DRAFT

In Reply Refer To:
FWS/AES/BCH/

Mr. Michael C. Gregoire
Deputy Administrator
Biotechnology Regulatory Services
Animal and Plant Health Inspection Service
4700 River Road
Riverdale MD 20737

Dear Mr. Gregoire:

The Animal and Plant Health Inspection Service (APHIS) has requested formal consultation on the deregulation of glyphosate-tolerant creeping bentgrass (*Agrostis stolonifera*). Deregulation would allow this transgenic organism to be distributed nationwide. The present document is a biological opinion on the likely effects of that deregulation. We have relied on the Service's Regional Offices for information and analysis to support this opinion. We greatly appreciate the cooperative efforts of APHIS staff, particularly Susan Koehler and Michael Blanchette, in carrying out this wide-ranging and complex consultation.

Consultation History

The Service first met with APHIS staff in 2004 to discuss an appropriate scope and strategy for APHIS to address its responsibility for compliance with section 7 of the Endangered Species Act in considering a petition by the Monsanto Company and the Scotts Company to deregulate a glyphosate-tolerant creeping bentgrass referred to as ASR368. Additional discussions ensued between the two agencies over several years, and on November 16, 2007, APHIS transmitted a request for formal consultation to the Service. That request was accompanied by a Biological Evaluation (BE) and related background information bearing on the petitioned deregulation. Additional discussions have taken place since the request, and on August 26, 2008, APHIS supplemented its BE with an addendum responding to then-recent designations of critical habitat for two listed plant species. On February 25, 2009, the Service transmitted a draft biological opinion to APHIS and its applicants, and additional discussions and meetings took place subsequently, including a visit by Scotts personnel to affected areas in the Willamette Valley in April, 2009.

Description of the Proposed Action

The proposed action evaluated in this consultation is the deregulation in whole of glyphosate-tolerant creeping bentgrass. This deregulation would allow seed and plants of the deregulated organism to be sold and grown throughout the United States. The BE anticipated effects to 69 listed species and adverse effects to 11 listed species. These species are named in the request for

consultation.

Species Addressed and Summary Conclusions

The information and analysis supporting the conclusions presented below are contained in two enclosures, one originally prepared by the Service's Sacramento, California, Fish and Wildlife Office and the other by our Portland, Oregon, Fish and Wildlife Office. In all, we find that two species are likely to be jeopardized and the critical habitats of two species are likely to be adversely modified by the proposed action. For an additional 24 species, we find that the proposed action is likely to have adverse effects, but not to cause jeopardy.

The Service finds that the proposed action is likely to jeopardize the continued existence of the following endangered species, for both of which APHIS found likely adverse effect, but not jeopardy.

Willamette daisy (*Erigeron decumbens var. decumbens*)
Bradshaw's lomatium (*Lomatium bradshawi*)

The Service finds that the proposed action is likely to adversely modify designated critical habitat of the following endangered species. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

Fender's blue butterfly (*Icaricia icarioides fenderi*)
Willamette daisy (*Erigeron decumbens var. decumbens*)

The Service concludes that the following species are likely to be adversely affected, but not jeopardized, by the proposed action. Those marked with an asterisk are among those also found by APHIS to be likely to be adversely affected. Double asterisks indicate a species that APHIS found likely to be affected, but not likely to be adversely affected.

Endangered
Contra Costa goldfields (*Lasthenia conjugens*)
Greene's Tuctoria (*Tuctoria greenei*)
Burke's goldfields (*Lasthenia burkei*)
Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*)
Hairy orcutt grass (*Orcuttia pilosa*)
Sebastapol meadowfoam (*Limnanthes vinculans*)
Pitkin Marsh lily (*Lilium pardalinum* ssp. *pitkinense*)
Presidio clarkia (*Clarkia franciscana*)
Baker's stickyseed (*Blennosperma bakeri*)
San Francisco lessingia (*Lessingia germanorum*)*
Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*)*
White sedge (*Carex albida*)
Soft bird's beak (*Cordylanthus mollis* ssp. *mollis*)*

Sacramento orcutt grass (*Orcuttia viscida*)
Nelson's checkermallow (*Sidalcea nelsoniana*)*
Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*)*
Fender's blue butterfly (*Icaricia icarioides fenderi*)*

Threatened
Golden paintbrush (*Castilleja levisecta*)
Slender Orcutt grass (*Orcuttia tenuis*)
San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*)
Hoover's spurge (*Chamaesyce hooveri*)
Fleshy owl's-clover (*Castilleja campestris* ssp. *succulenta*)
Colusa grass (*Neostapfia colusana*)
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
California red-legged frog (*Rana aurora draytonii*)**

The Service concurs, based on the information presented in the BE, that the proposed action is not likely to adversely affect the remaining 58 species named in the request for consultation or to adversely modify critical habitat of any listed species other than the two indicated above.

REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR 402.02) implementing section 7 of the Act define reasonable and prudent alternatives (RPAs) as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the proposed Federal action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, the Service believes, avoid the likelihood of the Federal action jeopardizing the continued existence of listed species or destroying or adversely modifying critical habitat.

No alternatives are available that allow the intended purpose of the proposed action to be met and that also avoid jeopardy or adverse modification of critical habitat. A summary of potential RPAs that were considered but rejected is discussed below.

Partial Deregulation: Excluding Sale to Non-Commercial (Non-Golf Course) Agents

The Scotts Company indicated during an April 2009, meeting that the original intention of their marketing was to sell glyphosate tolerant creeping bentgrass to golf courses with a turf manager on staff who was educated in the use and maintenance of the new product. Scotts further asserted that creeping bentgrass grown on golf courses would never be allowed to flower, therefore, eliminating the risk of pollen contamination to naturalized bentgrass populations.

Reasons for Rejection

1. Although theoretically plants would never be allowed to flower, it is possible that some seed may end up in the rough where plants are routinely allowed to reach heights were flowering could occur. A single plant that flowers could result in the release of the glyphosate tolerant gene into the wild.
2. Anytime seed is moved, there is a risk of escape. Seed could be lost during initial seeding efforts and could establish on adjacent properties. The recent escape of glyphosate tolerant sugar beets in the Willamette Valley of Oregon (Hall 2009) and of herbicide resistant rapeseed in Japan (Saji *et al.* 2005, Aono *et al.* 2006) illustrate the difficulty in controlling movement of herbicide resistant species.
3. APHIS may not have the authority to enforce this type of requirement. Once the bentgrass were deregulated, APHIS would no longer be involved in the commercial exchange of the product. Additional management that would be required to monitor the distribution of glyphosate tolerant creeping bentgrass would be beyond the scope of APHIS' authority, therefore violating RPA criterion (2), above.

Partial Deregulation: Excluding Growth or Sale of Glyphosate Tolerant Creeping Bentgrass in Oregon and Washington

Oregon and Washington, specifically the Willamette Valley and Puget Trough, are areas of primary concern for the potential release of glyphosate tolerant creeping bentgrass. Bentgrass species are known weeds in these areas and are often controlled with glyphosate formulations. Ideally, if glyphosate tolerant creeping bentgrass were never able to reach the Willamette Valley and Puget Trough, the concerns for the listed species in these areas would be alleviated.

Reasons for Rejection

1. There is no mechanism in place to control the movement of glyphosate tolerant creeping bentgrass across state lines.
2. Sale and commercial production of glyphosate tolerant creeping bentgrass are the main methods of introduction; however, seed from this species is light and easily dispersed. Movement from adjacent states could occur through equipment sharing, movement of vehicles, or even movement of seed or stolons on human beings, especially on shoes or golf bags. The recent escape of glyphosate tolerant sugar beets in the Willamette Valley of Oregon (Hall 2009) and of herbicide resistant rapeseed in Japan (Saji *et al.* 2005, Aono et al. 2006) illustrate the difficulty in controlling movement of herbicide resistant species.
3. Excluding this product from Oregon and Washington would slow the rate of glyphosate tolerant gene incorporation into naturalized populations; however, there is no evidence that it would stop it. Therefore, the timeline anticipated for Jeopardy and adverse modification would be changed, but the end result would remain the same.
4. APHIS' biological evaluation does not explain its ability to implement partial deregulation so it is unclear if this alternative meets RPA criterion (2), above.

Sterile Glyphosate Tolerant Creeping Bentgrass Production

The greatest concern raised by deregulation of glyphosate tolerant creeping bentgrass is due to the potential for seed or pollen to move into natural areas with suitable bentgrass habitat. Most of the Willamette Valley and Puget Trough areas support bentgrass. Therefore, the concern over establishment of seed or hybridization between glyphosate tolerant pollen and naturalized bentgrass populations is substantial. A sterile glyphosate tolerant creeping bentgrass that reproduced solely through asexual means (stolons) would alleviate these two, large issues.

Reasons for Rejection

1. Sterile invasive species can still be substantial threats. Examples of asexual invasive species include: male-sterile Japanese knotweed (*Fallopia japonica* var. *japonica*) (Bailey *et al.* 2007), giant salvinia (*Salvinia molesta*) (Jacono 1999), and giant cane (*Arundo donax*) .
2. The purpose of the action is to deregulate a seed-producing crop. A sterile species would not be able to produce the crop that was intended; therefore this potential alternative would not achieve the goal of the action, and, therefore, would violate RPA criterion (1), above.
3. This alternative is likely outside the authority of APHIS to implement, and, therefore, may violate RPA criterion (2), above.

INCIDENTAL TAKE STATEMENT

This biological opinion finds the proposed action is likely to jeopardize listed species and to destroy or adversely modify critical habitat, and no reasonable and prudent alternatives can be identified. Therefore, no incidental take exemption can be provided. Any incidental taking of listed animal species is prohibited by section 9 of the Act.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends that APHIS support research into the environmental effects and means for control of transgenic herbicide-resistant cultivated plants.

REINITIATION NOTICE

Not applicable since this biological opinion finds the proposed action is likely to jeopardize listed species and destroy or adversely modify critical habitat, and no reasonable and prudent alternatives can be identified.

Please contact Dr. John J. Fay of the Division of Consultation, Habitat Conservation

Planning, Recovery and State Grants at 703/358-2106 to discuss any continuing activity related to this consultation.

Sincerely,

Gary Frazer
Assistant Director for Endangered Species

Enclosures

cc: 420-ARLSQ-FWS/TE RF
420-ARLSQ-FWS/AES/BCH (Jfay)
Regional Directors, Regions 1-8

DRAFT

BIOLOGICAL OPINION

STATUS OF THE SPECIES / ENVIRONMENTAL BASELINE

The Environmental Baseline is an analysis of the effects of past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impacts of State or private actions which are contemporaneous with the consultation in process. Because the action area for this proposal is national in scale, and includes the entire jurisdiction of the Sacramento Fish and Wildlife Office (SFWO), the information presented below for each species regarding distribution, the reasons for decline and threats to survival, and critical habitat essentially constitutes both the Status of the Species and Environmental Baseline.

CALIFORNIA RED-LEGGED FROG (*Rana aurora draytonii*)

Species Description and Life History: The California red-legged frog (CRLF) was listed as threatened on May 23, 1996 (U.S. Fish and Wildlife Service, 1996). The final Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*) was published on September 12, 2002 (U.S. Fish and Wildlife Service, 2002a). The CRLF is the largest native frog in the western United States, ranging from 4 to 13 centimeters long. (1.5 to 5 inches). The abdomen and hind legs of adults are largely red. The back has small black flecks and larger irregular dark blotches. These have indistinct outlines on a brown, gray, olive, or reddish background color. The spots on the frogs' backs usually have light centers. Lateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3 inches in length, and the background color of the body is dark brown and yellow with darker spots. California red-legged frogs breed from November through March with earlier breeding records occurring in southern localities.

The diet of the CRLF is highly variable. Larvae probably eat algae. Invertebrates are the most common food items of adult frogs. Vertebrates, such as Pacific tree frogs and California mice, are frequently eaten by larger frogs. Juvenile frogs are active both during the day and at night, whereas adult frogs are largely nocturnal. Feeding activity likely occurs along the shoreline and on the surface of the water.

The CRLF occupies a fairly distinct habitat, combining both specific aquatic and riparian components. Adults need dense, shrubby or emergent riparian vegetation closely associated with deep (greater than 2 1/3-foot deep) still or slow moving water. The largest densities of California red-legged frogs are associated with deep-water pools with dense stands of overhanging willows and an intermixed fringe of cattails. Well-vegetated terrestrial areas within the riparian corridor may provide important sheltering habitat during winter. California red-legged frogs aestivate (enter a dormant state during summer or dry weather) in small mammal burrows and moist leaf litter. They have been found up to 100 feet from water in adjacent dense riparian vegetation.

Historic and Current Distribution: The historic range of the CRLF extended along the coast from the vicinity of Point Reyes National Seashore, Marin County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California,

Mexico. California red-legged frogs have been documented in 46 counties in California, but now remain in only 238 streams or drainages in 31 counties.

California red-legged frogs are still locally abundant within portions of the San Francisco Bay area (including Marin County) and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico.

Reasons for Decline and Threats to Survival: California red-legged frogs are currently threatened by human activities: degradation and loss of its habitat through urbanization, mining, improper management of grazing, recreation, invasion of nonnative plants, impoundments, water diversions, degraded water quality and introduced predators. These factors have resulted in the isolation and fragmentation of habitats within many watersheds. This often prevents dispersal between sub-populations. The fragmentation of existing habitat, and the continued colonization of existing habitat by nonnative species, may represent the most significant current threats to the CRLF.

Critical Habitat: Critical Habitat was designated for the California red-legged frog on April 13, 2006 (Federal Register 71:19243; http://ecos.fws.gov/docs/federal_register/fr5071.pdf) and is proposed to be increased. The rule currently identifies approximately 450,288 acres within 34 critical habitat units in Alameda, Butte, Contra Costa, El Dorado, Kern, Los Angeles, Marin, Merced, Monterey, Napa, Nevada, San Benito, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Ventura and Yuba counties, California.

When designating critical habitat, the Service is required to list the known primary constituent elements essential to the conservation of the species, and that may require special management considerations and protection (50 CFR § 424.14). Such physical and biological features include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species (Service 2006).

The primary constituent elements (PCEs) for the red-legged frog are based on the current knowledge of the life history, biology, and ecology of the species and the requirements of the habitat necessary to sustain the essential life history functions of the subspecies. The four identified primary constituent elements are defined as: (1) aquatic breeding habitat; (2) non-breeding aquatic habitat; (3) upland habitat; and (4) dispersal habitat.

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)

Species Description and Life History: The valley elderberry longhorn beetle (VELB) was listed as a threatened species with critical habitat under the Act on August 8, 1980 (USFWS 1980). Critical habitat been designated in two locations along the American River in the Sacramento metropolitan area. The VELB is dependent on the elderberry (Sambucus spp.), its host plant, which is a locally common component of the remaining riparian forests and savanna areas and,

to a lesser extent, the mixed chaparral-foothill woodlands of the Central Valley. Use of the elderberry shrubs by the VELB, a wood borer, is rarely apparent. Historical distribution of the species is not known, but specimens were collected in the following Sacramento Valley watersheds: Sacramento River, Putah Creek, and American River; and in the following San Joaquin Valley watersheds: Calaveras River, and Merced River.

Historic and Current Distribution: As of November 2008, the California Natural Diversity Database contained 196 occurrences for this species in 44 drainages throughout the Central Valley, from a location along the Sacramento River in Shasta County, southward to an area along Caliente Creek in Kern County. Populations occur from the Central Valley floor, up to 3000 feet elevation in the Sierra Nevada Foothills (CNDDB 2008). While it is not known exactly how many of these occurrences are located within the action area, several golf courses are known to contain elderberry shrubs that are occupied by this beetle.

Reasons for decline and Threats to Survival: The species continues to be threatened by habitat loss and fragmentation, predation by the non-native Argentine ants (*Linepithema humile*) (Huxel 2000), and possibly other factors such as pesticide drift, non-native plant invasion, improper burning regimes, off-road vehicle use, rip-rap bank protection projects, wood cutting, and over-grazing by livestock (CNDDB 2008).

Threatened and Endangered Plants

BAKER'S STICKYSEED (*Blennosperma bakeri*)

Species Description and Life History: Baker's stickyseed was listed as endangered on December 2, 1991 (Federal Register 56:61173 (http://ecos.fws.gov/docs/frdocs/1991/91-28813.pdf). Critical habitat has not been designated. Baker's stickyseed, which is also known as Sonoma sunshine, is a small (up to 12 inches in height), annual herb in the aster family (Asteraceae). The plant has alternate, narrow, hairless leaves, 2 to 6 inches long. The upper ones have 1 to 3 lobes, the lower ones none.

From March through April, the species produces yellow daisy-like flowers. The yellow disk flowers have white pollen and stigmas. Sterile ray flowers, which are yellow or sometimes white, have red stigmas. The lobe pattern of the leaves and the color of ray stigmas separate this species from other in the genus. See Hickman (1993) in General Information about California Plants, below, for a detailed description.

Historic and Current Distribution: *Blennosperma bakeri* is found in grasslands and vernal pools. The species is restricted to the Laguna de Santa Rosa and Sonoma areas in Sonoma County. According to the CNDDB, there are currently 22 populations believed to be extant. Several other populations have been extirpated.

Reasons for Decline and Threats to Survival: Approximately 30 percent of the historic occurrences have been eliminated or seriously damaged. Most of the remaining sites are threatened by urbanization, wastewater effluent irrigation, and agricultural land conversion. Westward expansion of the City of Santa Rosa threatens at least half the remaining habitat.

BURKE'S GOLDFIELDS (*Lasthenia burkei*)

Species Description and Life History: Burke's goldfields was listed as endangered on December 2, 1991 (U.S. Fish and Wildlife Service, 1991). Critical habitat has not been designated. Burke's goldfields is a small, slender annual herb in the sunflower family (Asteraceae). It has narrow, opposite leaves. The plant can be easily confused with other goldfields such as Contra Costa goldfields (*L. conjugens*) by people not trained in botany. Flowers bloom from April until June. Both the ray and disk flowers are yellow, while the pappus (seed appendage that aids dispersal by acting like a little parachute) usually consists of one long bristle and several short bristles.

Historic and Current Distribution: This vernal pool species is known only from southern portions of Lake and Mendocino counties and from northeastern Sonoma County. Historically, 39 populations were known from the Cotati valley, 2 sites in Lake County, and one site in Mendocino County. The occurrence in Mendocino County is most likely extirpated. From north to south in the Cotati Valley, the species ranges from north of the community of Windsor to east of the city of Sebastopol.

Reasons for Decline and Threats to Survival: Primary threats to the species consist of activities that result in the destruction of the plants or hydrologic changes in their vernal pool habitats. Such activities include urbanization, industrial development, agricultural land conversion, off-highway vehicle use, horseback riding, trampling by grazing cattle, and road widening. Damage or destruction of vernal pool habitat happens quickly and easily due to the extremely friable nature of the soil and the dependency of the pool upon an intact durapan (impermeable subsurface soil layer).

BUTTE COUNTY MEADOWFOAM (*Limnanthes floccosa* ssp. *californica*)

Species Description and Life History: Butte County meadowfoam was listed as endangered on June 8, 1992 (U.S. Fish and Wildlife Service, 1992). The final rule to designate critical habitat for 15 vernal pool species, including Butte County meadowfoam, was published on August 6, 2003 (U.S. Fish and Wildlife Service, 2003b). The most recent final rule for critical habitat was published on February 10, 2006 (U.S. Fish and Wildlife Service, 2005b). Butte County meadowfoam is a small annual with erect stems less than 9.8 inches tall. The stem and leaves are densely pubescent. The alternate leaves are pinnately compound, up to 3.1 inches long, and consist of 5 to 11 leaflets on a long petiole. The individual leaflets are approximately 0.4 inch long and vary from narrow to egg-shaped; their margins may be smooth, toothed, or lobed. A single flower arises in the axil of each upper leaf. The fragrant flowers are cup- or bowl-shaped and consist of 5 petals, 5 sepals, 5 pistils, and 10 stamens on a long flower stalk. The petals are 0.31 to 0.39 inch long, white with yellow veins, and have two rows of hairs at the base. The sepals are about the same length as the petals and are densely pubescent on both their inner and outer surfaces. Although the sepals are not fused, the dense hairs hold them together, preventing the flower from opening fully. The pistils are separate at the base, but the upper parts are fused. Each pistil is capable of producing a nutlet; the nutlets are egg-shaped, 0.12 to 0.18 inch long, and covered with cone-shaped tubercles. As the nutlets mature, the petals turn inward, and at maturity the entire flower, including the nutlets, falls off the plant as a unit. The diploid chromosome number for all Limnanthes species is 10 (Mason 1952, Arroyo 1973, McNeill and

Brown 1979, Ornduff 1993).

Butte County meadowfoam seeds germinate in the late fall after the rainy season begins. Butte County meadowfoam typically begins flowering in February, reaches peak flowering in March, and may continue into April, if conditions are suitable. Nutlets are produced in March and April, and the plants die back by early May (Jokerst 1989, Dole and Sun 1992). Nutlets of Butte County meadowfoam are apparently dispersed by water and can remain afloat for up to 3 days (Hauptli et al. 1978). However, most meadowfoam nutlets are dispersed only short distances. Thus, Butte County meadowfoam nutlets would not be expected to disperse beyond their pool or swale of origin. Birds and livestock are potential sources of long-distance seed dispersal, but specific instances of such dispersal have not been documented (Jain 1978).

Historic and Current Distribution: Butte County meadowfoam is found primarily in vernal swales and to a lesser extent on the margins of vernal pools (Arroyo 1973, Dole 1988, Jokerst 1989, BioSystems Analysis, Inc. 1993). Butte County meadowfoam has always been confined to the Northeastern Sacramento Valley Vernal Pool Region. Butte County meadowfoam is believed to occur in five natural centers of concentration, totaling 21 naturally occurring populations (CNDDB 2006). The southernmost area of concentration is the Shippee Road area between Chico and Oroville. Three other centers of concentration are within the City of Chico at the Chico Municipal Airport, Bidwell Ranch, and the vicinity of the Humboldt Road and SR 32 intersection. In addition, a fifth location was found in 2005, on North Table Mountain east of the intersection of Highways 149 and 70. In addition to the 21 natural occurrences, an experimental population of Butte County meadowfoam has been introduced on the Tuscan Preserve in northwestern Butte County (Kelley et al. 1994). The introduction site was just outside of the known historical range of the taxon and thus marginally increased its range.

Several races of Butte County meadowfoam exist. Jokerst (1989) identified "north" and "south" races of Butte County meadowfoam in the Chico "sphere of influence" based on morphology. Later, in studies of enzyme systems, Dole and Sun (1992) confirmed that these races differed genetically. They also identified genetically distinct races that they called "northeast" and "southwest," with the latter referring to the type locality.

Butte County meadowfoam is a narrowly distributed annual plant in the meadowfoam or false mermaid family (Limnanthaceae). The range of the subspecies lies entirely within Butte County, California. Butte County meadowfoam is found primarily on the margins of vernal swales and to a lesser extent on the margins of vernal pools located on alluvial terraces in annual grasslands with mima mound topography. Mima mounds are soil mounds of unknown origin that are a few feet in height. The species is restricted to a narrow 28-mile strip along the eastern flank of the Sacramento Valley from northwestern to central Butte County (CNDDB 2007). The species was first collected in 1914 near the intersection of State Highway 99 and Shippee Road, south of the City of Chico. However, it was not differentiated from the more widespread *L. floccosa* ssp. *floccosa* (woolly meadowfoam) until 1973, when it was determined to be a distinct taxon and given the name *L. floccosa* ssp. *californica* (Arroyo 1973). The 2005 Recovery Plan reported 21 natural Butte County meadowfoam occurrences (20 extant and one extirpated prior to the listing) and one introduced occurrence (C. Sellers, Community Service Department, City of Chico, in litt. 2006, CNDDB 2007). Seven of those occurrences have been discovered since the time of listing in 1992 (North Table Mountain, Upper Rock Creek, and five localities on Dove Ridge

Conservation Bank), but the range of the species remains largely unchanged. The occurrences are found at 165 to 1,167 feet in elevation (McNeill and Brown 1979, CNDDB 2007). The experimental locality at Tuscan Preserve, also known as the Wurlitzer Ranch, in northern Butte County, was established from seed from the Doe Mill occurrence (C. Sellers, in litt. 2006).

Reasons for Decline and Threats to Survival

Habitat of Butte County meadowfoam has been lost or fragmented by urban development and road construction in Butte County. One occurrence is known to have been extirpated by construction of an apartment complex and a portion of another occurrence was lost from commercial development. Portions of nine of the 20 extant natural occurrences of Butte County meadowfoam are protected from development; the remaining 11 natural occurrences are located on privately owned land and are unprotected. All occurrences, even those that are protected from development, are vulnerable to habitat loss or degradation resulting from changes in the amount of surface and subsurface water hydrology, introduction of invasive plants, and in areas adjacent to agricultural or residential uses, introduction of pesticides and herbicides.

All occurrences in the area of Humboldt Road and SR 32 intersection are threatened variously by proposed residential, school, or road development projects. Occurrence number 7, for example, is threatened by three proposed subdivisions (Meriam Park (Service 2007), Stonegate (Service 1993), and Eastgate (Service 2002b)) and a high school (Canyon View High School (Service 2003)). The two occurrences in the Vina Plains core area are located on unprotected private land for which we have no information on possible development plans. Of the five occurrences in the Chico area, one has been considered extirpated since before the listing (east of Diesel Road), and two are threatened by potential indirect effects, such as changes in hydrology and introduction of invasive plants, from airport expansion (CNDDB 2008). Of the seven localities in the Oroville area, the occurrence on Shippee Road is located on unprotected private land. Five localities in the Oroville core area are found in the Dove Ridge Conservation Bank, which as noted earlier, may be subject to effects from vernal pool and swale expansion (Loafer Creek LLC undated); however, the beneficial or adverse effects of this expansion on the hydrology of Butte County meadowfoam habitat have not yet been analyzed.

In addition to the threats from development projects that have already been proposed, rapid population growth is predicted for all of Butte County and its urban areas. The City of Chico predicts the construction of approximately 20,000 new housing units and a 61 percent increase in population by 2030 (Butte County Association of Governments 2006). The population of Butte County is expected to increase by 48 percent by 2030 (Butte County Association of Governments 2006). The need for additional housing and associated development will likely threaten the remaining unprotected occurrences of Butte County meadowfoam which are mostly located in or near existing urban areas or roads.

Another potential threat is lack of pollinators. Although Butte County meadowfoam is capable of setting seed in the absence of insect pollinators, continuing adaptation to environmental changes is not possible without the genetic recombination that occurs during cross-pollination. Considering the widespread habitat destruction and degradation in the area where Butte County meadowfoam is endemic, breeding habitat for pollinators could well be declining. However, the identity of pollinators for this subspecies must be determined before their population and habitat

status can be evaluated.

COLUSA GRASS (*Neostapfia colusana*)

Species Description and Life History: Colusa grass was listed as threatened on March 26, 1997 (U.S. Fish and Wildlife Service, 1997). It is a robust, tufted annual in the grass family (Poaceae) that grows 3-12 inches tall. The lower portions of the stems lie on the ground; the upper portions are erect and terminate in dense cylindrical, spike-like inflorescences that superficially resemble small ears of corn. The inflorescence and overall appearance of the plant are unique, so this species is not easily confused with any other. Its closest relatives are the Orcutt grasses. Colusa grass is the only extant species in the genus Neostapfia. Colusa grass has the broadest ecological range among the Orcuttieae. It occurs on the rim of alkaline basins in the Sacramento and San Joaquin Valleys, as well as on acidic soils of alluvial fans and stream terraces along the eastern margin of the San Joaquin Valley and into the adjacent foothills (Stone et al. 1988). Colusa grass has been found in Northern Claypan and Northern Hardpan vernal pool types (Sawyer and Keeler-Wolf 1995). It also occurs in the beds of intermittent streams and in artificial ponds (Stone et al. 1988, EIP Associates 1999).

Historic and Current Distribution: Colusa grass is restricted to the Sacramento and San Joaquin Valleys. Converting habitat to agricultural use has eliminated the type locality in Colusa County and at least seven populations have been eliminated in Merced and Stanislaus Counties. The majority of extant occurrences are in the Southern Sierra Foothills Vernal Pool Region, where they are concentrated northeast of the City of Merced in Merced County and east of Hickman in Stanislaus County (Service 2005a). Approximately 44 populations remain along a 100-mile stretch of the eastern San Joaquin Valley in Merced and Stanislaus Counties; four populations exist in Yolo and Solano Counties.

Reasons for Decline and Threats to Survival: Most of the remaining populations continue to be variously threatened by agricultural land conversion, urbanization (particularly in Merced County), herbicide contaminated runoff, inappropriate livestock grazing, and competition from introduced weedy species that tend to displace Colusa grass. Two populations are currently protected at the Nature Conservancy's Jepson Prairie Preserve in Solano County and five occupied vernal pools are protected at the Flying M Ranch in Merced County (Service 2005b). Three additional occurrences of Colusa grass are located on Federal land, which offers more options for conservation. Two are located on McClellan Air Force Base in Yolo County and one is located on the Arena Plains Unit of the Merced National Wildlife Refuge in Merced County.

CONTRA COSTA GOLDFIELDS (*Lasthenia conjugens*)

Species Description and Life History: Contra Costa goldfields was listed as endangered on October 22, 1997. The final rule to designate critical habitat for 15 vernal pool species, including Contra Costa goldfields, was published on August 6, 2003. Costa goldfields typically grow in vernal pools, swales, moist flats and depressions within a grassland matrix (CNDDB 2007), and have been found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Volcanic Ashflow (Sawyer and Keeler-Wolf 1995). Landforms and geologic formations for sites where Contra Costa goldfields occur have not been identified. Elevations for this species range typically range from 2 to 61 meters (6 to 200 feet), but one

occurrence in Napa County was recorded at 455 meters (1,460 feet) the Monterey occurrences are at 122 meters (400 feet) (CNDDB 2007). Contra Costa goldfields is an annual flowering plant in the aster family (Asteraceae) that grows 10 to 30 centimeters tall (4 to 12 inches) and usually has a branched stem. The leaves are opposite, light green, and hairless. The lower leaves have smooth margins, but stem leaves have one or two pair of narrow lobes. The daisy-like flower heads are terminal, solitary, and all disk and ray flowers are golden-yellow (Greene 1888; Ornduff 1993). The phyllaries (bracts below the flower head in the aster family) are one-quarter to one-half fused; where all other species of Lasthenia have either free phyllaries or phyllaries fused more than two thirds of their length. The achenes (fruit) of Contra Costa goldfields are less than 1.5 millimeters (0.06 inch) long and always lack a pappus (the hair-like or scale-like structures attached to an achene, which often assist in dispersal) (Ornduff 1969, Ornduff 1993). Contra Costa goldfields flower from March to June (Ornduff 1966, Ornduff 1976) and are self-incompatible. Habitat for Contra Costa goldfields includes vernal pools, swales, moist flats, and depressions within a grassland matrix (CNDDB 2007).

The two most commonly reported associates are Italian ryegrass (*Lolium multiflorum*) and popcorn flower (*Plagiobothrys* spp.). Other plant species that occur at several Contra Costa goldfield sites include brass buttons (*Cotula coronipifolia*), valley downingia (*Downingia pulchella*), California eryngo (*Eryngium aristulatum*), smooth goldfields (*Lasthenia glaberrima*), common mousetail (*Myosurus minimus*), and California semaphore grass (*Pleuropogon californicus*) (CNDDB 2007). Other rare plants that co-occur with Contra Costa goldfields include alkali milk-vetch (*Astragalus tener* var. *tener*), few-flowered navarretia (*Navarretia leucocephala* ssp. *pauciflora*), and Greene's legenere (*Legenere limosa*) (CNDDB 2007).

