figure 2 did not appear linked to the seasonal grazing, but rather the result of declining soil moisture availability caused by the aging and growth of the surrounding spruce trees, discussed under Threat Factor A below (Imper, unpubl. data 2008). Research is underway to determine whether that effect is indeed occurring.



Lilium occidentale is easily grown in the greenhouse, and has been propagated since 1994 at a nursery near Eureka for use in population augmentation (Imper 2001). Establishment from seed *in situ* (i.e., in the wild without greenhouse propagation) has also been pursued, but with a lower success rate than for bulbs. Seed plots at the Table Bluff Ecological Reserve planted in 1993 and 1998 exhibited 7 percent survival after 4 years in the relatively moist spruce forest, and between 1 and 4 percent survival in the drier coastal prairie (Bencie and Imper 2003a). The survival rate for transplanted bulbs ranged 20-30 percent. Bulbs were transplanted from the greenhouse to four sites at the Table Bluff Ecological Reserve in 1998, in what was considered suitable habitat. After 11 years, all the colonies still exist, but 3 of the 4 colonies are declining and have yet to produce a flowering plant. The fourth colony exhibits good growth and reproduction, and has successfully recruited new plants (Imper, unpubl. data 2008). Guerrant (2006) conducted an experimental introduction of *L. occidentale* at the New River Area of Critical Environmental Concern (ACEC) near Bandon, Oregon, in 1996, focused on whether the propagule type (bulb, new and old seed), substrate type, and source population influence growth and survival. After 9 years the survival rate was 42 percent for transplanted bulbs, and 25 percent for sown seed. None of the plants had yet reached reproductive status. Although the survival rate is higher than for the efforts at the Table Bluff Ecological Reserve, only about 4 percent of the total plants were multi-leaved after 9 years, an exceedingly slow growth rate, similar to the 3 experimental introduction sites at the Table Bluff Ecological Reserve that appear to be failing. These results suggest that suitable micro-sites for the plant are not easily identified, and that it takes many years to determine whether an introduced population will persist.

Spatial Distribution

Lilium occidentale is endemic to northern California and southern Oregon within about 4 miles of the coast, extending from north of Coos Bay, Oregon, about 200 miles to Humboldt Bay in California (Figure 1). Carl Purdy first described *L. occidentale* from unspecified locations in the headlands around Humboldt Bay (Purdy 1897). The plant was initially collected in Oregon, near Brookings, by Morton Peck in 1913. The overall geographic range for the species has not changed, so far as we know, from its historical extent or its distribution at the time the species was listed. At that time the distribution was described as 31 small (less than 0.001 acres to 10 acres), isolated, densely clumped populations spread over 7 widely separated regions. However, many of the occurrences cited as existing or status unknown when the species was listed were poorly documented, difficult to distinguish, and included many observations along roads (e.g., Morrison Road east of Bandon [EO's 019, 020, 021]; Fourmile Road south of Bandon, Airport Road north of Port Orford [EO 014, 026 and others], that appear to have been largely isolated plants (Table 1). Therefore, the information available at the time of listing is not particularly useful to assessing trends as much as an assessment of impacts to the more significant populations and suitable habitat across the range since 1994. We do know that since it was listed, three relatively large sites (Cape Blanco, Hulton, Witschi), two small sites (Boak Lane; New River ACEC), and a site east of Bandon about which little is known (City of Bandon) were discovered. At the same time many known occurrences at Shore Acres and Sunset Bay State Parks (including EO 001), the Bowman site (EO 004), a small site at New River ACEC, Brookings Marsh, and another site east of Bandon discovered in 1994 (but not known at the time of listing) were extirpated. In addition, most of the occurrences noted along the road segments cited above could not be relocated (Imper, unpubl. data 2008), and the amount of occupied habitat at various sites at the time of listing has declined dramatically (Point St George, Crescent City Marsh). Therefore, the trend overall is decidedly downward in spatial distribution since *L. occidentale* was listed.

All known occurrences, including extant, presumed extirpated or status unknown, grouped by recovery area are listed in Table 1. The occurrences have been combined into what are referred to as "principle populations" for management and recovery planning purposes. The principle populations are intended to eliminate confusion in identifying discrete occurrences, and make the accounting of populations more accurate and meaningful. They are also intended to approximate biologically-meaningful populations (i.e., a group of plants among which genetic transfer is sufficient to offset divergence among its component parts due to differential natural selection or random genetic drift) that have some potential, with aggressive restoration effort, to meet the recovery criteria.

The 23 extant principle populations listed in Table 1 and Table 2 range in size from less than 0.1 acre to more than 6 acres, totaling about 40 acres of occupied habitat. The characteristics of an additional site recently reported on City of Bandon property are not yet known. The size distribution of the 23 populations is as follows: less than 0.1 acre (2 sites); 0.1 – 0.5 acre (7 sites); 0.5 – 1 acre (5 sites); 1-5 acres (7 sites); greater than 5 acres (2 sites). Ownership of the 23 populations includes: State of Oregon (6 populations); Bureau of Land Management (1 site); State of California (3 sites); Del Norte County, California (1 site); private ownership (12 sites). Two sites span two ownerships.

Abundance

The listing rule indicated that of the 31 populations known at that time, 18 populations contained up to 50 plants, 8 contained 51 to 200 plants, 4 contained 201 to 600 plants, and 2 contained about 1,000 plants or more. Schultz (*in litt.* 1988) calculated a known population of 661 flowering and at least 2,750 non-flowering plants in 1988. The sites discovered after 1988 added anywhere from 1,100 to more than 2,100 flowering plants (see Table 1).

Using the above categories, of the current 23 defined principle populations listed in Table 1, 5 populations probably contain up to 50 plants; 8 likely range from 51-200 plants; 8 range from 201-600 plants, and 2 populations exceed 1,000 plants (Table 1). Comparison of total population estimates at the time of listing is not particularly useful given the great uncertainty in population estimates. Inventories of most of the populations at the time of listing were not intensive, and undoubtedly did not account for all browsed individuals or small vegetative plants. A census of flowering plants is somewhat more reliable, but is always conservative due to the possibility of full-year dormancy, potential for losses to early season deer browsing, and the difficulty in seeing reproductive plants that are either still in bud or past flowering. Currently, total population census data are only available for a few populations; flowering population estimates are available for most populations.

The population trends indicated in Table 1 are for the short-term, usually a function of the time since the last vegetation maintenance effort. The Cape Blanco population is the only site considered reasonably stable in the long-term, due to the ongoing grazing lease. The two populations located within the Bonneville Power Administration (BPA) distribution power line right-of-way, Morrison Road and Hultin, are stable with respect to vegetation maintenance, which BPA performs periodically for their power line (BPA 2006a, 2006b; Service 2006b), but both sites are highly threatened in other ways. In order to better describe the population status and the effect conservation actions have had since the species was listed, brief site histories for representative populations are included under the Threat Factor (A-E) most applicable to those populations.

Habitat or Ecosystem

Lilium occidentale has not been widespread in recent times, although historical records suggest it was more common than it is today. After the ice age, rising sea levels flooded marine benches that likely would have provided for *L. occidentale*. The resulting fragmentation of habitat could help explain the disjunct nature of its current distribution near the coast.

Lilium occidentale occurs in freshwater fens, coastal prairie and scrub, and the transition zones between these vegetation types. Stunted non-flowering plants also can occur within spruce forest. Sites are often near the ocean where fog is common, and where evidence suggests fog drip may provide an important late season moisture source (Imper and Sawyer 1996). Populations occur from just above sea level at Crescent City Marsh, to a maximum 300 feet in elevation, and from ocean-facing bluffs nearly 4 miles inland. The climate is characterized by cool, wet winters and warm, dry summers. About three-quarters of the rain falls from October to May. Summers are dominated by the North Pacific high pressure zone which generates moderate but consistent northwest winds.

Table 1: Historical and extant occurrences of *Lilium occidentale*, from north to south, indicating the designated principle populations (name in bold) and other site characteristics. Table prepared for the 2008 5-year status review.

EO#[1]	Occurrence Name[2]	Trend[3]	Last Observed (O) or surveyed (S)	Population Estimate At Listing[4]	Current Population Estimate[4]	Ownership[5]	Observer and year
RECOVERY ZONE 1							
013	**Hauser Bog**	Increase	2003(S),2008(O)	43R(I)	>130R/>600T	Private, ODOT	Imper 2003,2008
001	**Bastendorff Bog**	Stable	2007(S)	60R/>500T	48R/>500T	OPRD	Pickering 2007
001	Sunset Bay State Park	Extirpated	2006(O)	>10R	--	OPRD	Imper 2006
016	**Shore Acres State Park (No. and So.)**	Decline	2002(S),2008(O)	57R	53R/380T	OPRD	Imper 2002, Pickering 2008
RECOVERY ZONE 2							
	Brown	Extirpated			--	Private	
020	**Morrison Road BPA**	Stable	2005(S),2008(O)	33R/66T(I)	>73R/>134T	Private	Imper 2005, 2008
	City of Bandon (New)	?	2008		>6R(I)	Bandon	Imper 2008
021	Geiger Creek[6]	?	2006(O)		?	Private/ Coos Co	Imper 2006
019	Johnson Creek[6]	?	2006(O)		?	Private/ Coos Co	Imper 2006
	Hultin BPA (New)	Stable	2008(S)		>200R	Private	Imper 2008
	Sexton/Webb	Decline	2007(O)	>19T(I)	>40R	Private	Imper 2007
	Boak Lane (New)	?	2008(S)		70R	Private/ Coos Co	Imper 2008
004	Bowman 1, 2 and 3[7]	Extirpated	2007(O)	>70R/>700T (1989)	--	Private	Imper 2007
	Fourmile 1 & 2[6]	?	2007(O)		--	Private/ Coos Co.	Imper 2007
	Fourmile Road (Witschi) (New)	?	2003(S),2008(O)		209R/488T	Private	Imper 2003, Guerrant 2008
	New River ACEC	Extirpated	2004	2R (2003)	--	BLM	Imper 1997
	New River ACEC (Muddy Lake)(New)	?	2008(S)		20R/25T	BLM	Guerrant 2008
	New Lake 1 and 2	Extirpated	2006		--	Private	Imper 2006
008	Langlois Bog	Extirpated			--		
003.027	**Floras Lake State Park**	Decline	2002(S),2008(O)	12R/26T(I)	>44R/128T	OPRD	Imper 2002, 2008
025,026	Blacklock 2 and 3 (see EO003)	?	2008(O)		?		
014	Airport Road 1,2 and So.[6]	?	2008(O)		?	Private	Imper
	Cape Blanco SP (New)	Stable	2008(S)		201R	OPRD	Imper 2008
	Lower Sixes River 1,2 and 3	Extirpated			--		
	Elk River 1 and 2	Extirpated			--		
	Port Orford	Extirpated			--		
RECOVERY ZONE 3							
	Nesika Beach 1	Extirpated			--		
006	Geisel Monument	Extirpated	2004(O)		--		Imper 2004
	Geisel Monument State wayside	Extirpated	2004(O)		--		Imper 2004
	Otter Point SP	Extirpated?			?		
	Pistol River 1 and 2	Extirpated	1980(O)		--		Ballantyne 1980

Table 1 (continued): Historical and extant occurrences of *Lilium occidentale*, from north to south, indicating the designated principle populations (name shaded) and other site characteristics. Table prepared for the 2008 5-year status review.