Historical and Current Distribution: Contra Costa goldfields has been reported in ten counties, which include: Alameda, Contra Costa, Marin, Mendocino, Monterey, Napa, Santa Barbara, Santa Clara, Solano, and Sonoma. The CNDDB reports 32 occurrences of this species, including 7 that are extirpated, 4 potentially extirpated and one which has not been seen since 1937 and may be extirpated. Twenty occurrences are likely extant (CNDDB 2007). However, there is uncertainty due in part to the difficulty of relocating sites, based on vague site descriptions and also because this species may reappear on a site after several years, even if it is absent during a given survey. Additionally, CNDDB occurrences have in some cases either been deleted or lumped, making tracking of the number of occurrence difficult. Informal status surveys have occurred at the following sites: Travis AFB, the State Route 4 preserve, Don Edwards San Francisco Bay NWR, North Suisun Mitigation Bank, Fort Ord, and various localities in Solano County. Through a section 6 grant from the Service, the Solano County Water Agency has recently conducted a series of studies to investigate the genetics, seed bank, and populations of Contra Costa goldfields in Solano County, for development of the Solano Habitat Conservation Plan (LSA 2007). Surveys in Solano County are scheduled to continue for another two to three years to gather sufficient population and life history data (LSA, 2007). Monitoring has not been sufficient to quantify abundance and identify trends, especially because population numbers for this species vary widely from year to year (Service 2005; B. Pardieck, Muir Heritage Land Trust, pers. comm., 2007; CNDDB 2007). For the 20 presumed extant occurrences of this species catalogued in CNDDB, one occurrence has decreasing trends, one occurrence has a fluctuating trend, and the remaining occurrences are listed as unknown. One occurrence in Alameda County has not been seen since 1959 (CNDDB 2007).

Contra Costa goldfields is known from 20 extant occurrences; at the time of listing there were only 13 known occurrences. This species is currently found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Volcanic Ashflow (Sawyer and Keeler-Wolf 1995). Currently, the number of occurrences reported by CNDDB is 20 within 7 counties; however, the number of populations represented by these occurrences has not been determined (CNDDB 2007). At the time of listing, Contra Costa goldfields were known to occur in four counties: Napa, Contra Costa, Alameda, and Solano. Contra Costa goldfields are now also known to occur in Marin, Monterey, and Sonoma Counties.

The additional localities since listing include one in Sonoma County, one in Marin County, one in Solano County, and three in Monterey County. Of these new localities, the Monterey and Solano County occurrences are currently protected; they are located at Fort Ord and the North Suisun Mitigation bank. The other localities are also essential to the recovery goals for this species and should be permanently protected to ensure the recovery of this species. This species is believed to be extirpated from Santa Barbara, Santa Clara, and Mendocino Counties (Service 1997; Service 2005a; CNDDB 2007). These extirpations occurred primarily from habitat conversion to urbanization, vineyards, competition from invasive plant species, and agriculture (CNDDB 2007). The majority of the presumed extant localities are located in Solano County, where nine localities are presumed extant (CNDDB 2007). The next largest concentrations of populations are in Monterey County and Alameda County with three occurrences each (CNDDB 2007). The majority of occurrences of Contra Costa goldfields are not protected. The only protected occurrences of this species include three occurrences within the former Fort Ord, in Monterey County, one occurrence at Travis Air Force Base (AFB), in Solano County, one occurrence at North Suisun Mitigation Bank in Solano County, one occurrence at the State Route 4 Preserve, in Contra Costa County, and two occurrences at the Don Edwards San Francisco Bay National Wildlife Refuge (NWR). Threats such as urbanization, wetland drainage, industrial development, agricultural land conversion, ditch construction, off highway vehicle use, road widening, trampling by cattle, vineyards, competition from weedy invasive plants, inappropriate livestock grazing, elimination of grazing, and drainage channels threaten the extant occurrences of this species (Service 2005a; CNDDB 2007).

Reasons for Decline and Threats to Survival: The 1997 listing rule states that restricted habitats/ranges and small population size are a threat to Contra Costa goldfields. Current threats include those discussed in the 1997 final rule, as well as climate change/drought, competition from invasive plant species and improper or lack of grazing regimes.

Competition from invasive plant species poses a primary threat to this species. Non-native grasses occur commonly in vernal pool complexes and have become a threat to native vernal pool species through their capacity to change pool hydrology. Non-native grasses maintain dominance at pool edges, sequestering light and soil moisture. Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinata*) increase thatch buildup, which leads to increased oxygen depletion in the pools (Dunne and Leopold 1978) and contributes to the shortening of inundation periods through increased evapotranspiration (Marty 2005). As vernal pool complexes become surrounded by residential development and disturbed habitat, the likelihood of invasion by non-native plants increases (Zedler and Black 2004). Residential and municipal landscaping provides a constant seed-source of non-native plants. Urban runoff, combined with the urban seed-source, are likely to convert the vernal pools to patches of

nonnative weeds and grasses. Activities such as deep-ripping (breaking up the clay pan by thrusting metal prongs into the soil and dragging them with heavy machinery so water can drain from the area) and gravel mining disturb the habitat and allow non-native species to become more easily established (Service 2005a). Small reserves may be particularly susceptible to degradation by non-native species, particularly when the reserves are located in a matrix of development and are associated with chronically disturbed transportation corridors (Zedler and Black 2004).

CNDDB 2007 reports seven Contra Costa goldfield occurrences that are threatened by competition from invasive plants such as Italian ryegrass (*Lolium multiflorum*). Italian ryegrass threatens occurrences in Alameda County and a Napa County occurrence that is within the Napa River core recovery area (CNDDB 2007). Grazing ceased on the Napa County site in 2005, off road vehicle use has occurred, and Italian ryegrass has been invading (CNDDB 2007). Invasive plants have also become a concern for the State Route 4 preserve in Contra Costa County, since grazing had been discontinued for a number of years (B. Pardieck, Muir Heritage Land Trust, pers. comm., 2007). Non-native grasses such as Italian rye grass not only shade out short-statured plants like Contra Costa goldfields, but can also negatively impact vernal pool hydrology by decreasing inundation periods in pools (Marty 2004). In addition, encroachment of nonnative plants often follows surface disturbing activities such as discing, grading, filling, and off-road vehicle use (Service 2005a).

CONTRA COSTA WALLFLOWER (*Erysimum capitatum* var. *angustatum*)

Species Description and Life History: The Contra Costa wallflower is one of the many varieties of the western wallflower (*Erysimum capitatum*) and is a biennial or short-lived perennial sub-shrub of the Brassicaceae (mustard) family (USFWS 1984b). It was listed as endangered on April 26, 1978. The erect plant is unbranched and grows 6 to 18 inches in height (Dale 1986). The leaves of the Contra Costa wallflower occur in basal rosettes, are narrowly lance-shaped with toothed edges, and have two-branched hairs covering the lower 4 to 8 inches of the leaf. The attractive yellow to yellow-orange flowers grow on short stalks in a loose cluster at the ends of the main stem, with the four petals in a cross shape typical of this family (Dale 1986; Hickman 1993).

The reproductive phenology of this species encompasses germination in October, leafing from October through December, budding in February, flowering in March (peaking in April or May), and fruiting in April (peaking in July). Seeds are wind-dispersed beginning in mid-May and peaking in September. Unlike other members of the mustard family, pollination of the Contra Costa wallflower is by a variety of unspecialized insects, including bees nesting along the open banks (USFWS 2002c). The wallflower grows in soil types classified as sand to sandy loam. Precise information about the specific requirements of the Contra Costa wallflower are not well known; however, the plant has been observed growing in steep areas of unstable sand, especially on north-facing slopes adjacent to the river (USFWS 1984, 2002c; S. Euing, USFWS, pers. comm. 2007). This plant has also been observed growing in a variety of conditions, including stable dunes of fine sand containing some clay and sparsely vegetated with herbs and shrubs; uneven river front bluff faces and edges; flat terrain in excavated areas; and flat hard pan areas 160 to 660 feet from the river where the hard pan is broken and loose, sandy soil is exposed (USFWS 2002c).

Historic and Current Distribution: The Contra Costa wallflower is endemic to the riverine dune habitat found within and immediately adjacent to the Antioch Dunes NWR. Antioch Dunes National Wildlife Refuge is located in the San Francisco Bay-Delta area along the south shore of the San Joaquin River about 40 miles northeast of San Francisco. The Antioch Dunes NWR consists of 67 acres divided into two separate parcels: the Stamm unit to the west (41 acres) and the 26-acre Sardis unit to the east (14 acres owned by the USFWS and 12 acres owned by Pacific Gas and Electric). The two units are separated by less than one mile and the Georgia-Pacific gypsum plant lies between the two units. Once part of an extended riverine sand dune system, the relic dune habitat at Antioch hosted a variety of endemic plants and insects (USFWS 2002c).

Reasons for Decline and Threats to Survival: During the last 150 years the dune habitat was seriously degraded by sand removal, the overgrowth of invasive, non-native plants, and by recreational use (USFWS 1984b). Few of the endemic species remain at the Antioch Dunes NWR; however, the Contra Costa wallflower, the Antioch Dunes evening primrose, and the Lange's metalmark butterfly were all given increased protection when those species were listed and when the refuge was established (USFWS 2002c).

Few-flowered Navarretia (*Navarretia leucocephala* ssp. *pauciflora*)

Species Description and Life History: The few-flowered navarretia was listed as endangered on June 18, 1997. As summarized in our Recovery Plan (U.S.. Fish and Wildlife Service, 2005a), navarretias are annual herbs of the phlox family (Polemoniaceae). These plants are small, funnel-shaped, and are only 0.4 to 1.6 inches tall and approximately twice as wide due to branches originating near the base of the stem. The stems are white with purple streaks and approximately 0.02 inch in diameter. Each flower head is 0.16 to 0.39 inch-wide and contains between 2 and 20 pale blue or white flowers. The fruit of this species is a papery capsule that breaks open only when wet (U.S. Fish and Wildlife Service, 2005a).

The few-flowered navarretia is extremely rare. This species is dependent on vernal pools for survival and its life history is closely linked to the hydrology of these wetlands. This species is found only on vernal pools on substrates of volcanic origin, specifically in Northern Basalt Flow and Northern Volcanic Ashflow Vernal Pools. Extant localities in Lake County are in "flats" of recent alluvium in mountainous areas; site specific details are not known for Napa County sites.

Historic and Current Distribution: This species is found in Lake and Napa counties, in the Lake-Napa Vernal Pool Region. All occurrences are within an approximately 20-square mile area (CNDDB 2007). The CNDDB reports eight known occurrences of this species; six in Lake County and two in Napa County (CNDDB 2007). However, it is difficult to determine the actual number of localities because of some plants exhibit characteristics that are intermediate between the few-flowered navarretia and many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha*) as discussed below and because some occurrences historically reported have very vague location descriptions and these locations may represent known sites by different names (Bittman 1989). Few-flowered navarretia was first given the Latin name *Navarretia pauciflora*. This taxon was subsequently reduced in rank and assigned the name *Navarretia leucocephala* ssp. *pauciflora* (Day 1993). Many-flowered navarretia, also federally-listed as endangered, was reduced in rank and assigned the name *Navarretia leucocephala* ssp. *plieantha*. Some

populations of Navarretia consist of individuals intermediate in characteristics between two subspecies. According to Dr. Alva Day (in litt. 1997), these plants are not properly called hybrids nor "intercrosses," as the final listing rule (U.S. Fish and Wildlife Service 1997) described them. Dr. Day (in litt. 1997) has distinguished two types of intermediate specimens, which others have identified as either many-flowered navarretia or few-flowered navarretia. One group is intermediate between many-flowered navarretia and few-flowered navarretia, and the other is intermediate between manyflowered navarretia and Baker's navarretia (*N. leucocephala* ssp. *bakeri*).

Reasons for Decline and Threats to Survival: The Mead Ranch, in Napa County, is the only locality that is protected from development under a conservation easement (CNDDB 2007) held by the Napa Valley land trust (Napa Valley Land Trust 2008). However, this easement allows for conversion of 30 additional acres to vineyards. It is unknown if the areas available for conversion are suitable for the few-flowered navarretia.

The Recovery Plan incorrectly states that the locality near the town of Cobb, Lake County, is protected under a conservation easement. Instead, this locality is designated by Lake County as a "Natural Area" (T. Elliot, Lake County Planning, Building, and Development Department, pers. comm. 2007). The designation of "Natural Area" is used by Lake County to draw attention to parcels that have vernal pools or serpentine soils to make landowners aware of additional permits that may be necessary to obtain from State or Federal agencies if these sensitive resources will be impacted (T. Elliot, pers. comm. 2007). In the past, botanists have reported few-flowered navarretia at the California Department of Fish and Game's (CDFG) Loch Lomond Preserve. Currently, it is not known if few-flowered navarretia, many-flowered navarretia, or an intermediate species occurs at this site (A. Day, in litt. 1989, 1997; R. Bittman, CDFG, pers. comm. 2007). If few-flowered navarretia occurs at these preserves, then the species would be protected from habitat loss. All of the remaining sites are on private land and not protected.

Fleshy Owl's-Clover (*Castilleja campestris* ssp. *succulenta*)

Species Description and Life History: The fleshy owl's-clover was listed as threatened on March 26, 1997 (U.S. Fish and Wildlife Service, 1997). Fleshy owl's-clover is an annual herb in the snapdragon family (Scrophulariaceae). Some recent treatments transfer it to the broomrape family (Orobanchaceae). Its stems are erect, generally 2-10 inches tall, and may be branched or unbranched. The leaves are succulent and brittle. Bright yellow to white flowers appear in May, clustered near the ends of branches and surrounded by leafy bracts. Like other members of Castilleja and related genera, it is hemiparasitic (partly parasitic) on the roots of other plants. The species' range overlaps that of the related *Castilleja campestris* ssp. *campestris* in Stanislaus County, but the latter can be distinguished by its usually more brittle leaves, shorter bracts, larger corollas and longer stigma.

Fleshy owl's-clover occurs in Northern Claypan and Northern Hardpan vernal pools (Sawyer and Keeler-Wolf 1995) within annual grassland communities. The plant is known from both small and large pools and it has been reported to occur in pools with both long and short inundation periods and from both shallow and very deep vernal pools (EIP Associates 1999).

Historical and Current Distribution: Fleshy owl's-clover is endemic to the rolling lower foothills

and valleys of the eastern San Joaquin Valley. With the exception of one occurrence in San Joaquin County, it occurs exclusively in the Southern Sierra Foothills Vernal Pool Region (Service 2005a). Through 2005, the California Natural Diversity Data Base (2005) had catalogued 91 occurrences of fleshy owl's clover. Ninety of these occurrences are presumed to be extant. Approximately 70 percent of the occurrences are in Merced County, 12 percent in Fresno County, ten percent in Madera County, five percent in Stanislaus County, and one percent in San Joaquin County.

Reasons for Decline and Threats to Survival: Fleshy owl's-clover populations are variously threatened by loss and degradation of habitat resulting from urban development, agricultural land conversion, discing, flood control projects, overgrazing or lack of grazing, and highway expansion projects. Three populations of fleshy owls-clover occur primarily within designated reserves, on two "tabletop" mountains near Millerton Lake in Fresno County (Service 2005a). The Sierra Foothill Conservancy's Big Table Mountain Preserve includes all of one population. The second population is shared between the preserve and the adjacent U. S. Bureau of Land Management property. The third population is within the California Department of Fish and Game's Big Table Mountain Preserve. At least seven occurrences of this plant occur on the Flying M Ranch in Merced County, which is protected from development by a conservation easement managed by The Nature Conservancy (Service 2005a,b). Several other occurrences are in public ownership and are not necessarily protected from development or managed for the benefit of this plant or other vernal pool taxa. There are extensive occurrences of this plant on the University of California campus in Merced County (Service 2005a).

Greene's Tuctoria (*Tuctoria greenei*)

Species Description and Life History: Greene's tuctoria was listed as endangered on March 26, 1997 (U.S. Fish and Wildlife Service, 1997). Critical habitat for this species was originally designated on August 6, 2003 (U.S. Fish and Wildlife Service, 2003) and was revised on August 11, 2005 (U.S. Fish and Wildlife Service, 2005b). Greene's tuctoria is a small, tufted annual in the grass family (Poaceae). The plant has several to many stems 2-6 inches tall, each ending in a spike-like inflorescence that may be partly enfolded in the upper leaf. The genus *Tuctoria* is distinguished from other Orcutt grasses (in the genus *Orcuttia*) by the spiral arrangement of the spikelets (flowers) and other characteristics of its flower parts (Stone et al. 1988; Service 1997). Greene's tuctoria has been found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Hardpan (Sawyer and Keeler-Wolf 1995) on both low and high terraces (Stone et al. 1988). Occupied pools are or were underlain by iron-silica cemented hardpan, tuffaceous alluvium, or claypan (Stone et al. 1988). Greene's tuctoria appears to grow most frequently in shallower pools than other members of the tribe or on the shallow margins of deeper pools (Service 2005a). The Central Valley pools containing this species occur in grasslands, whereas the Shasta County occurrence is surrounded by pine forest (CNDDB 2005).

Historic and Current Distribution: Greene's tuctoria has been reported from a total of 41 occurrences in Fresno, Madera, Merced, San Joaquin, Stanislaus, Tehama, Shasta, and Tulare Counties (Service 2005a, Stone et al. 1988, CNDDB 2005). About half of the historical occurrences of Greene's tuctoria are presumed to be extant, nine are extirpated, and ten occurrences are possibly extirpated (Alexander and Schlising 1997, CNDDB 2005). The majority of the 22 extant occurrences are in the Northeastern Sacramento Valley Vernal Pool

Region, particularly in the Vina Plains. The next largest concentration is in the Southern Sierra Foothills Vernal Pool Region, where the only remaining occurrences are in eastern Merced County. Greene's tuctoria is believed to be extirpated from Fresno, Madera, San Joaquin, Stanislaus, and Tulare Counties (Service 2005a, Stone et al. 1988, CNDDB 2005). Six occurrences of Greene's tuctoria occur in The Nature Conservancy's Vina Plains Preserve (Service 2005a). One occurrence of Greene's tuctoria is protected on the Drayer Ranch Conservation Bank in Merced County. A population in Glenn County occurs on the Sacramento National Wildlife Refuge.

Reasons for Decline and Threats to Survival: One potential factor unique to Greene's tuctoria and some other vernal pool plant species may be decimation by grasshopper outbreaks. Grasshoppers have been noted consuming entire populations of Greene's tuctoria before they set seed (Griggs 1980, Griggs and Jain 1983, Stone et al. 1988). Agricultural conversion, urbanization, and inappropriate livestock grazing practices pose threats to virtually all of the occurrences remaining in the San Joaquin Valley. At least nine historic populations of Greene's tuctoria have been eliminated by conversion of habitat to irrigated agriculture. Six historic populations are known or presumed to have been eliminated by overgrazing, and at least one population has been eliminated by urbanization. Agriculture, overgrazing and urban development continue to threaten most of the 19 remaining populations (California Department of Fish and Game 1991, Service 1997), all of which are on private land.

Hairy Orcutt Grass (*Orcuttia pilosa*)

Species Description and Life History: The hairy Orcutt grass was listed as endangered on March 26, 1997 (U.S. Fish and Wildlife Service, 1997). This species was listed as endangered by the California Department of Fish and Game in 1979, and the California Native Plant Society has placed it on List 1B (rare or endangered throughout its range). Hairy Orcutt grass is a small, tufted annual in the grass family (Poaceae). The plant has several stems 2-8 inches tall, each stem ending in a long, spike-like inflorescence. Spikelets are strongly congested at the upper end of the inflorescence. The equal-length lemmas are deeply cleft into fine teeth that are sharp-pointed or short-awned. Foliage is grayish, with soft, straight hairs. This species is found in vernal pools located on high or low stream terraces and alluvial fans (Stone et al. 1988). Hairy Orcutt grass occurs in Northern Basalt Flow, Northern Claypan, and Northern Hardpan vernal pools within annual grasslands (Sawyer and Keeler-Wolf 1995). It occupies vernal pools with a wide range of sizes and co-occurs with other rare plants at numerous sites.

Historic and Current Distribution: The historical range of hairy Orcutt grass includes the eastern margins of Sacramento and San Joaquin Valleys from Tehama County south to Stanislaus County and through Merced and Madera counties. There are 39 documented occurrences of hairy Orcutt grass in the CNDDB (2008); however 11 of those occurrences are listed as extirpated and one occurrence as possibly extirpated. Currently, the main area of concentration for hairy Orcutt grass is in Tehama County, where ten occurrences of this species are documented at the Vina Plains. An isolated occurrence in central Butte County is in the same region. Eleven occurrences are in the Southern Sierra Foothills Vernal Pool Region, including nine extant occurrences in Madera County between the City of Madera and Millerton Lake, and two in eastern Stanislaus County (CNDDB 2008). All six extant occurrences in the Solano-Colusa Vernal Pool Region are on the Sacramento National Wildlife Refuge in Glenn County

(Stone et al. 1988, Keeler-Wolf et al. 1998, CNDDB 2008).

Relatively large populations of hairy Orcutt grass are protected at the Nature Conservancy's Vina Plains Preserve in Tehama County (Broyles 1987, Alexander and Schlising 1997, CNDDB 2008) and at the Sacramento National Wildlife Refuge in Glenn County. A small occurrence is also now protected at a California Department of Transportation conservation site in Madera County. In addition, hairy Orcutt grass is also found on Bureau of Reclamation land in Fresno County. The species has also been introduced into created vernal pools in Madera County and the introduction effort appears to have been a success with flowering individuals documented in the year following the creation of the vernal pools (Service 2005a).

Reasons for Decline and Threats to Survival: Conversion of vernal pool habitat to irrigated agriculture or to urban uses has been the primary factor leading to decline in this species. Of the 24 native, extant populations and one translocated population, only 12 populations are considered stable (Stone et al. 1988). Urbanization, agricultural land conversion, a highway expansion projects, discing, off-highway vehicle use, and competition from nonnative weeds continue to threaten most of the remaining populations (Service 2005a).

Hoover's spurge (*Chamaesyce hooveri*)

Species Description and Life History: Chamaesyce hooveri was listed as threatened on March 26, 1997. It is a summer annual member of the Euphorbiaceae (spurge family) that is a vernal pool endemic. Hoover's spurge forms gray-green mats from a few inches to a few feet across. The flowering structure is a small, highly simplified cup-like "cyathium," as in all other spurges (Chamaesyce and Euphorbia). The flowering structure in Hoover's spurge has petal-like glands that are red to olive in color. Flowers bloom in July. This species is readily distinguished from other species of *Chamaesyce* by characteristics of growth habit, plant color and leaf shape. It is distinguished from plants in the genus Euphorbia on the basis of growth habit, vascular anatomy, and photosynthetic pathway. Hoover's spurge generally grows in relatively large, deep vernal pools among the rolling hills, remnant alluvial fans and depositional stream terraces at the base of the Sierra Nevada foothills. It tends to occur where competition from other species has been reduced by prolonged seasonal inundation or other factors.

Historic and Current Distribution: Hoover's spurge has been reported in six counties: Tehama, Butte, Glenn, Stanislaus, Merced, and Tulare. Thirty occurrences have been reported to CNDDB and we know of an additional locality found on the Hamilton Ranch mitigation site in Tehama County (LSA 2003; C. Witham, biological consultant, per. comm. 2007). An occurrence as defined by the CNDDB is a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies. We have used locality to refer to populations, individuals, or colonies that have not been reported to the CNDDB, and sites to refer to collections of occurrences and localities. Of the 31 known sites 27 sites are presumed to be extant (LSA 2003; CNDDB 2007). The majority of the presumed extant sites are located in the Vina Plains area, in Tehama and Butte Counties, where 14 occurrences and one locality are presumed extant (LSA 2003; CNDDB 2007). The next largest concentration of occurrences is in Tulare County, where seven occurrences are presumed extant. The CNDDB indicates that of the 26 occurrences that are listed as "presumed extant," 6 occurrences have not been surveyed in over 20 years and another 8 have not been surveyed since the late 1980s. Because surveys have

not been performed at many of these occurrences in nearly twenty years, the actual status of these occurrences is not known at this time. The majority of occurrences of Hoover's spurge are not protected. Ten occurrences of this species that are protected from the direct effects of development include: The Nature Conservancy's Vina Plains Preserve in Butte and Tehama Counties, Sacramento NWR, and California Department of Fish and Game's Stone Corral Ecological Reserve.

Lake County Stonecrop (*Parvisedum leiocarpum*)

Species Description and Life History: As summarized in our Recovery Plan (Service 2005a), Parvisedum leiocarpum is a low, erect to spreading annual in the stonecrop family (Crassulaceae) with reddish stems 3 to 5 centimeters (1 to 2 inches) tall. The fleshy, oblong leaves are 4 to 5 millimeters (0.16 to 0.20 inch) long and fall off the stem by flowering time. The inflorescence is a cyme (flat-topped or convex flower cluster) of campanulate (bell-shaped) yellow flowers that are crowded on curving stems in two rows. The five petals are 3 to 3.5 millimeters (0.12 to 0.14 inch) long with large, club-shaped, red nectaries. The five carpels have smooth surfaces. Parvisedum leiocarpum flowers in April and May (CDFG 2005).

Parvisedum leiocarpum is extremely rare. This species is dependent on vernal pools for survival and its life history is closely linked to the hydrology of these wetlands. This species is found only on vernal pools on substrates of volcanic origin. This species is found in Lake County, in the Lake-Napa Vernal Pool Region.

Historic and Current Distribution: Parvisedum leiocarpum was described from an area 10.4 kilometers (6.5 miles) north of Lower Lake, Lake County, California. Two similar taxa occur within the range of *S. leiocarpa*. *Parvisedum pentandrum* (Central California stonecrop) differs in having shorter petals, top-shaped flowers, and carpels with glandular bumps on the surfaces. *Crassula connata* (sand pygmyweed) differs in having only one to a few, four-petaled flowers above each leaf base not arranged in definite cymes.

Parvisedum leiocarpum is found on volcanic substrates in areas of impeded drainage, such as in and along the margins of vernal pools and depressions in bedrock. The historical range of the species encompasses six collection localities within a 16-kilometer (10-mile) radius from Siegler Springs near Lower Lake, Lake County, California (CDFG 2005). Elevations of occurrences range from 395 to 790 meters (1,300 to 2,600 feet) (CDFG 2005). The extant occurrences of *S. leiocarpa* collectively cover a total area of less than 1.2 hectares (3 acres). All occurrences are located on private lands. An occurrence as defined by the CNDDB is a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies.

Loch Lomond Coyote Thistle (*Eryngium constancei*)

Species Description and Life History: Eryngium constancei was listed by an emergency rule as endangered on August 1, 1985. A permanent final rule affirming the listing was published on December 23, 1986. It has slender, loosely branched stems 20 to 30 centimeters (7.9 to 11.8 inches) tall, which may be decumbent or upright. The entire plant is covered with downy hairs. The mature leaves are 11 to 16 centimeters (4.3 to 6.3 inches) long, with the petiole accounting

for most of the length. The leaf blade is lance-shaped and may have a smooth, sharply toothed, or lobed margin. The bracts are narrow, spiny-margined, and shorter than the leaves. In this species, the rounded flower heads are only 3 to 5 millimeters (0.12 to 0.20 inch) in diameter; however, the stems supporting the flower heads may be as much as 8 centimeters (3.1 inches) long. Each flower head contains only five to seven tiny flowers. The petals are approximately 1 millimeter (0.04 inch) long and are white or tinged with purple. Fruits of this species are egg-shaped and approximately 2 millimeters (0.08 inch) long.

Historic and Current Distribution: Eryngium constancei has been reported in Lake and Sonoma Counties in California. Three occurrences have been reported to CNDDB and we know of an additional locality in an unnamed pool near Cobb in Lake County. An occurrence as defined by the CNDDB is a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies. We have used locality to refer to populations, individuals, or colonies that have not been reported to the CNDDB, and sites to refer to collections of occurrences and localities. Of the four sites all are presumed to be extant (CNDDB 2007). The majority of sites of E. constancei are not protected. One occurrence of this species is protected from the direct effects of development at Loch Lomond in Lake County.

Many-flowered Navarretia (*Navarretia leucocephala* ssp. *plieantha*)

Species Description and Life History: Navarretia leucocephala ssp. plieantha was listed as endangered on June 18, 1997. As summarized in our Recovery Plan (Service, 2005a), navarretias are annual herbs of the phlox family (Polemoniaceae). Many flowered navarretia forms mats 5 to 20 centimeters (2.0 to 7.9 inches) across and 1 to 3 centimeters (0.4 to 1.2 inches) high. The stems have a peeling, white surface and are highly branched. Stem thickness is 0.8 to 1.4 millimeters (0.03 to 0.06 inch) and is more or less uniform throughout its length. The leaves are 3 to 4 centimeters (1.2 to 1.6 inches) long and are either entire or have a few thread-like lobes. Flower heads are 1.5 to 2 centimeters (0.6 to 0.8 inch) across and contain between 10 and 60 pale blue flowers. Each flower in the head is 5 to 6 millimeters (0.20 to 0.24 inch) long. Each fruit may contain as many as three seeds (Mason 1946; Day 1993b). The fruit of this species is a papery capsule that breaks open only when wet (Service 2005a). The chromosome number is unknown.

Navarretia leucocephala ssp. *plieantha* was first given the Latin name *Navarretia plieantha*. This taxon was subsequently reduced in rank and assigned the name Navarretia leucocephala ssp. plieantha (Day 1993). *Navarretia leucocephala* ssp. *pauciflora* (few-flowered navarretia), also federally-listed as endangered, was reduced in rank from *Navarretia pauciflora* and assigned the name *Navarretia leucocephala* ssp. *pauciflora*. Some populations of *Navarretia* consist of individuals intermediate in characteristics between these two subspecies. According to Dr. Alva Day (in litt. 1997), these plants are not properly called hybrids nor "intercrosses," as the final listing rule (U.S. Fish and Wildlife Service 1997) described them. Dr. Day (in litt. 1997) has distinguished two types of intermediate specimens, which others have identified as either *N. leucocephala* ssp. *plieantha* or *N. leucocephala* ssp. *pauciflora*. One group is intermediate between *N. leucocephala* ssp. *plieantha* and *N. leucocephala* ssp. *pauciflora*, and the other is intermediate between *N. leucocephala* ssp. *plieantha* and *N. leucocephala* ssp. *bakeri* (Baker's navarretia). For convenience, we refer to all of these as *N. leucocephala* ssp. *plieantha* throughout this review, but the population at the type locality is referred to as "typical" *N.*

leucocephala ssp. *plieantha*.

Historic and Current Distribution: *Navarretia leucocephala* ssp. *plieantha* is extremely rare. This species is found only on substrates of volcanic origin and is dependent on vernal pools, vernal lakes, and swales for survival. Its life history is closely linked to the hydrology of these wetlands. The CNDDB reports seven known occurrences of this species; five in Lake County and two in Sonoma County (CNDDB 2007). Of the seven occurrences the CNDDB (2007) has catalogued as *N. leucocephala* ssp. *plieantha*, all are considered to be extant. Two localities for *N. leucocephala* ssp. *plieantha* are protected as reserves. The only typical population of *N. leucocephala* ssp. *plieantha* occurs at Boggs Lake Ecological Reserve that is co-owned and managed by California Department of Fish and Game and The Nature Conservancy. The California Department of Fish and Game manages the Loch Lomond Vernal Pool Ecological Reserve.

Pitkin Marsh Lily (*Lilium pardalinum* ssp. *pitkinense*) - E

Species Description and Life History: Pitkin Marsh lily was listed as endangered on October 22, 1997 (Federal Register 62-54791). Critical habitat has not been designated. The Pitkin Marsh lily is an herbaceous perennial in the lily family (Liliaceae). The slender, erect stems reach 1 to 2 m (3 to 6 ft) in height. Leaves are yellow-green, up to 14 cm (5.5 in) long, and 1 to 2 cm (0.4 to 0.8 in) wide. The flowers are large, showy, and nodding. The petals, which are reflexed from the middle, are red at the outer edge changing to yellow at the center with small, deep maroon dots mostly within the yellow zone. Anthers (pollen-bearing part of the stamen) are purple-brown. The fruit is an elliptical capsule containing many rounded seeds. The species flowers from June to July. *Lilium pardalinum* ssp. *pitkinense* is distinguished from *L. pardalinum* ssp. *pardalinum* by generally shorter petals and anthers.

Pitkin Marsh lily grows only in freshwater marshes and wet meadows that are 35 to 60 m (115 to 200 ft) in elevation. Pitkin Marsh lily occurs only in permanently-saturated, sandy substrates among grasses and shrubs in freshwater marsh or wet meadow habitats in Sonoma County. Associated species include blackberry (Rubus sp.), western azalea (Rhododendron occidentalis), buckthorn (Rhamnus spp.), and introduced grasses.

Historic and Current Distribution: Historically, the Pitkin Marsh lily was known from three populations in two marshes. The populations occurred over a distance of 13 km (8 mi) in western Sonoma County. Since 1975, access to one of the sites has been denied by the landowner. As a result, the status of this population has not been confirmed.

Currently, only one occurrence is known to be extant as no access for surveys has been granted at the other site since 1975 (Mark Skinner). Confirmation of whether the species is still extant in this area is not possible without conducting ground surveys at the appropriate time of year. The one site where Pitkin Marsh lily is still known to occur is under a permanent conservation easement held by California Department of Fish and Game (CDFG). The site has been under the stewardship of the Milo Baker Chapter of the CNPS which has been conducting surveys and habitat enhancements for the past several years. On that site, Pitkin Marsh lily is found scattered in several small colonies within an approximately 3 acre area within the 19-acre conservation easement boundaries.

At the time of the 1997 listing, an estimated 300 individual plants remained on the two historical sites (Guggolz, pers. comm. 1996 in Service 1997). Because of the lack of information from the northern marsh site, and that only reproductive stems were counted during the recent surveys at the one extant site, it is difficult to compare the numbers from the time of listing to determine any trend in abundance. However, it appears in the past few years, the number of reproductive stems and seedlings may be decreasing on the one extant site despite efforts to protect the lily colonies from herbivory and reducing the encroachment of invasive nonnative blackberry and grasses. With apparently decreasing numbers at the one confirmed extant site, limited availability of suitable habitat within its restricted range, the taxon remains highly vulnerable to extinction.

Reasons for Decline and Threats to Survival: Pitkin Marsh lily is threatened by encroachment by invasive plants (which may be a result of release from grazing) including nonnative grasses such as tall fescue, velvet grass, Armenian blackberry, and willow (Cooley, pers. comm. 2007; Patterson 2005). Additionally, increases in nutrients from livestock on surrounding lands and other agricultural uses on surrounding properties in the watershed, and alteration of hydrology by surrounding residential and agricultural land uses threaten this species. Small occurrence sizes and presumed low genetic diversity also continue to threaten Pitkin Marsh lily due to the vulnerability of small populations to a range of environmental, demographic, and genetic stochastic factors.

PRESIDIO CLARKIA (*Clarkia franciscana*)

Species Description and Life History: The Presidio clarkia was listed as endangered on February 3, 1995 (U.S. Fish and Wildlife Service, 1995). Critical habitat has not been designated for this species. This species is included in the Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area, September 30, 1998 (http://ecos.fws.gov/docs/recovery_plans/1998/980930c.pdf). Presidio clarkia is a slender, erect, herbaceous annual of the evening-primrose family (Onagraceae). It grows to 16 inches tall with few, very small and narrow leaves. The lavender-pink petals have a lighter basal portion and a reddish-purple basal spot. The slender capsule is 1-2 inches long. Presidio clarkia can be distinguished from reddened clarkia (Clarkia rubicunda), also known as ruby chalice fairyfan, a related species that may occur in the same area, by the fact that its petals have irregular teeth on their apex margin (reddened clarkia has petals rounded at the apex).

Historic and Current Distribution: Presidio clarkia is restricted to grassland communities on serpentine soils in San Francisco and Alameda counties. Two populations are known from the San Francisco Presidio. Three are known from the Oakland Hills in Alameda County, all from within 0.5 mile of each other. Total plant numbers fluctuate greatly; the upper limit reported in recent years is approximately 8,000 plants.

Serpentine soils are formed from weathered volcanic (ultramafic) rocks such as serpentinite. dunite, and peridotite. These soils provide a harsh environment for plant growth. Several factors contribute to the inhospitability of serpentine soils to plant growth including: 1) a low calcium-magnesium ratio; 2) lack of essential nutrients such as nitrogen, potassium, and phosphorous; and 3) high concentrations of heavy metals (mineral toxicity). However, species such as Presidio

clarkia are adapted to serpentine soils.

Reasons for Decline and Threats to Survival: The Presidio populations are threatened by habitat degradation. Pedestrian and mountain bicycle traffic on and near trails threatens the habitat. The species is also threatened by road maintenance (mowing) at the Presidio. Mowing of grasslands before Presidio clarkia has set seed also threatens the populations. Populations at the Presidio also are threatened by the encroachment of nonnative plant species, including cape ivy (Senecio mikanioides), iceplant (Carpobrotus spp.), blackberries (Rubus spp.), and by natives planted outside their natural range, such as Monterey pine (Pinus radiata). The three populations of Clarkia franciscana in Alameda County are all threatened by nonnative species such as pampas grasses (Cortaderia selloana and C. jubatum) and French broom (Genista monspessulanus).

SAN FRANCISCO LESSINGIA (*Lessingia germanorum*)

Species Description and Life History: The San Francisco lessingia was listed as endangered on June 19, 1997 (U.S. Fish and Wildlife Service, 1997). Critical habitat has not been designated for this species. This species is included in the *Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*, 2003. San Francisco lessingia is a low-growing, slender-stemmed annual herb of the aster family (Asteraceae). Robust plants have diffusely branched stems and grow up to one foot high, spreading close to the ground. Small plants may be very short and nearly erect, with few or no branches. Leaves are narrowly lance-shaped, lobed and toothed or entire, mostly an inch or less long. The leaves and stems are covered with grayish, wooly, loosely interwoven hairs. Flower heads are lemon-yellow and are mostly solitary at the ends of stems. The heads consist of tubular lemon yellow disc florets with a brownish or purplish band on the lobes of the corolla. There are no ray florets. The seed-like dry fruits are crowned with hairlike bristles which enable them to be dispersed readily by wind. Flowering occurs in late summer and fall; seed dispersal occurs very late in summer and in fall-winter. See Hickman (1993) in General Information about California Plants, below, for a detailed description of the species.

Historic and Current Distribution: San Francisco lessingia occurred historically in stabilized older coastal sand dunes and sandy soils with moderately open scrub or herbaceous vegetation on the San Francisco peninsula. The species grows most abundantly in vegetation gaps, blowouts, erosional slopes or disturbed sandy soil with sparse vegetation. See the Recovery Plan (above) for a detailed discussion of this species' distribution.

Reasons for Decline and Threats to Survival: San Francisco lessingia has historically been endangered by competition with invasive non-native vegetation and native scrub vegetation, residential and commercial development, sand quarrying, trampling and recreational activities, inadequate regulatory mechanisms, bulldozing, incidental use of fertilizers, and other urban land use activities.

San Joaquin Valley Orcutt Grass (*Orcuttia inaequalis*)

Species Description and Life History: The San Joaquin Valley Orcutt grass was listed as threatened on March 26, 1997 (U.S. Fish and Wildlife Service, 1997). It is a small, tufted annual in the grass family (Poaceae). The plant has several stems 2-6 inches tall, ending in a spike-like

inflorescence. The foliage is grayish, with soft, straight hairs. San Joaquin Valley Orcutt grass is distinguished from other Orcuttia species by the shape of the lemma (part of the grass flower) and by the hat-like shape of the inflorescence at maturity. The plant occurs in vernal pools.

Historical and Current Distribution: San Joaquin Valley Orcutt grass is the only Orcutt grass restricted to the San Joaquin Valley. Its distribution is restricted to the Southern Sierra Foothills Vernal Pool Region (Keeler-Wolf et al. 1998). Historically, its range included the eastern margin of the valley from Stanislaus County to Tulare County. At least half these populations have been extirpated, including all of those in Stanislaus and Tulare Counties. Of the 52 occurrences of this species recorded in the CNDDB, 32 are presumed extant; 17 are extirpated, and three others are considered possibly extirpated (CNDDB 2007). Most of the remaining populations are located in a 36-mile-long strip in Fresno, Merced, Tulare, and Madera Counties (Stone et al. 1988, CNDDB 2007).

The primary area of concentration of presumed extant occurrences is northeast of Merced in Merced County, with 19 occurrences on the Flying M Ranch and adjacent lands (EIP Associates 1999). The occurrences of this species on the Flying M Ranch are protected through a conservation easement with The Nature Conservancy (Service 2005a). Eastern Merced County is considered a critical region for the conservation of this species due to the large number of extant occurrences in this area and due to the large expanse of quality habitat that remains in this region (Service, 2005a). In addition, two populations of San Joaquin Orcutt grass occur on Federal land; a natural population is managed by the U.S. Bureau of Land Management (BLM), and a translocated population occurs on BLM land.

Reasons for Decline and Threats to Survival: Conversion of grasslands to agricultural use and some agricultural activities have eliminated at least five historically known populations of this species. Urbanization is also a threat to the San Joaquin Valley Orcutt grass. Agricultural and urban development has probably eliminated additional undocumented populations. Several remaining populations continue to be threatened by flood control projects, continued urban and agricultural expansion and competition from nonnative weeds (Stone et al. 1988, U.S. Fish and Wildlife Service, 2005a).

Sebastopol meadowfoam (*Limnanthes vinculans*)

Species Description and Life History: Sebastopol meadowfoam was listed as endangered on December 2, 1991 (U.S. Fish and Wildlife Service, 1991). Critical habitat has not been designated. Sebastopol meadowfoam is a small (up to 12-inch tall), multi-stemmed herb of the false mermaid family (Limnanthaceae). Although the first leaves are narrow and undivided, leaves on the mature plant have three to five undivided leaflets along each side of a long stalk (petiole). The shape of the leaves distinguishes Sebastopol meadowfoam from other members of the Limnanthes genus. Small, bowl-shaped, white flowers appear April through May. The white flowers are born singly at the end of stems. See Hickman (1993) in General Information about California Plants, below, for a detailed description of the species.

Historic and Current Distribution: The species has not been recorded outside southwestern Cotati Valley, where it occurs in less than thirty locations. It is found in seasonally wet meadows, swales and vernal pools in the Laguna de Santa Rosa, Sonoma County. The species

ranges from the city of Graton, east to Santa Rosa, southeast to Scenic Avenue, and southwest to the community of Cunningham, largely surrounding the northern and western perimeter of the city of Sebastopol.

Reasons for Decline and Threats to Survival: Primary threats to the species consist of activities that result in the destruction of the plants or hydrologic changes in their habitats. Such activities include urbanization, industrial development, agricultural land conversion, off-highway vehicle use, horseback riding, trampling by grazing cattle and road widening.

Slender Orcutt grass (*Orcuttia tenuis*)

Species Description and Life History: This species was listed as threatened on March 26, 1997. Slender Orcutt grass is a member of a small tribe (three genera and nine species) of semi-aquatic grasses that are unique among grasses in exhibiting single-cell C4 photosynthesis, which occurs in only 0.003% of known species of C4 flowering plants (Boykin et al. in review). Plants with C4 photosynthesis utilize a more complex biochemical process than most plants (with C3 photosynthesis) in converting CO_2 to energy, which increases photosynthetic efficiency at low CO_2 concentrations (Boykin et al. unpublished manuscript). The species is endemic to California vernal pools. Disjunct occurrences of the species occur in vernal pools on remnant alluvial fans, high stream terraces, and recent basalt flows from the Modoc Plateau in northeastern California, west to Lake County, and south through the Central Valley to Sacramento County. The plant has also been reported from other natural and artificial seasonal wetlands such as creek terraces, stock ponds, and borrow pits; however, occurrence records suggest that most such locations are altered vernal pool habitats (CNDDB 2006). Slender Orcutt grass occurs across a wide range of elevations (27m – 1,856 m, or 90 ft – 5,761 ft), but is associated primarily with vernal pool habitat on Northern Volcanic Ashflow and Northern Volcanic Mudflow substrates. The species is typically associated with larger and/or deeper vernal pools (typically ≥ 30 cm, or 11.8 in deep) that have relatively long periods of inundation. The plant is also restricted to the deepest portion of the pools (Service 2005). The main habitat requirement for the plant appears to be inundation of sufficient duration and quantity to eliminate most competition and to meet the plant's physiological requirements for prolonged inundation, followed by gradual desiccation (Griggs and Jain 1983, Corbin and Schoolcraft 1990). However, pools that normally retain moisture until the end of summer allow out-competition of slender Orcutt grass by marsh vegetation (Scirpus spp., Typha spp.) (Griggs and Jain 1983).

Populations of slender Orcutt grass can vary greatly in size from year to year; fluctuations in population size of up to four orders of magnitude have been recorded. The grass germinates even in dry years, but the proportion surviving to maturity varies (Service 2005a). Population trends for this species on managed or protected lands appear to be stable over time, although quantitative monitoring has apparently been discontinued at many sites. Ongoing monitoring of these occurrences does show large, inter-annual fluctuations in the number of living plants at many sites, with some years producing no living plants in some locations (C. Lentz in litt. 2006, L. Serpa pers. comm. 2006).

Historic and Current Distribution: Recent surveys on the Modoc NF have located additional occurrences, thereby increasing the number of occurrences within the Modoc Plateau Vernal Pool Region (C. Beyer in litt. 2006a). Few additional occurrences have been discovered in other

regions: one new occurrence has been found in the Southeastern Sacramento Valley Region, within Sacramento's urban development boundary. Its size and status are unknown (Sacramento County undated). Most occurrences on private lands were last evaluated in the late 1980s. At this time, the population trends for 61 occurrences are listed as unknown (CNDDB 2006).

Reasons for Decline and Threats to Survival: The reduction and fragmentation of habitat due to urban development, flood control projects, landfill projects, highway development, and agricultural land conversion are listed as the primary threats to this species in the 1997 listing rule. Habitat degradation from agricultural and human-related changes to vernal pool hydrology is listed as an additional threat. Consistent with the 1997 rule, the largest continuing threat to this species is land type conversion and urban development along the periphery of urban areas, especially in the Redding and Sacramento areas (Service 2005a, C. Martz pers. comm. 2006). For example, the new occurrence found within Sacramento's urban development boundary is currently threatened by surrounding development (Sacramento County undated). The population of California is expected to increase to 58 million, almost double the 1990 State population, by 2040 (Field et al. 1999). Between 1994 and 2005, the Sacramento FWS office engaged in Section 7 consultations for projects with impacts to approximately 20,250 ha (50,000 ac) of vernal pool habitat, including loss of 10,125 ha (25,000 ac) to residential, commercial, and industrial development (Service 2005a,b). This loss is expected to continue as urban boundaries expand further through high and low terrace formations on the eastern side of the valley.

More subtle threats have the ability to change habitat suitability in natural lands remaining within the developed landscape. For example, loss of vernal pool habitat to residential, commercial, and industrial development can also lead to modification of remaining suitable habitat. Development can result in the loss of hydrological connections that sustain the remnant vernal pools. Vernal pool plants are sensitive to variations in the period of vernal pool inundation (Bauder 2000); populations of slender Orcutt grass could be impacted by such changes. On private lands, numerous pools with slender Orcutt grass occurrences have either been partially filled, or remain on relatively small parcels of lands adjacent to development (CNDDB 2006). Some pools have been partially drained, while others are inundated during longer periods of time due to nearby irrigation or runoff from development (CNDDB 2006).

Changes to vernal pool habitat associated with residential development include facilitation of the introduction of non-native plants to vernal pool habitats (Zedler and Black 2004). Non-native grasses occur commonly in vernal pool complexes and have become a threat to native vernal pool plants through their capacity to change pool hydrology. Exotic grasses maintain dominance at pool edges, sequestering light and soil moisture, promoting thatch build-up, and shortening inundation periods. Although the mechanism responsible for the change in inundation is not documented, reduction in inundation period is thought to be due to increased evapo-transpiration at the vernal pools (Marty 2005). In areas near the urban boundary, cattle-grazing is often discontinued in anticipation of land use changes (C. Martz pers. comm.). Cessation of cattle grazing has been found to exacerbate the negative effects of invasive non-native plants on vernal pool inundation period. The change in vernal pool inundation due to loss of grazing is an emerging threat for this species, especially in the Sacramento Valley (C. Lentz in litt. 2006, C. Martz pers. comm.). Vernal pool inundation was reduced by 50 – 80% in the Southeastern Sacramento Valley when grazing was discontinued (Marty 2005).

The vernal pools of the Modoc Plateau are not threatened by development, but habitat suitability for some populations may be modified by OHV use and the alteration of pools by damming and excavating to provide cattle watering holes (and maintenance of alterations). These activities pose continued threats to individual populations. Numerous pools harboring slender Orcutt grass occurrences in this region have been fenced to exclude grazing and protect occurrences; however, cessation of grazing may have less effect on pool inundation in the Modoc Plateau region (Marty 2005, A. Sanger in litt. 2006, C. Beyer in litt. 2006b).

Suitable habitat for this species may also be modified through changes to vernal pool hydrology at a relatively large scale. Recent research by Rains et al. (2006) has illustrated the manner in which many, if not most, vernal pools located on duripan or claypan in the Central Valley appear to be supported by perched aquifers. In these hydrological features, seasonal surface water and perched groundwater hydrologically connect uplands, vernal pools, and streams at the catchment scale. Perched groundwater discharges from uplands to vernal pools thereby stabilizing the pools, and causing them to remain inundated for longer periods than would be the case if they were recharged only by precipitation. Accordingly, small changes in local land use, such as development of irrigated agriculture or parkland may have considerable impacts on vernal pools, although the degree to which such changes affect pools is poorly understood. (Rains et al. 2006).

Loss of suitable habitat has been offset to some extent by the development of conservation banks. Stillwater Plains Conservation Bank within the Northeastern Sacramento Valley Region has created suitable habitat for slender Orcutt grass. However, in the last several years the inflated price of land along the urban front in the Redding area has provided an unexpected threat to preservation of suitable slender Orcutt grass habitat by reducing the land-purchasing capability of conservation and governmental organizations (C. Martz pers. comm.).

Slender Orcutt grass occurrences on conservation banks and small preserves are often subject to the same threats as occurrences on unprotected, fragmented habitat. Disruption of perched aquifers underlying small protected parcels may impact populations within preserves. In addition, development of offsite banks may not adequately protect the rare landform types associated with specific plant species or meet the functional equivalence of the original wetlands ecosystems (see discussion in Wacker and Kelly 2004). In the Southeastern Sacramento Valley Region, Wacker and Kelly (2004) illustrated that the majority of project site characteristics were replicated at the corresponding mitigation sites. However, when compared at the landscape scale across all development projects, they found that relatively rare pool types, such as Northern Volcanic Mudflow pools, are decreasing while Drainageway pools (pools formed in recent alluvial deposits over other formations, which typically support lower species richness) are becoming more common. The four occurrences of slender Orcutt grass in Sacramento County are found on the high terrace Laguna Formation (Sacramento County undated). High terrace formations generally support larger and deeper (longer lasting) pools (Wacker and Kelly 2004). Although projects have occurred fairly equally on high and low terrace sites in the study area, compensation sites were established disproportionately on low terrace formations (Wacker and Kelly 2004). Such shifts in availability of landform types could have negative consequences for persistence of the grass, although the degree of risk is unknown.

In summary, habitat for slender Orcutt grass continues to be highly fragmented throughout most of its range due to conversion of natural habitat for urban and agricultural uses. This

fragmentation results in small isolated populations of this species in all areas but the Modoc Plateau. Highly fragmented, small populations may be highly susceptible to extirpation due to stochastic events, inbreeding depression, or additional environmental disturbance (Gilpin and Soule 1986; Goodman 1987). If an extirpation event occurs in a population that has been fragmented, the opportunities for natural re-colonization will be greatly reduced due to physical isolation from other source populations. In addition, both protected and unprotected populations in the Central Valley may be increasingly subject to decreased suitability of habitat due to competitive exclusion by either native Eleocharis spp (as grazing is discontinued near urban expansion), invasive non-native plant species such as waxy manna grass (C. Witham pers. comm., C. Martz, CDFG, in litt. 2006), or changes in hydrology of vernal pools (Service 2005, Rains et al. 2006, C. Witham pers. comm.).

SOLANO GRASS (*Tuctoria mucronata*)

Species Description and Life History: Tuctoria mucronata was listed as an endangered species on September 28, 1978 (U.S. Fish and Wildlife Service 1978). A recovery plan was then prepared, which became effective 7 years following the listing (U.S. Fish and Wildlife Service 1985). In 2005, critical habitat was designated for T. mucronata and several other vernal pool species in Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Evaluation of Economic Exclusions From August 2003 Final Designation; Final Rule (U.S. Fish and Wildlife Service 2005). Solano grass is in the Orcuttieae tribe of the grass family Poaceae (Reeder 1965). Solano grass was originally described under the name *Orcuttia mucronata*, based on specimens collected "12 miles due south of Dixon, Solano County" (Crampton 1959:108). Reeder (1982) transferred this species to a new genus, Tuctoria, resulting in the currently accepted name *Tuctoria mucronata*. Other common names are Crampton's Orcutt grass (Griggs 1977b), mucronate orcuttia (Smith et al. 1980), and Crampton's tuctoria (Skinner and Pavlik 1994). Characteristics of the Orcuttieae were described earlier in this document under the *Neostapfia colusana* account and those common to the genus Tuctoria were presented in the T. greenei account. *Tuctoria mucronata* is grayish-green, pilose, and viscid. The tufted stems are decumbent, 12 centimeters (4.7 inches) or less long, and do not branch. The leaves are 1 to 4 centimeters (0.4 to 1.6 inches) long, are rolled inward, and have pointed tips. The inflorescence is 1.5 to 6 centimeters (0.6 to 2.4 inches) long, and its base is partially hidden by the uppermost leaves. As for all plants in this genus, the spikelets are arranged in a spiral; the 7 to 19 spikelets in the inflorescence of T. mucronata are crowded together. Spikelets range from 7 to 13 millimeters (0.28 to 0.51 inch) in length and consist of 5 to 10 florets, plus two glumes. The lemmas are 5 to 7 millimeters (0.20 to 0.28 inch) long and taper towards the tip, which is curved outward. The lemma teeth are not obvious except for the central one, which has a sharply pointed tip up to 1 millimeter (0.04 inch) long. Tuctoria mucronata has smooth seeds about 3 millimeters (0.12 inch) long and a diploid chromosome number of 40 (Crampton 1959; Reeder 1982, 1993). Unlike Tuctoria greenei, the inflorescence of T. mucronata remains partly hidden by the leaves, even at maturity. In addition, T. mucronata stems are shorter than those of T. greenei, and the former has tapered lemmas and larger, smoother seeds. The spiral arrangement of the spikelets and single obvious tooth per lemma distinguish T. mucronata

Historic and Current Distribution: Tuctoria mucronata has been found only in the Northern Claypan type of vernal pool (Sawyer and Keeler-Wolf 1995) within annual grassland (California

Natural Diversity Data Base 2005). Pools where T. mucronata occurs tend to be milky from suspended sediments (Holland 1987). The pools that are occupied in Solano County are more properly described as alkaline playas or intermittent lakes, due to their large surface area (Crampton 1959, U.S. Fish and Wildlife Service 1985a), whereas those at the Yolo County site are "relatively small" (C. Witham in litt. 2000a). Soils underlying known T. mucronata sites are saline-alkaline clay or silty clay in the Pescadero series (Crampton 1959, California Natural Diversity Data Base 2003).

Known occurrences are at elevations of about 5 to 11 meters (15 to 35 feet) (California Natural Diversity Data Base 2005). Tuctoria mucronata is most commonly associated with Frankenia salina, Eryngium aristulatum, and Neostapfia colusana; N. colusana occurred near T. mucronata at all three sites. Additional associates include Cressa truxillensis, Distichlis spicata, Phyla nodiflora, Crypsis schoenoides, Eleocharis
macrostachya, and Malvella leprosa (Crampton 1959, California Natural Diversity Data Base 2003). Other than N. colusana, the only other rare plant featured in this recovery plan that co-occurs with T. mucronata is Astragalus tener var. tener; the two taxa grow in the same vernal pool complex in Yolo County, but are not found in the same pool (California Natural Diversity Data Base 2005).

Reasons for Decline and Threats to Survival: Specific threats to Tuctoria mucronata are described below. One additional factor potentially involved in the decline of this particular species may be overcollection (T. Griggs in litt. 2000, California Natural Diversity Data Base 2005). Other additional factors include the evidence that the Yolo County habitat for Tuctoria mucronata has been degraded by discing, excavation, herbicide runoff, application of salt, and industrial contaminants in the groundwater (K. Fuller pers. comm. 1997, C. Witham in litt. 2000a, California Natural Diversity Data Base 2005). A number of specific threats to the species are also continuing. These include competition from aggressive plants at all three known sites where the species occurs or formerly occurred. The primary competitors are Phyla nodiflora at Olcott Lake (C. Witham in litt. 2000a), Malvella leprosa and Crypsis schoenoides at the other site in Solano County (California Natural Diversity Data Base 2003), and Lepidium latifolium (broad-leaved pepper-weed) in Yolo County (K. Fuller in litt. 1999). Altered hydrology may threaten the Olcott Lake occurrence, if it is extant (T. Griggs in litt. 2000). Effects of inappropriate grazing continue to threaten the other Solano County population, as does trampling by hunters (California Natural Diversity Data Base 2005). Eradication of Lepidium latifolium is occurring at the Yolo County site, however, habitat degradation continues to be a threat (California Natural Diversity Data Base 2005, N. McCarten in litt. 2005). Small population size is a threat to the occurrence southwest of Olcott Lake, and to the one at Olcott Lake if it is not already extirpated. In 2005, the site southwest of Olcott Lake had declined to 3 plants and the Olcott Lake site has had no plants since 1993 (California Natural Diversity Data Base 2005).

Conservation Efforts

The Nature Conservancy acquired Olcott Lake in 1980 as part of the Jepson Prairie Preserve. The preserve was transferred to the Solano County Farmlands and Open Space Foundation in 1997, which manages it jointly with the University of California, Davis (C. Witham in litt. 1998). Livestock grazing is now excluded from the areas of the lake formerly occupied by Tuctoria mucronata (U.S. Fish and Wildlife Service 1985a, California Natural Diversity Data Base 2005). Money from the California Endangered Species Tax Check-Off Fund has been used to repair

fences and post signs in the Jepson Prairie Preserve (California Department of Fish and Game 1991). The Nature Conservancy (1991) conducted some research on the control of Phyla nodiflora using herbicides and mechanical removal in the early 1990s. Private individuals have partially implemented one II-111 aspect of the recovery plan, which was to survey suitable habitats for T. mucronata; their efforts led to the discovery of the two populations that were unknown at the time of listing (California Natural Diversity Data Base 2003).

SUISUN THISTLE (*Cirsium hydrophilum* var. *hydrophilum*)

Species Description and Life History: Suisun thistle was listed as endangered on November 20, 1997 (U.S. Fish and Wildlife Service, 1997). Suisun thistle is a perennial herb in the aster family (Asteraceae). It has slender, erect stems that are 3.0 to 4.5 feet tall and well branched above. The spiny leaves are deeply lobed. The lower leaves have ear-like basal lobes. The upper leaves are reduced to narrow strips with strongly spine-toothed margins. Pale lavender-rose flower heads, 1 inch long, grow singly or in loose groups. Flowers appear between July and September.

Historic and Current Distribution: Suisun thistle grows in the upper reaches of tidal marshes, where it is associated with narrowleaf cattail (*Typha angustifolia*), three-square or American bulrush (*Scirpus americanus*), Baltic rush (*Juncus balticus*) and saltgrass (*Distichlis spicata*). It is restricted to Suisun Marsh in Solano County.

In Suisun Bay, most of the 71,100 acres of tidal marshes that existed in 1850 were converted originally to agricultural land and then to diked seasonal wetlands used for waterfowl management. Only 9,340 acres within Suisun Marsh remain as tidal marsh. Most of the remaining tidal marshes are backed by steep levees, allowing for little or no transitional wetland habitat needed for Suisun thistle. By 1975, the plant was thought to have been extirpated from Suisun Bay because the subspecies had not been seen for about 15 years. The subspecies was later rediscovered in 1989 in Suisun Marsh.

The subspecies' current distribution is limited to scattered colonies within relict undiked high tidal marshes (fully tidal, emergent estuarine marshes) at Rush Ranch, the Joice Island portion of Grizzly Island Wildlife Area, and Peytonia Slough Ecological Reserve in Solano County. Field surveys have found several thousand individual plants at Rush Ranch and much smaller numbers at Grizzly Island Wildlife Area. The population at the Peytonia Slough Ecological Reserve declined to a single individual plant observed in 1996.

Reasons for Decline and Threats to Survival: Tidal wetland conversions to diked, managed, or muted tidal marshes; changes to channel water salinity and tidal regimes; mosquito abatement activities; marsh invasions by non-native plants; plant-eating insects; urban, industrial, and agricultural encroachment; impacts from livestock overgrazing; feral pigs; and impacts from unauthorized foot and off-road vehicle traffic.

Critical Habitat: Critical Habitat was designated on April 12, 2007 (Federal Register 72:18517). The Primary Constituent Elements for Suisun thistle are defined as (1) Persistent emergent, intertidal, estuarine wetland at or above the mean high-water line (as extended directly across any intersecting channels);(2) Open channels that periodically contain moving water with ocean-derived salts in excess of 0.5 percent; and (3) Gaps in surrounding vegetation to allow for seed

germination and growth.

EFFECTS OF THE ACTION

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area for this proposed action essentially covers the SFWO's jurisdiction. This can be seen in Figure 1 below, indicating known golf courses throughout the jurisdiction. As one of the primary effects of this action is the movement of glyphosate tolerant bentgrass away from its use sites, any habitat in the SFWO jurisdiction that can support this non-native invasive could be subject to this effect.

For this reason, it is not possible to determine and analyze the effects from all future development and human activities that are reasonably certain to occur throughout the action area. However, the Service anticipates that all existing threats to the species, identified above in the Status of the Species / Environmental Baseline section, are reasonably certain to continue.

Critical Habitat

For this consultation, the Service determined that there are numerous species under the SFWO's jurisdiction which have critical habitat designated that may be affected by the proposed action. We believe, based on the high potential for the movement of gt-cbg over long distances and the ability to transfer glyphosate resistance to related plant species, that glyphosate resistance will become established in non-native invasive plants throughout these designated critical habitats. However, the Service has determined that the proposed project may adversely affect, but is not likely to result in the destruction or adverse modification of these other designated critical habitats. This conclusion is based on the fact that *A. stolonifera*, or related species with which it can hybridize, are already existing non-native invasives throughout the vast majority of designated critical habitats for the species under consultation. While the introduction of glyphosate resistance in these invasive plants will likely reduce the ability to effectively control them, the introduction of glyphosate resistance does not necessarily confer a competitive advantage to these plants. Therefore, we believe that the establishment of glyphosate resistance will not significantly increase the threat already posed to critical habitat by the presence of these non-native invasives in the landscape. For these reasons, the Service concludes that for the designated critical habitats for the species listed above, the proposed action is unlikely to constitute an adverse effect rising to the level of destruction or adverse modification.

Effects Analysis for 16 Federally Listed Plant Species

<u>Scope of Analysis</u>

In analyzing the effects of a proposed action during consultation, the Service is required to consider any direct and indirect effects on the species or critical habitats, together with the effects of other activities that are interrelated or interdependent with the action, and then add

these effects to the environmental baseline. Direct effects are the immediate effects of the action and are not dependent on the occurrence of any additional intervening actions for the impacts to species or critical habitat to occur. These can include the effects of interrelated and interdependent actions. Interrelated actions are part of the proposed action and depend on the proposed action for their justification, while interdependent actions are those that have no independent utility apart from the proposed action under consultation. Indirect effects are those for which the proposed action is an essential cause, and that are later in time, but still are reasonably certain to occur.

The Service applied this scope of analysis to the action under consultation, APHIS' proposed deregulation of gt-cbg. In doing so, we included consideration of the effects from one of the two interdependent actions by the petitioners that would not occur but for the proposed deregulation: the petitioners' subsequent intent to market gt-cbg for sale to golf courses in California (the second of the two interdependent actions, the petitioners' intent to revise the product label for one of its glyphosate formulation in order that it can be applied to the gt-cbg on golf courses, will be discussed further below in the effects section for animal species). As discussed in the Biological Evaluation for this consultation (USDA, 2007b), this interdependent action is linked with the proposed gt-cbg deregulation and is therefore reasonably certain to occur should the deregulation process be finalized. In addition, although the petitioners do not intend to market gt-cbg for residential, industrial, or other recreational applications, we believe it is reasonably certain that gt-cbg will end up being used to some extent for these purposes, considering the Biological Evaluation states that "APHIS regulations under 7 CFR 340 do not explicitly provide the Agency with the authority to regulate the commercial sale or licensing of deregulated products or to enforce such stewardship plans of deregulated products" (USDA, 2007b). Therefore, in evaluating the proposed action on listed species, the Service based its effects analysis on the reasonable certainty that the action will likely result in widespread use of the gt-cbg on existing and future golf courses throughout the jurisdiction of the SFWO, and a determination that gt-cbg will also be used in other non-golf course settings throughout our jurisdiction in California.