EO#[1]	Occurrence Name[2]	Trend[3]	Last Observed (O) or surveyed (S)	Population Estimate At Listing[4]	Current Population Estimate[4]	Ownership[5]	Observer and year
RECOVERY ZONE 4							
015,024	**Borax = Black Mound 1 and 2; Rainbow Rock 1 & 2**	Decline	2005(S)	?	>100R/>300T	Private	Imper/ Friedman 2005
002,023	**Harris Beach SP (Highway site)**	Decline	2008(S)	51R/74T	39R/75T	ODOT, OPRD	Imper 2008
018	**Harris Beach SP (Powerline site)**	Decline	2002(S),2008(O)	>300R	96R/222T	OPRD	Imper 2002,2008
009,022	Brookings Bog	Extirpated	2004(O)	2R?	--		Imper 2004
RECOVERY ZONE 5							
025, 026	**Point St George 1,2 (3 colonies)**	Stable/ Decline[8]	2008(S)	>300R	>300R	Del Norte Co	Imper 2008
028	**Crescent City Marsh main Crescent City 1**	Decline	2008(S)	>2500R[9]	>1200R[8]	Private/ CDFG	Imper 2008
027	**Crescent City Marsh (Hambro N) (2 colonies)Crescent City 2**	Decline	2008(S)		15R/17T	private	Imper 2008
029	**Crescent City Marsh (Hambro 101) (Crescent City Marsh)**	Decline	2008(S)		3R/17T	private	Imper 2008
030,031	**Crescent City Marsh satellite sites Crescent City, Cres City 3 (3 colonies))**	Decline	2008(S)		7F/69T	CDFG	Imper 2008
RECOVERY ZONE 6							
014	Bayside	Extirpated			--		
018	Ryan's Slough	Extirpated			--		
	Eden Tract	Extirpated			--		
004	Humboldt Hill	Extirpated			--		
005	Still Ranch	Extirpated			--		
022	**Table Bluff Ecological Reserve (TBER)**	Decline	2008(S)	355R/>2000T	110R/>2000T	CDFG	Kalt/Wear 2008
010	**McMurray) former Barry**	Decline	2005(S)	75R/>800T	96R	Private	Imper 2005
021	**Hiser (former Johnson)**	Stable/Decline	2005(S),2007(O)	95R/310T	134R/347T	Private	Imper 2005,2007
024	**Christensen**	Stable/Decline	2007(S)	96R/165T	169R/227T	Private	McRae 2007

[1]CNDDB identification # = occurrence number assigned by the California Natural Diversity Database (CNDDB 2008) or Oregon Heritage Program Databank (ONRHD 2008).
[2]Shaded names are designated as "principle" populations (see text)
[3]Estimated short-term trend (e.g., 5-10 year basis).
[4](I) = incomplete survey; R = reproductive plants; T = total plants.
[5]Abbreviations: ODOT = Oregon Department of Transportation; OPRD = Oregon Parks and Recreation Department; Coos Co. = Coos County; BLM = Bureau of Land Management; CDFG = California Department of Fish and Game.
[6]Lower Fourmile 1 and 2, Geiger Creek, Johnson Creek, Airport Road: include a few scattered plants on roadside. Not considered viable for purposes of recovery population.
[7]Bowman 1-3: A few plants remaining in 10 foot square area. Not viable for purposes of recovery.
[8]One of three colonies judged stable short-term; two in decline.
[9]Population estimate based on 24 fixed plots, used as an index of flowering population size.

The species occurs on two types of soils, decomposed peat or muck substrate, or soils that are poorly drained due to a shallow iron pan (e.g., Blacklock, Bandon, or Bullard series in Oregon), or clay layer (e.g., Joeney series in Oregon; Hookton series in California). In all known occurrences the soils are high quality native soils, exhibiting good structure, very low bulk density (on the order of 55-60 pounds per cubic foot or less, and high organic content (Imper *et al*. 1987, Imper and Sawyer 1994, Imper, unpubl. data 2008). Research at the sites on Table Bluff, Humboldt County, California in the 1990's correlated the local distribution of *L. occidentale* with soils that were more acid, cooler, contained more organic material, were less dense and exhibited better soil structure compared to adjacent unoccupied soils. The plant also preferred soils that retained moisture later into the growing season, and allowed greater percolation of summer rainfall (Imper 1992a, 1992b, 1993, 1994, 1995b; Imper and Sawyer 1991, 1992a, 1993, 1994).

Although *Lilium occidentale* habitat appears to vary dramatically across its range (e.g., freshwater marsh, coastal prairie, spruce forest), all sites share many common features. With the exception of spruce forest, all of the habitats are early successional in development, which provides the necessary conditions for growth and reproduction. In the case of spruce forest, the dark, moist, acid understory conditions are well suited for establishment of *L. occidentale*, but the plant remains vegetative. Some of the species that occur at nearly all *L. occidentale* sites include: *Picea sitchensis* (Sitka spruce), *Malus fusca* (Oregon crabapple), *Salix* spp. (willow), *Myrica californica* (western wax myrtle), *Gaultheria shallon* (salal), *Spiraea douglasii* (western spiraea), *Vaccinium ovatum (*evergreen huckleberry) species of *Rubus* (blackberry, salmonberry), *Lonicera involucrata* (black twin-berry), *Calamagrostis nutkaensis* (Pacific reed-grass), *Carex obnupta* (slough sedge), *Gentiana sceptrum* (gentian), *Lotus formosissimus* (trefoil), *Blechnum spicant* (deer fern) and *Pteridium aquilinum* (bracken fern). Other species that are generally restricted to the range in Del Norte County and north include: *Pinus contorta* ssp. *contorta* (shore pine) and *Chamaecyparis lawsonia* (Port Orford-cedar), *Ledum glandulosum* (Labrador tea), *Rhododendron occidentale* (western azalea), *Rhododendron macrophyllum* (Pacific rhododendron), *Tofieldia glutinosa* (western tofieldia), *Trientalis arctica* (Arctic starflower), *Sanguisorba officinalis (*great burnett), *Sphagnum* spp. (peatmoss), and *Viola palustris* (marsh violet). Species such as *Polystichum munitum* (swordfern), *Holcus lanatus* (velvetgrass), and *Anthoxanthum odoratum* (sweet vernal grass) are more common in the south end of the range. A few species, including *Xerophyllum tenax* (beargrass), *Vaccinium uliginosum* (western bilberry), and *Cornus canadensis* (bunchberry) occur only with *L. occidentale* in the unique vegetation associated with Blacklock and related soils. Although undoubtedly more common together in the past, there are only two sites currently where the *Darlingtonia california* (pitcher plant) grows with *L. occidentale*, due to a steep decline in *Darlingtonia* fens along the coast in recent decades. Based on its associated species, the Del Norte County sites are more similar to the northern part of the range in Oregon than to the Humboldt County sites in California, which to some extent agrees with observed genetic differences across the range (DeWoody and Hipkins 2006).

Lilium occidentale requires a habitat that maintains a delicate balance between maintaining adequate moisture to avoid desiccation during the growing season, and avoiding prolonged inundation when it needs to grow; thus, the close association with soils that either "perch" water near the surface and stay relatively moist, or where the water table drops seasonally to expose the

bulbs. The species also does best in low to moderate height, structurally diverse vegetation that offers an abundance of "edges" allowing it to escape deer and other browsers, yet open enough to provide adequate light for growth and reproduction. The latter requirement undoubtedly explains its common association with trails, roadsides, and openings in vegetation. Very dense, tall shrub growth reduces reproduction and survivorship, and closure of the overstory canopy, although tolerated by young or small plants if it is moist, eventually may eliminate the population entirely. These two balancing acts, with respect to moisture and light requirements, substantially limit the kinds of habitats the species will thrive in, and probably explain much of its rarity.

The requirement for early successional vegetation requires that some agent of disturbance periodically limits competing species without causing permanent damage to the soils. For the past 150 years, that disturbance agent has been fire for some sites, particularly before effective fire suppression became available in the mid-20th century. For example, the Bandon Fire of 1936 likely was important in maintaining several *Lilium occidentale* populations in the Bandon, Oregon, area. The declining condition of the Webb/Sexton population (Imper, unpubl. data 2008), which until recently supported a large *Darlingtonia* fen, suggests that vegetation which has not burned or otherwise been disturbed since the 1936 fire is now either completely unsuitable for *L. occidentale*, or declining rapidly. A fire on Table Bluff, Humboldt County, in the early 1900's probably helped maintain its habitat at the Table Bluff Ecological Reserve or other sites on Table Bluff (Imper *et al*. 1987), and a fire at Floras Lake State Park in the 1960's appears to have been important in maintaining the largest concentration of *L. occidentale* in the park. However, other than those specific cases, there is no evidence that fire helped maintain *L. occidentale* habitat for many decades. For most sites across the range, livestock grazing has been the principle disturbance factor. Virtually all of the remaining California occurrences were subject to at least low level livestock grazing until the 1980's, and many of the remaining sites in Oregon had a grazing history, including the Borax site until the early 1990's (Radaeke Associates 2006), Cape Blanco (currently grazed), Floras Lake State Park, and Shore Acres State Park (Rittenhouse 1999). With respect to the past 150 years then, we can surmise that the majority of extirpated populations of *L. occidentale* were either 1) eliminated by development; 2) severely overgrazed, which led to soils degradation and other conditions unsuitable for *L. occidentale*, or 3) were not grazed at all, which allowed natural succession to replace the open habitat previously maintained by disturbance (fire, elk, other) with dense shrub land or forest.

Stepping back prior to European settlement in the 1850's, there is good reason to believe *Lilium occidentale* habitat was burned repeatedly by Native Americans along this part of the coast (Anderson 2006, Bicknell and Austin 1991, Schultz 1989), which may explain the frequent occurrence of the species on coastal headlands (e.g., Cape Arago, Cape Blanco, Point St George, Table Bluff). Presumably elk played a major role prior to European settlement. Back even further, we know that at least 31 large ungulate species ranged over the western United States and northern Mexico as little as 13,000 years ago (Foreman 2004).

Changes in Taxonomic Classification or Nomenclature

There has been no change in taxonomic status of this species since it was described, although the existence of two forms of *Lilium occidentale* has been debated over the years. Ballantyne (1980) and Skinner (1988) contended that two forms, referred to as the "Oregon" and "California"

varieties, were taxonomically distinct. In general, the "California" form, perhaps best represented by populations at Table Bluff, California, is more likely to be found on mineral-based soils with either a clayey subsurface horizon or iron pan that serves to impede drainage (Imper 1997). This form is characterized by wider leaves, a greater degree of whorling in the leaf arrangement, a taller height, and multiple flowers, all of which are characteristics more typical of *L. columbianum*. The "Oregon" form is more likely to be found in fen habitat with deep organic peat or muck soils (Imper 1997). This form typically has narrower leaves, exhibits little or no whorling, may be shorter, and with fewer flowers, all of which are more characteristic of *L. pardilinum* ssp. *vollmeri*. Indeed, a genetics investigation by DeWoody and Hipkins (2006) suggested that three of the four populations of *L. occidentale* on Table Bluff formed a group generally distinct from the other populations sampled, and more closely linked to *L. columbianum* genetically than any other population. Hybrid swarms do exist between *L. occidentale* and *L. columbianum* frequently across the range (e.g., Bastendorf Bog, Morrison Road site, Hulton site, Cape Blanco State Park, Borax site, Point St George site). No overt evidence of hybridization between *L. occidentale* and *L. pardilinum* ssp. *vollmeri* has been reported in the literature or observed (Imper, unpubl. data 2008).

However, more thorough inventory and inspection of populations across the range has found an intermingling of the two morphological forms in both states (Schultz *in litt.* 1988, Imper *et al*. 1987), that generally coincides with local differences in habitat. Past distinction of the varieties as "California" and "Oregon" appears in large part due to the fact that the largest population, which fits the "Oregon" form well, was not discovered in California until 1991. The best interpretation at this time seems to be that the variation seen between the forms often correlates with differences in environment, less often correlates with proximity to the similar congener species, and at the extreme southern end of the range (Table Bluff) is currently supported by defined genetic differences.

Genetics

Although aberrant floral structure in *Lilium occidentale* has been occasionally noted at various sites throughout the range (Service 1998), there is no indication that the frequency of misshapen flowers or other evidence of inbreeding depression and deleterious mutations has increased (Imper, unpubl. data 2008). However, greater understanding of the genetic structure of *L. occidentale* was identified as a recovery task, and will provide a baseline of genetic diversity in this endangered species. Artificial propagation has and will continue to be an important element in the recovery of *L. occidentale*. For that reason, knowledge of the geographic variability in genetic structure was needed to inform seed collection and seedling transfer decisions.