Invasive Potential of Glyphosate-Tolerant Creeping Bentgrass

Invasive non-native weeds pose a threat to all of the federally-listed plants identified in Table 1 below. The degree of this threat may vary between the listed plants identified; however, the actual physical threat posed remains fundamentally the same – invasive weeds may outcompete listed plants for available habitat, with the potential for either limiting population expansion opportunities for the listed plants or actually becoming established directly within existing populations of listed plants and eventually gaining dominance of the site. In addition, invasive non-native weeds may also outcompete other native plants closely associated with the listed plants. This has the potential to disrupt any local pollinator populations, and therefore be detrimental to those listed plants that are pollinator-dependent. Creeping bentgrass (*Agrostis stolonifera*) is a known non-native invasive plant established in many locations throughout the SFWO's jurisdiction.

The Biological Evaluation (BE) (USDA 2007b) describes creeping bentgrass as a fast-growing, outcrossing perennial which is biologically and ecologically highly variable, and widespread in managed and natural environments. It can easily adjust and adapt to the local environment, with

vegetative spread and reproduction by: tillers (aboveground stems that grow upward), stolons (horizontal aboveground stems or runners), wind-pollinated flowers, and tiny (0.07 mg) seeds that are dispersed by wind, water and animals (Kik et al 1990). It hybridizes with at least 11 well characterized species of *Agrostis* (Belanger et al. 2003, Wipff and Fricker 2001) and 2 *Polypogon* (rabbitsfoot grass) species (Wipff and Fricker 2001) found in the United States. Creeping bentgrass and several of the hybridizing species can be weedy or invasive in many situations. It forms dense mats that exclude other plant species, thus producing a monoculture with little to no interstitial space available for colonization or expansion by other plants. Once creeping bentgrass is established, little growth of new seedlings occurs within the stand even if overseeding is practiced (Cattani and Struik, 2001). Tiller growth in young bentgrass plants, under non-competitive conditions, was found to be exponential (Cattani and Struik, 2001). It is also particularly well adapted to wetlands. Several non-native *Agrostis* and *Polypogon* non-native species occur throughout the range of threatened and endangered plants in California (http://www.calflora.org/ , accessed 12/01/08).

According to the BE (USDA, 2007b), initial field studies of gt-cbg being grown for seed production found that gene flow through pollen dispersal to resident *Agrostis* species could occur over a distance of 8 – 13 miles in a given season. Gene flow to a sentinel *Agrostis stolonifera* plant in these studies demonstrated that glyphosate tolerance was transferred to the resulting hybrid *Agrostis* seed (Watrud et al. 2004). Subsequent studies found persistence of the glyphosate tolerant strain even after the test fields were destroyed and all gt-cbg plants had been removed. After three years, glyphosate tolerant plants were found several kilometers outside the original study sites (Reichman et al. 2006). In 2007, the Scotts Co. was fined by APHIS for escape of glyphosate-tolerant creeping bentgrass during field trials (USDA 2007a).

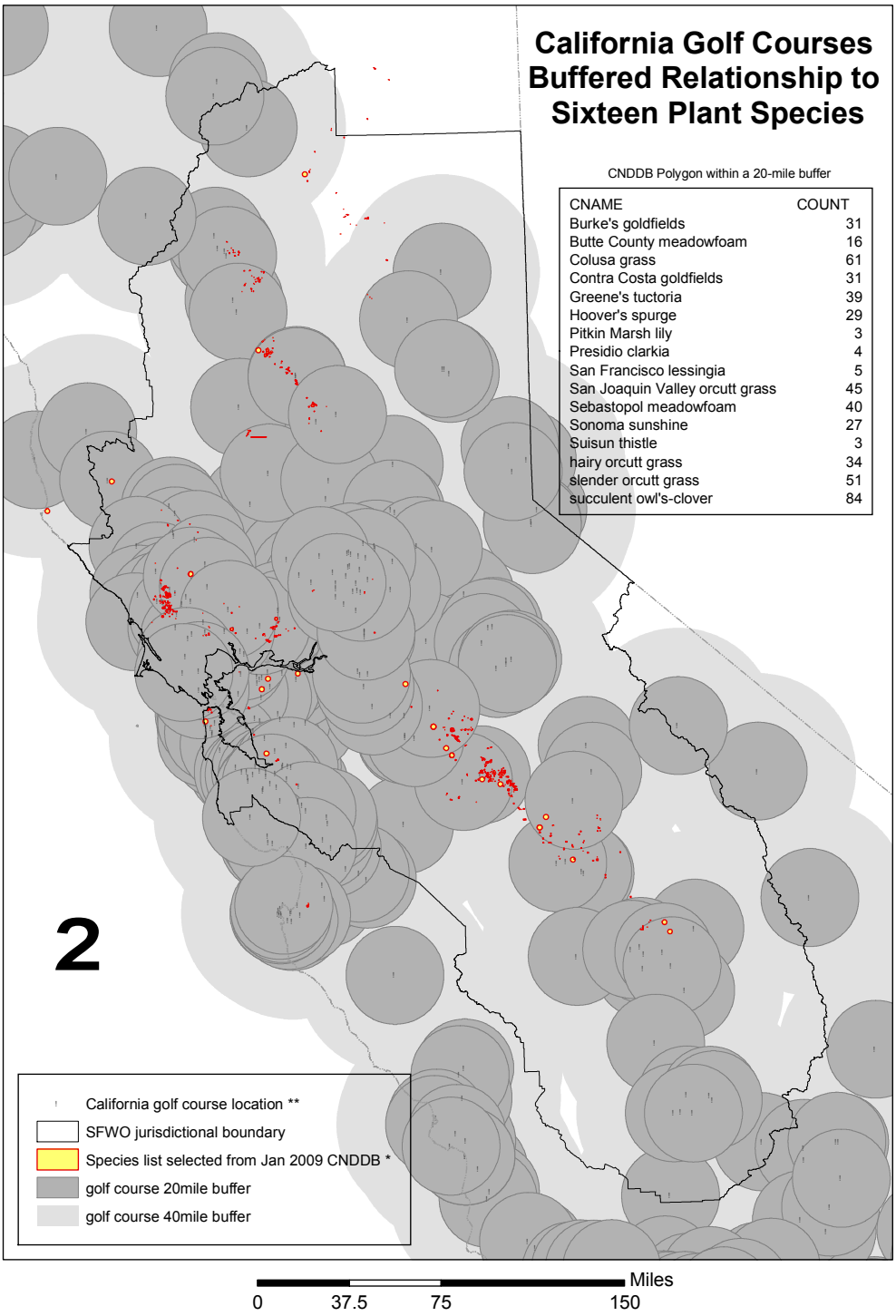
As further explained in the BE (USDA, 2007b), "[i]f gene flow occurred over this distance every year and resulted in the establishment of hybrid populations carrying the gene, the distance over 30 years might be expected to be 8 or 13 miles x 30, or 240 to 390 miles from seed production sites. Wind, water, animal, and human dispersal of seed and vegetative propagules is possible, and may be quite variable. Once pollen flow establishes populations distant from the production sites, the dispersal agents noted would be capable of moving seed and propagules over unknown distances."

Based on this information regarding the potential for gene flow from gt-cbg to resident *Agrostis* and *Polypogon* species, the Service evaluated the likelihood for glyphosate tolerance to show up in the habitats occupied by 16 federally-listed plants under the SFWO's jurisdiction. The federally-listed plants identified in Table 1 below are those we identified that either already have *Agrostis* or *Polypogon* species established in their ranges or are associated with the habitat types that can readily support these invasive species, and are located where only those herbicides labeled for wetland or aquatic uses could be applied.

According to various websites (*e.g.*, http://www.golflink.com/golf-courses), there are over 1100 golf courses in California. We were unable to determine the current exact number of existing courses within the geographic boundary of the SFWO's jurisdiction; however, we did have access to a GIS layer of California golf courses and we were able to overlay this onto our jurisdictional map. With this overlay, we were then able to plot a 20-mile buffer around each known golf course and compare this to known locations of our 16 federally-listed plants from the

California Natural Diversity Database (CNDDB). As seen clearly in Figure 1, there is at least one golf course within a 20 mile radius of a known location for each of the federally-listed plants identified. In many cases, there are multiple courses within 20 miles of known plant locations. Using the worst-case scenario of having every one of these golf courses convert to gt-cbg, their proximity to listed plant occurrences leads to the very high probability that glyphosate tolerance will show up in resident *Agrostis* and *Polypogon* species in listed plant habitats within 1 to 2 years. In drawing this conclusion, it is also important to note that the GIS layer we used for golf courses is likely outdated, with the probability that there are many more established courses now, and that we have no way of knowing how many more are either in development or being planned. This suggests an even greater potential source for gt-cbg seed and pollen, and subsequent gene flow into listed plant habitats.

Figure 1



* California Natural Diversity Database. Biogeographic Data Branch. Department of Fish and Game. January 2009

** 2008 ESRI Data & Maps for use with ESRI software

While the Service understands that turf management on golf courses (*i.e.*, regular mowing and maintenance) may serve to somewhat limit the spread of gt-cbg via seed and pollen dispersal, the anticipated use of gt-cbg in other non-golf course settings as described earlier will likely undergo different management regimes, or possibly even no management at all. Such situations are therefore likely to result in an additional source of seed and pollen available for dispersal throughout the range of listed plants. Considered together, the expected use of gt-cbg on golf courses and other turf settings will ultimately result in the establishment of glyphosate tolerant non-native invasive plants in the habitats of these 16 federally listed plants.

Effects Analysis

The Service based its effects analysis of the proposed action on all of the information outlined above: the proposed action of deregulating gt-cbg, the effects from the interdependent action of marketing gt-cbg for sale in California, the biological and ecological characteristics of creeping bentgrass, the high potential for gt-cbg to move away from its intended use sites, the proximity of known golf course sites and other potential gt-cbg use areas to documented occurrences of threatened and endangered plants, and the ability for gt-cbg to hybridize with and transfer glyphosate tolerance to other non-native invasive plants.

After reviewing the project description within the scope of effects analysis outlined above, we determined that there would be no direct effects on listed species or critical habitats from either the proposed action or the interdependent action; however, we have concluded that the two actions combined would result in indirect effects both to listed plant species and their critical habitats. These indirect effects would occur in two basic forms: 1) glyphosate-tolerant invasive weed species will become established within listed plant habitats, either from the direct spread of gt-cbg itself or through its hybridization with other *Agrostis* or *Polypogon* hybrids, and 2) the use of gt-cbg on golf courses (both from future courses as well as from existing courses converting from non-bentgrass turf to gt-cbg) and other turf settings will result in an overall increase in the amount of creeping bentgrass available in California to invade listed plant habitats. While the increased use of gt-cbg may not result in a significantly substantial addition to the creeping bentgrass population already existing in California, any intentional new planting of bentgrass will likely serve to negate any gains made in past control efforts in listed plant species habitats.

Both of the indirect effects described above, the introduction of glyphosate tolerance and the overall increase in creeping bentgrass populations, are likely to adversely affect the listed plants in Table 1 below. The presence of non-native invasive weeds, such as *Agrostis* and *Polypogon* species, is identified as a threat for each of the 16 federally-listed plants described. Within natural systems, creeping bentgrass and other non-native invasives are typically controlled with glyphosate because of its efficacy, the fact that it binds readily to soil particles making overspray that reaches soil inactive and non-transitory, and it is labeled for use in aquatic habitat restoration (Rodeo™ and Aquamaster® formulations). The only other herbicide that includes a formulation labeled for use over aquatic environments is imazapyr (Habitat® formulation). Imazapyr is a poor alternative to glyphosate for several reasons. Both are broad-spectrum, non-selective systemic herbicides; however, they differ somewhat in their mode of action and chemical characteristics, and these differences are highly relevant in determining the risk these chemicals pose for applications in sensitive plant habitats.

Plant uptake of imazapyr is through foliage and roots, and it is then translocated to meristematic tissues where it disrupts protein synthesis and interferes with cell growth and DNA synthesis. In contrast, plant uptake of glyphosate is via foliage only, where it inhibits enzymatic activity essential for biosynthesis and causes plant cell death (Franz *et al*., 1997; Kamrin, 1997; USEPA, 2006). The risk from glyphosate to non-target plants is from direct drift to foliage, whereas the risk from imazapyr is from both foliage and root uptake.

Imazapyr is water-soluble and a weak organic acid that is non-volatile and is persistent and mobile in soil. Commercial formulations contain either imazapyr acid or an imazapyr isopropylamine salt, both of which are generally dissolved aqueously. However, imazapyr is mainly in anionic form at typical environmental pHs. Since anions (negatively-charged ions) tend to be weakly sorbed to most soils (in effect, repelled by soil matrix surfaces which are generally negatively charged), imazapyr would be expected to be mobile in most soils (C. Johnson pers. comm., 2009). Glyphosate solubility is similar to that of imazapyr; however, glyphosate has a greater affinity to adsorb to soils (C. Johnson, pers. comm., 2009). Adsorption reduces offsite movement, as well as residual toxicity. This indicates that when end-use formulations are applied over soils, there is a greater potential for imazapyr to move away from the application site in surface or sub-surface water, with the subsequent risk of adverse impacts to non-target plants through root uptake. While imazapyr and glyphosate have similar reported half-lives (Mangels 1994, Kamrin 1997, U.S. EPA 2006), imazapyr's combination of water-solubility, low soil adsorption, and long residence time offers increased opportunities for movement away from target sites and impacts to surrounding vegetation.

Based on the above information, the Service believes that the establishment of glyphosate tolerance into non-native invasive weeds such as *Agrostis* and *Polypogon* species in listed plant habitats removes the only viable effective tool for controlling their spread. Without effective control, land managers will be unable to remove the risk posed by those invasives such as *Agrostis* that exhibit a natural competitive advantage over native plants, severely limiting the ability to restore degraded habitats.

Conclusion

It is reasonably certain, based on the factors presented above, that gt-cbg and other glyphosate tolerant *Agrostis* and *Polypogon* hybrids will become established in the range of the listed plants in Table 1, and that these glyphosate tolerant plants will pose a more intractable threat than their non-glyphosate tolerant varieties. The introduction of glyphosate tolerance will adversely affect the 16 listed plants as it will result in the removal of glyphosate as the most effective tool in reducing the threat of non-native invasives. This reduced control then substantially limits the ability to restore listed plant habitats degraded by these invasive species.

However, these glyphosate tolerant species are not anticipated to have an ecologically competitive advantage over the non-tolerant varieties, and therefore the risk they currently pose to listed plants will not be increased by the introduction of glyphosate tolerance. Based on the information available to us regarding the degree of threat currently posed by non-native species, it does not appear as though any resident *Agrostis* or *Polypogon* populations are currently demonstrating a tendency to dominate suitable areas around these 16 listed plant populations and

preclude their expansion, or to invade existing listed plant populations and exert dominance at the site. As a result, we do not believe that the level of threat currently posed from the resident *Agrostis* and *Polypogon* populations will result in the loss of any of these 16 listed plant populations, nor is it likely to preclude their recovery.

After reviewing the current status of the species, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Deregulation of Glyphosate Resistant Bentgrass Project is likely to adversely affect, but is not likely to jeopardize the continued existence of the following species:

Table 1

Neostapfia colusana	Colusa grass	T	LAA
Lasthenia conjugens	Conta Costa goldfields	E	LAA
Castilleja campestris ssp. *succulenta*	Fleshy owl's-clover	T	LAA
Tuctoria greenei	Greene's tuctoria	E	LAA
Lasthenia burkei	Burke's goldfields	E	LAA
Chamaesyce hooveri	Hoover's spurge	T	LAA
Limnanthes floccosa ssp. *californica*	Butte County meadowfoam	E	LAA
Orcuttia inaequalis	San Joaquin Valley orcutt grass	T	LAA
Orcuttia pilosa	Hairy orcutt grass	E	LAA
Orcuttia tenuis	Slender orcutt grass	T	LAA
Limnanthes vinculans	Sebastapol meadowfoam	E	LAA
Lilium pardalinum ssp. *pitkinense*	Pitkin marsh lily	E	LAA
Clarkia franciscana	Presidio clarkia	E	LAA
Blennosperma bakeri	Baker's stickyseed	E	LAA
Lessingia germanorum	San Francisco lessingia	E	LAA
Cirsium hydrophilum var. *hydrophilum*	Suisun thistle	E	LAA

Effects Analyses for Three Federally Listed Plants

Using the same scope of analysis and parameters described above for the 16 plants in Table 1,

the Service also evaluated the effects of the proposed action on three specific federally listed plants in the SFWO's jurisdiction: white sedge (*Carex albida*), soft bird's beak (*Cordylanthus mollis* spp. *mollis*), and Sacramento orcutt grass (*Orcuttia viscida*). These three plants underwent a separate effects analysis due to the fact that the current threat to these species from non-native invasive plants is significantly greater than to the 16 identified above.

White Sedge (*Carex albida*)

As described in the final listing rule, white sedge is a perennial herb in the Cyperaceae family. White sedge was found in perennial wetlands and hillside seeps, between 45 and 60 m (150 and 200 ft) in elevation. The only known extant population is from a site called Pitkin Marsh, supporting mixed native willow riparian, oak woodland, grasslands, perennial freshwater marsh containing seeps and other diverse wetland features such as two "quaking" fens. An observed drying trend in the marsh was noted in the 1997 listing coincident with the addition of wells and other land uses, and the increase in invasive native and nonnative vegetation continues, such as *Festuca arundinacea* (tall fescue), *Holcus lanatus* (velvet grass), Armenian *Rubus armeniacus* (= Himalayan) blackberry [=*Rubus discolor, R. procerus*], and willow (*Salix* sp.) (G. Cooley, California Department of Fish and Game, pers. comm. 2008). White sedge is scattered in six or seven patches (colonies) on a 27-acre property (Patterson 2005, Warner 2008); however, the colonies occupy less than a few acre footprint within that property.

Perennial grasses such as creeping bentgrass (cbg) may behave ecologically much like native perennial bunchgrasses, and may effectively become permanent naturalized components of the grassland, since their phenology and growth-forms and environmental tolerances overlap considerably with native perennial grasses (Baye 2005). Creeping bentgrass has been documented as common at Pitkin Marsh (Warner 2008; P. Warner, Botanical Consultant, pers. comm. 2008), and currently co-occurs intimately within the white sedge colonies in at least three patches at the one known remaining location (P. Warner, Consulting Botanist, pers. comm. 2008). There are multiple golf courses located within 20 miles of Pitkin Marsh (Figure 2), with the closest one (Sebastopol Golf Course) being approximately 2 miles away.

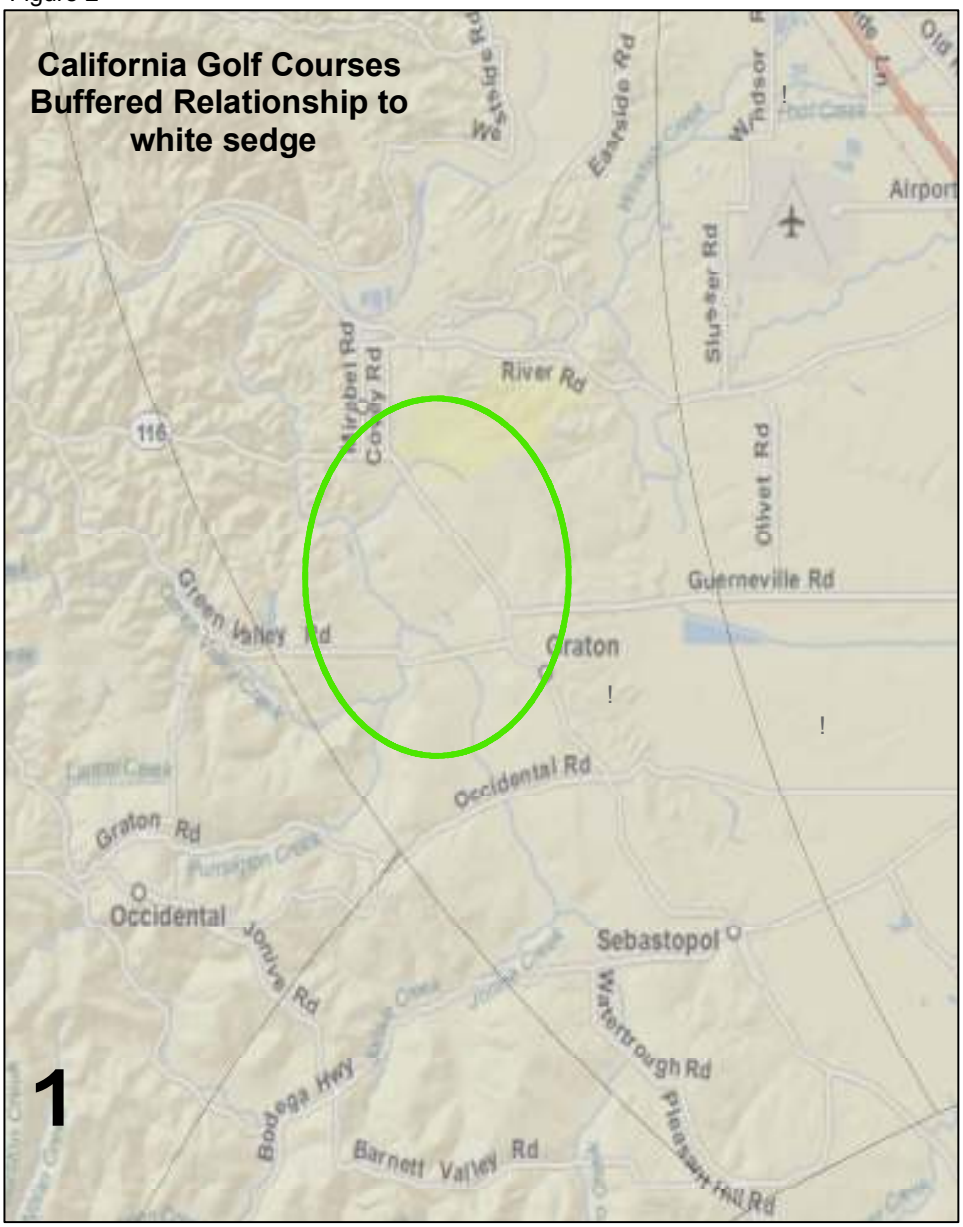
Because of the proliferation of cbg already existing at Pitkin Marsh, and the ease by which glyphosate tolerance can be transferred from gt-cbg populations, the cbg at Pitkin Marsh will likely develop this tolerance in a very short timeframe. The gt-cbg would be difficult to control as it is already adapted to common grassland restoration techniques such as mowing and grazing (K. Symonds in litt. 2008). In the marsh containing white sedge, current management that relies on glyphosate (*e.g.*, hand applications) would no longer be effective, leaving only the herbicide imazapyr as a treatment tool. Due to the issues described earlier surrounding imazapyr as an inappropriate alternative to glyphosate for control, the introduction of gt-cbg at this site will severely restrict the ability to prevent the bentgrass from outcompeting and ultimately displacing the white sedge.

Conclusion

The degree of invasion potential of gt-cbg into the white sedge population, coupled with the loss of glyphosate as a control tool, is likely to adversely affect this species. After reviewing the

current status of the species, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Deregulation of Glyphosate Resistant Bentgrass Project is likely to adversely affect, but is not likely to jeopardize the continued existence of the white sedge.

Figure 2



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Soft Bird's Beak (*Cordylanthus mollis* spp. *mollis*)

The soft bird's beak was listed as endangered on November 20, 1997. It is found predominantly in the upper reaches of salt grass/pickleweed marshes at or near the limits of tidal action. It is associated with pickleweed or Virginia glasswort (*Salicornia virginica*), saltgrass (*Distichlis spicata*), fleshy or marsh jaumea (*Jaumea carnosa*), alkali seaheath (*Frankenia salina*) and seaside arrowgrass (*Triglochin maritima*). Soft bird's-beak is endemic to the San Pablo Bay and Suisun Bay area. The subspecies was historically found in high tidal marshes along the Petaluma River and Napa River through the Carquinez Strait to Suisun Bay and the San Joaquin-Sacramento River Delta in Marin, Sonoma, Napa, Solano, Contra Costa, and Sacramento Counties. It is currently found in 11 widely scattered populations at 9 sites, ranging from Point Pinole and Fagan Slough marsh through the Carquinez Strait to Suisun Bay in Napa, Solano and Contra Costa Counties. The largest population in a 2000 survey (Grewell et al. 2003) covered only approximately 4.7 acres at the Hill Slough Wildlife Area in Suisun Marsh. The next largest populations are found in 0.77 acre and 0.2 acre, at Benecia State Recreation Area and Rush Ranch respectively.

A 1999-2003 vegetation survey at the Suisun Marsh (CDFG 2004) (http://www.iep.ca.gov/suisun/dataReports/reports/ChangeDetectionReport2003.pdf,) shows a number of nonnative species of concern. Acreages estimated for selected species or alliances were as follows: *Polypogon monspeliensis* (generic), 30.50 acres; *Lepidium latifolium*, 1060 acres, and *Agrostis avenacea* , 29.04 acres. Other Agrostis species present at Suisun Marsh include *Agrostis stolonifera* (creeping bentgrass), *Agrostis exarata*, and *Agrostis viridis* (Estrella pers. comm. 2008). *Polypogon monspeliensis, A. stolonifera*, *A. exarata*, and *A. viridis* can hybridize with creeping bentgrass. *A. avenacea* is not known to form hybrids with creeping bentgrass (USDA 2007b). *Lepidium latifolium*, a tall, clonal herb in the mustard family that establishes in dense stands is one of the most potentially detrimental to soft bird's beak region-wide in the middle and upper brackish tidal marsh zones. *Lepidium latifolium* generally excludes soft bird's beak*;* there are no reports of its populations regenerating annually under spreading tall canopies of *Lepidium latifolium*. The invasion of brackish tidal marshes by *Lepidium latifolium* has proceeded rapidly in the last two decades. It currently threatens soft bird's beak populations at Rush Ranch and Southhampton Marsh (B. Grewell, P. Baye pers. observ. 1991-1999) and at the Benecia State Recreation Area (Baye, pers. comm. 2008) where the population is found within approximately 0.77 acres. There are current efforts and ongoing planning to manage *Lepidium latifolium* in Suisun Marsh.

Polypogon monspeliensis, an annual grass with 8 – 40 inch stems is one of the most common grasses found throughout California's wetlands, including seasonally or permanently saturated wetlands and under brackish and saline conditions (Hickman 1993, Suisun RCD 2000). The Goals Project (2000) identified that most high salt marsh zones in San Francisco Bay include many non-native species that sometimes dominate the zone and two of the eleven common non-native plants of the high salt marsh zone include *Polypogon monspeliensis* and *Lepidium latifolium*. It is reasonable to assume that successful control of *Lepidium latifolium* would likely open up opportunities for other non-native species such as *Agrostis* and *Polypogon* spp. to become more widespread throughout soft bird's beak populations, the largest found in only 4.7 acres. Although no estimates are available for the populations of *A. stolonifera*, *A. exarata*, and *A. viridis* at Suisun Marsh or other soft bird's beak population sites, their populations can be

problematic. *A. stolonifera* is known to grow in brackish waters throughout Suisun Marsh and can be confused with the native saltgrass (Baye, pers. comm. 2008). Baye (pers. comm. 2008) further noted that *A. stolonifera* and *Polypogon monspeliensis* can readily establish after grading during restoration efforts for soft bird's beak.

There are numerous golf courses near known soft bird's beak locations (Figure 3). Because of the proximity of soft bird's beak to these golf courses and to identified *Agrostis stolonifera and Polypogon monspeliensis* occurrences, and the ease by which gt-cbg can travel, gt-cbg will likely become established in the soft bird's beak populations from Point Pinole and Fagan Slough marsh through the Carquinez Strait to Suisun Bay in Napa, Solano and Contra Costa Counties. *Agrostis* and *Polypogon* spp. occur throughout the current range of soft bird's beak. Grewell (2004) noted that experimental tests indicate vegetation gap creation is a successful restoration technique that will enhance rare plant establishment and fitness, *but the benefits can be offset by exotic plant invasions*. Demographic monitoring revealed seedling life stage vulnerability that can influence population growth and persistence. High seedling mortality was strongly correlated with the presence of exotic winter annual plant species (e.g. *Polypogon monspeliensis*) that are unsuitable hosts for endangered root hemiparasites (Grewell 2004). Successful control efforts of *Lepidium latifolium* may open up opportunities for other non-native species, such as *Polypogon monspeliensis* which is an inappropriate host for soft bird's beak, to become further established.

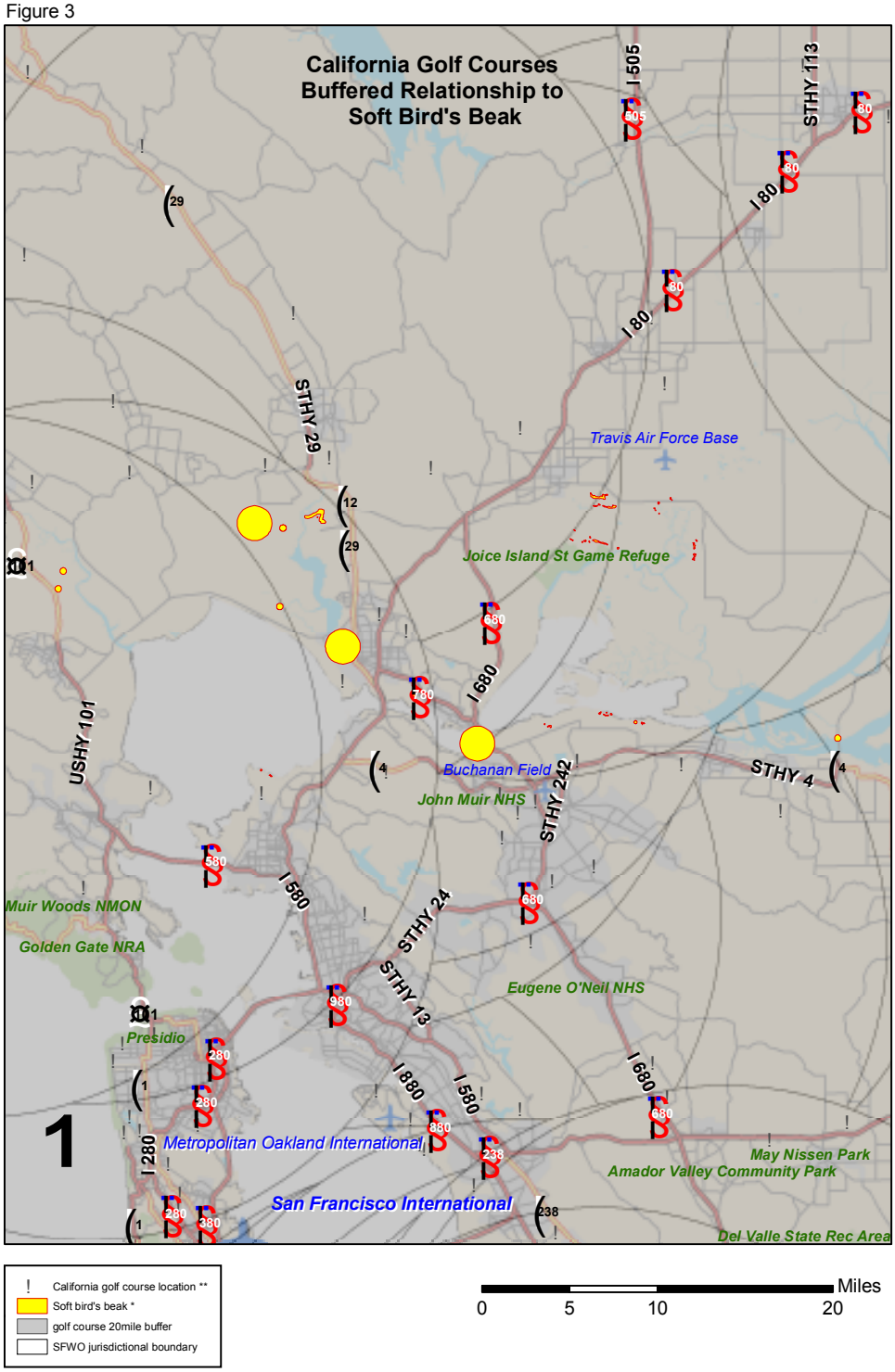
Glyphosate as Rodeo® is one of the few herbicides that can be used over the water in wetlands in California that has been shown to be effective for control of the main invasive plant, *Lepidium latifolium*, which is considered a threat to soft bird's-beak in its designated critical habitat. Fair to moderate control is obtained, and repeat applications may be necessary for complete control. At Rush Ranch, land managers use glyphosate to control non-native species because of the timing in which it can be used in and around aquatic landscapes (Wallace pers. comm. 2008). Because glyphosate is the only effective and feasible herbicide used in aquatic environments, repeat applications of glyphosate herbicides to control non-native plants (e.g. *Lepidium latifolium*) will likely result in the selection of *Agrostis* or *Polypogon* species that are glyphosate resistant.