DeWoody and Hipkins (2006) investigated the genetic structure of *Lilium occidentale* using codominant, biparentally inherited genetic markers (isozymes, or different forms of chemically distinct, but functionally similar enzymes). Moderate levels of genetic variation were observed in the 458 plants sampled from 15 populations for this study, which indicated that proximate populations are more genetically similar than distant populations.

No significant evidence was found of genetic subgroups corresponding with habitat type in *Lilium occidentale*, but there was evidence that either two or three genetic subgroups may be present in the group sampled, depending on how the samples are identified. Populations from

separate but similar habitat types show no evidence of sharing a common ancestor. There was some evidence indicating *L. occidentale* populations form a continuum between the two congener species, *L. columbianum* and *L. pardilinum* ssp. *vollmeri*, regardless of soil type, with *L. columbianum* basal to three populations of *L. occidentale*. Theoretic analysis of gene flow suggested most populations sampled were genetically connected, with the exception of the McMurray, Christensen, and Table Bluff Ecological Reserve populations, which only share significant migrants with each other and *L. columbianum*.

Tests for genetic differentiation indicated that near panmictic (randomly interbreeding) gene flow occurs between most populations of *Lilium occidentale*, with the exception being the McMurray, Christensen, and Table Bluff Ecological Reserve populations at Table Bluff, Humboldt County, that appear to comprise a genetically unique group that may interbreed with *L. columbianum*. Seed from these populations should be restricted to within this group and not distributed among other populations. Significant isolation by distance was observed among all populations of *L. occidentale*, indicating that significant gene flow over large distances (150 km) does not occur in this species. As a result, movement of germplasm (seeds, pollen, bulbs) should be restricted to localized areas to mimic this natural distribution.

Lilium occidentale, *L. pardilinum* ssp. *vollmeri*, and *L. columbianum* appear to be genetically similar, having similar levels of genetic diversity and sharing alleles (different forms of a particular gene) at all gene loci (DeWoody and Hipkins 2006). Two results indicated potential hybridization between *L. occidentale* and either of its other two congeners, but studies designed to test for hybridization are required to confirm this result. First, the lack of gene flow between the McMurray, Christensen, and Table Bluff Ecological Reserve populations and all other populations of *L. occidentale*, added to evidence suggesting they share some level of derivation from the Crescent City Marsh Wildlife Area population, indicate that these populations may be the result of hybridization between *L. occidentale* and *L. columbianum*. Second, population assignment tests based on the genetic analyses showed three individual plants clustered outside of the *L. occidentale* group: one from the Crescent City Marsh Wildlife Area population clustered with *L. pardilinum* ssp. *vollmeri*; one from the McMurray population clustered near *L. columbianum*; and a sample from the Point St. George population was intermediate to all three clusters, indicating potential admixture.

Based in part on the DeWoody and Hipkins (2006) investigation, a genetics management plan was prepared to help guide future population augmentation, reintroduction, and introduction efforts (Guerrant 2008). The plan includes recommendations for managing genetic diversity, ranging from the broad scale (e.g., monitor populations and habitat quality, implement habitat management) to recommendations regarding use of transition matrix demographic studies and *ex situ* seed bank conservation. Specific methods are recommended to maintain or increase genetic diversity, including population augmentation, reintroduction, introduction, and mediated gene flow using pollen transfer. The plan also recommends transfer zones, or geographical areas supporting similar populations, to be adhered to when transferring pollen, seed or plants. Although hybridization with other *Lilium* species, primarily *L. columbianum*, and in one case *L. kelloggii* (Imper, unpubl. data 2008), has occurred for nearly a century or more, and continues to occur across the range, there is no evidence that the genetic intermingling poses an immediate threat to *L. occidentale*. There are no current plans to investigate the influence of hybridization.

Species-specific Research and/or Grant-supported Activities

A partial list of activities focused on *Lilium occidentale* since the species was listed, along with funding source, includes:

Section 6 (Endangered Species Act) funded projects (CDFG – State Partner):

- *Lilium occidentale* inventory on public lands in Humboldt and Del Norte Counties, California (Bencie and Wear 2004a).
- Grazing Monitoring Plan, Crescent City Marsh Wildlife Area (Bencie and Wear 2004b): developed monitoring plan and installed permanent plots throughout Crescent City Marsh in preparation for resumed livestock grazing.
- Life History and Experimental Habitat Study, Table Bluff Ecological Reserve and Crescent City Marsh Wildlife Area, 1997-2005 (Bencie and Kalt 2007): Investigation of *L. occidentale* life history, impacts of browsing and grazing, and methods for maintaining suitable habitat.

Service Coastal Grant Program funded:

- Life history and experimental habitat management study, Shore Acres and Floras Lake State Parks, The Nature Conservancy (ongoing).
- Vegetation treatment at Bastendorf Bog and Shore Acres State Park sites (2005-present).
- Development of a conservation strategy for Crescent City Marsh, Smith River Alliance; California Native Plant Society contributed match funding (ongoing).
- Vegetation treatment at Harris Beach State Park (2005-present).

Service recovery funds and/or staff commitment, Arcata FWO and Newport FWO:

- Genetics study (DeWoody and Hipkins 2006).
- Genetics Management Plan (Berry Botanic Garden 2008).
- Crescent City Marsh hydrological study (ongoing); partial contribution from Elk Valley Rancheria, Crescent City.
- Six-acre deer exclosure fence, Table Bluff Ecological Reserve (Arcata FWO, 2008).
- Vegetation management with goats; various sites near Crescent City and Harris Beach State Park (Arcata FWO, 2004 and 2008).
- Manual vegetation treatment, California Conservation Corps, Table Bluff, Humboldt County (Arcata FWO, 2005-present).
- Construction waterline and fence at Harris Beach State Park (Newport FWO, ongoing).
- Continuous soil temperature monitoring at 9 sites throughout the range; continuous groundwater level monitoring at Bastendorff Bog and Harris Beach State Park sites (Arcata FWO, ongoing).

CDFG funded:

- Grazing infrastructure improvements, Table Bluff Ecological Reserve (1987-2008).
- *Lilium occidentale* population monitoring, Table Bluff Ecological Reserve and Crescent City Marsh Wildlife Area sites (semi-continuous 1992-2008).
- Crescent City Marsh Wildlife Area Draft Management Plan (Wear 2003).

Bureau of Land Management funded:

- Reintroduction study at New River Area of Critical Environmental Concern (Ed Guerrant, Berry Botanic Garden).

Private funded:

- North American Lily Society: grant for *Lilium occidentale* inventories at three Oregon State Parks (2003).
- Verizon Network: materials for exclosure fence around *L. occidentale* habitat, Harris State Park (2005); mitigation for unauthorized vehicle entry into wetland habitat.

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 Endangered Species Act.

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

Threats

At the time of listing in 1994, several factors were cited as eliminating or modifying *Lilium occidentale* habitat, including general development; clearing for livestock grazing; utilities installation at Brookings; and others. A new factor since it was listed, which threatens the largest population of *L. occidentale* range-wide, is the prolonged flooding of the Crescent City Marsh. That threat is described in detail under the representative site histories below.

From the 1940's until the species was listed, conversion of habitat to cranberry farms, roads, and residential dwellings continued to eliminate *L occidentale* and suitable habitat between Bandon and Port Orford, Oregon, an area that likely contained the greatest concentration of the species in Oregon more than 50 years ago (Ballantyne 1980, Schultz 1989). Cranberry agriculture continues to eliminate a large amount of suitable habitat each year, currently accounting for the largest loss of suitable habitat. The most important soils occupied by *L. occidentale* in Oregon, the Blacklock/Bandon/Bullards complex, are preferred for cranberry use due to their water perching capability. As a result, the region between Bandon and Port Orford, comprising the majority of these soils in Oregon, has been subject to explosive cranberry development over the past decade. In some cases, the amount of land converted to cranberries in regions over many square miles south of Bandon doubled between 1993 and 2005, now accounting more than 50 percent of the land base in some areas (Imper, unpubl. data 2008). Comparison of aerial photography taken between 1993 and 2005 documents many stream channels and associated wetlands simply disappearing into the cranberry bogs.

Many of the smaller roadside occurrences cited when *Lilium occidentale* was listed could not be relocated (Imper, unpubl. data 2008), often due to driveway construction, cranberry development, grading, non-native species, or other developments overrunning the general area. From a population standpoint, it is not economically feasible to protect scattered individuals along roadsides. However, implementation of roadside management practices beneficial to *L.*

occidentale along key County roads would be highly beneficial with respect to providing genetic corridors between principle populations, and contribute to maintaining genetic diversity.

Representative site histories for populations threatened by destruction of habitat are provided below. All of these populations are also threatened by vegetation encroachment (Factor E), but are included here to illustrate the different kinds of threats included under Factor A.

Fourmile Road (Witchis), Bandon, Coos County, Oregon (Recovery Zone 2):
A complete census of this unique population was made in 2003 (Imper, unpubl. data 2008). A total of 488 plants, including 209 reproductive plants, were found scattered over about a half acre. Habitat consists of relatively dark beachpine forest that invaded a former fen. Aerial photographs from the 1940's indicate the fen was quite open, probably grazed, and likely contained a larger *Lilium occidentale* population (Imper, unpubl. data 2008). The health of this population is dependant on the landowner conducting periodic manual clearing of trees and shrubs. Population trends are not available, because the landowner has denied Service staff access to the property since 2004. The feasibility of expanding this population is not known.

Morrison Road/Hultin Sites (BPA Right-of-Way), Coos County, Oregon (Recovery Zone 2):
Lilium occidentale occurs within a 2-mile segment of the Bonneville Power Administration power line right-of-way east of Bandon (Service 2002). This segment includes virtually all of the undisturbed Blacklock soils remaining in the BPA power line corridor. The Hultin *L. occidentale* population occurs at the west end of this segment, scattered over more than 6 acres of habitat. Based on a brief inventory in 2008, the reproductive population exceeds 200 plants (Imper, unpubl. data 2008). The total population has not been estimated, but is undoubtedly much larger. The BPA maintains a fire-safe zone beneath the power lines, within which trees and brush are cut generally on a 4-year cycle (BPA 2006a, 2006b; Service 2006b). The Service is currently attempting to negotiate a conservation easement on the property. The perpetual habitat maintenance provided by the BPA represents incalculable savings to the Service in future habitat maintenance costs. Although BPA will continue to manage the site, the entire area supporting *L. occidentale* is scheduled to be converted to cranberry production if the current effort to secure a conservation easement fails (Imper, unpubl. data 2008).

The east end of the occupied BPA right-of-way segment (Morrison Road vicinity) was inventoried by Rittenhouse (1994), who observed 66 *Lilium occidentale* plants, including 33 reproductive plants. A thorough census in 2002 (Service 2002) resulted in 134 total plants, including 73 reproductive plants. Additional *L. occidentale* are scattered in the vegetation maintained by both BPA and Coos-Curry Power Cooperative. The abundance of suitable habitat located under and near the power lines in this area suggests this population has great potential for expansion. Due to the vegetation maintenance conducted by BPA, the Morrison Road and Hultin populations, together with the Cape Blanco State Park population (under grazing lease), are the only *L. occidentale* populations not currently threatened by vegetation encroachment. However, the *L. occidentale* within the right-of-way corridor are vulnerable to conversion to agriculture uses, and encroachment by introduced invasive species, such as *Ulex europaeus* (gorse) and *Cytisus scoparius* (scotsbroom). A portion of this population was sprayed with the systemic herbicide Garlon 2 in 2003, in conjunction with non-native species control. The

herbicide did not appear to have long-term impact on *L. occidentale*, based on population monitoring in 2004 (Imper, unpubl. data 2008).

Borax (former Rainbow Rock/Black Mound sites), Curry County, Oregon (Recovery Zone 4):
The Borax population includes several historical *Lilium occidentale* occurrences scattered over a large property north of Brookings, Oregon, owned by the Borax Corporation for more than 100 years. The property includes the southernmost Blacklock soils in Oregon, and abundant, diverse *L. occidentale* habitat. The entire Borax population was inventoried in 2004 and 2005, in conjunction with approval of a Master Plan of Development which would allow construction of up to 1,000 residential units (Imper, unpubl. data 2008, Radaeke Associates 2006). Not less than 320 plants and at least 200 reproductive plants occur in six wetland areas across the property, generally within a power line corridor. The portion of the population outside the power line corridor (i.e., the original Rainbow Rock occurrence) is severely threatened by vegetation encroachment. The proposed subdivision would fragment the *L. occidentale* population and alter the hydrology. The current development plan calls for residential setbacks ranging as little as 0-25 feet from habitat containing *L. occidentale*. In addition, it appears the Coos-Curry Power Cooperative may soon abandon this power line, eliminating the ongoing maintenance of *L. occidentale* habitat (Imper, unpubl. data 2008).

Crescent City Marsh, Del Norte County, California (Recovery Zone 5):
The Crescent City Marsh supports the largest population of *Lilium occidentale*, more than 50 percent of the total reproductive plants range wide, and 4 of the 23 identified principle populations for the species (Table 1). As in 1994, the marsh continues to be subject to sporadic logging, grading, and residential development around its edge (Imper, unpubl. data 2008). A casino was recently approved adjacent to the marsh, and a residential subdivision was rezoned doubling the number of potential lots, both of which potentially could alter the hydrology of the marsh. A lumber mill filled as much as 7 acres of wetland on the north edge of the marsh. The U.S. Army Corps of Engineers (USACE) eventually issued a violation under the Clean Water Act, and a voluntary restoration order is underway (Service 2006c, SHN 2008).

A more immediate threat to *Lilium occidentale* in Crescent City Marsh is increased flooding due to blocked culverts draining the marsh to the ocean. Accumulation of sand and debris on the upper beach, potentially aggravated by offshore disposal of dredge material from the adjacent marina, has reduced the ability to drain the marsh. Monitoring for the past four years and anecdotal evidence from local residents suggest that the water level in the marsh has risen in the past decade, and in 2005 and 2006 remained above the depth of the *L. occidentale* bulbs until well into July. Emergence of *L. occidentale* in those years was delayed dramatically. Comparison of total spring precipitation to the abundance of flowering *L. occidentale* in the main portion of the marsh since 1997 (Figure 3) shows a strong negative relationship (note rainfall is plotted in reverse). The decline in the *L. occidentale* population index starting in 2001, from which it has not yet rebounded, suggests the continued high spring rainfall between 1997 and 2000, combined with poor drainage from the marsh, may have caused up to 50 percent mortality in the flowering *L. occidentale* population (Bencie and Kalt 2007, Imper, unpubl. data 2008). A high mortality rate was also observed in another part of the marsh, where the only remaining plants are located at higher elevations (Imper, unpubl. data 2008).

A rise in ocean level as a result of climate change also would reduce the ability to drain the marsh, and lead to further loss of *Lilium occidentale* habitat and a portion of its population. Fortunately, at least for *L. occidentale*, there is evidence that the ocean level at Crescent City, contrary to all other locations in California, may be falling rather than rising. The California Coastal Commission (2001) predicts that due to the landmass rising more quickly than the ocean level, there is a 90 percent probability that the net change in sea level relative to the landmass will be a drop of nearly one inch by the year 2025.

The entire Crescent City Marsh was passively grazed by cattle until the 1980's, when the CDFG purchased about 40 percent of the marsh and established the Crescent City Marsh Wildlife Area. The remainder is owned by Hambro Forest products. For its size, the marsh supports the largest concentration of rare plant species on the North Coast of California. Monitoring and research conducted since 1992 has documented a progressive decline in early successional habitats throughout the marsh (Wear 2003; Bencie and Kalt 2007; Imper and Sawyer 1992b, 1997). The majority of woody trees and large shrubs in much of the marsh date from about 1980, when grazing was removed. The draft Crescent City Marsh Wildlife Area management plan calls for reintroduction of grazing (Wear 2003). Focused attempts at manual vegetation control during the past 10-12 years, and controlled goat grazing applied in 1997, 2003, and 2008 were successful at maintaining small colonies of *L. occidentale*, but those results were short-lived. Three of the 4 discrete populations of *L. occidentale* in the marsh have been reduced to only a few plants each, while the main population appears to have declined from in excess of 2,500 reproductive plants in the early and mid-1990's, to perhaps half that today (Bencie and Kalt 2007, Imper, unpubl. data 2008).

A conservation strategy is being developed that will prioritize key protection needs (easements and acquisitions), develop a public outreach program, and identify funding sources. The Service is also coordinating with the California Department of Transportation to maintain, and hopefully upgrade the culverts draining the marsh under State Highway 101.

Figure 3. *Lilium occidentale* flowering plant abundance in Crescent City Marsh compared to spring precipitation 1997-2008
Figure created for the 2008 5-year review

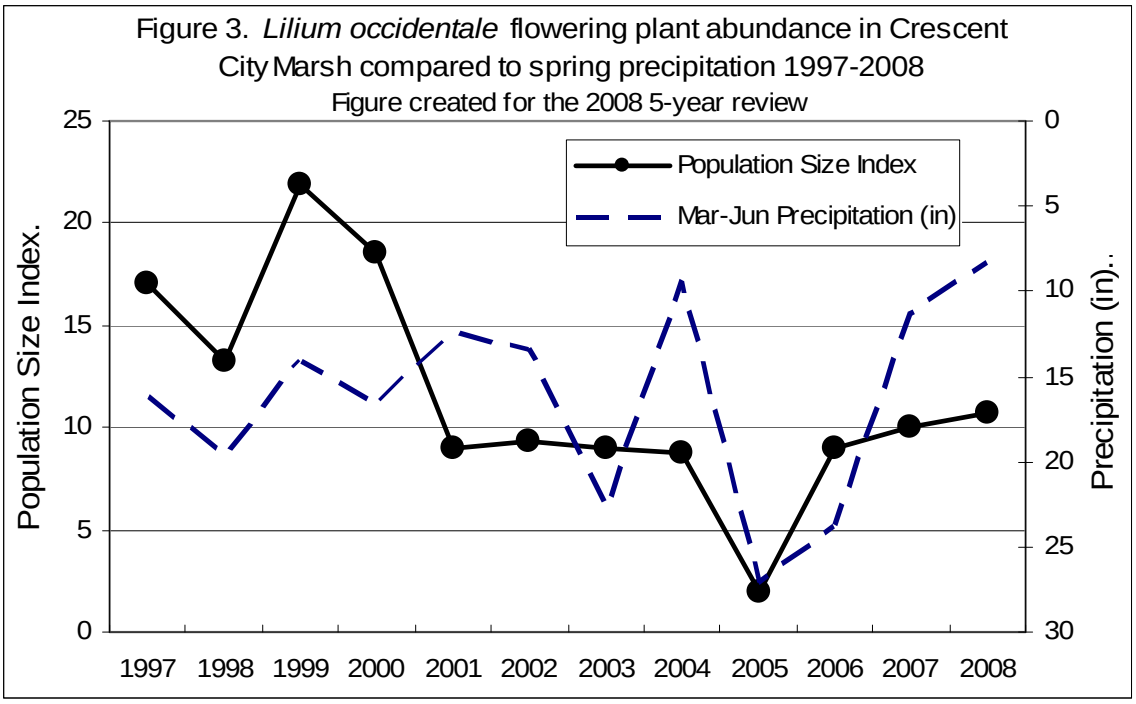


Table Bluff Ecological Reserve, Humboldt County, California (Recovery Zone 6):
The Table Bluff Ecological Reserve was a cattle ranch until acquired by the CDFG in about 1986. At that time, the *Lilium occidentale* population largely consisted of many small, non-reproductive plants scattered in the dark, barren understory of a 35-year old spruce forest. Up to 50 reproductive plants occurred along the edge and in openings of the spruce (Imper *et al*. 1987). The plant was absent in an adjacent 80-year old spruce stand, even though soil and light conditions appeared conducive to the species. The cattle were excluded in 1988 and about half the spruce stand was taken out over the next 10 years. The number of reproductive *L. occidenta*le increased more than 10-fold, reaching a peak of more than 800 in 2000 (Imper and Sawyer 1994). However, complete removal of the cattle triggered successional changes in the spruce forest and coastal prairie that were detrimental to *L. occidentale*. Cattle were reintroduced to a portion of the habitat in 1997, on an experimental basis. Also in the late 1990's, deer browsing increased dramatically, and in 2007 eliminated more than 80 percent of the population reproductive effort. A deer exclosure was constructed in 2008, which helped reduce the browsing. Nevertheless, only 161 reproductive plants were recorded in 2008 (Imper, unpubl. data 2008). The apparent steep decline in reproductive plants did not appear related to deer impacts or inadequate light conditions. Evidence is now pointing to a possible change in the soil moisture regime as a result of the increasing size of the remaining spruce trees, now averaging 55-50 years old and 3-4 feet diameter at breast height, and their associated higher evapotranspiration rates. Current research is focused on that possible threat. If the older spruce are eliminating *L. occidentale* in the understory as a result of a higher evapotranspiration rate, future management may necessarily need to include complete stand replacement on perhaps a 50-year cycle, or less. These results should be applicable to several other sites where *L. occidentale* occurs in close association with spruce (e.g., Bastendorff Bog, Shore Acres, Fourmile Road).

McMurray Site, Table Bluff, Humboldt County, California (Recovery Zone 6):
Management efforts for *Lilium occidentale* began here in the mid-1980's. Volunteers constructed a fence to exclude cattle, and monitored the population each year (Imper 1992b). The fenced area was enlarged in 1994 to include roughly an acre. Soon after the initial fencing, it became evident that complete exclusion of cattle grazing was detrimental to the lily (Imper 1993b, 1994). Beginning in 1994 the exclosure was opened to passive cattle use in the fall and winter. However, the passive grazing was not of sufficient intensity or duration to maintain the habitat, and volunteer work parties or the California Conservation Corps manually cleared the habitat over the year. *Lilium occidentale* was also grown at Freshwater Farms Nursery in Eureka, from seed collected on the property, and periodically planted back to the site (Imper 2001). In 2004 the population was estimated at 100 flowering plants and over 200 juvenile plants. The property was sold in 2004. Attempts to secure a conservation easement or acquire the property at that time failed. The new owner withdrew access to the site, and reportedly intends to develop the property.

<u>Summary of threats and conservation actions taken since listing</u>

Great effort has been expended since the species was listed to locate additional populations and expand existing populations (Imper, unpubl. data 2008). Bencie and Wear (2004a) utilized soils GIS layers and other regional data available from agencies to prioritize likely occurrence areas,

and then surveyed the 10 most likely sites, with no success. Extensive potential habitat remains to be surveyed across the range, particularly between Port Orford and Bandon, Oregon, but the rapid growth of dense vegetation and preponderance of private property in the area makes conducting surveys problematic. As a safeguard against the continued destruction of habitat and populations, beginning in 1983, *Lilium occidentale* seed were collected periodically from many of the populations and stored at the Berry Botanic Garden in Portland. The current accessions represent over 400 individual plants, with in excess of 19,000 seed held in reserve (Berry Botanic Garden 2008). In addition, various means have been used to educate the public and other agencies on the importance of conserving the species, and methods for preventing the destruction of habitat, including:

- Information posted on the Service websites;
- Development of a draft survey protocol (Service 2008);
- Guidance documents prepared for local governments (Service 2004, 2007);
- Repeated landowner and local agency contacts across the range (Imper, unpubl. data 2008);
- Population monitoring involving volunteers, and the landowners where possible;
- Artificial propagation at a nursery in Humboldt County and at Shore Acres State Park;
- Augmentation of existing populations in Humboldt County;
- Pursuit of conservation easements and landowner agreements.

See Table 2 for a summary of habitat threats and conservation efforts.