Because *Polypogon monspeliensis* is considered an ineffective host plant for soft bird's-beak, the presence of glyphosate tolerant hybrids of creeping bentgrass with *P. monspeliensis* would likely threaten this subspecies as well as its designated critical habitat. Inappropriate host plants such as *Polypogon monspeliensis* in *Cordylanthus mollis ssp. mollis* habitat are likely the most significant threat to all occurrences of the species (Bloom in litt. 2008).

Conclusion

The degree of invasion potential of gt-cbg into the soft bird's beak population, coupled with the loss of glyphosate as a control tool, is likely to adversely affect this species. After reviewing the current status of the species, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Deregulation of Glyphosate Resistant Bentgrass Project is likely to adversely affect, but is not likely to jeopardize the continued existence of the soft bird's beak.

Figure 3



* California Natural Diversity Database. Biogeographic Data Branch. Department of Fish and Game. January 2009

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Sacramento Orcutt Grass (*Orcuttia viscida*)

Sacramento orcutt grass is a narrowly distributed annual grass in the Orcuttieae tribe of the grass family Poaceae. The range of the species lies in a narrow zone of remnant depositional stream terraces at the base of the Sierran foothills (Stone *et al*. 1988) in Northern Hardpan and Northern Volcanic Mudflow vernal pools. The species was first collected in 1936 near Phoenix Field, northeast of the City of Sacramento, and is now known from nine occurrences, all in eastern Sacramento County. One occurrence, in Phoenix Park, was established by the introduction of seeds from a nearby natural occurrence in 1978 and continues to persist (Stone *et al*. 1988, CNDDB 2008). The occurrences are found at an elevation of 46 to 82 meters (150 to 270 feet) on high-terrace vernal pools that range in area from 0.1 hectare (0.25 acre) to 0.28 hectare (2.03 acres). Two occurrences have been extirpated, one by urban development and one by conversion of the vernal pool habitat to a stockpond. Monitoring of Sacramento orcutt grass occurrences shows that the threat of competition from invasive, nonnative plants has increased since the time of listing.

Phoenix Park is an urban park with lawns, trails, and adjacent residential development. *Agrostis* and related species are adapted to a wide variety of habitats including several types that are found at Phoenix Park. These habitats include marshes, stream and lake margins, ditches, grasslands and pastures, open woodlands, damp arable land, paths, urban parks and lawns, and rough ground such as roadsides, prairies, meadows, and vernal pools (Grime *et al.* 1988 and Kik *et al.* 1991 in Watrud *et al.* 2004). Because of its habitat plasticity, *Agrostis stolonifera* is found in vernal pools and is likely to grow at the same water depth as Sacramento orcutt grass. Vernal pools at the Phoenix Park occurrence of Sacramento orcutt grass are infested with weedy species, including *Glyceria declinata* and *Agrostis stolonifera,* due to changes in the pools' hydrology and fertility (J. Gerlach, consulting biologist, pers. comm. 2008).

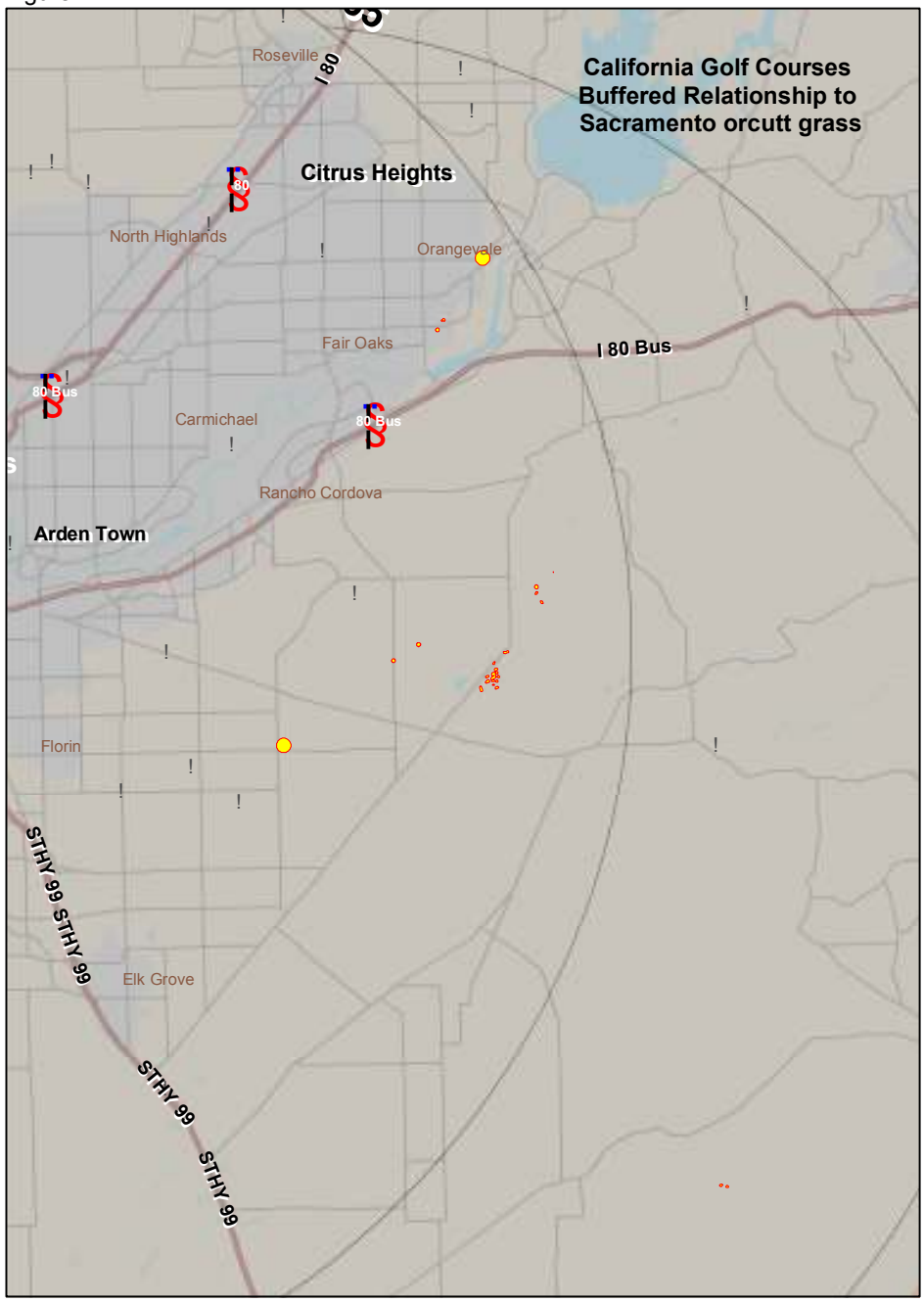
All of the nine Sacramento orcutt grass populations are located between approximately 2 miles and 12.5 miles from one or more golf courses. Currently 17 golf courses are located within a 12.5-mile radius of one or more Sacramento orcutt grass populations (Figure 4). Should any of these golf courses begin using the gt-cbg, the grass will ultimately become directly established in the wetlands supporting the Sacramento orcutt grass or may hybridize with *Agrostis stolonifera* already present there and produce glyphosate-resistant offspring.

Because of the proximity of *Agrostis stolonifera* to Sacramento orcutt grass at Phoenix Park (within the same pool), and the ease by which gt-cbg can travel, gt-cbg will likely become established in vernal pools in Phoenix Park. Moreover, due to the proximity of likely future sources of gt-cbg to vernal pools in Sacramento County that support Sacramento orcutt grass, gt-cbg will become established in additional occurrences of the species. Competition with nonnative perennial grasses is one of the biggest threats to Sacramento orcutt grass and its habitat. The gt-cbg would be difficult to control as it is already adapted to common grassland restoration techniques such as mowing and grazing, and the loss of the use of glyphosate as a control measure will severely restrict the ability to prevent the gt-cbg and glyphosate tolerant *Polypogon* hybrids from outcompeting and ultimately displacing Sacramento orcutt grass.

Conclusion

The degree of invasion potential of gt-cbg into the Sacramento orcutt grass population, coupled with the loss of glyphosate as a control tool, is likely to adversely affect this species. After reviewing the current status of the species, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Deregulation of Glyphosate Resistant Bentgrass Project is likely to adversely affect, but is not likely to jeopardize the continued existence of the Sacramento orcutt grass.

Figure 4



* California Natural Diversity Database. Biogeographic Data Branch. Department of Fish and Game. January 2009

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Effects Analysis for California Red-legged Frog

As discussed earlier in our effects analysis for listed plant species, we evaluated the proposed action along with two interdependent actions by the petitioners that would not occur but for the proposed deregulation of gt-cbg: 1) the intent to market gt-cbg for sale to golf courses and 2) the intent to revise the product label for a specific glyphosate product so that it can be applied to the gt-cbg on golf courses. This second interdependent action would amend the currently labeled usages for Round Up Pro, a glyphosate formulation used in terrestrial applications and with restricted usage in or near aquatic habitats, to include applications for weed control in gt-cbg settings. The Service does not have any comprehensive list of herbicides typically used to control weed pests on golf course tees, fairways, and greens; however, based on the proposal to revise the label for Round Up Pro in conjunction with the proposed deregulation of gt-cbg, we believe it is likely that Round Up Pro is either not currrently registered for use on golf courses or is not a preferred control mechanism due to the potential for impacts to desirable turfgrass. Therefore, the Service evaluated the effects of the proposed action under the reasonable assumption that the use of this terrestrial formulation of glyphosate on existing and future golf courses would be significantly increased over current weed control practices, thereby increasing its presence in the environment.

Golf courses, particularly those in arid or semi-arid environments, need to irrigate in order to keep the playing turf viable throughout the dry parts of the year. Offsite movement of this irrigation water, which may contain fertilizers and pesticides applied to the turf, can occur either through surface or subsurface pathways and can introduce contaminants into non-target aquatic systems. In addition, aerial drift of these contaminants can occur from many common application methods. Existing golf courses in the SFWO's jurisdiction are widely distributed and often include either human-made or natural aquatic components, or occur near sensitive aquatic ecosystems such as vernal pools. In many cases, these aquatic golf course components are tied in to larger watersheds or other aquatic ecosystems. Based on these factors and those discussed below it is our belief that the changes in glyphosate use associated with the proposed action pose a significant risk to certain federally listed aquatic or aquatic-dependent species and their habitats.

<u>Environmental Concentrations from Offsite Movement</u>

Drift and non-target toxicity to aquatic organisms from pesticide use is of considerable concern. Glyphosate, in its terrestrial formulations (Round Up and Round Up Pro) has been documented to have acute and chronic toxicity to aquatic species such as Ranid frogs, catfish, crayfish, and various species of aquatic invertebrates. As a result, glyphosate is approved for use in its aquatic formulation (Rodeo) to minimize impacts to aquatic resources. Laboratory toxicity data suggests that glyphosate is not the source of non-target toxicity observed in aquatic organisms and that other inert and proprietary ingredients such as adjuvants, surfactants, and spreaders contained in the terrestrial formulations is the main source of aquatic toxicity. In order of increasing toxicity, the relative aquatic toxicity for glyphosate and its formulations is as follows: Round Up > Rodeo > glyphosate. However, toxicity and monitoring data are most often expressed in terms of glyphosate concentration when in fact it is the formulation being used that is of greatest concern.

Monitoring information for glyphosate in surface waters is limited and somewhat variable. Tsui and Chu (2008) reported on glyphosate concentrations in experimental wetlands after treatment with Round Up applied using a hand held sprayer, and found glyphosate was transported several meters from treated areas within 30 minutes post treatment. Glyphosate concentrations in estuarine waters were as high as 2.191 mg/L within 1 day post treatment in an area that received no direct herbicide application. Freshwater concentrations were nearly an order of magnitude lower with a maximum glyphosate concentration of 0.216 mg/L again observed in an area that received no direct herbicide application. There was no measurable wind during application and no precipitation before or after application. Aerial drift and deposition on the water surface followed by transport within wetlands via wind driven currents was the most likely mechanism responsible for glyphosate concentration patterns observed in these wetlands. In the estuarine system, maximum glyphosate concentrations were nearly an order of magnitude higher than U.S. Environmental Protection Agency (EPA) modeling estimates for aquatic applications (i.e. Rodeo) and approximately 20 times higher than estimated Round Up formulation concentrations using a five percent drift estimate for terrestrial applications (USEPA 2008). Concentrations remained elevated for approximately 3 days post treatment in the estuarine wetland and remained at detectable concentrations for the duration of the experiment (approx. 30 days). Concentrations declined more rapidly in the freshwater wetland, but remained at detectable concentrations throughout the experiment. In both wetlands, glyphosate was deposited on surface sediments and was degraded more rapidly in the estuarine than freshwater wetland. The presence of higher concentrations of chelating elements such as copper and iron in the freshwater wetland appear to be responsible for faster decrease in aqueous glyphosate as it is deposited in the sediments and may become less bioavailable to microbial degradation as a result of complexation with these chelating elements.

In their recent effects determination for glyphosate effects on the California red-legged frog, the EPA cites a USGS study that sampled for glyphosate in overland flow and in surface water in the Leary Weber Ditch Basin, Hancock County, Indiana (Baker et al., 2006). The 2.5 mi^2 study basin is primarily agricultural (87%), farmed with corn and soybeans, and flow in the ditch is dominated by tile-drain contributions. Overland flow and surface water samples were collected during two storm events occurring one to two weeks following pesticide application. Glyphosate was detected in all overland flow samples. In the first storm event, glyphosate concentrations in overland flow were approximately 0.3 mg/L to 0.5 mg/L and were approximately an order or magnitude lower in the second storm event. Glyphosate was detected in 13 of 19 surface water samples taken from the Leary Weber Ditch.

Based on EPA approved dilution calculations incorporating a drift parameter of five percent for terrestrial applications, the estimated aqueous concentration of terrestrial formulation that should occur in adjacent areas using labeled application rates is 0.0952 mg/L. Based on a forty percent average active ingredient concentration of terrestrial glyphosate formulations, including Round Up Pro, the estimated aqueous glyphosate concentration is 0.038 mg/L. Tsui and Chu (2008) observed freshwater glyphosate concentrations that were 6 times higher than these estimates within 1 day post treatment. Glyphosate concentrations in estuarine waters were 60 times higher within 1 day post treatment and remained greater than an order of magnitude higher for up to 3 days post treatment. Based on the same forty percent active ingredient concentrations, terrestrial Round Up formulation concentrations may have been as much as an order of magnitude higher than EPA estimates in adjacent freshwater habitat. In the Baker *et al*. study (2006), glyphosate

concentrations an order of magnitude above those predicted by EPA models were observed in sheet flow samples collected one week post application and did not reach estimated levels until 2 weeks post application. Terrestrial formulation concentrations in sheet flow from this site may have been as high 1666 µg/L for as long as one week after application. These concentrations are within the range of concentrations known to cause acute toxicity in aquatic invertebrate species.

Glyphosate and its formulations also have aquatic toxicity impacts to amphibians. No Observable Adverse Effects Concentrations (NOAEL) for glyphosate effects on the African clawed frog (*Xenopus laevis*) were between 0.1 and 0.3 mg/L, and was acutely toxic with LC50 concentrations between 0.825 and 0.975 mg/L. The estimated Lowest Observable Adverse Effect Concentration (LOAEC) for mortality in the leopard frog (*Rana pipiens*) was 0.75 mg/L. LC50 concentrations for the green frog (*Rana clamitans*) and leopard frog (*Rana pipiens*) were between 1.65 and 2.175 mg/L, respectively (EPA 2008). In a recent laboratory experiment, Relyea (2005) found that a commercially available Round Up formulation applied to laboratory mesocosms at labeled rates resulted in 79% mortality in juvenile frogs (*Hyla versicolor, Bufo americanus, Rana pipiens*) within one day and 98% mortality of all tadpoles within 3 weeks of application.

As discussed above, concentrations of glyphosate and its formulations approach acute and chronic effects thresholds in aquatic environments when applied according to currently labeled standards. This has significant individual and population level consequences for listed species that may impact their survival and recovery. Safety margins that have been recommended for use in risk assessments involving sensitive species range from 0.05 (Ripley et al 2004; Urban and Cook 1986) to 0.5 (EPA 2004), and when applied increase the risk of changes in glyphosate use to federally listed aquatic species.

Conclusion

Based on the information available regarding the potential for offsite movement of terrestrial glyphosate formulations (Round Up), and data on toxicity of these formulations to amphibians, the Service believes that the proposed action of deregulating gt-cbg will adversely affect the California red-legged frog, but will not jeopardize its continued existence.

Effects Analysis for Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) (beetle)

Direct, Indirect and Cumulative Effects

Given the locations of known occurrences of the beetle on and adjacent to golf course lands, it is likely that the beetle would be affected by the deregulation of gt-cbg. While we do not anticipate that the proposed action will directly affect this listed species, our analysis is based on the indirect effects resulting from the increased use of glyphosate that will occur as a result of the proposed action. As a result of this bentgrass being glyphosate resistant, it is anticipated that glyphosate will be used in greater quantities on golf courses. While golf courses may currently use various formulations of glyphosate for management of weedy vegetation, since it is a non-selective herbicide, current application tends to be focused so as not to eliminate non-target species. With the deregulation and use of gt-cbg, glyphosate is likely to be applied in a less site-specific manner, therefore increasing risk of affecting the beetle due to the drift or inadvertent

application of the herbicide to occupied habitat.

Beetles spend most of their life as larvae within the stems of elderberry shrubs. Beetles emerge from shrubs between mid-March though June, with adult activity spanning just a few weeks (USFWS 1984). Application of glyphosate to areas adjacent occupied beetle habitat is likely to result in adverse effects to the beetle through direct contact with the herbicide, or through the loss of habitat. Although no specific is available to assess the toxicity of glyphosate on the valley elderberry longhorn beetle, formulations of glyphosate have been considered to be slightly toxic to aquatic invertebrates, and its use has shown a decline in the abundance of terrestrial invertebrates (House et. al 1987; Cox 1995), as such, it is likely that glyphosate may result in injury or mortality of the beetle. Additionally, because glyphosate in a broad spectrum herbicide, incidental application of glyphosate on elderberry shrubs is likely to result in partial or complete die-back of the shrub. The death of this sole host plant will result in the loss of food and habitat for both the adult beetle and beetle larvae, which is likely to lead to the mortality of larvae within affected stems.

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Deregulation of Glyphosate Resistant Bentgrass Project, is not likely to jeopardize the continued existence of valley elderberry longhorn beetle. Most known beetle occurrences are not located on golf courses, therefore the proposed action would not lead to a substantial decline in number of the beetle, a substantial reduction in range of the beetle and it would not preclude the recovery of the beetle.

NOT LIKELY TO ADVERSELY AFFECT

Giant garter snake (*Thamnophis gigas*)

During our initial evaluation of potentially affected species, the Service had determined that the proposed action may affect, and was likely to adversely affect the giant garter snake (GGS). This determination was based on habitat degradation resulting from gt-cbg invasion and impacts associated with increased use of glyphosate that is likely to occur as a result of the deregulation of gt-cbg for use on golf courses. After further review it is unlikely that gt-cbg poses a significant risk of habitat degradation as it is only semi-aquatic and poses little risk of reducing suitable aquatic habitat and it is unlikely to out compete and displace other native and non-native species that may be used as cover for the GGS. Non-native invasive plant species, such as evening primrose and water hyacinth, that pose a risk to GGS are fully aquatic and are currently not fully controlled using glyphosate and require alternative herbicides or other methods for their control. The GGS is a reptile that utilizes aquatic habitat for dispersal and foraging. The GGS is a reptile and has no fully aquatic life stage. As a result the risk to aquatic species associated with increased glyphosate use does not apply. Additionally, any impacts to aquatic GGS prey that may occur with increased glyphosate use are expected to be negligible relative to other threats to the species. Based on this, we have determined that the proposed action may affect, but is not likely to adversely affect the giant garter snake.

Shasta Crayfish (*Pacifastacus fortis*)

During our initial evaluation of potentially affected species, the Service had determined that the proposed action may affect, and was likely to adversely affect the Shasta crayfish. This determination was based on the increased use of glyphosate that is likely to occur as a result of the deregulation of gt-cbg for use on golf courses, and the effects of various formulations of glyphosate on aquatic animals. After further review; given the limited range of this listed crayfish and that it is unlikely the increased glyphosate use promoted by deregulation of ct-gbg will come in contact with water occupied by this species, we have determined that the proposed action is not likely to adversely affect the Shasta crayfish.

Delta green ground beetle (*Elaphrus viridis*)

During our initial evaluation of potentially affected species, the Service had determined that the proposed action may affect, and was likely to adversely affect delta green ground beetle. This determination was based on impacts associated with increased use of glyphosate that is likely to occur as a result of the deregulation of gt-cbg for use on golf courses. After further review it is unlikely that gt-cbg poses a significant risk to this species. The delta green ground beetle is a insect that occupies the outer margins of vernal pools as well as connecting habitat and has no fully aquatic life stage. As a result the risk to aquatic species associated with increased glyphosate use does not apply. Additionally, any impacts to this beetle's prey that may occur with increased glyphosate use are expected to be negligible. Based on this, we have determined that the proposed action may affect, but is not likely to adversely affect the delta green ground beetle.

Lange's Metalmark Butterfly (*Apodemia mormo langei*)
and
Contra Costa Wallflower (*Erysimum capitatum* var. *angustatum*)

During our initial evaluation, the Service had determined that the proposed action may affect, and was likely to adversely affect both Lange's metalmark butterfly and Contra Costa wallflower. We based this determination on information indicating that glyphosate was used as a tool for the management and recovery of these listed species. The deregulation of gt-cbg is likely to preclude the use of glyphosate as a management tool for these species. However, upon further review, it was determined that glyphosate is not used to manage for these species. Additionally, there is no information available to indicate that creeping bentgrass, or sexually compatible species, poses a threat to either of these species, or that an increased use of glyphosate is likely to adversely affect these species due the lack of proximity to golf courses. As such, we have determined that the proposed action is not likely to adversely affect Lange's metalmark butterfly or Contra Costa wallflower.

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DRAFT

Biological Opinion
regarding
The Effects of the Animal and Plant Health Inspection Service's Proposed Deregulation of Genetically Modified, Glyphosate Tolerant Creeping Bentgrass on Endangered Species Act-listed Wildlife and Plant Species and their Critical Habitats

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U.S. Fish and Wildlife Service
Drafted by: Oregon Fish and Wildlife Office,
Portland, Oregon

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Director, U.S. Fish and Wildlife Service

Contents

DRAFT

INTRODUCTION

This document transmits the Fish and Wildlife Service's (Service) biological opinion based on our review of the Animal and Plant Health Inspection Service's (APHIS) proposed national deregulation of glyphosate tolerant creeping bentgrass (*Agrostis stolonifera*) under the Plant Pest Act and its effect on the following listed species and critical habitats: the endangered Fender's blue butterfly (*Icaricia icarioides fenderi*), endangered Willamette daisy (*Erigeron decumbens* var. *decumbens*), endangered Bradshaw's lomatium (*Lomatium bradshawii*), threatened Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), threatened Nelson's checkermallow (*Sidalcea nelsoniana*), threatened golden paintbrush (*Castilleja levisecta*) and critical habitat for the Fender's blue butterfly, Kincaid's lupine, and the Willamette daisy. This biological opinion was developed in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your November 16, 2007, request for formal consultation was received on November 17, 2007.

This biological opinion is based on information provided in the September 2006 biological evaluation prepared by APHIS and other sources of information cited herein. A complete decision record of this consultation is on file at the Service's Endangered Species Program Office in Arlington, Virginia (hereafter referred to as the Service's Washington Office).

CONSULTATION HISTORY

On November 16, 2007, APHIS submitted a request (and a biological evaluation) to the Washington Office of the Service for formal consultation on its proposal to deregulate glyphosate tolerant creeping bentgrass.

On June 4, 2008, the Washington Office asked the Regions and their respective field offices to consider the potential effects of the action on listed species and critical habitat. In its biological evaluation, APHIS identified several listed species in Oregon and California that were likely to be adversely affected by the proposed action. Elsewhere, no adverse effects to listed species or critical habitat were anticipated. The Service's Region 1 determined that a listed plant species (the golden paintbrush) in southwest Washington was also likely to be adversely affected.

The extent to which the proposed action could adversely affect listed species has not been well characterized in the literature. Although the threats of invasive, non-native grasses in general is commonly understood, the effect of creeping bentgrass on the conservation of listed species was not well studied at the time the Service began working with APHIS on this consultation. In recent critical habitat rules and draft recovery plans, the Service documented threats from non-native invasive grasses, but did not explicitly discuss concerns over creeping or other bentgrass species.

To understand the potential risk posed by a glyphosate tolerant creeping bentgrass, the Service sought to ascertain how pervasive and invasive glyphosate intolerant creeping bentgrass was throughout Oregon and southwest Washington. To do this, the Service's Oregon Fish and Wildlife Office (OFWO) contacted relevant experts including landowners, land managers, and restoration ecologists for information about the dominance of creeping bentgrass in and around

listed species in Oregon, management of creeping bentgrass, and the effect of creeping bentgrass on listed species. Data obtained from these contacts are summarized in Service (2008a) and provide an estimate of the level of bentgrass invasion across listed species habitats in Oregon. In a concurrent effort, staff from the Service's Washington Fish and Wildlife Office (WFWO) attempted to determine levels of creeping bentgrass invasion in and around golden paintbrush populations; the results of that effort are reported herein.

At the time of these professional opinion surveys, it was believed that the primary bentgrass weed in Oregon and southwest Washington was creeping bentgrass, *Agrostis stolonifera*. However, bentgrass species are difficult to distinguish and the taxonomy of the genus has been much debated in the literature. Since the professional opinions were collected, it has been determined that multiple species of bentgrass, including creeping bentgrass, are problem weeds in and around listed species in Oregon and southwest Washington. For that reason, the information in Service (2008a) that reported exclusively *Agrostis stolonifera* infestation levels has been interpreted in this biological opinion as non-specific bentgrass species infestation levels.

Initial responses from restoration experts to the OFWO's solicitation for information indicated a strong concern for bentgrass invasion and highlighted the difficulties of managing bentgrass (Service 2008a), which is a competitive, ruderal species capable of reproducing by both sexual and asexual means (Banks *et al.* 2005, Cattani and Struik 2001). Further investigation of best available information on this subject revealed concerns for crossing between the glyphosate tolerant creeping bentgrass and other bentgrass species (Banks et al. 2005, Belanger et al. 2003, Christoffer 2003, Wipff and Fricker 2001) and the potential for pollen of the glyphosate tolerant creeping bentgrass to move long distances (Watrud *et al.* 2004).

On February 25, 2009, the Service provided a draft biological opinion to APHIS and the applicants in this consultation, the Monsanto Company (Monsanto) and The Scotts Company (Scotts). The draft biological opinion included findings that the proposed action is likely to jeopardize the Willamette daisy and Bradshaw's lomatium and adversely modify critical habitat for the Fender's blue butterfly and the Willamette daisy. This draft biological opinion did not include any reasonable and prudent alternatives (RPAs). Several potential RPAs were considered but rejected because they did not meet the criterion of an RPA to avoid jeopardy and adverse modification.

In response to the draft biological opinion, Scotts sent a letter, dated March 17, 2009, to the Service. The following day, Service personnel met with Scotts' representatives in Washington, D.C., to discuss concerns over the draft biological opinion. At that time, Dr. Paul Henson, the OFWO State Supervisor, offered to host Scotts' personnel in Oregon for a tour of Willamette Valley sites being impacted by the presence of bentgrass.

Scotts traveled to Oregon for a two-day field trip followed by a meeting with the Service on April 10, 2009. During the site visits, Scotts personnel stated that none of the plants they saw were creeping bentgrass but were, in fact, other species of bentgrass, most likely dryland bentgrass (Agrostis castellana). Scotts maintained that creeping bentgrass was not a weed in the Willamette Valley. Scotts collected samples for grow-out and genetic analysis to determine conclusively what species were present.

Scotts sent another letter to the Service on April 29, 2009, indicating further concerns over the draft BO, and reiterating that creeping bentgrass was not a weed in the Willamette Valley.

In an effort to determine which species of bentgrass were present in and around listed plants in the Willamette Valley of Oregon, OFWO personnel worked with experts on bentgrass genetic analysis from the U.S. Environmental Protection Agency (USEPA) to analyze samples from several sites in the Willamette Valley including some of the sites where Scotts had raised concerns over the identity of the plants.

Results from this analysis determined that creeping bentgrass was located at several sites known to support listed plants (Reichman 2009). Scotts provided results from its genetic work that acknowledged that creeping bentgrass and dryland bentgrass were found at the sites visited on the tour in April (Scotts 2009). Given time and resource constraints, neither of these survey efforts was statistically rigorous or representative of the Willamette Valley-Puget Trough region as a whole. However, these results show that multiple species of bentgrass, including creeping bentgrass, occur in and around populations of the listed species and critical habitat addressed in this opinion.

On June 5, 2009, Dr. Paul Henson provided several options to APHIS and Scotts for completing the biological opinion. Those options included additional research or completion of the analysis in the biological opinion based on best available existing information. On July 6, 2009, APHIS requested the option of a thorough analysis of information currently available, but not continued research. APHIS also requested a final biological opinion by mid-August, 2009.

BIOLOGICAL OPINION

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

DESCRIPTION OF THE PROPOSED ACTION

The action described and analyzed in the biological evaluation was complete deregulation of glyphosate tolerant creeping bentgrass. This action would allow the sale and transport of this product throughout the United States. Deregulation would remove any restrictions from APHIS on the sale and distribution of glyphosate tolerant creeping bentgrass.

STATUS OF THE SPECIES AND CRITICAL HABITAT

The Status of the Prairie Ecosystem in Oregon and Southwest Washington

The species and critical habitats discussed below depend upon prairie habitat located in Oregon and Washington. Wet and upland prairies are two of the most endangered ecosystems in North America (Noss *et al.* 1995, Christy and Alverson 1994, Hammond and Wilson 1993). Because of this rarity, each acre of extant prairie habitat is vital to supporting prairie-endemic, listed species. Both habitat types are subject to loss and degradation due to agricultural and urban development, succession to woody species, and encroachment by invasive species.

Prairies were traditionally maintained by frequent fires that disturbed the habitat, prevented encroachment by woody species, and maintained a grass-dominated ecosystem (Franklin and Dyrness 1973). European settlement and subsequent fire suppression have encouraged succession within prairies from open grassland to closed forests over large expanses of former prairie. In most prairies, woody plants such as roses (*Rosa* spp.), hawthorn (*Crataegus* spp.), and Douglas fir (*Psuedotsuga menziesii*) will dominate a site unless they are removed through active management.

In addition to the threat of succession, prairies are frequently invaded by non-native species (Vesely and Tucker 2004). These species often exploit the open structure and interstitial spaces that are characteristic of functional prairies (Fimbel 2004, Wilson 1998). Non-native species often exhibit more aggressive characteristics and out-compete native vegetation resulting in a less diverse plant community. In prairies, invasion by non-native species can reduce the function of the ecosystem by eliminating the necessary bare spaces that allow for establishment and expansion of native prairie plants (Fimbel 2004, Wilson 1998). Bentgrass is known to be an aggressive invader of listed species habitat (Service 2008a). Control of bentgrass infestations is limited to treatment by herbicides because tilling, burning, or manual pulling has not been effective in controlling bentgrass infestations within listed species habitat in the Willamette Valley (Trevor Taylor, City of Eugene Parks and Open Spaces, pers. comm., 2008). Glyphosate is a preferred herbicide for natural areas, public lands, and rights-of-way (Banks *et al.* 2005).

Management of wet and upland prairies often overlap as the transition from wet to dry habitat occurs in gradations. Wet prairie may be located at toe slopes of upland prairie; upland habitat may be found on hummocks in wet areas. The overlap between these two habitats can increase the challenges for successful management.

In this analysis, we have examined the impacts of bentgrass and the implications of glyphosate tolerance on listed species and their critical habitats, but there are other invasive species that complicate management for threatened and endangered plants and animals in prairies.

Fender's Blue Butterfly

Listing Status and Critical Habitat

The Fender's blue butterfly was listed as endangered, without critical habitat, on January 25,

2000 (Service 2000a). Critical habitat for the Fender's blue butterfly was designated on October 6, 2006 (Service 2006a). Critical habitat units have been designated in Benton, Lane, Polk and Yamhill Counties, Oregon. The primary constituent elements (PCEs) of critical habitat for the Fender's blue butterfly are the habitat components that provide: (1) early seral upland prairie or oak savanna habitat with undisturbed subsoils that provides a mosaic of low growing grasses and forbs, and an absence of dense canopy vegetation allowing access to sunlight needed to seek nectar and search for mates; (2) larval host-plants: Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), longspur lupine (*L. arbustus*), or sickle-keeled lupine (*L. albicaulis*); (3) adult nectar sources, such as the tapertip onion (*Allium acuminatum*), narrow-leaved onion (*Allium* amplectens), Tolmie's mariposa lily (*Calochortus tolmiei*), common camas (*Camassia quamash*), clearwater cryptantha (*Cryptantha intermedia*), common woolly sunflower (*Eriophyllum lanatum*), Oregon geranium (*Geranium oreganum*), Oregon iris (*Iris tenax*), pale flax (*Linum angustifolium*), blue fax (*Linum perenne*), meadow checkermallow (*Sidalcea campestris*), rose checkermallow (*Sidalcea malviflora* ssp. *virgata*), bird vetch (*Vicia cracca*), common vetch (*V. sativa*), and tiny vetch (*V. hirsuta*); and (4) stepping stone habitat consisting of open areas with the physical characteristics appropriate for supporting the short-stature prairie/oak savanna plant community (i.e., well-drained soils) within 1.2 miles of and between lupine patches to provide for dispersal, connectivity, population growth, and, ultimately, viability.

Reasons for Listing

Habitat loss, encroachment of shrubs and trees into prairie habitats due to fire suppression, habitat fragmentation, invasion by non-native plants, and elimination of natural disturbance regimes all threaten the survival of the Fender's blue butterfly. Few populations occur on protected lands; most occur on private lands that are only managed to maintain native prairie habitats with the cooperation of the private land owners. These populations are at high risk of loss to development or continuing habitat degradation (Service 2000a). Currently only 946 acres are known to support the host plant and, therefore, the reproductive stage of the Fender's blue butterfly lifecycle; approximately 2,200 acres are believed to provide additional nectar habitat necessary for the adult Fender's blue butterflies (Service 2009).

The prairies of western Oregon have been extensively invaded by non-native plants that shade or crowd-out important native species. Fast-growing, non-native shrubs such as Armenian blackberry (*Rubus armeni*acus) and Scotch broom (*Cytisus scoparius*), non-native grasses such as bentgrass (Service 2008a) and tall oatgrass (*Arrhenatherum elatius*), and non-native forbs such as meadow knapweed (*Centaurea x pratensis*) can dominate prairie habitat and inhibit the growth of the lupine larval host plants and native nectar sources on which the Fender's blue butterfly depends (Hammond 1996, Schultz *et al.* 2003). Over half of known Fender's blue butterfly habitat is currently invaded by bentgrass (Service 2008a); invasion by other species has not been quantified, but is anticipated to be moderate to high. When these highly invasive non-native plants become dominant, they can effectively preclude butterflies from using the native plant species they need to survive and reproduce (Hammond 1996). Properties being managed to maintain functional prairie rely upon various techniques including tilling, burning, mowing, hand removal of woody debris, and use of herbicide to control invasive species. Herbicide is often the most efficient and effective method for controlling invasive species. In the absence of a regular disturbance regime, native trees and shrubs also invade prairie habitats and can impair the function of Fender's blue butterfly habitat. Common native species found to encroach on

undisturbed prairies include the Douglas fir (*Pseudotsuga menziesii*), Oregon white oak (*Quercus garryana*), Oregon ash (*Fraxinus latifolia*), Douglas' hawthorn (*Crataegus douglasii*), and poison oak (*Toxicodendron diversilobum*).
Habitat fragmentation has isolated the remaining populations of the Fender's blue butterfly to such an extent that butterfly movement among suitable habitat patches may now occur only rarely, which is not expected to maintain the population over time (Schultz 1998). The rarity of host lupine patches and fragmentation of habitat are recognized as the major ecological factors limiting Fender's blue butterfly reproduction, dispersal, and subsequent colonization of new habitat (Hammond and Wilson 1992, 1993, Hammond 1994, Schultz 1997, Schultz and Dlugosch 1999). Extirpation of remaining small populations is expected from localized events and probable low genetic diversity associated with small populations (Schultz and Hammond 2003).

Based on population viability analyses, Schultz and Hammond (2003) reported that the Fender's blue butterfly was at a high risk of extinction throughout most of its range. However, since that time, a number of new occupied sites have been discovered that are contributing to the viability of the Fender's blue butterfly population (Hammond 2008, 2007, 2006, 2005, 2004), although no new viability analyses have been completed with these data.

Life History and Ecology

Adult Fender's blue butterflies live approximately 10 to 15 days and rarely travel farther than 1.2 miles (two kilometers) over their entire life span (Schultz 1998). Although only limited observations have been made of the early life stages of the Fender's blue butterfly, the life cycle of the species is likely similar to other subspecies of Icaricia icarioides (Hammond and Wilson 1993). The life cycle of the Fender's blue butterfly may be completed in one year. An adult Fender's blue butterfly may lay approximately 350 eggs over her 10 to 15-day lifespan, of which perhaps fewer than two will survive to adulthood (Schultz 1998, Schultz *et al.* 2003). Females lay their eggs on perennial lupines (*Lupinus sulphureus* ssp. *kincaidii*, *L. arbustus*, or, occasionally, *L. albicaulis*) that serve as larval food plants during May and June (Ballmer and Pratt 1988). Newly hatched larvae feed for a short time, reaching their second instar in the early summer, at which point they enter an extended diapause. When the lupine plant senesces, diapausing larvae remain in the leaf litter at or near the base of the host plant through the fall and winter. Larvae become active again in March or April of the following year, although some larvae may be able to extend diapause for more than one season depending upon the individual and environmental conditions. Once diapause is broken, the larvae feed and grow through three to four additional instars, enter their pupal stage, and, after about two weeks, emerge as adult butterflies in May and June (Schultz *et al.* 2003).

Fender's blue butterflies have limited dispersal ability. Adult butterflies may remain within 1.2 miles of their natal lupine patch (Schultz 1998), although anecdotal evidence suggests that adult Fender's blue butterflies may disperse as far as 3.1 to 3.7 miles from their natal lupine patch (Hammond and Wilson 1992, Schultz 1998). At large patches, such as the main area at Willow Creek in Lane County, 95 percent of adult Fender's blue butterflies are found within 33 feet of lupine patches (Schultz 1998).

Habitat Characteristics

Habitat requirements for the Fender's blue butterfly include lupine host plants (*Lupinus sulphureus* ssp. *kincaidii* or *L. arbustus*, and occasionally *L. albicaulis*) for larval food and oviposition sites and native wildflowers for adult nectar food sources. Nectar sources used most frequently include narrow leaf onion (*Allium amplectens*), Tolmie's mariposa lily (*Calochortus tolmiei*), dwarf checkermallow (*Sidalcea malviflora* ssp. *virgata*), common wooly sunflower (*Eriophyllum lanatum*), and Oregon geranium (*Geranium oreganum*) (Wilson *et al.* 1997, York 2002, Schultz *et al.* 2003). Non-native vetches (*Vicia sativa* and *V. hirsuta*) are also frequently used as nectar sources (Schultz *et al.* 2003). The population size of the Fender's blue butterfly has been found to correlate directly with the abundance of native nectar sources (Schultz *et al.* 2003). At least 12 acres of high quality habitat are necessary to support a population of Fender's blue butterflies (Crone and Schultz 2003, Schultz and Hammond 2003); most prairie habitat within the range of this species is degraded and of low quality, therefore, a much larger area is likely required to support a viable butterfly population.

Kincaid's lupine is the preferred larval host plant for most known Fender's blue butterfly populations. At two sites, Coburg Ridge and Baskett Butte, the Fender's blue butterfly feeds primarily on spur lupine, even though Kincaid's lupine is present (Schultz *et al.* 2003). A third lupine, sickle-keeled lupine, is used by the Fender's blue butterfly where it occurs in poorer quality habitats (Schultz *et al.* 2003). It is interesting to note that the Fender's blue butterfly has not been observed to use broadleaf lupine (*Lupinus latifolius*), a plant commonly eaten by other subspecies of *Icaricia icarioides*, even though it occurs in habitats occupied by the Fender's blue butterfly (Schultz *et al.* 2003).

Population Trends and Distribution

The Fender's blue butterfly was discovered in 1929. Few collections were made between the time of the subspecies' discovery and Macy's last observation of the Fender's blue butterfly on May 23, 1937, in Benton County, Oregon (Hammond and Wilson 1992). The Fender's blue butterfly was rediscovered in 1989 at the McDonald Research Forest, Benton County, Oregon, where it was found to be associated primarily with Kincaid's lupine, a rare lupine, and occasionally spur lupine (*L. arbustus*) or sickle-keeled lupine (*L. albicaulis*) (Hammond and Wilson 1993).

The Fender's blue butterfly is endemic to the Willamette Valley and persists at about 30 sites on remnant prairies in Yamhill, Polk, Benton, and Lane counties (Hammond and Wilson 1993, Schultz *et al.* 2003, Service unpublished data). Fender's blue butterfly populations occur on upland prairies characterized by native bunch grasses (*Festuca* spp.). The association of the Fender's blue butterfly with upland prairie is mostly a result of its dependence on Kincaid's lupine, although it often uses wet prairies for nectaring and dispersal. Sites occupied by the Fender's blue butterfly are predominantly located on the western side of the Willamette Valley, within 21 miles of the Willamette River. Based on a recent synthesis of existing data by Schultz *et al.* (2003), the current range wide population of this species is estimated to be 3,000 to 5,000 individuals. Fewer than ten sites with populations of 100 adult butterflies or more are known (Table 1). Many of these large populations are found in the west Eugene area and include: Eaton Lane, Fir Butte, North Green Oaks, Shore Lane, and the Willow Creek populations. These

populations are valuable to the recovery of the species; however, recent work with private landowners in the middle to northern Willamette Valley has greatly improved the status of numerous populations in Yamhill, Polk, and Benton Counties. The ongoing collaboration between these landowners, local government, and the Service is likely to significantly increase the recovery potential for this species.

Table 1. Estimated Fender's blue butterfly population size (number of individuals) at surveyed sites between 2000 – 2007.

Site	County	Year							
		2000	2001	2002	2003	2004	2005	2006	2007
Henkle Way	Benton	ns	ns	ns	Ns	1	2	20	20
McDonald State Forest	Benton	667	494	451	425	509	84	98	370
Oak Creek Rd.	Benton	3	2	1	1	2	Ns	Ns	ns
West Hills Road	Benton	ns	103	132	211	307	216	370	235
Wren	Benton	ns	ns	ns	75	484	180	800+*	1280*
Big Spires	Lane	ns	5	2	0	0	Ns	3	ns
Coburg Ridge	Lane	ns	ns	ns	154	236	23	221	355
Eaton Lane (N & S)	Lane	18	36	ns	60	257	98	59	100
Fir Butte	Lane	82	ns	ns	289	446	60	120	159
Fir Grove (previously Burn Area)	Lane	ns	ns	32	71	128	6	46	20
Fisher Butte	Lane	ns	0	ns	0	15	3	6	4
N. Green Oaks	Lane	2	8	ns	36	107	118	101	162
S. Green Oaks	Lane	3	6	ns	39	53	28	33	23
Oxbow West	Lane	ns (701 eggs)	ns	ns	122	79	4	17	30
Royal Amazon	Lane	0	0	0	0	0	0	0	0
Shore Lane	Lane	0	7	ns	138	246	133	91	189
Spires Lane (E & W)	Lane	75	76	ns	111	223	35	40	88
Willow Creek Bailey Hill	Lane	169	47	ns	343	418	22	324	165
Willow Creek Main	Lane	1147	467	ns	843	725	129	337	354
Willow Creek North Area	Lane	123	63	ns	79	129	17	98	105
Oak Basin	Linn	-	-	-	-	-	-	23	ns
Baskett Butte	Polk	922	223	753	1236	1615	768	1416	1385
Baskett Butte North	Polk	ns	ns	ns	18	ns	46	Ns	60
Dallas	Polk	50	ns	ns	Ns	ns	Ns	Ns	40-60
Fern Corner	Polk	6	7	14	0	0	0	0	0
McTimmonds Valley	Polk	12	24	19	18	24	10	Ns	10
Mill Creek	Polk	25	22	48	50	43	20	?	12
Monmouth - Falls City	Polk	6	0	6	200?	200?	100?	Ns	100?
Deer Creek Park	Yamhill	0	0	0	1	0	2	0	2
Gopher Valley	Yamhill	12	7	22	20	10	10	20	80-100*
Oak Ridge	Yamhill	168	192	293	240	259	96	100?	240*

Key
Ns = not surveyed.
- = population not known to exist.
? = rough estimate obtained without using Hammond's protocol (Miller and Hammond 2007; Greg

Site	County	Year							
		2000	2001	2002	2003	2004	2005	2006	2007
Fitzpatrick, The Nature Conservancy, pers. comm., 2008). * = count includes newly identified sites/areas that were not counted during previous population estimates.									

Conservation and Restoration Actions

Biologists from Federal and state agencies and private conservation organizations are engaged in active research and monitoring programs to improve the status of the Fender's blue butterfly. Recent research has focused on population viability analyses (Schultz and Hammond 2003), metapopulation dynamics and the effects of habitat fragmentation (Schultz 1998), population response to habitat restoration (Wilson and Clark 1997, Kaye and Cramer 2003, Schultz et al. 2003), and developing protocols for captive rearing (Shepherdson and Schultz 2004).
Recent studies have shown that Fender's blue butterfly populations respond positively to habitat restoration. Mowing, burning, and mechanical removal of weeds have all resulted in increasing Fender's blue butterfly populations. At two sites in the West Eugene Wetlands (The Nature Conservancy's Willow Creek Natural Area and the Bureau of Land Management's Fir Butte site), both adult and larval Fender's blue butterflies have increased in number following mowing to reduce the stature of herbaceous non-native vegetation, although the response to habitat restoration is often complicated by other confounding factors, such as weather fluctuations (Schultz and Dlugosch 1999, Fitzpatrick 2005, Kaye and Benfield 2005).

Wilson and Clark (1997) conducted a study on the effects of fire and mowing on the Fender's blue butterfly and its native upland prairie at Baskett Slough National Wildlife Refuge in the Willamette Valley. Although fire killed all larvae in burned patches, female Fender's blue butterflies from the nearby unburned source patch were able to colonize the entire burned area, including lupine patches that were 350 feet from the unburned source plants. They found that Fender's blue butterfly eggs were 10 to 14 times more abundant in plots that were mowed or burned compared to undisturbed, control plots. Woody plants were reduced 45 percent with burning and 66 percent with mowing.

Fender's blue butterfly population trends have been correlated with lupine vigor; high leaf growth appears to produce larger butterfly populations. At the U.S. Army Corps of Engineers' Fern Ridge Reservoir, the Fender's blue butterfly population has increased dramatically since fall mowing of lupine patches has been implemented. The abundance of Fender's blue butterfly eggs was found to be correlated with the abundance of Kincaid's lupine leaves at a number of study sites (Kaye and Cramer 2003); egg abundance increased substantially at sites that had been treated to control non-native weeds (Schultz et al. 2003).

Fender's blue butterfly populations occur on public lands or lands that are managed by a conservation organization at the Service's Baskett Slough National Wildlife Refuge, the Army Corps of Engineers' Fern Ridge Reservoir, the Bureau of Land Management's West Eugene Wetlands, The Nature Conservancy's Willow Creek Preserve and Coburg Ridge easement, and on a small portion of Oregon State University's Butterfly Meadows in the McDonald State Forest. All of these parcels have some level of management for native prairie habitat values. The Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration and Fender's blue butterfly recovery are key focus areas of the program in the Willamette Valley.

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Willamette Valley that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Status of Critical Habitat

In total, 13 critical habitat units totaling 3,010 acres have been designated for the Fender's blue butterfly. Each of these units represents habitat containing the features essential to the conservation of existing core populations of the Fender's blue butterfly throughout its range. Each unit was occupied at the time of designation, and each unit represents a population that is currently isolated from other populations. All 13 units are necessary to the function of the designated critical habitat. Unit descriptions are presented in the final critical habitat rule (Service 2006a), and are herein incorporated by reference.

Threats to the critical habitat include: habitat loss caused by development; encroachment by woody species due to loss of the traditional disturbance regime; and invasion of non-native species (Service 2006a), including bentgrass (Service 2008a). Bentgrass has been detected within 86 percent of critical habitat acres for the Fender's blue butterfly (Service 2008a).

Fender's blue butterfly critical habitat occurs on federal, local government, and private lands. Federal land managers currently employ herbicide applications, burning, mowing, and other management techniques to control and mitigate threats to the critical habitat. According to land managers in the Willamette Valley**,** herbicide application is often the most efficient and cost effective management tool available.

Intended Conservation Function of Critical Habitat

The intended conservation function of the critical habitat, as described in the final rule designating it, is to support viable core populations of the Fender's blue butterfly. The key to this support is the maintenance or expansion of large blocks of protected, high quality prairie habitat that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Willamette Daisy

Listing Status and Critical Habitat

The Willamette daisy was listed as endangered, without critical habitat, on January 25, 2000 (Service 2000a). Critical habitat was designated on October 6, 2006 (Service 2006a). Critical

habitat units were designated in Benton, Lane, Linn, Marion and Polk Counties, Oregon. The PCE of critical habitat is (1) the habitat components that provide early seral upland prairie or oak savanna habitat with a mosaic of low growing grasses, forbs, and spaces to establish seedlings or new vegetative growth, with an absence of dense canopy vegetation that provides sunlight for individual and population growth and reproduction, and with undisturbed subsoils and proper moisture and protection from competitive invasive species.

Reasons for Listing

The Willamette daisy is threatened by habitat loss due to urban and agricultural development, successional encroachment into its habitat by trees and shrubs, competition with non-native weeds, and small population sizes (Kagan and Yamamoto 1987, Clark et al. 1993, Gisler 2004). Currently, only 283 acres are known to support this species (Service 2009).
Habitat loss and degradation are two of the greatest threats to Willamette daisy. The Service (2000a) estimated that habitat loss is occurring at 80 percent of the remaining 84 remnants of native prairies occupied by the Willamette daisy and Kincaid's lupine. At the time of its listing, it was estimated that 24 of the 28 extant Willamette daisy populations occurred on private lands and, "without further action, are expected to be lost in the near future" (Service 2000a). Invasive species are also found to degrade habitat around Willamette daisy populations.

Willamette daisy populations occurring on private lands are the most vulnerable to threats of development because state and Federal plant protection laws have little effect on private lands. Likewise, vulnerability arising from small population sizes and inbreeding depression may be a concern for this species, regardless of land ownership (Service 2000a).

Life History and Ecology

The Willamette daisy is an herbaceous perennial that occurs as single plants or clumps of genetically identical ramets (Clark et al. 1993). It blooms in June and early July and produces seeds in late summer (Cronquist 1955). Seedlings emerge in late winter or early spring, and plants require two to four years to reach flowering size. Large plants appear to spread vegetatively, but this spread is localized around the established plant (Clark *et al.* 1995).

The fruits of the Willamette daisy are single-seeded achenes and have a number of small capillary bristles (the pappus) attached to the top, which allow them to be distributed by the wind. Population size can substantially affect reproductive success in this species. Populations of the Willamette daisy with fewer than 20 individuals appear to suffer a high rate of reproductive failure due to inbreeding depression and reduced probability of successful pollination (Kaye *et al.* 2006).

A variety of insects have been observed to visit the flowers of the Willamette daisy; potential pollinators include solitary bees (*Ceratina* sp., *Megachile* sp., *Nomada* sp., *Halictus ligatus*, and *Ashmeadiella* sp.), beetles (*Meligethes nigrescens* and *Acanthoscelides pauperculus*), flies (*Toxomerus marginata*, *T. occidentalis* and *Tachina* sp.), and butterflies (*Phyciodes campestris*) (Kagan and Yamamoto 1987, Clark *et al.* 1993, Jackson 1996, Gisler 2004).

Habitat Characteristics

The Willamette daisy typically occurs in open, wet to drier prairies without woody overstories (Clark *et al.* 1993). The wet prairie grassland community is typically dominated by tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), and a number of Willamette Valley endemic forbs. It is a flat, open, seasonally wet prairie with bare soil between the pedestals created by the bunching tufted hairgrass (Kagan and Yamamoto 1987). On drier upland prairie sites, associated species commonly include *Aster hallii*, Roemer's bunchgrass (*Festuca idahoensis* ssp. *roemeri*) and poison oak (Meinke 1982, Clark *et al.* 1993).

Many Willamette daisy sites are invaded by non-native species including numerous non-native grasses: false brome (*Brachypodium sylvaticum*)(Clark *et al.*1993), tall oatgrass (*Arrhenatherum elatius*)(Clark 2000), redtop (as *Agrostis alba*, but now understood to be *Agrostis gigantea*), bentgrass (*Agrostis tenuis*), silver hairgrass (*Aira caryophyllea*), little quakinggrass (*Briza mino*r), crested dogtail grass (*Cynosurus cristatus*), orchardgrass (*Dactylis glomerata*), velvet grass (*Holcus lanatus*), timothy (*Phleum pratense*), and Kentucky bluegrass (*Poa pratensis*)(Kagan and Yamoto 1987). One group of non-native species, bentgrass, has invaded at least 107 acres (38 percent) of the total 283 acres of Willamette daisy habitat (Service 2008a).

The Willamette daisy is found on heavier soils; specific soil series are identified in the draft recovery plan for this species, are hereby incorporated by reference (Service 2008b).

Population Trends and Distribution

The Willamette daisy is endemic to the Willamette Valley of western Oregon. Herbarium specimens include collections from 1881 to 1934; the plant was presumed to be extinct from 1934 to 1980 (Clark *et al.* 1993, Gisler 2004). The species was rediscovered in 1980 in Lane County, Oregon, and has since been identified at more than 30 sites. The Willamette daisy has been collected in Benton, Clackamas, Lane, Linn, Marion, Polk, Yamhill, and Washington Counties, Oregon, but today the species occurs in Benton, Lane, Linn, Marion, and Polk Counties, Oregon; at those sites, there are about 350 acres of occupied habitat.

The population size of the Willamette daisy may fluctuate substantially from year to year. Detecting trends in Willamette daisy populations is complicated by the biology and phenology of the species, which includes sporadic flowering from year to year. In addition, Clark *et al.* (1993) stated that non-reproductive individuals can be very difficult to find and monitor due to their inconspicuous nature, and that the definition of individuals can be complicated when flowering clumps overlap.

Conservation and Restoration Actions

Some research has been conducted on the ecology and population biology of the Willamette daisy, effective methods for habitat enhancement, and propagation and reintroduction techniques (Clark *et al.* 1995, 1997, Wilson and Clark 1997, Kaye and Kuykendall 2001b, Leininger 2001, Kaye *et al.* 2003b). The results of these studies have been used to direct the management of Willamette daisy populations at sites that are managed for native prairie values.

The efficacy of mowing and burning as tools to restore habitat for the Willamette daisy is under investigation. Preliminary findings indicate that Willamette daisy plants responded with increased crown cover in mowed plots as compared to unmowed plots; this study is continuing

and will also evaluate the effects of fire on the Willamette daisy (Kaye *et al.* 2003b).

Several studies have investigated the feasibility of growing the Willamette daisy in controlled environments for augmentation of wild populations. It is likely that conservation of the Willamette daisy may require augmenting small populations with propagated individuals (Clark *et al.* 1995). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005).

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Willamette Valley that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Status of Critical Habitat

There are nine critical habitat units totaling 718 acres for the Willamette daisy, each of which represents habitat containing the features essential to the conservation of core populations across the range of the species. There are very few extant populations of the Willamette daisy documented outside of Eugene, Oregon, and all of the designated critical habitat units are necessary to maintain the geographic extent of the species. Unit descriptions are presented in the final critical habitat rule (Service 2006), and are herein incorporated by reference.

Willamette daisy critical habitat is currently affected by urban and agricultural development, successional encroachment into its habitat by trees and shrubs, small size and isolated nature of populations, and competition with non-native weeds (Service 2006a); non-native species competition includes invasion by bentgrass (Service 2008a). Currently, approximately 470 acres (66 percent) of 718 total acres of designated critical habitat are subject to invasion by these species (Service 2008a).

Intended Conservation Function of Critical Habitat

The intended conservation function of the critical habitat is to support viable core populations of the Willamette daisy. The key to this support is the maintenance or expansion of large blocks of protected, high quality prairie habitat that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Bradshaw's Lomatium

Listing Status and Critical Habitat

Bradshaw's lomatium (also known as Bradshaw's desert-parsley) was listed as endangered,

without critical habitat, on September 30, 1988 (Service 1988).

Reasons for Listing

Expanding urban development, pesticides, encroachment of woody and invasive species, herbivory, and grazing are threats to remaining Bradshaw's lomatium populations (Service 1988). Bradshaw's lomatium is known from 843 acres of habitat throughout the Willamette Valley and Puget Trough (Service 2009). The majority of Oregon's Bradshaw's lomatium populations are located within a 10-mile radius of the City of Eugene. The continued expansion of this city is a potential threat to the future of these sites. Even when the sites themselves are protected, the resultant changes in hydrology caused by surrounding development can adversely alter the species' habitat (Meinke 1982, Gisler 2004). The populations in Washington occur on private lands and are not protected (Gisler 2004).

Populations occurring on roadsides are at risk from maintenance activities, and from adverse effects of management on adjacent lands. Pesticide use on agricultural fields and herbicide application adjacent to roads may adversely impact Bradshaw's lomatium populations across its range. There is concern that pesticides kill the pollinators necessary for plant reproduction; Bradshaw's lomatium does not form a seed bank, therefore, any loss of pollinators (and subsequent lack of successful reproduction) could have an immediate effect on population numbers (Kaye and Kirkland 1994).

Woody plant species encroachment is one of the most significant threats to this species. Historically, Willamette Valley prairies were periodically burned (Johannessen *et al.* 1971). Since Euro-American settlers arrived, fire suppression has allowed shrubs and trees to invade grassland habitats resulting in succession from open prairie to closed canopy, forested habitat.

Life History and Ecology

Bradshaw's lomatium blooms in the spring, usually in April and early May. The flowers have a spatial and temporal separation of sexual phases, presumably to promote outcrossing, resulting in protandry on a whole plant basis, and protogyny within the flowers. A typical population is composed of many more vegetative plants than reproductive plants. The plant is pollinated by insects. Over 30 species of solitary bees, flies, wasps and beetles have been observed visiting the flowers (Kaye and Kirkland 1994, Jackson 1996).

Bradshaw's lomatium does not spread vegetatively and depends exclusively on seeds for reproduction (Kaye 1992). The large fruits have corky thickened wings, and usually fall to the ground fairly close to the parent. Fruits appear to float somewhat, and may be distributed by water. The fine-scale population patterns at a given site appear to follow seasonal, microchannels in the tufted hairgrass (*Deschampsia cespitosa*) prairies, but whether this is due to dispersal, habitat preference, or both, is not clear (Kaye 1992, Kaye and Kirkland 1994).

The species generally responds positively to disturbance. Low intensity fire appears to stimulate population growth of Bradshaw's lomatium. The density and abundance of reproductive plants increased following fires (Pendergrass *et al.* 1999), although monitoring showed the effects to be temporary, dissipating after one to three years. Frequent burns may be required to sustain population growth, as determined from population models (Caswell and Kaye 2001, Kaye *et al.*

2001).

Habitat Characteristics

Bradshaw's lomatium is often associated with tufted hairgrass. In wetter areas, Bradshaw's lomatium occurs on the edges of tufted hairgrass patches or sedge bunches in patches of bare or open soil. In drier areas, it is found in low areas, such as small depressions, trails or seasonal channels, with open, exposed soils. The grassland habitat of Bradshaw's lomatium frequently includes these species: sedges (*Carex* spp.), California oatgrass (*Danthonia californica*), coyote-thistle (*Eryngium petiolatum*), Willamette Valley gumweed (*Grindelia integrifolia*), rushes (*Juncus* spp.), field woodrush (*Luzula campestris*), and yampah (*Perideridia* sp.) (Kagan 1980).

Introduced pasture and turf grasses such as bentgrass (*Agrostis* spp.) (Reichman 2009, Service 2008a), sweet vernal grass (*Anthoxanthum odoratum*), velvet grass (*Holcus lanatus*), western panicgrass (*Dichanthelium acuminatum*), little quaking grass (*Briza minor*), orchard-grass (*Dactylis glomerata*), tall fescue (*Festuca arundinacea*), velvet grass (*Holcus lanatus*), and Kentucky bluegrass (*Poa pratensis*) may also be present (Kagan 1980). Bentgrass species have been found on 282 acres (33 percent) of this species' habitat (Service 2008a). Management, including grazing, mowing, burning, and use of herbicides, is being implemented at a number of sites and is necessary to maintain the quality of the habitat so that it can support Bradshaw's lomatium.

Bradshaw's lomatium is restricted to wet prairie habitats. These sites have heavy, sticky clay soils or a dense clay layer below the surface that results in seasonal hydric soils. The dense clay layer drains slowly, which results in a perched water table in winter and spring. Specific soil types are identified in the draft recovery plan and are hereby incorporated by reference (Service 2008a).

Population Trends and Distribution

The distribution and abundance of Bradshaw's lomatium was poorly documented historically. The lack of collections between 1941 and 1969 lead to the assumption that the taxon might be extinct. By 1980, following a study of the species, six populations of Bradshaw's lomatium were located, including one large population (Kagan 1980). Currently, 40 new sites have been discovered, including three large populations.

Prior to 1994, Bradshaw's lomatium was considered an Oregon endemic, its range limited to the area between Salem and Creswell, Oregon (Kagan 1980). In Oregon, there are currently about 38 occurrences of Bradshaw's lomatium in three population centers located in Benton, Lane, Linn, and Marion Counties, Oregon (Gisler 2004, Oregon Natural Heritage Information Center 2004). Most of these populations are small, ranging from about 10 to 1,000 individuals, although the two largest sites each have over 100,000 plants. In 1994, two populations were discovered in Clark County, Washington. One of the two Washington populations is the largest known occurrence of Bradshaw's lomatium.

Conservation and Restoration Actions

Bradshaw's lomatium plants can be grown from seed in a greenhouse environment (Kaye et al.

2003a). Plants may be successfully established at existing populations or new locations through out-planting of greenhouse-grown plants. Direct seeding has a relatively high success rate (17 to 38 percent), and is improved by removal of competing vegetation (Kaye and Kuykendall 2001b, Kaye et al. 2003a). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

In addition to other management techniques, research has recently focused on the role of grazing in maintaining Bradshaw's lomatium habitat. Grazing in the springtime, when the plants are growing and reproducing, can harm the plants by biomass removal, trampling, and soil disturbance; however, late-season livestock grazing, after fruit maturation, has been observed to lead to an increase in emergence of new plants, and the density of plants with multiple umbels, although it did not alter survival rates or population structure (Drew 2000).