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

Lilium occidentale is a very showy plant with great horticultural appeal. Horticultural collection was considered to be a significant threat at the time of listing, in part due to past publication of specific locations in professional journals. Schultz (1989) and Ballantyne (1980) reported numerous observations of flowers picked, or seed and bulbs being collected, often by lily breeders. Ballantyne (1980) believed that repeated publication of the location of a California population in lily society yearbooks between 1934 and 1972 led to decimation of the population by lily growers and breeders. However, the actual threat that past and current collection posed to individual populations is impossible to gauge, since in no case have we had an accurate accounting of the proportion of the population impacted. Given the frequent difficulty in detecting the majority of individuals within any one population, in most cases a single collection probably would not constitute a major threat. Nevertheless, there is good evidence that collection of plant parts has occurred frequently in the past, and such collections currently pose a threat to the smaller populations.

Table 2: Past and current conservation and management efforts for the principle populations of *Lilium occidentale*. Table prepared for the 2008 5-year status review.

Site Name	Last habitat restoration and/or maintenace	Public ownership or otherwise protected	Reliable *Lilium occidentale* management plan in place	Current Threat: (D)evelopment; (E)ncroachment; (H)ydrology			Est'd current occupied Habitat (ac)	Est'd suitable habitat available for restoration (ac)
				D[1]	E	H		
Zone 1								
Hauser Bog	ODOT manual 2003	10% ODOT; 90% no	No	M[1]	M	?	1	>5
Bastendorff Bog	Manual 2005 (partial)	Yes	No		M	?	2	>5
Shore Acres State Park	Manual 2005 (partial)	Yes	No		M		.5	>10
Zone 2								
Morrison Road BPA	Manual - BPA 4-year cycle	No	No	H			<1	>3
City of Bandon	--	Yes	No		?	?	?	?
Hultin BPA	Manual - BPA 4-year cycle	No	No	H			6+	>10
Sexton/Webb	--	No	No	H	H		<1	>5
Boak Lane	Manual - County Roads – annual?	No	No	H	H		<.25	?
Fourmile Road (Witschi)	Manual - annual?	No	No	H	H		<.5	>1
New River ACEC	--	Yes	No		H		<.25	>1
Floras Lake SP	--	Yes	No		H		>3	>20
Cape Blanco SP	Grazing - annual	Yes	No		M-L		~2	>10
Zone 4								
Borax	Manual – Coos-Curry Power Coop (partial)	No	No	H	H	H	3-4	>10
Harris Beach SP (Highway)	Manual/goats 2007-08	Yes	No		M		<.5	1
Harris Beach SP (Powerline)	Manual/goats 2007-08 (partial)	Yes	No		M		<2	>5
Zone 5								
Point St George	Manual/goats 2005 (partial)	Yes	No*		H		1.5	>8
Crescent City Marsh (main)	--	Yes	Draft – not yet implemented		H	H	10?	>30
Crescent City Marsh (Hambro No.)	Goats/manual 2007 (partial)	No	No		H		<.1	>5
Crescent City Marsh (Hambro So.)	--	No	No		H		<.1	>2
Crescent City Marsh satellite sites	Goats/manual 2007 (partial)	Yes	Draft plan not yet implemented		H	H	<.5	>10
Zone 6								
Table Bluff Ecological Reserve	Cattle - annual Manual 2005	Yes	Yes		L	H	<4	>6
McMurray	Manual/Cattle - 2003	No	No	H	H		<.5	>2
Hiser	Manual - 2005	No	No	L	M		<1	>2
Christensen	Manual - 2005	No[2]	No	L	H		<1	1-2

[1]D = development; E = encroachment; H = hydrological modification; H = high; M = moderate; L = low threat.
[2]Condition of development permit allows access for monitoring and management of *Lilium occidentale*.

FACTOR C: Disease or Predation

Deer herbivory

Deer herbivory was identified as a threat for several Oregon and California populations at the time of listing, and continues to threaten, or at a minimum severely reduce the reproductive vigor of many populations. Even if not lethal, deer remove a considerable fraction of flowers and fruit, thus seriously reducing the reproductive output at many sites. Deer herbivory has occurred at nearly all sites, and often eliminated a majority of a population's annual seed production. Deer seem to preferentially browse the upper stems of reproductive plants at all stages of development. The concentration of adult lilies in small open areas increases their vulnerability, especially after removal of encroaching vegetation that undoubtedly reduces their visibility and accessibility. While large adult populations in diversely structured habitat can certainly withstand normal browsing activity, most populations would greatly benefit by deer exclusion. The pattern of vegetation removal will affect deer behavior, and simultaneous clearing of areas away from lilies would undoubtedly redirect some browsing pressure.

The most severe documented impact from deer browsing is occurring at the Table Bluff Ecological Reserve (Bencie and Kalt 2007). Management for *Lilium occidentale* at the Table Bluff Ecological Reserve began in 1987. Since then, losses to deer generally ranged less than 10 percent of the annual fruit production until the late 1990's, when it increased. By 2007, an estimated 80-90 percent of the annual potential fruit production was consumed (Imper, unpubl. data 2008). The reasons for the increase are not clear, but probably had to do with reduced poaching, relocation of a residential area away from the preserve, and the increase in grassland and scrub vegetation as a result of spruce removal. Attempts to fence the deer out between 2005 and 2007 failed, and illustrated the extreme challenge in maintaining a deer-proof fence in an isolated area. A more substantial fence was constructed by the Service in 2008, with only limited success. Due to the high cost of resources needed to maintain the fence, and the high potential for failure, a more desirable option from the standpoint of reducing browsing impacts is herd control. However, the CDFG has been unwilling to implement such a program at the Table Bluff Ecological Reserve. Another option, which has been untested, is to treat an abundance of habitat outside *L. occidentale* habitat in a similar manner, such that the conditions attracting deer would be well dispersed. Other *L. occidentale* populations have exhibited noticeably high losses to deer, including Hauser, Bastendorff, Harris State Park, Point St. George, and others (Imper, unpubl. data 2008). Other fencing efforts that largely failed were at the Christensen site and Shore Acres State Park (Imper, unpublished data 2008). One site that surprisingly has exhibited almost no deer depredation for the past 10 years or more is the Crescent City Marsh Wildlife Area population, perhaps due to the dense, often inundated marsh vegetation (Bencie and Kalt 2007).

Small mammal herbivory

In some cases small mammals, such as voles (*Microtus* spp.), have been observed browsing on *Lilium occidentale* (Imper unpub. data 2008). Substantial browsing by small mammals has been observed at the Christensen site in Humboldt County (McRae and Imper 1994), and the Crescent City Marsh Wildlife Area (Bencie and Kalt 2007), which in both cases, seemed to be stimulated by the placement of a short fence around the area, which ironically was intended to keep the mammals out. However, measured impacts on *L. occidentale* from small mammal depredation

overall appear relatively small compared to deer (Bencie and Kalt 2007; Imper, unpubl. data 2008)

Insect and other factors
Grazing of leaves, buds, and flowers by Coleopteran (beetle) and Lepidopteran (butterfly, moth) larvae was observed in the past at one California site (Imper *et al*. 1987), but significant impact from these sources has not been reported or observed in recent years.

Livestock grazing
Overgrazing by livestock was identified as one of the anthropogenic threats to *Lilium occidentale* at the time of listing, particularly for four sites in Humboldt County, California. Cattle and other livestock grazing eliminated abundant suitable and occupied habitat for *L. occidentale* in the century following first European settlement in the 1850's, and as late as 1980, unrestricted cattle grazing was occurring on nearly all the California sites and at least one site in Oregon (Imper *et al*. 1987, Imper, unpubl. data 2008, Schultz 1989, Radaeke Associates 2006). Exclusion of grazing at three of the four sites on Table Bluff in the late 1980's led to an immediate tripling of flowering and fruit production (Imper 1995a, 1995b; Imper and Sawyer 1996; McRae and Imper 1995).

Although cattle represent an obvious physical hazard to individual plants during the growth period, evidence indicates that its past categorical characterization as a major threat may be overstated. In contrast to deer and small mammals that are often very selective for *Lilium occidentale*, cattle often remove only the upper portion of the plant as a consequence of feeding on surrounding vegetation. Different modes of grazing are significant, since *L. occidentale* appears well able to tolerate trampling or partial browsing without die back, and still derive benefit from photosynthesis for the remainder of the season. Overall evidence suggests that while cattle grazing reduces individual reproductive potential, so long as there is adequate seed production and recruitment to offset mortality, that impact may be of little consequence compared to the benefits to its habitat. Uncontrolled grazing could lead to soil compaction and negatively impact *L. occidentale*. However, soil densities measured over several years of controlled grazing at the Table Bluff Ecological Reserve have showed no obvious increase (Bencie and Kalt 2007, Imper, unpubl. data 2008). The absence of any permanent degradation of soils in response to low-moderate grazing is not surprising, given the long grazing history at many sites, which does not appear to have negatively impacted the high quality, native, organic rich soils on which *L. occidentale* occurs.

In general, the timing, intensity and duration of livestock grazing determines whether it constitutes a threat or a crucial management tool necessary to conserve *Lilium occidentale*. Controlled grazing has been effectively utilized as a vegetation management tool (see discussion under Factor E), although not without public controversy. Application of controlled goat grazing at various *L. occidentale* sites near Crescent City in winter 2007-2008 generated considerable controversy in a portion of the local environmental community, and demonstrated the urgent need for further public education on the merits and implementation of controlled grazing for endangered species management (Ma 2008). At the same time, grazing of *L. occidentale* habitat at Harris Beach State Park, Brookings, generated positive publicity regarding management for endangered species (Babin 2007). Overgrazing is not a current threat to any known *L.*

occidentale population, but private landowners could at any time reintroduce livestock in such a manner that would threaten *L. occidentale*.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing, the regulatory protections cited as relevant to *Lilium occidentale* included the Federal Clean Water Act, the State Endangered Species Acts in both California and Oregon, and the Wildflower Protection Act in Oregon. Both the provisions and the level of enforcement of these laws were considered inadequate to ensure the continued survival of *L. occidentale*. In addition to these, other regulations are pertinent to the species' conservation in California that were not mentioned when the species was listed. The following is a current listing of regulatory mechanisms affecting *L. occidentale*:

Federal Protections

Clean Water Act: At the time *Lilium occidentale* was listed, the primary Federal regulatory protection was assumed to be provided by the Clean Water Act, in combination with the Federal Endangered Species Act, since in most cases the species occupies wetlands expected to fall under the jurisdiction of the USACE. Under section 404, the 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). Until recently, the USACE interpreted "waters of the United States" expansively to include not only traditional navigable waters and wetlands, but also other defined waters that were adjacent or hydrologically connected to traditional navigable waters. However, recent Supreme Court rulings have called that interpretation into question. On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld the expansive interpretation as it applied to two cases involving "isolated" wetlands. Currently, the USACE 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 USACE 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).

Since listing, the Clean Water Act has essentially failed to provide any regulatory protection for *Lilium occidentale*, due to a variety of reasons. First, although *L. occidentale* almost always occupies wetlands based on presence of hydric soils, hydrophytic vegetation, and wetland hydrology (Imper, unpub. data 2008), their hydrological connection to navigable waterways is often not apparent, and therefore may fail to meet the "significant nexus" standard described in the recent USACE and USEPA memorandum. Even habitat considered to be among the driest across its range (Table Bluff Ecological Reserve) technically qualify as jurisdictional wetlands (Seney 2007), but would likely fail the significant nexus test.

Secondly, the USACE has been either unable or unwilling to enforce the Clean Water Act over virtually the entire range of *Lilium occidentale* in southwest Oregon, in cases where activities would impact the species. As a result, there has been large-scale conversion of potential and likely occupied *L. occidentale* habitat to cranberry bogs. The impact of non-enforcement was

demonstrated at two *L. occidentale* sites in Brookings, Oregon in the 1980's and early 1990's, where wetland fill activities eliminated or severely impacted those populations (Service 1998). More recent examples of non-enforcement were the impacts from cranberry development-related fill on the Webb and Sexton populations in the early to late 1990's (Imper, unpubl. data 2008). There has, to date, never been any formal consultation between the USACE and the Service regarding potential impacts of cranberry development on *L. occidentale*, even though that industry likely has eliminated literally hundreds, if not thousands, of acres of potentially suitable habitat between Bandon and Port Orford, Oregon, in the last several decades (Imper, unpubl. data 2008). Our examination of aerial photography indicates the impacted habitat contains an abundance of stream channels (likely jurisdictional wetlands) that were rerouted or filled in the process.