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Willamette Valley and the Puget Trough that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Kincaid's Lupine

Listing Status and Critical Habitat

Kincaid's lupine was listed as threatened, without critical habitat, on January 25, 2000 (Service 2000a). A recovery outline for the species was published in 2006 (Service 2006b). Critical habitat was designated on October 6, 2006 (Service 2006a). Critical habitat units were designated in Benton, Lane, Polk and Yamhill Counties, Oregon, and Lewis County, Washington. The PCEs of critical habitat are the habitat components that provide: (1) early seral upland prairie or oak savanna habitat with a mosaic of low growing grasses, forbs, and spaces to establish seedlings or new vegetative growth, with an absence of dense canopy vegetation so that sunlight is available for individual and population growth and reproduction, and with undisturbed subsoils and proper moisture and protection from competitive invasive species; and (2) the presence of insect pollinators, such as bumblebees (*Bombus mixtus* and *B. californicus*), with unrestricted movement between existing lupine patches, which is critical for successful lupine reproduction.

Reasons for Listing

The three major threats to Kincaid's lupine populations are habitat loss, competition from non-native plants, and elimination of historical disturbance regimes (Wilson *et al.* 2003). Habitat loss from a wide variety of causes (e.g., urbanization, agriculture, silvicultural practices and roadside maintenance) has been the single largest factor in the decline of Kincaid's lupine (Service 2000a)

and is likely to continue as private lands are developed. At least 49 of 54 sites occupied by Kincaid's lupine in 2000, at the time listing occurred, were on private lands and are at risk of being lost unless conservation and restoration actions are implemented (Service 2000a). In total, there are only 700 acres of habitat known to support this species (Service 2009).

Habitat fragmentation and isolation of small populations may cause inbreeding depression in Kincaid's lupine. The subspecies was likely wide-spread historically, frequently outcrossing throughout much of its range, until habitat destruction and fragmentation severely isolated the remaining populations (Liston *et al.* 1995). There is some evidence of inbreeding depression, which may result in lower seed set (Severns 2003). Hybridization between Kincaid's lupine and spur lupine has been detected at Baskett Slough National Wildlife Refuge (Liston *et al.* 1995).

Invasion by non-native species contributes to lower prairie quality and concomitant reduced population viability of native species, including Kincaid's lupine.

Most prairie sites require frequent disturbances to inhibit succession of trees and shrubs. Before settlement by Euro-Americans, the regular occurrence of fire maintained the open prairie habitats essential to Kincaid's lupine. The loss of a regular disturbance regime, primarily fire, has resulted in the decline of prairie habitats through succession by native trees and shrubs. When this species was listed, we estimated that 83 percent of upland prairie sites were succeeding to forest in the range of Kincaid's lupine (Service 2000a).

Life History and Ecology

Flowering of the Kincaid's lupine begins in April and extends through June. As the summer dry season arrives, Kincaid's lupine becomes dormant, and it is completely senescent by mid-August (Wilson *et al.* 2003). Pollination is largely accomplished by small native bumblebees (*Bombus mixtus* and *B. californicus*), solitary bees (*Osmia lignaria*, *Anthophora furcata*, *Habropoda* sp., *Andrena* spp., *Dialictus* sp.) and occasionally, European honey bees (*Apis mellifera*) (Wilson *et al.* 2003). Insect pollination appears to be critical for successful seed production in Kincaid's lupine (Wilson *et al.* 2003).

Kincaid's lupine reproduces by seed and vegetative spread. It is able to spread extensively through rhizome growth. Individual clones can be several centuries old (Wilson *et al.* 2003), and become quite large with age, producing many flowering stems. Excavations and morphological patterns suggest that plants 33 feet (10 meters) or more apart can be interconnected by below-ground stems (Wilson *et al.* 2003). Reproduction by seed is common in large populations where inbreeding depression is minimized and ample numbers of seeds are produced. In small populations, seed production is reduced and this appears to be due, at least in part, to inbreeding depression (Severns 2003).

Kincaid's lupine is vulnerable to seed, fruit, and flower predation by insects, which may limit the production of seeds. Floral and fruit herbivory by larvae of the silvery blue butterfly (*Glaucopsyche lygdamus columbia*) has also been reported (Kuykendall and Kaye 1993). The vegetative structures of Kincaid's lupine support a variety of insect herbivores, including root borers, sap suckers and defoliators (Wilson *et al.* 2003). Kincaid's lupine is the primary larval host plant of the endangered Fender's blue butterfly (Wilson *et al.* 2003). Female Fender's blue butterflies lay their eggs on the underside of Kincaid's lupine leaves in May and June; the larvae

hatch several weeks later and feed on the plant for a short time before entering an extended diapause, which lasts until the following spring (Schultz *et al.* 2003). Kincaid's lupine, like other members of the genus *Lupinus*, is unpalatable to vertebrate grazers. Kincaid's lupine forms root nodules with *Rhizobium* spp. bacteria that fix nitrogen, and also has vesicular-arbuscular mycorrhizae, which may enhance the plant's growth (Wilson *et al.* 2003).

Habitat Characteristics

In the Willamette Valley and southwestern Washington, Kincaid's lupine is found on upland prairie remnants where the species occurs in small populations at widely scattered sites. A number of populations are found in road rights-of-way, between the road shoulder and adjacent fence line, where they have survived because of a lack of agricultural disturbance. Common native species typically associated with Kincaid's lupine include: Roemer's fescue (*Festuca idahoensis* ssp. *roemeri*), California oat-grass (*Danthonia californica*), Tolmie's mariposa lily (*Calochortus tolmiei*), common wooly sunflower (*Eriophyllum lanatum*), and wild strawberry (*Fragaria virginiana*) (Service 2006b).

In Douglas County, Oregon, Kincaid's lupine appears to tolerate more shaded conditions, where it occurs at sites with a canopy cover of 50 to 80 percent (Barnes 2004). In Douglas County, tree and shrub species dominate the sites, including *Pseudotsuga menziesii*, California black oak (*Quercus kelloggii*), Pacific madrone (*Arbutus menziesii*), ponderosa pine (*Pinus ponderosa*), incense cedar (*Calocedrus decurrens*), hairy Manzanita (*Arctostaphylos columbiana*) and poison oak.

Invasive species commonly encroach upon Kincaid's lupine habitat and include: bentgrass (Service 2008a), tall oat-grass (*Arrhenatherum elatius*), slender false brome (*Brachypodium sylvaticum*), orchard grass (*Dactylis glomerata*), tall fescue (*Festuca arundinacea*), Armenian blackberry (*Rubus armeniacus*), and Scotch broom (*Cytisus scoparius*) (Wilson *et al.* 2003). Creeping bentgrass has been found on 67 acres (ten percent) of the 700 acres known to support Kincaid's lupine populations (Service 2008a). In the absence of fire, some native species, such as poison oak and bracken fern (*Pteridium aquilinum*), invade prairies and compete with Kincaid's lupine. Maintenance of prairie requires active management of the site. Control of invasive species and removal of encroaching woody species is part of the management program on a number of sites under Federal, State, and private land ownership.

Kincaid's lupine has been found on heavy, generally well-drained soils; a list of soil series is included in Wilson *et al.* (2003) and is hereby incorporated by reference.

Population Trends and Distribution

Kincaid's lupine is found in dry upland prairies from Lewis County, Washington, south to the foothills of Douglas County, Oregon; however, most of the known populations are found in the Willamette Valley. Historically, the species was documented from Vancouver Island, British Columbia, Canada (Dunn and Gillet 1966), but has not been located in that region since the 1920s (Kaye 2000). Kincaid's lupine has been reported from about 57 sites, comprising approximately 750 acres of total lupine cover (Wilson *et al.* 2003, Kuykendall and Kaye 1993). In 2004, two small populations were found at Drew's Prairie and Lacamas Prairie to the east of the Boistfort Valley in Lewis County (Caplow and Miller 2004). Current data indicate

approximately 700 acres of Kincaid's lupine exists throughout its range (Service 2009).

Conservation and Restoration Actions

Active research efforts have focused on restoring the essential components of Kincaid's lupine habitat by mimicking historic disturbance regimes. Prescribed fire and mowing before or after the growing season have been effective in reducing the cover of invasive non-native plants; following treatments, Kincaid's lupine has responded with increased leaf and flower production (Wilson et al. 2003). Research has also been conducted on seed germination, propagation and reintroduction of Kincaid's lupine (Kaye and Kuykendall 2001a and 2001b, Kaye and Cramer 2003, Kaye et al. 2003a). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005).

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Willamette Valley and the Puget Trough that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Status of Critical Habitat

There are 13 Kincaid's lupine critical habitat units totaling 584 acres. Units that are within pollinator flight distance function to support large, connected metapopulations with proper management and restoration. Each unit functions as part of the whole designation and is considered essential to the function of Kincaid's lupine critical habitat. Unit descriptions are presented in the final critical habitat rule (Service 2006), and are herein incorporated by reference.

The three major threats to Kincaid's lupine critical habitat are: (1) loss due to conversion to urban, agriculture, or silviculture development; (2) competition from non-native plants; and (3) elimination of historic disturbance regimes (Wilson et al. 2003). Approximately 519 acres (89 percent) of the 584 total acres of designated Kincaid's lupine critical habitat are subject to invasion by bentgrass (Service 2008a). Adequate function of the PCEs is currently being maintained through active management by Federal, State, and County land managers at one-fourth of the designated critical habitat. The remaining land within critical habitat is managed through cooperation from the private land owner and relies heavily on cost-effective and efficient control of invasive species and removal of encroaching woody plants.

Intended Conservation Function of Critical Habitat

The intended conservation function of the critical habitat is to support viable core populations of the Kincaid's lupine. The key to this support is the maintenance or expansion of large blocks of protected, high quality prairie habitat that are subject to management including: periodic

disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Nelson's Checkermallow

Listing Status and Critical Habitat

Nelson's checkermallow was listed as threatened, without critical habitat, on February 12, 1993 (Service 1993).

Reasons for Listing

Nelson's checkermallow is threatened by urban and agricultural development, ecological succession that results in shrub and tree encroachment of open prairie habitats, and competition with invasive weeds (Service 1993).

At many Willamette Valley sites, seedling establishment is inhibited by the dense thatch layer of non-native grasses (Gisler 2004). Other factors specific to Nelson's checkermallow include pre-dispersal seed predation by weevils (Gisler and Meinke 1998), the potential threat of inbreeding depression due to small population sizes and habitat fragmentation (Gisler 2003). Nelson's checkermallow has been found on 1,350 acres throughout the Willamette Valley and Puget Trough (Service 2009).

Life History and Ecology

In the Willamette Valley, Nelson's checkermallow begins flowering in mid-May, and continues through early September, depending upon the moisture and climatic conditions of the site. Coast Range populations experience a shorter growing season and generally flower later and senesce earlier. Nelson's checkermallow inflorescences are indeterminate, and often simultaneously exhibit fruits, open flowers, and unopened buds. Seeds are deposited locally at or near the base of the parent plant and may be shed immediately or persist into winter within the dry flower parts that remain attached to the dead stems. Above-ground portions of the plant die back in the fall, usually followed by some degree of regrowth at the base, with the emergence of small, new leaves that persist through the winter directly above the root crown. It is not uncommon for some plants to continue producing flowers into the fall and early winter, although this is usually limited to one or two small stems per plant, with little consequent seed production (Service 1998).

Perfect-flowered Nelson's checkermallow are protandrous, with complete temporal separation of male and female phases in individual flowers (Gisler and Meinke 1998). This prevents self-fertilization and discourages selfing. Outcrossing is encouraged because pollinators leave male-phase flowers at the top of one raceme and then fly to female phase flowers on the bottom of the next raceme. Female plants, which lack male flowers, are obligately outcrossed (Gisler and Meinke 1998). In most Willamette Valley (but not Coast Range) populations, female (male-sterile) Nelson's checkermallow plants vastly outnumber perfect plants. Nelson's checkermallow is also capable of vegetative expansion via rhizomes (CH2MHill 1986, Glad et al. 1994).

Nelson's checkermallow is pollinated by a variety of insects, including at least 17 species of bees, three species of wasps, nine species of flies, six species of beetles, and five species of lepidopterans (Gisler 2003).

Pre-dispersal seed predation by weevils (*Macrorhoptus sidalceae*) is extremely high in many populations, and may severely curtail, if not virtually eliminate, seed survival in many populations (Gisler and Meinke 1998). The weevils are native, host-specific, and are themselves parasitized by tiny undescribed wasps (Gisler and Meinke 1998).

Four other native *Sidalcea* species are found within the geographic range of Nelson's checkermallow (Hitchcock and Cronquist 1973, Gisler 2004): dwarf checkermallow (*Sidalcea malviflora* ssp. *virgata*), meadow checkermallow (*Sidalcea campestris*), Cusick's checkermallow (*Sidalcea cusickii*), and hairy-stemmed checkermallow (*Sidalcea hirtipes*). There is a strong potential for interspecific hybridization among Nelson's checkermallow and its congeners in the region, although there are some ecological and genetic reproductive barriers to prevent it from occurring (Gisler 2003, 2004).

Population Trends and Distribution

Nelson's checkermallow has been collected in Benton, Clackamas, Linn, Marion, Polk, Tillamook, Yamhill, and Washington Counties, Oregon, and Cowlitz and Lewis Counties, Washington. Nelson's checkermallow is currently known from about 65 sites, distributed from southern Benton County, Oregon, northward to Cowlitz and Lewis Counties, Washington (CH2MHill 1997, Service 1998). This species also occurs in several higher elevation west slope Coast Range meadows in Yamhill, Washington, and Tillamook Counties, Oregon. Known populations range in elevation from 145 to 1,950 feet.

Habitat Characteristics

In the Willamette Valley, Nelson's checkermallow is known from wet prairies and stream sides. Although occasionally occurring in the understory of Oregon ash (*Fraxinus latifolia*) woodlands or among woody shrubs, Willamette Valley Nelson's checkermallow populations usually occupy open habitats supporting early seral plant communities. These native prairie remnants are found at the margins of sloughs, ditches, and streams, roadsides, fence rows, drainage swales and fallow fields. Soil textures of the occupied sites vary from gravelly, well-drained loams to poorly drained, hydric clay soils (CH2MHill 1986, Glad *et al.* 1994).

Some of the plants commonly associated with Nelson's checkermallow in the Willamette Valley include: common rush (*Juncus effusus*), sedge (*Carex* spp.), western spiraea (*Spiraea douglasii*), black hawthorn (*Crataegus douglasii*), large-leaved avens (*Geum macrophyllum*), and Oregon ash (Service 1998). Most sites have been densely colonized by invasive weeds, especially introduced forage grasses; common non-native species found with Nelson's checkermallow include: tall fescue (*Festuca arundinacea*), rose (*Rosa* spp.), Canada thistle (*Cirsium arvense*), common St. John's wort (*Hypericum perforatum*), blackberry (*Rubus* spp.), timothy (*Phleum pratense*), velvet grass (*Holcus lanatus*), vetch (*Vicia* spp.), oxeye-daisy (*Chrysanthemum leucanthemum*), colonial bentgrass (*Agrostis tenuis*), bentgrass (*Agrostis* spp.)(Service 2008a), meadow foxtail (*Alopecurus pratensis*), reed canary grass (*Phalaris arundinacea*), geranium (*Geranium* spp.), bird's-foot trefoil (*Lotus corniculatus*) and wild carrot (*Daucus carota*)

(Service 1998). Bentgrass has been documented on 119 acres (nine percent) of the total 1,350 acres of Nelson's checkermallow habitat (Service 2008a).

Coast Range Nelson's checkermallow populations typically occur in open, wet to dry meadows, intermittent stream channels, and along margins of coniferous forests, with clay to loam soil textures (Glad *et al.* 1987). These areas generally support more native vegetation than Willamette Valley sites. Native plants commonly associated with Nelson's checkermallow in the Coast Range include: spear-head senecio (*Senecio triangularis*), strawberry (*Fragaria virginiana*), rush (*Juncus* spp.), sedge (*Carex* spp.), and yarrow (*Achillea millefolium*); non-native associated species often include tansy ragwort (*Senecio jacobaea*), velvet grass (*Holcus lanatus*), and timothy (*Phleum pratense*) (Service 2008a).

Conservation and Restoration Actions

Studies of the reproductive ecology of Nelson's checkermallow have shown that it has a highly complex breeding system that facilitates both outcrossing and selfing (Gisler and Meinke 1998); this study also suggested that control of seed predation by native weevils may be needed to enhance reproductive success at some populations which are heavily infested with weevils. The species has proved to be readily grown in controlled environments, and several approaches have successfully cultivated healthy plants for augmentation of existing populations (Gisler 2003). Outplantings have been successfully established at numerous protected sites throughout the range of the species. Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

Despite ease of propagation, Nelson's checkermallow, like all prairie plants, suffers from a lack of suitable habitat. The threats facing prairie habitat as a whole remain in effect for Nelson's checkermallow despite advances in outplanting programs.

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Willamette Valley and the Puget Trough that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

Golden Paintbrush

Listing Status and Critical Habitat

The golden paintbrush was listed as threatened without critical habitat on June 11, 1997 (Service 1997).

Reasons for Listing

The golden paintbrush is threatened by: conversion of native prairie habitat to agriculture, residential, or commercial use; competition from encroaching native and nonnative vegetation; the modification of grassland habitat through succession of vegetation in the absence of aboriginal burning; and impacts to prairies from grazing wildlife (deer, voles, rabbits) and domestic animals (horse and cows) that reduce the size and distribution of golden paintbrush populations. More than 97 percent of native prairie habitat known to exist in the Puget Sound region has been lost to succession, exotic species invasion, and conversion to agricultural or urban development (Chappell *et al.* 2001, Crawford and Hall 1997, Noss *et al.* 1995). Currently, only 15 acres of occupied golden paintbrush habitat are documented (Ted Thomas, Service, pers. observation, 2009).

Invasive species threaten golden paintbrush as they threaten other prairie dependent species. At many golden paintbrush-occupied sites, natural regeneration of this species is inhibited by a dense thatch layer of nonnative grasses (Pearson and Dunwiddie 2006). In addition, as an obligate outcrosser, golden paintbrush is severely threatened by inbreeding depression due to its small population size and high degree of habitat fragmentation (Kaye and Lawrence 2003).

On the prairies of Puget Sound, especially the large acreage of intact prairies of South Puget Sound, bentgrass species are ubiquitous (Chappell and Caplow 2004). Dr. Rex Crawford (Washington Department of Natural Resources, pers. comm., 2008) concludes that bentgrass species have increased on Puget Sound prairies over the past 25 years. Studies by Thysell and Carey (2001) indicated an increasing dominance of many exotic species, including *Agrostis* spp., on south Puget Sound prairie habitat. At the Rocky Prairie Natural Area Preserve in South Puget Sound that includes five acres of golden paintbrush, bentgrass species were found in 100 percent of vegetation plots measured by Chappell and Caplow (2004), with an average cover of five percent.

Life History and Ecology

The golden paintbrush is a perennial plant of the figwort family (Scrophulariaceae). Historically it was considered a short-lived perennial (5 to 6-year lifespan) (Dunwiddie *et al.* 2001), but recently it has been suggested that this plant may be longer lived than previously assumed (Arnett and Thomas 2008). This species is an outcrossing species primarily pollinated by *Bombus* spp. (bumblebees) and is known to reproduce only from seed (Lawrence and Kaye 2009, Kaye and Lawrence 2003, Wentworth 2001). The plant flowers from April through June; bright yellow bracts make this plant conspicuous. The species may be hemi-parasitic, using a host plant for seedling development and survival (Gamon 1995, Heckard 1962, Sheehan and Sprague 1984). It can also germinate and flower without the presence of a host plant (Lawrence and Kaye 2009, Wentworth 1994).

Habitat Characteristics

The golden paintbrush once occupied prairies and coastal grasslands throughout the Puget Trough, Washington, and Georgian Basin, British Columbia and prairie habitat in the Willamette Valley, Oregon. Optimum habitat for the golden paintbrush occurs on prairies that are dominated by native grasses and forbs (Pearson and Dunwiddie 2006, Caplow and Chappell

2005, Kaye and Kuykendall 2001b, Gamon *et al.* 2001). The golden paintbrush is intolerant of shade and is reduced in numbers and may be quickly lost as a prairie component in response to competition from taller vegetation, including rhizomatous and stoloniferous bentgrasses (*Agrostis* spp.), cool-season perennial grasses (tall oat grass), shrubs, such as Scotch broom (*Cytisus scoparius*), or the ubiquitous Douglas-fir (*Pseudotsuga menziesii*) (Arnett and Thomas 2008).

Nonnative grasses, including creeping and colonial bentgrass (*Agrostis spp*.), are relatively common species on Puget Sound prairies (Marty Chaney, Natural Resource Conservation Service, pers. comm., 2008; Barbara Wilson, Oregon State University, pers. comm., 2008). For example, on one of the most pristine prairie sites where golden paintbrush occurs, *Agrostis* species were found at relatively low cover in every plot surveyed (Chappell and Caplow 2004). Based on annual surveys of golden paintbrush, invasive nonnative *Agrostis* species are present at approximately 75 percent of all known locations of golden paintbrush (Chappell and Caplow 2004). In addition to management of invasive species, golden paintbrush requires disturbance for successful germination, survival and growth of seedlings (Pearson and Dunwiddie 2006, Lawrence 2005) and exhibits characteristics of a management-dependent species (Arnett and Thomas 2008, Lawrence and Kaye 2006, Scott *et al.* 2005, Dunwiddie *et al.* 2001).

Population Trends and Distribution

The golden paintbrush is currently known from eleven populations: nine in Washington, within Island, San Juan and Thurston counties; and two on small islands (Trials Island and Alpha Islet) near Victoria, British Columbia, Canada (Arnett and Thomas 2008). With the exception of the population at Rocky Prairie Natural Area Preserve in Thurston County, Washington, this species is only found on islands. Prior to 1938, collections had been made from six historic locations in the Willamette Valley, Oregon. Extensive botanical surveys have been conducted throughout the grasslands of the Willamette Valley (Kaye *et al.* 1997; Hitchcock and Cronquist 1973; Johannessen *et al.* 1971; Thelinius 1968; Kaye, 2009) and no plants or populations of golden paintbrush have been observed or reported in Oregon since prior to 1938 (Lawrence and Kaye 2006, Godt *et al*. 2005, Caplow 2004, Wentworth 2001, Service 2000b and 1997). The golden paintbrush occupies only 15 acres throughout its entire range. Except for the Rocky Prairie Natural Area Preserve in Thurston County, Washington, which is dedicated to golden paintbrush conservation, no existing populations of golden paintbrush are more than one acre in size.

Since publication of the Service's Recovery Plan for this species (Service 2000b) and a Reintroduction Plan (Caplow 2004), several new populations of golden paintbrush have been introduced onto new habitat within Washington, and existing populations there have been augmented and receive regular management. The Service, in coordination with the Willamette Valley National Wildlife Refuge Complex and other conservation partners also plans to reestablish golden paintbrush populations in the Willamette Valley (Kaye, 2009), in accordance with the Recovery Plan (Service 2000b) for this species. Nine outplantings of approximately 200 golden paintbrush plants were planted as a test in the Willamette Valley in 2004 (Lawrence 2005, Lawrence and Kaye 2009). Remnants of these outplantings are currently known from at least two locations in the Willamette Valley (Kaye 2009). One of these reintroductions (at Bellfountain Prairie on Finley National Wildlife Refuge) has 60 plants remaining, based on monitoring conducted in May 2009.

Conservation and Restoration Actions

All eleven remaining native populations of the golden paintbrush receive annual management, including mowing, tree removal, burning, and herbicide application. Spot treatment is favored over broadcast application of herbicide on golden paintbrush sites. This management reduces competition from native and nonnative tree, shrub, and grass species.

Golden paintbrush seeds, collected primarily from Washington State and two collections from British Columbia, have been banked at the Berry Botanic Garden in Portland, Oregon and the Center for Plant Conservation facility at the University of Washington Botanic Garden (Arnett and Thomas 2008).

Management plans have been developed and are being implemented for populations of the golden paintbrush at the Rocky Prairie Natural Area Preserve and the Nass Preserve and Fort Casey, both on Whidbey Island. The Service, Washington Department of Natural Resources Natural Heritage Program, The Nature Conservancy, and members of the Golden Paintbrush Recovery Team have developed conservation partnerships with all but one of the private landowners where golden paintbrush occurs.

Trial populations of golden paintbrush were introduced to the Willamette Valley as part of a Master's project in 2004 (Lawrence 2005, Lawrence and Kaye 2009). Information gathered during this study will be used to inform the future outplantings in the Willamette Valley, some of which have been funded and are scheduled to occur in the near future (Kaye 2009). Given golden paintbrush's extremely restricted distribution, small populations, and dependence on outcrossing, re-establishment of viable populations in the Willamette Valley is essential to recovery of the species (Service 2000b, Kaye and Lawrence 2003, Arnett and Thomas 2008). The Service is also working collaboratively with the Department of Defense (DOD), and the National Park Service (NPS) to introduce golden paintbrush onto their lands in the fall of 2009 and 2010. In addition to new populations, the Service, The Nature Conservancy, and other conservation partners have planted golden paintbrush to augment existing populations and to reintroduce the plant onto suitable habitat to create new populations that will contribute to the species' recovery.

Survival and Recovery Needs

1. Maintain the viability of the existing population by protecting occupied habitat, and controlling encroachment by shrubs and trees and reducing threats from non-native plants on these sites.

2. Increase the size and distribution of large blocks of protected, high quality prairie habitat within the Puget Trough and the Willamette Valley that are subject to management including: periodic disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and control of non-native plants.

ENVIRONMENTAL BASELINE

Status of the Prairie Ecosystem

Prairie habitat within the Willamette Valley and Puget Trough has been greatly reduced since European settlement (Noss *et al.* 1995, Christy and Alverson 1994, Hammond and Wilson 1993).

The remaining prairie occurs in small, fragmented remnants across the landscape; therefore it is necessary to preserve and restore prairie habitat in order to ensure the survival and recovery of the prairie-endemic, listed species. Due to lack of a natural fire regime, other disturbance is necessary to maintain the habitat in its open, early seral stature. Land managers rely upon mowing, prescribed burning, woody plant removal, tilling, and herbicide use to reduce the rate of succession to closed canopy.

In addition to prevention of native woody species encroachment, land managers also control for non-native species invasion. Herbicides, including glyphosate, are common tools for invasive species control. Glyphosate is a preferred herbicide for use in natural areas, public lands, and right-of-ways (Banks *et al.* 2005). Land managers from Fern Ridge Reservoir, City of Eugene Parks and Open Spaces, E.E. Wilson, the Willamette Valley National Wildlife Refuge Complex, and various private lands all indicated that control of invasive species, specifically bentgrass, was a part of their management (Service 2008a). From the survey of land managers who manage bentgrass, all use glyphosate products as part of their weed management practices (Service 2008a).

Wet Prairie

Within wet prairies, management of non-native species relies heavily upon glyphosate formulations labeled for use in aquatic or saturated environments. Use of these herbicides occurs as broadcast and spot applications.

Upland Prairie

Land managers can utilize a different suite of herbicides in uplands than are available for wet prairie habitat. Sethoxodim (trade name Poast) is commonly used to control grasses, although it is grass-specific and cannot be used to control broadleaf weeds that may be problematic. Glyphosate remains one of the most widely used herbicides even in areas where other herbicides are available due to its low toxicity, high soil binding capacity, and broad spectrum effectiveness.

Species-Specific Baseline

The action area (defined as the area directly or indirectly affected by the proposed Federal action) for this consultation encompasses the entire range of the Fender's blue butterfly and its critical habitat, Willamette daisy and its critical habitat, Bradshaw's lomatium, Kincaid's lupine and its critical habitat, Nelson's checkermallow, and golden paintbrush. For that reason, the Status of the Species and Critical Habitat section, in conjunction with the status for each habitat type as described above, reflects the Environmental Baseline.

EFFECTS OF THE ACTION

In completing this analysis, the Service considered information from many sources including peer-reviewed publications, unpublished reports, and personal communications with experts. The following key findings were made based on consideration of that information:

1. Bentgrass plants (creeping and other species of *Agrostis*) are found within wet and upland prairies of western Oregon and Washington.
2. The listed species and critical habitats addressed in this biological opinion are found within western Oregon and Washington.
3. Management of wet and upland prairie habitat is currently in place to control the levels of bentgrass infestation in and around listed species populations in these areas.
4. Control of bentgrass and other invasive species includes the use of glyphosate.
5. Glyphosate tolerant bentgrasses could not be controlled with the current management practices and tools available; therefore it would exert a significantly increased adverse impact on listed species conservation.

The action of deregulating glyphosate tolerant creeping bentgrass is anticipated to result in the following:

1. Glyphosate intolerant creeping bentgrass is expected to be directly pollinated by glyphosate tolerant creeping bentgrass plants grown in the Willamette Valley and Puget Trough.
2. Hybridization between closely related, glyphosate intolerant bentgrass species and glyphosate tolerant creeping bentgrass is expected to occur.
3. This pollination and hybridization is expected to result in glyphosate tolerance being conferred to wild populations of bentgrass plants. Continued use of glyphosate both through direct applications and through indirect overspray, is expected to result in a selection pressure that would favor glyphosate tolerant plants.
4. Glyphosate will be ineffective at controlling glyphosate tolerant bentgrass plants.

Alternative herbicides to glyphosate exist, but cannot always be used due to label restrictions or concerns for non-target plants, including listed plants in managed prairie habitats:

1. In upland areas, alternatives to glyphosate exist that could be effective against glyphosate tolerant bentgrass species and could be used around listed species. However, the effectiveness, costliness, and ease of use have not been established for these alternatives. Non-herbicide alternatives are not effective against bentgrass.
2. In wet prairies, the only alternative herbicide labeled for use for aquatic habitat restoration is imazapyr. This herbicide is known to move in soil and can harm or kill non-target plants. In areas where listed species occur, a broad-spectrum herbicide that can move away from the target weed and injure or kill non-target species, including threatened and endangered plants, is not an acceptable alternative. In wet areas, no herbicide alternatives exist and non-herbicide treatments are not effective against bentgrass.

To assist in our analysis, we developed a simplified, conceptual model describing the baseline and pathways of effects we are considering in this opinion (See Figure 1).

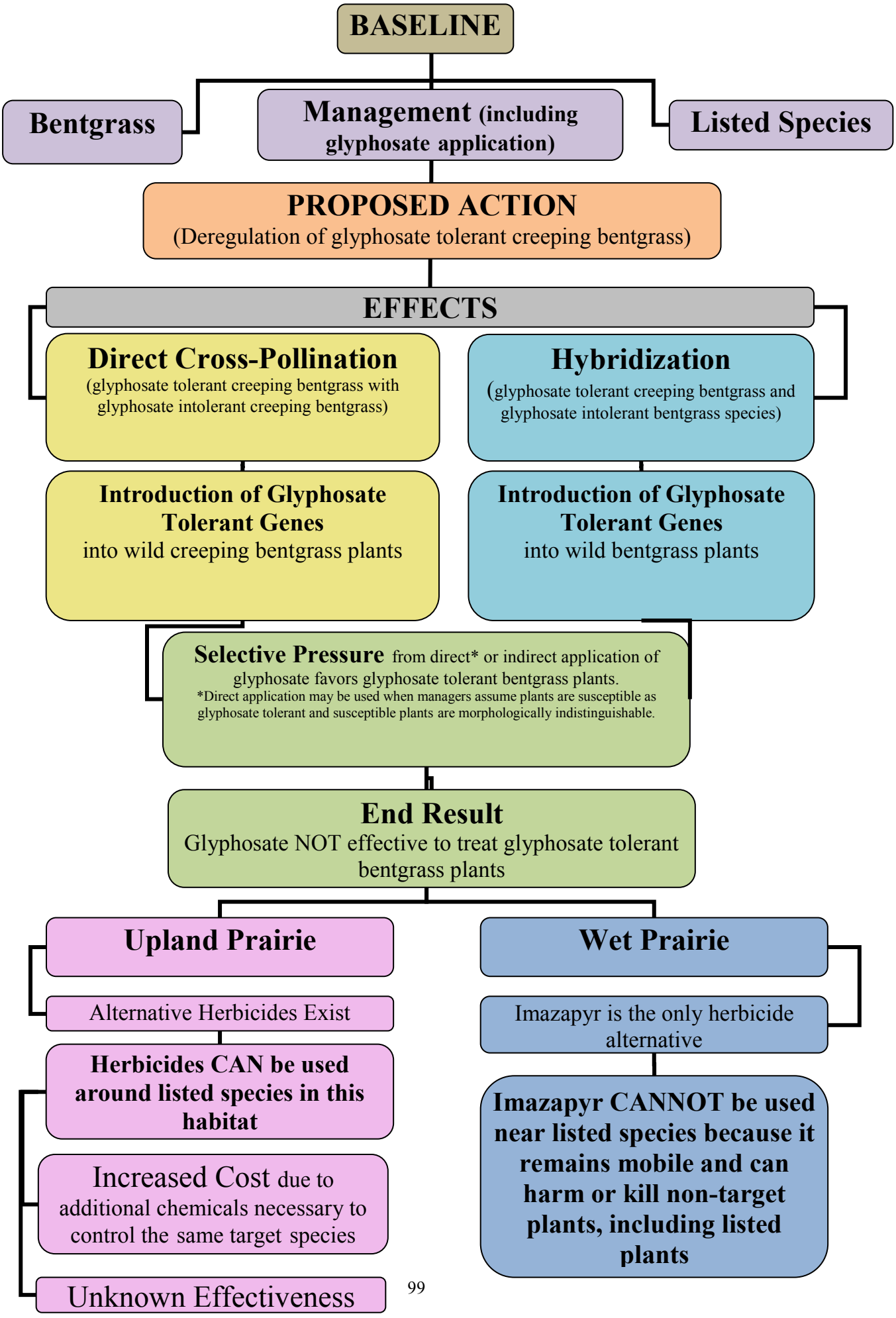

Figure 1. Conceptual Model of Consultation Analysis.