Finally, in one of the two known cases to date where the USACE exerted permit jurisdiction over a project that was known to have the potential for direct and significant impacts on *Lilium occidentale*, no regulatory protection for the species resulted (Imper unpub. data. 2008). In 2006, the USACE permitted wetlands to be filled at the Bandon Crossings Golf Course near Bandon, Oregon (Service 2006a). The USACE determined that the construction of the overall golf course was not interrelated and interdependent, as defined in the Endangered Species Act (the "but for" clause), on the specific portion of the course construction that directly impacted jurisdictional wetlands. In this case, two of the 18 golf holes were located within a wetland that separated the majority of the golf course from a large area of potential habitat for *L. occidentale*. In the opinion of the Service, construction of the overall golf course qualified as an interdependent activity (Service 2006a). As a result, some 40 acres of potential habitat in close proximity to known *L. occidentale* was eliminated without Service involvement, and without a botanical survey. The Service did not concur with the determination made by the USACE that the project was not likely to have an adverse effect on *L. occidentale*, and issued an after-the-fact biological opinion for the project that indicated a significant impact to the species may have occurred.

Endangered Species Act of 1973, as amended: Section 7(a)(2) of the Endangered Species Act requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed plant species. Section 9 of the Endangered Species Act prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. The Endangered Species Act, in combination with provisions of the Clean Water Act, provides an opportunity for the Service to be involved in the permitting of many projects throughout the range of *Lilium occidentale.* However, the USACE has requested initiation of only a few informal consultations and no formal consultations with the Service regarding potential impacts on *L. occidentale* since the Endangered Species Act was passed in 1973.

In addition, recent changes to the interpretation of the regulations implementing the Endangered Species Act (Service and National Oceanic Atmospheric Administration, Interagency Cooperation Under the Endangered Species Act, December 16, 2008, 73 FR 76272) will make it less likely the Service is involved in some types of future project planning and permitting. The

regulatory changes allow Federal agencies, such as the USACE, to determine the effects of their own actions in certain circumstances without technical assistance from the Service, and change the causation standard used in determining whether an action is interrelated and interdependent under the provisions of the Endangered Species Act. As a result, it will be less likely that the Service will be asked to consult informally on some Federal projects with potential impacts to *Lilium occidentale*.

National Environmental Policy Act (NEPA): 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 a project, NEPA requires the agency to analyze the potential impacts on the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would 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 fully mitigated, only that impacts be assessed and the analysis disclosed to the public. There is no case to date where this law has provided any tangible protection for the species.

State Protections in California

California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA): The provisions of CESA (California Fish and Game Code, section 2080 *et seq*.) in combination with the NPPA (Division 2, Chapter 10, section 1908) generally prohibit the unauthorized take of State-listed species, require State agencies to consult with the CDFG on activities that may affect a State-listed species, and restrict the import or export, possession, purchase, or sales of any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and allow take that is incidental to otherwise lawful activities. However, private landowners are exempt from the prohibitions on take of plants in the process of land use development, even if it results in habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify the CDFG 10 days in advance of changing land use in order to allow salvage of listed plants. Due to the very unique characteristics of *Lilium occidentale* habitat, salvage of plants is unlikely to be successful unless the plants are relocated to currently occupied or known suitable habitat. As a result, these two laws offer little in the way of regulatory protection for the species.

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. 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. Overall, this law has not been as important as the California Coastal Act in protecting *Lilium occidentale* populations.

California Coastal Act of 1976: The strongest regulatory protection for *Lilium occidentale* at the state level is offered by the California Coastal Act. The entire known distribution of *L.*

occidentale in California occurs within the California Coastal Zone, subject to restrictions on some kinds of development within sensitive habitat areas, including wetlands and endangered species habitat. Public disclosure of environmental impacts, opportunity for public input, and project mitigation measures are other potentially beneficial elements of the law. Almost all development within the coastal zone requires a coastal development permit from either the Coastal Commission or a local government with a certified Local Coastal Program. While the certified Local Coastal Programs vary little in the mandated degree of protection, the implementing governments can vary in the interpretation, and more importantly, the degree of enforcement of the California Coastal Act provisions. Del Norte County, in particular, has not implemented their Local Coastal Program in a manner that has prevented unlawful, deleterious impacts on the Crescent City Marsh and its watershed, and other potential *L. occidentale* habitat elsewhere in the County (Service 2006c). Nevertheless, we believe the California Coastal Act has undoubtedly prevented many of the California *L. occidentale* sites from being developed over the past 30 years.

State Protections in Oregon

Oregon Endangered Species Act: As noted at the time of listing, *Lilium occidentale* is listed as endangered in the State of Oregon, and therefore is protected under that State's Endangered Species Act. The Oregon Endangered Species Act in general regulates the take, import, export, transport, purchase or sales of any threatened species or endangered species listed by the State. All state agencies, defined as any publicly funded governmental subdivision of the State of Oregon such as state, county, and municipal agencies, public utility districts, state institutions of higher learning, public school districts, port authorities, public irrigation districts, and publicly owned airports, must consult and cooperate with the Oregon Department of Agriculture prior to implementation of any ground disturbing action. The restrictions on take under this law only apply to State-owned or leased lands. The Oregon Endangered Species Act provides protection from agency-related development projects to 6 of the 14 principle remaining populations of *L. occidentale* in Oregon, and a portion of a seventh population, that are located on State-owned lands (Table 1). However, yet undiscovered populations in Oregon, which most likely will occur on private property, would not be protected.

Oregon Removal-Fill Law (ORS 196.795-990): The Removal-Fill law theoretically is Oregon's most comprehensive regulatory program for activities that cause wetland change (Walker 2006). The law generally requires a permit from the Oregon Division of State Lands when more than 50 cubic yards of material is removed or placed as fill in waters of the state. "Waters of the state" are defined as "natural waterways including all tidal and non-tidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and non-navigable, including that portion of the Pacific Ocean that is in the boundaries of this state." The law applies to all landowners, whether private individuals or public agencies. While this could be an important regulation protecting *Lilium occidentale*, since unlike the Clean Water Act, it regulates removal of material, the law has not provided any protection to date for the species. An assessment by the Division of State Lands in 2002 found the law to be highly ineffective in stemming the loss of wetlands in the Willamette Valley for the period 1982-1994, particularly regarding losses to agriculture (Walker 2006). Seventy percent of the total changes to wetlands appeared to be violations not authorized by a permit, and none of the wetland

changes caused by agricultural conversions were authorized, which constituted 81 percent of the violations.

Webb/Sexton Site (Recovery Zone 2):

A brief site history of the Webb/Sexton population illustrates how *Lilium occidentale* is threatened by a lack of regulatory enforcement in some sites. Rittenhouse originally documented a portion of this site in 1999 (ORNHD 2008), observing at least 19 *Lilium occidentale* plants within a *Darlingtonia* fen east of Bandon, Oregon. No complete census has been conducted. A portion of this fen was subsequently eliminated by cranberry development, as was a *Darlingtonia* fen on an adjacent property (Imper, unpubl. data 2008). While the population of *L. occidentale* prior to agricultural conversion cannot not be known, as of 2004 the remainder of the two fens contained at least 45 reproductive plants and many more juvenile plants. The violation of the Clean Water Act was reported to the USACE and Oregon Division of State Lands, who failed to bring enforcement action. Much of the remaining fen habitat is declining due to encroachment by Port Orford-cedar and beachpine. One of the owners has recently subdivided the property, and is marketing lots adjacent to the *Darlingtonia* fens and *L. occidentale* sites. That owner is willing to consider an easement on the wetland portion of the property. Due to the large amount of habitat available for restoration, this population has great potential for expansion.

Summary of the Inadequacy of Existing Regulatory Mechanisms

In summary, the Endangered Species Act, in combination with the Clean Water Act, theoretically provide the greatest level of regulatory protection for *Lilium occidentale*. However, recent reinterpretation and the lack of enforcement of the Clean Water Act, particularly in Oregon, have resulted in little regulatory protection for the species. The Oregon Endangered Species Act, and in California, the California Coast Act and the California Environmental Quality Act, provide the greatest protection at the state level. However, protection under those laws is largely discretionary, and in Oregon there is essentially no prohibition of take on private property. The regulatory environment continues to be inadequate to protect this species, in large part due to a decline in the protection provided by the Clean Water Act.

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

Other natural or manmade factors identified at the time *Lilium occidentale* was listed included competitive exclusion by shrubs and trees, overgrazing, encroachment by non-native invasive species, and genetic impoverishment. The continuing threat posed by overgrazing was discussed under Factor C.

Threats

Non-Native Plants

The most significant long-term threat to *Lilium occidentale* is competitive exclusion by shrubs and trees. Heightened competition is a consequence of the rapid and uninterrupted progression of ecological succession resulting from lack of disturbance (e.g., fire, grazing) for the past one to three decades for most sites. Although *L. occidentale* seedlings and juvenile plants can in some cases survive under closed canopy greater than 90 percent, the species is unable to successfully

reproduce under those conditions. Data collected at the Table Bluff Ecological Reserve suggest an upper canopy closure threshold of 60-70 percent cover in order to flower (Imper and Sawyer 2001). Schultz (1989) suggested that at least 11 populations were stressed from competition due to excessive canopy closure. Currently, nearly all of the principle populations are considered to be suppressed with respect to reproductive output. Therefore, rather than overgrazing constituting a threat, it is the lack of appropriate levels of grazing, or other adequate disturbance regime, that poses the greatest threat for many sites in both California and Oregon.

Invasion by the non-native shrub *Ulex europaeus* (common gorse) into habitat for *Lilium occidentale* was identified as a threat in the past near Floras Lake State Park (Ballantyne 1980). Invasive species such *U. europeus, Cytisus scoparius* (scotch broom), *Rubus procerus* (himalayaberry) and others continue to threaten several sites across the range, including Hauser, Morrison, and Hultin sites under the BPA powerline, and Boak Lane and Harris State Park sites (Imper, unpubl. data 2008). In addition, *Phalaris arundinacea* (reed canarygrass), while not a current threat, is poised to invade wetlands across the range, the most worrisome being Crescent City Marsh.

Small Population Size

Since many populations of *Lilium occidentale* continue to be very small (e.g., less than 50 flowering plants; Table 1), loss of genetic diversity due to inbreeding and/or random genetic drift may continue be a serious problem in some populations. In the past, populations of *L. occidentale* were certainly highly clumped and may often have contained fewer than a few hundred adults. However, a larger effective population size most likely prevailed as a result of moderate gene flow among populations (presumably due to seed transport internally by deer, and possibly pollen transported by hummingbirds), which were undoubtedly more abundant and less isolated from each other than at present. Populations below an effective size of about 5,000 plants will generally maintain insufficient adaptive genetic variability for long-term adaptation to a changing environment, and those below 500 will experience accumulation of mildly deleterious mutations due to random genetic drift and inbreeding depression (Service 1998). Although this factor continues to be a threat due to the small population sizes, plants with genetic abnormalities observed during monitoring and other field work have not obviously increased since the species was listed (Imper, unpubl. data 2008). Implementation of the recently completed genetics management plan (Guerrant 2008) should help mitigate this threat.

Climate Change

Global climate change likely constitutes a significant new threat for the species. Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field *et al*. 1999, Cayan *et al*. 2005, IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. We do know that *Lilium occidentale* is particularly vulnerable to desiccation in the seedling and juvenile stages (see discussion under Species Biology and Life History). The species is restricted to habitats that provide adequate soil moisture, but are not inundated throughout the growing season. As a result, any change in the timing and amount of precipitation, or soil and air temperatures, could potentially render habitat unsuitable. In

addition, the reproductive phenology of *L. occidentale* is closely linked to temperature. While we lack adequate information to make accurate predictions regarding the effects of climate change on *L. occidentale*, we can say that the rarity of *L. occidentale*, combined with its relatively unique habitat and its demonstrated sensitivity to soil moisture conditions and temperature, suggest that it may be among the species affected by climate change. Another potential result of climate change is increased sea level, which potentially could impact the largest population of *L. occidentale* located at the Crescent City Marsh Wildlife Area (see Factor A).

Brief site histories are included below for selected populations threatened by natural or man-made factors:

Hauser Bog, Coos County, Oregon (Recovery Zone 1):
This small fen was relatively open in 1989 (Schultz 1989). Rittenhouse (1994) recorded 43 flowering plants, most of which were concentrated in a small area on the east edge of the fen. His inventory was not comprehensive, did not account for browsed individuals, and did not estimate the total population. By 2002, various shrubs and trees, particularly *Spiraea douglasii*, were expanding in the fen, and the number of flowering *Lilium occidentale* was declining dramatically. The Oregon Department of Transportation manually cleared the majority of the fen in October 2002, cutting shrubs to less than 3 feet high, and taking out many trees. A thorough census in 2003 recorded 238 seedling-size plants, 308 mature plants, and 63 flowering plants (including browsed, reproductive-stage plants). In 2008, the population size was considered at least as large as in 2003. The amount of occupied habitat expanded substantially since 2002, with a large number of *L. occidentale* observed flowering out in the open portion of the fen. *Spiraea douglasii* shrubs are currently 5-6 feet tall, suggesting the maintenance cycle for this site, if manual vegetation control is the method employed, will need to be on the order of 7 to 10 years in order to maintain a healthy flowering population of *L. occidentale*. The habitat supporting 90 percent of this population is privately owned; the Oregon Department of Transportation owns the remaining 10 percent. There is abundant, presumed suitable habitat located on private property nearby. Subject to a cooperative landowner, this population has great potential for expansion.

Bastendorff Bog/Sunset Bay State Park, Coos County, Oregon (Recovery Zone 1):
In 1987, Schultz (1989) estimated the population at Bastendorff Bog to number at least 500, including 60 reproductive plants, scattered over about 4 acres (Schultz 1989). Noting that fire was a historical factor in maintaining the open character of the bog, and observing the vegetation closing rapidly, Schultz recommended clearing the entire parcel. It is not known if Bastendorff Bog was affected by livestock grazing of the adjacent Simpson Estate (before it became Shore Acres State Park). In any case, the flowering population declined dramatically to 10 reproductive plants by 1994; the fen was subsequently cleared manually. By 1997, the number of reproductive plants rose to 42, but declined again to 11 by 2005. In 2005, approximately 2 acres were cleared, and the reproductive population has since risen to 48 (Guerrant 2008, Pickering 2008). Due to concern that the encroaching vegetation is modifying the hydrology of the site, continuous groundwater monitoring was implemented in 2007. Preliminary data (Imper, unpubl. data 2008) compared with data collected by Schultz (1989) and historical anecdotal evidence (Schultz 1989) suggest the water table may have declined dramatically.

Until recently, Sunset Bay State Park, located immediately south of Bastendorff Bog, contained several occurrences of *Lilium occidentale* and several *Darlingtonia* fens (Schultz 1989). All *Darlingtonia* and *L. occidentale* were completely overgrown by Sitka spruce and *Carex obnupta* (slough sedge) or other species (Imper, unpubl. data 2008). The State of Oregon recently added Bastendorff Bog to Sunset Bay State Park. The abundance of Blacklock soils on the north end of Sunset Bay State Park suggests that the Bastendorff Bog population has great potential for expansion onto Sunset Bay State Park, if a concerted effort at habitat restoration is implemented.

Floras Lake State Park, Curry County, Oregon (Recovery Zone 2):
Schultz documented *Lilium occidentale* at Floras Lake State Park, in an area that burned in the 1960's located southwest of the airport (Schultz 1989). A total of 26 plants including 12 reproductive plants were recorded in the same location in 1994, and 80 total plants and 21 reproductive plants were documented in 2002, including individuals scattered along various the trails and north of the runway in an area cleared for airport security (Imper, unpubl. data 2008). That clearing by the State Aeronautics Board was conducted as a security measure, and impacted a number of *L. occidentale*. Ironically, the clearing would have been highly beneficial had they not deposited a 2-3 foot deep layer of wood chip on the surface (Imper, unpubl. data 2008). A more carefully planned clearing of between 5-10 acres could greatly benefit this population, and potentially result in adequate habitat to support a recovery level population within the park. In general, the majority of the park is severely overgrown, such that most of the species diversity (including *L. occidentale*) is associated with the small openings, wetlands, and along the trails. Much of the park occurs on Blacklock soils.

Harris Beach State Park, Curry County, Oregon (Recovery Zone 4):
Two isolated concentrations of *Lilium occidentale* occur within the Harris Beach State Park. The highway site consists of a 0.7-acre fen, of which *L. occidentale* occupied less than half when formal monitoring began in 1994 (Imper, unpubl. data 2008). The total at that time was 39 plants and 20 reproductive plants. The population peaked in 1996 with 74 plants and 51 reproductive plants. The surrounding shrubs and trees encroached rapidly. By 2002 a thorough census found only 33 plants and 10 reproductive plants (Imper, unpubl. data 2008). The fen was manually cleared by the Youth Conservation Corps and Service staff in 2005 and 2006, and a perimeter fence was constructed around the habitat. The habitat was re-treated with goats to control encroaching vegetation in winter 2007-2008. In 2008, 75 plants and 39 reproductive plants were recorded (Imper, unpubl. data 2008). This site was impacted by repeated installation of buried utilities in the early 1990's, in violation of several laws.

The larger occurrence in the park was discovered in 1991 soon after the Coos-Curry Power Cooperative had mechanically treated their power line right-of-way, which passes through a portion of a large wetland. The population was estimated to include between 200 and 300 reproductive plants in 1994 (Imper, unpubl. data 2008). The habitat began to close rapidly by growth of woody shrubs and trees, and by 2004 the shrub layer exceeded 6-7 feet tall in portions of the marsh. A careful census in 2002 found 222 total plants with 96 reproductive plants (Imper, unpubl. data 2008). In 2004, a close inspection of the plant locations mapped in 2002 indicated many of the flowering plants had died (Imper, unpubl. data 2008). Subsequent visits indicated nearly all reproductive plants were gone from the power line corridor portion of the site

(Imper, unpubl. data 2008). In 2005 the Youth Conservation Corps and Service staff cleared a portion of the wetland, and in winter 2007-2008, manual cutting and approximately 260 goats helped clear approximately 3 acres. Another 3 acres remain to be cleared. In 2008, the number of plants and reproductive plants nearly doubled in the cleared habitat (Imper, unpubl. data 2008). Due to the rapidity of vegetation encroachment at this site, grazing or other suitable disturbance will be required on perhaps a 5-10 year basis. A boundary fence is scheduled to be installed in winter 2008-2009, to assist in future vegetation management. Due to a high fluctuating water table at this site, water table monitoring was initiated in 2006.

Point St. George, Del Norte County, California (Recovery Zone 5):
Point St. George was a cattle ranch until the late 1990's, when ownership passed to Del Norte County. When *Lilium occidentale* was listed, the population on the Point was estimated at about 400 reproductive plants, mainly concentrated in three areas of wet coastal prairie and wetland. The vegetation began to close in soon after cattle were removed, and by 1999, no plants could be found in one of the colonies that had contained 30 reproductive plants in 1991 (Imper, unpubl. data 2008). The habitat was mowed in 2003, and treated with goats in 2004. In 2008, for the first time in a decade, six reproductive *L. occidentale* were observed (Imper, unpubl. data 2008). A second colony declined nearly as fast, and was treated manually and with goats in 2004. That site is recovering slowly (Imper, unpubl. data 2008). A management plan was developed for Point St. George in 2003, which called for reintroduction of controlled grazing to conserve *L. occidentale* and a host of other rare species. However, due to Native American concern for potential damage to cultural sites, the grazing plan has been withdrawn; plans are being made for an experimental burn, and eventually broader application of fire as a vegetation management tool (Imper, unpubl. data 2008).

Summary of conservation actions taken since listing

The strategy for recovery of *Lilium occidentale* must necessarily include reintroduction of reliable, appropriate disturbance regimes at each site across the range, for which there are three options. Fire was an important factor historically, and efforts are being made to reintroduce fire to some sites. Manual vegetation control is labor intensive and expensive, but has been used widely to maintain habitat. Reintroduction of controlled grazing, either cattle or goats, has been used at many sites, and has the potential to be an economical and efficient method.

Manual Control Conservation Actions: The principle population habitats that have been manually controlled since *Lilium occidentale* was listed, from north to south, include: Hauser Bog (2005); Bastendorff Bog (1998, 2005); Shore Acres SP (1995, 2005); Fourmile Road site (annually); both Harris Beach State Park sites (2006, 2007); Point St. George (2 of 3 colonies either mowed or manually cleared, 2003, 2006); Crescent City Marsh (small areas, 1997, 2004-2008); Table Bluff Ecological Reserve (5 treatments since 1987); McMurray and Christensen sites (5 treatments since 1985); and Hiser site (2004). The Morrison Road and Hultin sites are routinely maintained by manual vegetation control by BPA, as part of their right-of-way maintenance. A portion of the Sexton site and the majority of the Borax site have in the past been mechanically maintained by Coos-Curry Power Cooperative. The Boak Lane site is routinely maintained by Coos County Public Works department. A small portion of the *L. occidentale* habitat at Floras Lake State Park, within the airport security zone, was mechanically treated in 2002.

Controlled Fire Conservation Actions: While initial plans were made to implement an experimental burn at the Table Bluff Ecological Reserve in 1994, the various involved agencies did not believe it was feasible during the part of the year when it would not pose a hazard to surrounding developments. A recent attempt to use fire to restore *Darlingtonia* fen habitat (a historical *Lilium occidentale* site) near New Lake, Curry County, failed. The only successful application of fire since 1994 was as an experimental treatment for several small test plots at Shore Acres and Floras Lake State Parks in 2006, as part of an experimental habitat restoration study by The Nature Conservancy (Pickering 2008).

Controlled Seasonal Grazing Conservation Actions: The principle populations that have been treated with controlled grazing, utilizing either cattle or goats, since *Lilium occidentale* was listed include: both Harris Beach State Park sites (2007); Point St George (2 of 3 colonies, 2003); Crescent City Marsh (a portion, 1997, 2003, 2008): Table Bluff Ecological Reserve (annual since 1998); McMurray and Christensen (intermittent since 1995); and Hiser (intermittent 1990-2004).

III. RECOVERY CRITERIA

The recovery plan for *Lilium occidentale* was approved March 31, 1998. 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 and/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.

Reclassification to threatened status will be evaluated when:

<u>Criterion 1 (Addresses All Listing Factors):</u>
At least 20 populations spanning the known range of the species are protected and managed to ensure their long-term survival. The distribution of these populations shall be as follows: three in recovery zone 1, five in zone 2, and four each in zones 4, 5, and 6.

Some former sites for *Lilium occidentale* considered to be individual occurrences at the time of listing or in the recovery plan have been combined in this review for the purpose of defining principle populations for management, and for the purpose of assessing progress in meeting this recovery criterion (Table 1). The number of current populations that could potentially be managed as a unit, and that consist of more than a few scattered roadside individuals or individuals known to exist on inaccessible private property, is 23 (Table 1). The distribution of these populations among the recovery zones is as follows:

Recovery zone	Target number of populations	Current number of populations
1	3	3
2	5	8
3	0	0
4	4	3
5	4	5
6	4	4

The total number of remaining populations of *Lilium occidentale* meets the stated criterion, and their distribution among the recovery zones nearly meets the stated criterion. However, many of these populations are not likely to ever meet the minimum population size criterion stated in criterion 2, due to the small area of habitat available. That limitation, combined with the extirpation of several *L. occidentale* populations and an abundance of (presumed) occupied habitat since the species was listed, indicates that the opportunities for attaining this criterion in the future are declining.

With regard to protection and management specifically aimed at *Lilium occidentale*, only one population is located on public land, covered under an approved management plan that focuses on management for the species. Nine populations are located on public lands with some level of ongoing management, but with no approved management plan. For most of these populations, the management to date has been insufficient prevent a decline in the populations. Six populations are privately owned, where the landowner is cooperating as far as allowing some kind of management for the species. None of these populations have any assurances in place for future protection or appropriate management. Five populations are currently unprotected and unmanaged.

Successful establishment of at least 20 secure populations, as called for in this criterion, would ensure the long-term viability of the species even if one or more populations are lost to development, either lawful (Factor A) or unlawful (Factor D); or are periodically impacted by uncontrolled horticultural collection (Factor B) or deer depredation (Factor C), which reduce its reproductive vigor temporarily. The threat posed by prolonged absence of adequate disturbance necessary to counter vegetation encroachment (Factor E), and that leads to a temporary decline in reproductive output by the plant, would be offset by the availability of other sites that maintain a high level of reproduction. In general, the existence of at least 20 healthy sites across the range should help will ensure that at any one time, reproductive output is adequate to address the threat associated with small population size and maintain healthy genetic diversity within the species (Factor E).

Criterion 2 (Addresses All Listing Factors):
Each of the 20 protected populations shall contain at least 1,000 flowering individuals, on average, during any 3 consecutive years.

The intent of ensuring a minimum average of 1,000 flowering individuals in each population is similar to the intent for Criteria 1 above, except on a population level. A large population, spread over a large area, should help to ensure that threats posed by development (Factor A), overcollection (Factor B), deer or other depredation (Factor C), lack of regulatory protection (Factor D), and decline in habitat suitability (Factor E) will effect only a portion of the population at any one time. In addition, a large population will help avoid the problems with inbreeding depression and other genetic effects induced by small populations (Factor E).

Of the 23 populations cited in Criterion 1 and listed in Table 1 that comprise more than a few plants, the current estimate of reproductive individuals is distributed as follows. This criterion has not been met.

Reproductive plants	Number of populations
Less than 50	7
50-100	6
100-300	8
300-500	1 (Point St. George)
>1,000	1 (Crescent City Marsh)

Delisting Criteria:
No criteria for delisting were included in the recovery plan. The plan deferred designating delisting criteria until the existing sites were stabilized and protected as viable populations.

IV. SYNTHESIS

The overall distribution of *Lilium occidentale* has not declined, and 6 new sites were documented since the species was listed. At the same time, at least three sites were confirmed extirpated (Brookings Bog, Bowman, Sunset Bay State Park), and hundreds of acres or more of potentially suitable but unsurveyed habitat has been converted to cranberry production in Oregon. The largest population range-wide, which contained 80 percent or more of the flowering population for the species when it was listed, has declined by up to 50 percent, due to suspected changes in its hydrology. The second-largest population in California at the time of listing has declined an equivalent amount, due in part to severe deer depredation and, more importantly, suspected changes in soil moisture availability as a result of forest development. Two of the largest populations in Oregon are imminently threatened by either cranberry development (Hultin) or residential development and vegetation encroachment (Borax). The owners of two of the largest sites have denied access to the Service (Fourmile Road, McMurray), and their status is unknown. Habitat at the majority of remaining sites is declining due to rapid encroachment by woody shrubs and trees. Livestock grazing, which served to maintain the majority of sites over the past 150 years, has been removed from all sites except two, where it existed into the 1980's or later. Fire is not a practical means of vegetation control at many sites, due to surrounding residential

development or nearby airports, and has not yet been successfully implemented at any site other than for small experimental plots. The species has received virtually no regulatory protection, due to the absence of State protection on private lands in Oregon, and both the lack of enforcement and agency reinterpretation of the Federal Clean Water Act.

Much research, monitoring, and habitat restoration effort has been focused on the species; yet, the species remains endangered. The recovery plan calls for 20 populations of 1,000 flowering individuals in order to support downlisting. The array of historical and extant sites has been combined to form 23 potentially manageable recovery populations. However, due to the small amount of available habitat, at least 7 of those populations are unlikely to ever support recovery size populations that counteract the threat of small population size; with the exception of Crescent City Marsh, none of the principle populations currently exceed 35 percent of the recovery population size goal. However, the species and its habitat are easily and economically maintained through controlled grazing. The failure to reintroduce appropriate disturbance, such as grazing, is due to a variety of reasons. Many private landowners are unwilling to manage their sites, or allow the Service access. Livestock grazing is either not practical at some sites, or in the case of Oregon State Parks, has not been an accepted part of their management culture. In some cases there has been outright public opposition to the use of grazing as a management tool. Fire is either not feasible, or is problematic at many sites due to surrounding development. Finally, the resource agencies lack resources and staff to implement aggressive manual or fire management programs.

Based on the results of this 5-year review, we conclude that *Lilium occidentale* continues to meet the Endangered Species Act definition of endangered. Overall, the risk to *L. occidentale* appears to have increased since the species was listed. Therefore, no status change is recommended 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

Although *Lilium occidentale* has continued to decline since it was listed, it has a high potential for recovery. Regions 1 and 8 of the U.S. Fish and Wildlife Service have assigned priority status to recovery of this species. Consequently, a comprehensive list of recovery actions is included below. It is clear from the success of past conservation activities that *L. occidentale* can be

recovered, but it will take concerted effort on the part of several agencies, including the Oregon Parks and Recreation Department, California Department of Fish and Game, and U.S. Army Corps of Engineers, to recover this species. The following actions are recommended to be initiated within the next 5 years.

Highest Priority Actions:

1) **Hauser Bog –** The Service should coordinate with the Oregon Departments of Agriculture and Transportation in order to:

a) Implement negotiations with the two private landowners to allow construction of a fence along the east boundary of the habitat, and enable future vegetation management on their property in conjunction with the Department of Transportation's management of their Sensitive Management Area. If possible, secure a conservation easement or other legal agreement for protection and management;
b) Expand the recently completed mitigation area (Riley Ranch project) located south of the fen to include additional removal of tree overstory canopy around the wetland area and connecting it to the existing *Lilium occidentale* population.

2) **Oregon State Parks –** The Service should coordinate with the Oregon Department of Parks and Recreation to implement the following habitat restoration projects:

a) Sunset Bay State Park: Continue manual clearing of the majority of the Bastendorff Bog parcel, and reconnect that population with former *L. occidentale/Darlingtonia* and/or former open Blacklock scrub habitat to the south and west of Bastendorff, near the sewer ponds and toward the park management office;
b) Shore Acres State Park: Pursue restoration of a somewhat enlarged habitat area that includes, and connects the three existing colonies of *L. occidentale* south of the Simpson Gardens;
c) Floras Lake State Park: Pursue restoration of large areas of habitat where suitable soils are known to occur, and which historically or currently supports *Lilium occidentale*, focused on two principle areas: the north end of the airport runway extending 300 feet or more north, east and west, and a second area starting at the main *L. occidentale* colony southwest of the hangers, and extending 500 feet or more north and west;
d) Harris Beach State Park: Complete the fence around the full extent of the powerline site, and pursue restoration of the remainder of *Lilium occidentale* habitat there.

3) **Point St George –** The Service should coordinate with Del Norte County, and the Elk Valley and Smith River Rancherias to conduct an experimental burn in *Lilium occidentale* habitat, and then implement broad scale burn treatment of all suitable habitat on the Point.

4) **Table Bluff Ecological Reserve –** Continue research on the relationship between tree size and soil moisture, and *Lilium occidentale* mortality; subject to those results, implement broad scale removal of spruce within the occupied habitat as appropriate.

5) Crescent City Marsh:

a) The Service, California Department of Transportation, California Coastal Commission, and the affected private landowner should move as quickly as possible to improve the drainage from Crescent City Marsh in order to prevent further decline in the largest population of *Lilium occidentale* range wide;
b) CDFG should reintroduce livestock grazing as soon as possible into the Crescent City Marsh Wildlife Area.

6) Regulatory Enforcement – The Service should assist the USACE and the Oregon Division of State Lands to improve their enforcement of the Clean Water Act and the Oregon Fill and Removal Act, in order to stem the ongoing high losses of wetlands and potential *Lilium occidentale* habitat in Coos and Curry Counties.

Other Recommended Actions:

1) Hauser Bog – The Service should coordinate with the Oregon Departments of Agriculture and Transportation in order to:

a) Finalize a manual vegetation management plan for their portion of Hauser Bog, which ensures future treatment at a required interval (estimated 7-10 years);
b) Negotiate access from the owners of wetland habitat directly across Highway 101, west of the Hauser Bog (formerly a part of Hauser Bog prior to highway construction), and conduct research necessary to determine suitability of that habitat for *L. occidentale*;
c) Increase the propagated seedling bank at Shore Acres State Park nursery; after a minimum 3 years in the nursery, outplant a portion of the propagated plants to the mitigation area, and (subject to access by adjacent landowners) outplant to suitable locations west of Highway 101.

2) Oregon State Parks – The Service should coordinate with the Oregon Department of Parks and Recreation in order to:

a) Define management boundaries for *Lilium occidentale*, based on habitat requirements and practical limitations, that are adequate to attain one or more recovery level populations at each of the five parks in which it occurs. Where feasible, these management areas should represent an expansion of the currently occupied habitat, and creation of suitable corridors of suitable habitat connecting the existing colonies of *L. occidentale*;
b) Determine the management strategy most appropriate to each park (manual or mechanical control, controlled burns, grazing), and the estimated treatment interval necessary to maintain the population at the minimum recovery level size; review the feasibility for modifying trailside maintenance methods to maximize suitable habitat for the plant (e.g., extended brush-cutting arm);
c) Determine the necessary endowment funds or other funding mechanism needed to fund the periodic maintenance requirements in the future, and identify potential funding sources;

d) Assist OPRD in developing specific *Lilium occidentale* conservation strategies for inclusion in each of the park management plans, which incorporate the above information;
e) Cape Blanco State Park: Pursue restoration of formerly suitable habitat north and west of the existing population, and begin restoration of suitable habitat corridors connecting all of the high quality Blacklock scrub areas located generally west of the occupied habitat; in addition, at least a portion of the habitat within and surrounding the *Darlingtoni*a fen at the south end of the park should support *L. occidentale*; that fen should be opened up and expanded through manual means, and if *L. occidentale* is not already present, the species introduced by seed and/or controlled propagation.

3) New River ACEC – The Bureau of Land Management should determine the extent of suitable habitat for *Lilium occidentale* within the ACEC and implement habitat restoration to include the nearby *Darlingtonia* fen.

4) Crescent City Marsh – CDFG should begin manual vegetation treatment within the Crescent City Marsh Wildlife Area, in a broad elevational zone surrounding the south portion of the marsh in order to restore suitable habitat at elevations above current summer high water levels.

5) General Landowner Agreements and Easements – The Service and both States should give increased focus to negotiating landowner agreements, and/or purchase of easements or fee title, in order to implement monitoring, protection and habitat restoration on all privately held populations, including in Oregon: properties under the BPA right-of-way, Webb/Sexton site, Boak Lane, Borax site, Fourmile Lane site, and in California: Hambro Industries, McMurray, Hiser and Christensen sites.

6) Coos County and Curry County Roads Departments – The Service should coordinate with these counties to facilitate roadside management along roads within suitable habitat for *Lilium occidentale*, which is conducive to the maintenance and spread of the species.

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

***Lilium occidentale* (Western Lily)**

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

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

Review Conducted By: David Imper

FIELD OFFICE APPROVAL:

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

Approve Michael M. Long Date 4/29/09

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, U.S. Fish and Wildlife Service, Region 8

Approve [signature] Date 5/4/09

Cooperating Regional Director, Fish and Wildlife Service

__X__ Concur _____ Do Not Concur

Signature [signature] Date 4/23/09