The following findings were used to complete the analysis of effects to listed species and critical habitat likely to occur with implementation of the proposed action:

1. Bentgrass species are aggressive invaders of wet and upland prairies throughout the Willamette Valley (Service 2008a).
2. Glyphosate tolerant creeping bentgrass readily crosses with glyphosate intolerant creeping bentgrass and is known to hybridize with other species of bentgrass resulting in glyphosate tolerant progeny (APHIS 2007, Banks *et al.* 2005).
3. Glyphosate tolerance is favored when glyphosate is used in and around a glyphosate tolerant plant and its glyphosate intolerant counterpart (Christoffers 1999).
4. Glyphosate is commonly used in the Willamette Valley in restorations, natural areas, (Service 2008a), and crop land (ODA 2009, 2008).
5. Viable pollen from glyphosate tolerant creeping bentgrass has been found up to 13 miles from the source (Watrud *et al.* 2004), and all sites currently known to support both listed species and bentgrass are within this distance from known grass seed farms or golf courses (Service 2008a).
6. There are no reasonable herbicide alternatives available to control glyphosate tolerant bentgrass species in wet environments in and around listed plant species when bentgrass plants are actively growing and standing water may be present (Tu *et al.* 2001).
7. The purpose of the proposed action is to market a turf grass that can be maintained weed-free by direct application (overspray) of glyphosate (APHIS 2007).

Direct and Indirect Effects

Effects to Prairie Habitat

Deregulation of glyphosate tolerant creeping bentgrass will allow the permittee (Monsanto/Scotts) to market, sell, and distribute its product throughout the country. At present, growth of glyphosate tolerant creeping bentgrass has been restricted to test areas as it is currently under regulation by APHIS. One such test area is located in Jefferson County, Oregon, 80 miles from commercial bentgrass production sites in the Willamette Valley. The 400-acre test field was planted within an Oregon Department of Agriculture (ODA)-sanctioned control area in 2002 (Reichman *et al.* 2006). The plants flowered in 2003 and were removed that fall and the following spring; all glyphosate tolerant material was reportedly destroyed (Zapiola *et al.* 2008).

During the year of production, viable glyphosate tolerant creeping bentgrass pollen traveled up to 13 miles from the source fields where it pollinated glyphosate intolerant bentgrass plants (Watrud *et al.* 2004). Prior to this trial, only small scale studies had been completed yielding much shorter pollen dispersal distances (Wipff and Fricker 2001). In subsequent years, despite attempts to eradicate all glyphosate tolerant material, individual creeping bentgrass plants were found that possessed the gene for glyphosate tolerance up to 2.4 miles from the study site (Reichman *et al.* 2006). Although genetic information was not released by Scotts that would allow researchers to determine explicitly the parentage of the glyphosate tolerant individuals, Reichman *et al.* (2006) determined that both seed and pollen dispersal were responsible for the escaped glyphosate tolerance. The results of these studies support the following findings:

- Viable creeping bentgrass pollen can travel great distances (e.g., 13 miles);
- Pollen from glyphosate tolerant creeping bentgrass can pollinate glyphosate intolerant creeping bentgrass plants; and
- Seed from glyphosate tolerant individuals can disperse outside of contained areas.

The listed species and critical habitats found in Oregon and Washington that are considered in this biological opinion occur in close proximity to known golf courses and grass seed production areas, where deregulated glyphosate tolerant creeping bentgrass is likely to be grown. Such close proximity creates a high risk of cross pollination of glyphosate tolerant creeping bentgrass with the naturalized, glyphosate intolerant creeping bentgrass, hybridization between glyphosate tolerant creeping bentgrass and other glyphosate intolerant bentgrass species, and invasion by glyphosate tolerant creeping bentgrass into habitat occupied by these listed species and their critical habitats in Oregon and Washington. A single glyphosate tolerant creeping bentgrass plant that reaches maturity and flowers could release pollen containing the glyphosate tolerant gene into the environment where it could pollinate wild, glyphosate intolerant creeping bentgrass and other bentgrass species. Further, it would be difficult to observe such an isolated incident, as glyphosate tolerant and glyphosate intolerant bentgrass plants are indistinguishable without genetic analysis. Detection of the release would be difficult to achieve, and would not likely occur before the plant had reached maturity and released pollen with the glyphosate tolerant gene into the environment, thus, continuing the spread of glyphosate tolerance in wild bentgrass populations. Attempts at control of these plants could still rely on glyphosate due to the inability to distinguish between the glyphosate tolerant and glyphosate intolerant individuals. This additional selection pressure would favor the growth and spread of the glyphosate tolerant individuals by reducing competition from susceptible bentgrass plants.

Invasive species threaten prairies in the same way as they threaten many other ecosystems. For prairie ecosystems, which require open spaces and bare ground, invasion by densely colonizing plants, such as certain bentgrass species, velvet grass, cattail (*Typha latifolia*), and Canada thistle (*Cirsium arvense*), can virtually eliminate the ecological function of interstitial spaces.

Bentgrass species are very successful invaders of native Willamette Valley and Puget Trough wet and upland prairie (Service 2008a, Ted Thomas, Service, pers. observation, 2009). Characteristics that have been selected for in bentgrass crop species enhance their ability to colonize and dominate natural ecosystems. Creeping bentgrass forms dense mats that exclude other species, thus producing a monoculture with little to no interstitial space available for colonization or expansion by other plants. These traits make creeping bentgrass a valuable turf grass for use in golf courses (Cattani and Struik 2001). Creeping bentgrass reproduces by seed and can expand vegetatively via stolons (Kik and Joneje 1990). The seed of bentgrasses is small, light in weight, and has been bred for high viability. Light seed may also result in the inadvertent “escape” of a bentgrass crop into adjacent areas of natural prairie habitat.

The transfer of glyphosate tolerance from creeping bentgrass into natural, weedy populations of related plants is of concern. A number of such transfers have already been documented as discussed below.

During the glyphosate tolerant creeping bentgrass trials in Jefferson County, glyphosate tolerance escaped into sentinel and natural creeping bentgrass plants that were up to 13 miles away from the source population (Watrud *et al.* 2004). A study conducted in following years found that naturalized, glyphosate tolerant plants were persisting in the environment despite the removal of the source population (Reichman *et al.* 2006).

In Canada, hybridization between a crop, rapeseed (*Brassica napus*), and its weedy relative, field mustard (*B. rapa*), resulted in glyphosate resistant weeds (Warwick *et al.* 2007, Yoshimuri et al. 2006) that persisted in the wild for three to five years even without the selective pressure of

glyphosate use (Warwick *et al.* 2007). Glufosinate resistance was also observed in wild populations of rapeseed (Yoshimuri *et al.* 2006, Knispel *et al.* 2008), and some plants exhibited resistance to multiple herbicides (Knispel *et al.* 2008).

In Japan, where production of transgenic *Brassica napus* is not permitted, escape of transgenic seed and plants (including glyphosate and glufosinate resistant *Brassica napus*) was documented around ports and roadsides (*Saji et al.* 2005). It was later determined that hybridization between the two herbicide resistant strains must have taken place as plants showing resistance to both glyphosate and glufosinate were documented (Aono et al. 2006).

In Mexico, transgenes were found in landrace maize plants (*Zea mays*) at 23 locations; several years later, transgenes were relocated at two of these sites (Piñeyro *et al*. 2008).

In the United States, the recently detected presence of glyphosate tolerant sugar beets in compost sold to homeowners further illustrates the potential for the unintended spread of a herbicide resistant crop species (Hall 2009). Sugar beets are likewise wind pollinated and were thought to be well controlled by the growers using the product. These examples are evidence of the type of unintentional release that can occur with transgenic or herbicide resistant crops.

Bentgrass is known to be a problem weed in restoration work as well as maintained natural areas (Service 2008a). For many land managers in the Willamette Valley, bentgrass is one of the greatest obstacles barring successful restoration (Service 2008a). It is found in virtually every prairie area in the Willamette Valley and represents a threat to those prairie sites in this area where it is not currently found (Service 2008a). Soil disturbance can create opportunities for bentgrass seed to establish in otherwise native plant species-dominated sites because of the ever-present seed source located in adjacent grass seed production fields and natural sites where wild bentgrass plants already grow. Tilling, burning, or manual pulling has not been effective as a control method for bentgrass (Trevor Taylor, City of Eugene Parks and Open Spaces, pers. comm., 2008).

Within natural systems, bentgrass is usually controlled with herbicide applications (Service 2008a). To date, glyphosate is the most common herbicide used to control bentgrass in the Willamette Valley for several reasons. Glyphosate is a preferred herbicide for natural areas (Banks *et al.* 2005); it is inexpensive and effective, it binds readily to soil particles making overspray that reaches the soil inactive and non-transitory, and it is labeled for use in aquatic habitat restoration situations (RodeoTM and Aquamaster® formulations). Management of invasive species that occurs during the early part of the growing season or after fall rains when plants are actively growing and are most susceptible to herbicide application may coincide with standing water remaining in seasonal wetlands and wet prairies. In these areas, only two herbicides are currently labeled for weed control: glyphosate and imazapyr. Imazapyr (Habitat® formulation) is a poor alternative to glyphosate because it does not readily bind to soil particles. Because imazapyr does not readily bind to soil particles, nor quickly degrade (Tu *et al.* 2001), it can harm or kill non-target plants including listed species and desirable natives.

Tables 2 and 3 summarize the effect determinations and estimated levels of bentgrass invasion for six listed species and three critical habitat designations affected by the proposed action in Oregon and Washington. The baseline extent of bentgrass invasion within the action area was determined for major populations and critical habitat units based on information provided by land managers and ecologists in the Willamette Valley and Puget Trough (Service 2008a, Ted

Thomas, Service, pers. observation, 2009). The total acreage occupied by listed species populations and critical habitat, the acreage of listed species occupied habitat/critical habitat surveyed for bentgrass occupancy, and the proportion of the surveyed acreage occupied by creeping bentgrass are reported in Tables 2 and 3 below.

Table 2. Listed species affected by the proposed deregulation of glyphosate tolerant creeping bentgrass and current levels of creeping bentgrass invasion within occupied habitat. The percent levels of invasion are based on surveys of land managers. Some occupied sites could not be assessed because they are privately managed or the manager was unavailable for comment; for these reasons, the percentages below are likely an underestimate of the actual extent of bentgrass invasion.

Common Name	Total Acres	Acres with Survey Information	Acres invaded by Bentgrass	Percent of Total Acres Invaded	Percent of Surveyed Acres Invaded
Willamette Daisy	283	110	107	38%	97%
Bradshaw's Lomatium	843	282	282	33%	100%
Fender's Blue Butterfly	946	544	498	53%	91%
Kincaid's Lupine	700	131	67	10%	51%
Nelson's Checkermallow	1,350	119	119	9%	100%
Golden paintbrush	15	15	2	13%	13%

Table 3. Critical habitat affected by the proposed deregulation of glyphosate tolerant creeping bentgrass and current levels of bentgrass invasion within the critical habitat. The percent levels of invasion are based on surveys of land managers. Some occupied sites could not be assessed because they are privately managed or the manager was unavailable for comment; for these reasons, the percentages below are likely an underestimate of the actual extent of bentgrass invasion.

Designation	Total Acres	Acres Surveyed	Acres Invaded by Bentgrass	Percent of Total Acres Invaded	Percent of Surveyed Acres Invaded
Fender's blue butterfly Critical Habitat	3,010	2,614	2,602	86%	100%
Willamette daisy Critical Habitat	718	493	470	66%	95%
Kincaid's lupine Critical Habitat	584	530	519	89%	98%

In the biological evaluation that APHIS provided to the Service, it was estimated that glyphosate

tolerant creeping bentgrass could be found in areas between 240 to 390 miles from the original source population within 30 years (APHIS 2007). The Willamette Valley of Oregon and Puget Trough of Washington, which supports the six species considered in this BO, are 166 miles long by 60 miles wide and 210 miles long by 80 miles wide, respectively. Glyphosate tolerance would likely be found in bentgrass populations throughout the Willamette Valley in 13 to 21 years, based upon the APHIS estimate of pollen movement (APHIS 2007). Glyphosate tolerance could spread through the Puget Trough in 17 to 27 years (APHIS 2007). These calculations rely upon the introduction of a single source population into the Willamette Valley and into the Puget Trough. With implementation of the proposed action, glyphosate tolerant creeping bentgrass could be grown in numerous locations within the Willamette Valley and Puget Trough, thus accelerating the potential spread of glyphosate tolerance. The glyphosate tolerant crop could be grown for seed production, on golf courses, and may even be found in lawns with numerous source populations. Given multiple sources for establishment of glyphosate tolerant bentgrass populations, the timeline for glyphosate tolerance of naturalized bentgrass populations would likely be much shorter than 13 to 27 years.

In addition to the threat of cross pollination between glyphosate tolerant creeping bentgrass and naturalized, glyphosate intolerant creeping bentgrass, *Agrostis* species are known to hybridize readily. Initial data collection efforts identified "creeping" bentgrass in areas that support listed species. However, further investigation by Scotts and the Service illustrated the complexity of identifying bentgrass species in these areas (Scotts 2009, Reichman 2009). Although creeping bentgrass was present, there were other *Agrostis* species identified including: dryland bentgrass (*Agrostis castellana*) and colonial bentgrass (*Agrostis capillaris*) (Reichman 2009, Scotts 2009). Given time constraints for completing this consultation, an exhaustive and statistically rigorous bentgrass survey effort could not be completed. There are no data available on the relative frequency of different bentgrass species in the Willamette Valley and Puget Trough, nor are the bentgrass species discussed in this biological opinion likely to be the only *Agrostis* species present within the action area. Instead, the Service has used the data provided by the Scotts Company and Dr. J. Reichman as a confirmation of the presence of these bentgrass species rather than as an indication of their relative abundance within the action area. Prior to April 2009, the Service was unaware that the "creeping" bentgrass identified by numerous land managers was a complex of bentgrass species including, but not limited, to *Agrostis stolonifera*. In the following discussion of the complex issue of landscape-level hybridization between a bentgrass crop and its wild relatives, scientific names will be used throughout to reduce confusion caused by variable common names.

Hybridization between *Agrostis stolonifera* and other *Agrostis* species has been studied by several researchers. Wipff and Fricker (2001) measured exchange of transgenes between glyphosate tolerant *Agrostis stolonifera*, glyphosate intolerant *Agrostis stolonifera*, and other *Agrostis species*; specific rates of hybridization were not reported. Christopher (2003) measured hybridization rates between *Agrostis stolonifera* and numerous other *Agrostis* spp. As expected, the rates of hybridization between species are lower than within species rates (Table 4). Belanger *et al.* (2003) studied the movement of transgenes as well; the rates reported in this study were much lower than those reported by Christoffer (2003) due to the study design. None of these studies measured hybridization at a landscape level.

Table 4: Hybridization rates between natural *Agrostis* species and genetically modified *Agrostis stolonifera* as reported in three studies.

Hybrid	Wipff and Fricker* Rates of Hybridization	Belanger et al.** Rates of Hybridization	Christoffer*** Rates of Hybridization
Agrostis capillaris x *Agrostis stolonifera*	Average of 12.3 individuals recovered per 25 x 51 cm flat	0.0440%	Average of 0.0188%
Agrostis castellana x *Agrostis stolonifera*	Average of 29.3 individuals recovered per 25 x 51 cm flat	0.0015%	Not reported, presumed 0 %
Agrostis canina x *Agrostis stolonifera*	7 individuals recovered per 25 x 51 cm flat	0.0000%	Not reported, presumed 0 %
Agrostis gigantea x *Agrostis stolonifera*	Average of 2.5 individuals recovered per 25 x 51 cm flat	0.0000%	0.0080%
Agrostis stolonifera x *Agrostis stolonifera*	Not reported	Average of 0.3840%	Average of 37.75%

* The *Agrostis stolonifera* used in this study was genetically modified to be resistant to glufosinate. The method by which numbers were reported made percentages impossible to report. Wipff, J.K. and Fricker, C., 2001. Gene flow from transgenic creeping bentgrass (*Agrostis stolonifera* L.) in the Willamette Valley, Oregon. International Turfgrass Society Research Journal 9: 224-242.

**The *Agrostis stolonifera* used in this study was genetically modified to be resistant to glufosinate. Belanger, F.C., T.R. Meagher, P.R. Day, K. Plumley, and W.A. Meyer., 2003. Interspecific hybridization between *Agrostis stolonifera* and related *Agrostis* species under field conditions. Crop Science 43: 240-246.

***The *Agrostis stolonifera* used in this study is the same line that is proposed for deregulation and is resistant to glyhposate. Christoffer, P.M., 2003. Transgenic glyphosate resistant creeping bentgrass: studies in pollen-mediated transgene flow. Masters of Science thesis. Washington State University. 84pp.

Although the hybridization rates reported here are lower than one percent, there are millions to billions of individual pollination events each growing season. Moreover, introduction of the glyphosate tolerant gene confers a distinct advantage to plants growing where glyphosate is used or glyphosate drift may be present. Therefore, although the rates of hybridization appear low, the risk of hybridization cannot be considered insignificant or negligible given the anticipated level of bentgrass species reproduction in the Willamette Valley and the Puget Trough.

The common use of glyphosate in restoration and crop lands is likely to favor selection of the

glyphosate tolerant bentgrass species over their glyphosate intolerant counterparts by killing or injuring susceptible plants and reducing competition between these forms (Christoffers 1999). Moreover, with glyphosate being used commonly to control current bentgrass invasions, glyphosate tolerant bentgrass may be directly sprayed as a means of controlling the presumed susceptible plants. This intense application of glyphosate is likely to result in a strong selective pressure being exerted on populations of mixed susceptible and resistant plants, because susceptible plants would be injured or killed by the glyphosate leaving only the glyphosate resistant plants to reproduce and survive. It is likely that, over time, the glyphosate tolerant plants would dominate under such conditions. With this artificial selection pressure in place, it is anticipated that the dominant source of creeping bentgrass pollen and seed would include the glyphosate tolerant gene.

Glyphosate tolerance in bentgrass would render current restoration management practices relying upon the use of glyphosate in wet prairie habitats ineffective, leaving only imazapyr as a treatment tool. Imazapyr is not an effective alternative to glyphosate because it remains more persistent as an active form in soil and could potentially harm or kill non-target species, which could include the listed plants or nectar plants the restoration actions seek to protect. Therefore, in wet areas that support certain listed species and critical habitat designations (Willamette daisy and its critical habitat, Bradshaw's lomatium, Fender's blue butterfly critical habitat), the proposed action is likely to result in extensive invasions by glyphosate tolerant bentgrass plants that are very difficult or impossible to control. In those situations, bentgrass is likely to occupy significant portions of wet prairie habitat that are needed by listed species to successfully reproduce and maintain or increase population size and distribution.

In upland areas, there are alternative herbicides to glyphosate that are likely to be effective in controlling the spread of glyphosate tolerant bentgrass (Andrew Hulting, Oregon State University Extension, pers. comm., 2008). For that reason, listed species and critical habitats that occur largely in somewhat drier areas (such as the Fender's blue butterfly, Kincaid's lupine, Nelson's checkermallow, golden paintbrush, and critical habitat for Kincaid's lupine) are likely to be less adversely impacted by the proposed action than those listed species and critical habitats that are dependent upon wet prairie. However, adverse impacts to these species and critical habitats in upland areas are likely to occur as a result of the proposed action because the alternative herbicides may be more expensive or may not treat all weed species (i.e., the product may be a grass-specific herbicide). The most likely candidate for control of glyphosate tolerant creeping bentgrass in uplands is sethoxydim (trade name Poast®); this is a grass-specific herbicide. We anticipate that, rather than finding a true replacement for glyphosate, managers will be forced to use other chemicals, such as sethoxydim, in addition to glyphosate. Simple accounting would dictate that using multiple chemicals to treat the same suite of weeds previously controlled by one herbicide, would increase the cost of management. It is not anticipated that budgets would increase correspondingly; therefore, either less area would be treated or the area treated would not be managed as effectively as it is now. Such conditions are likely to adversely impact the ability of listed species to successfully reproduce in upland prairie and adversely impact the condition of critical habitat in these areas to provide for recovery. In this way, adverse effects to listed species and critical habitats in upland areas are expected if glyphosate tolerant creeping bentgrass is deregulated.

The overall effects of the proposed action are expected to be similar on all six species and three critical habitats in Oregon and Washington considered in this biological opinion. The specific impacts of the proposed action by species and critical habitat are summarized below.

Direct and Indirect Effects of the Proposed Action on Listed Species and Critical Habitat

Fender's Blue Butterfly

The Fender's blue butterfly depends upon both its host plant (Kincaid's lupine, spurred lupine, or sicklekeel lupine) and nectar species in order to complete its life cycle. The Fender's blue butterfly lays its eggs on lupine plants that occur predominantly in upland habitat or on hummocks in wetter areas. Where bentgrass is found in upland prairie sites, non-glyphosate based herbicides are available that would make management of glyphosate tolerant creeping bentgrass more feasible (Andrew Hulting, Oregon State University Extension, pers. comm., 2008).

The proposed action is likely to result in glyphosate tolerant creeping bentgrass invasions that would adversely affect the areas already impacted by glyphosate intolerant bentgrass, 498 acres (53 percent) of 946 acres of occupied Fender's blue butterfly habitat, through transfer of the glyphosate tolerant gene to glyphosate intolerant bentgrasses and through seed and stolon establishment (Service 2008a). However, much of this area may be effectively managed with alternative chemicals because the habitat occurs in upland areas. Alternative herbicides are likely to effectively control the spread of glyphosate tolerant bentgrass in upland prairie, but likely not at current levels of control due to the increased time and cost associated with implementing alternative herbicide treatments.

In the southern portion of its range, in the west Eugene area, adult Fender's blue butterflies rely heavily upon neighboring wetlands and wet prairies for nectar food plants; this habitat also provides critical connectivity between upland habitat patches. This wet prairie habitat supports a large metapopulation of this species in the Eugene area and is likely to be significantly degraded by expansion of glyphosate tolerant bentgrass as a result of direct pollination and hybridization caused by the proposed action because no alternative herbicides are available for use in wet prairie sites that wouldn't also adversely impact lupine host plant as well as nectar plant species that the butterfly needs. This effect is likely to result in a decrease in the numbers and distribution of the Fender's blue butterfly in the west Eugene wetlands at the southern extent of its range where the butterfly depends on wet prairie habitat for adult nectar sources. The populations in the west Eugene area might persist, but would likely decline and individual populations could be lost entirely. However, this impact on the species is likely to be tempered by the likely persistence of multiple butterfly populations throughout the remainder of the Fender's blue butterfly's range that are dependent upon upland prairie habitat where effective control of bentgrass can be achieved with alternative herbicides, and where the protections and management afforded these sites pursuant to the take prohibitions, recovery provisions, and the section 7(a)(2) standard of the Act are likely to retain the potential for recovery (i.e., survival) of this species, although it is likely to delay the timing of that recovery.

Fender's Blue Butterfly Critical Habitat

Fender's blue butterfly critical habitat was designated in 2006. As noted above, the PCEs of this habitat include: (1) early seral prairie or oak savanna; (2) larval host plants (Kincaid's lupine, spurred lupine, and sickle-keeled lupine); (3) nectar sources; and (4) stepping stone habitat (habitat patches that connect larger, core areas) (Service 2006). Creeping bentgrass is currently

found on 2,602 acres (86 percent) of 3,010 acres of Fender's blue butterfly designated critical habitat (Service 2008a). The southern critical habitat units, including units FBB-10, 11, and 12, occur in partial wetland habitat; the remaining units of critical habitat are located in drier prairie habitat. Some of the critical habitat units include extensive wet areas that have already been negatively impacted by the presence of bentgrass and would be expected to be further degraded if glyphosate tolerant creeping bentgrass escaped into naturalized bentgrass populations, thus restricting management to the use of imazapyr. Bentgrass dominates prairie habitat, creating dense monocultures that eliminate interstitial spaces required to maintain the early seral stature of prairie habitat. Without effective management, creeping bentgrass is also anticipated to out-compete host plants and nectar species required for critical habitat function. Management of creeping bentgrass in the wet prairie-associated units would be severely limited.

Wet prairie units currently contain functional PCEs that support a large, functioning metapopulation of the Fender's blue butterfly and include numerous stepping stones (PCE 4) of nectar-related habitat (PCE 3). Bentgrass is an aggressive invader. The inability to control this invasive species would result in a loss of interstitial spaces and the lack of function of PCE 1. Furthermore, competition from bentgrass, particularly in wet areas where management is limited, could lead to loss of nectar species (PCE 3) that are required for the critical habitat units to function. The inability to effectively control bentgrass in units FBB-10, 11, and 12 as a result of the proposed action is likely to impair the function of Fender's blue butterfly critical habitat PCEs in those units. The final rule designating the critical habitat indicates that each critical habitat unit has a vital role to play in the conservation and recovery of the Fender's blue butterfly; therefore, these impacts are considered significant.

Willamette Daisy

As noted above in the Status of the Species section of this biological opinion, the Willamette daisy is a wet prairie species that is generally found in higher quality habitat. It can reproduce by seed or by vegetative spread. There are few large populations of this species and the ones currently in existence are being actively managed to control invasive species, including bentgrass (Service 2008a). More than 95 percent of occupied sites, for which data are available, currently suffer from invasion by bentgrass species (Service 2008a), which form dense mats that occupy otherwise open interstitial spaces needed for the Willamette daisy to maintain or expand its current population. Given the limitations discussed above of using imazapyr to control bentgrass in wet habitats, if glyphosate tolerant creeping bentgrass were deregulated, at least 107 acres (38 percent) of 283 acres of occupied Willamette daisy habitat would likely be subject to severe degradation through transfer of the glyphosate tolerant gene to the already present bentgrass populations within 21 years of initial introduction (APHIS 2007). The extent of this invasion is likely to increase through establishment of glyphosate tolerant seeds and stolons from neighboring, wild populations. For these reasons, implementation of the proposed action is likely to cause a significant reduction in the reproduction, numbers, and distribution of the Willamette daisy throughout its range by facilitating the invasion of bentgrass into remaining Willamette daisy populations to an extent that the species would not likely have the potential to survive and recover.

Willamette Daisy Critical Habitat

Willamette daisy critical habitat was designated in 2006, and includes wetter areas ideal for creeping and other bentgrass species. The PCE for critical habitat is (1) early seral upland

prairie, wet prairie, or oak savanna. Functional critical habitat for this species requires "open spaces between bunch grasses [that] allow *E. decumbens* var. *decumbens* to establish seedlings and vegetatively spread within a habitat patch" (Service 2006a). Currently, at least 66 percent of the designated critical habitat is infested with creeping bentgrass (Service 2008a). The proposed action would likely result in all bentgrass in these acres being glyphosate tolerant within 21 years (based on APHIS 2007) through the transfer of glyphosate tolerance to glyphosate intolerant bentgrass populations and through seed and stolon establishment. Glyphosate tolerant bentgrass would be particularly difficult to control in Willamette daisy critical habitat units due to the presence of water during the early growing season and again in the fall when additional growth would be most susceptible to herbicide application. For this habitat, imazapyr would be the only herbicide labeled for use on glyphosate tolerant creeping bentgrass in wet habitat restoration. As previously discussed, this herbicide is not a viable alternative to glyphosate due to its mobility in the soil and the potential for mortality of non-target plants. With no viable alternative herbicide, glyphosate tolerant bentgrass would fill in interstitial spaces (PCE 1) and degrade the early seral prairie condition (PCE 1) that is necessary for the critical habitat to properly function.

Bradshaw's Lomatium

As noted above in the Status of the Species section of this biological opinion, Bradshaw's lomatium is a perennial plant that reproduces exclusively by seed (Kaye 1992). It is found in very wet prairies, in wetlands, and along swales. Bradshaw's lomatium has been severely impacted by the presence of creeping and other bentgrass species in and around populations of the plant (Reichman 2009, Service 2008a) such that it forms dense mats that occupy otherwise open interstitial spaces needed for Bradshaw's lomatium to maintain or expand its current population. Given the limitations discussed above of using imazapyr to control bentgrass in wet habitats, the proposed action is likely to result in glyphosate tolerant bentgrass severely degrading 282 acres (33 percent) of 843 acres occupied by Bradshaw's lomatium by the transfer of the glyphosate tolerant gene to naturalized populations of bentgrass plants that currently impact Bradshaw's lomatium populations (Service 2008a). The extent of this invasion by glyphosate tolerant bentgrass is likely to increase through establishment of seed and stolons of glyphosate tolerant bentgrass. For these reasons, implementation of the proposed action is likely to cause a significant reduction in the reproduction, numbers, and distribution of the Bradshaw's lomatium throughout its range to an extent that the species would not likely have the potential to survive and recover.

Kincaid's Lupine

As noted above in the Status of the Species section of this biological opinion, Kincaid's lupine is found in prairie and oak savannah habitat throughout the Willamette Valley, north to the Puget Trough in Washington, and south to Douglas County in Oregon. Several populations of Kincaid's lupine are currently devoid of creeping bentgrass. The Douglas County, Oregon, populations of Kincaid's lupine contain no or very few individuals of creeping bentgrass. Throughout the Willamette Valley and into southern Washington, Kincaid's lupine occurs mostly in upland prairie or on slight rises in wet prairie. Kincaid's lupine is not an aggressive competitor and, although it can spread vegetatively and persist for a number of years, habitat invasion by bentgrass adversely affects this plant.

The proposed action would result in at least ten percent of known Kincaid's lupine habitat being invaded by glyphosate tolerant bentgrass through the transfer of glyphosate tolerance from

glyphosate tolerant creeping bentgrass to glyphosate intolerant bentgrass and escape of glyphosate tolerant creeping bentgrass propagules (seeds or stolons). In upland areas, the dominant habitat for this species, alternative herbicides may be effective against glyphosate tolerant bentgrass (Andrew Hulting, Oregon State University Extension, pers. comm., 2008). However, it is likely that increased cost and time associated with use of alternative herbicides may adversely affect Kincaid's lupine by decreasing the total area effectively managed to maintain adequate prairie function. The limitations on management involving the use of additional or more costly alternative herbicides is likely to result in larger expanses of degraded prairie habitat with a reduced carrying capacity to support Kincaid's lupine. For that reason, implementation of the proposed action is likely to cause a decrease in the number and distribution of Kincaid's lupine plants throughout its range, but this impact is tempered by the fact that this species occurs mostly in upland prairie or on slight rises in wet prairie where bentgrass can be effectively controlled by alternative herbicides. Therefore, the extent of this impact is not expected to preclude the potential for recovering this species, although it is likely to delay the timing of that recovery.

Kincaid's Lupine Critical Habitat

As noted above in the Status of the Species and Critical Habitat section of this biological opinion, Kincaid's lupine critical habitat was designated in 2006, and includes predominantly upland prairie habitat that is susceptible to invasion by bentgrass. Critical habitat PCEs are: (1) early seral upland prairie or oak savannah that includes interstitial spaces that "may serve as a site for future populations and may be critical for the long-term perseverance of the species" and (2) the presence of insect pollinators (Service 2006a). Without active management, bentgrass will dominate a prairie, which would eliminate the interstitial spaces necessary to maintain the early seral structure of the habitat (PCE 1). Dominance by bentgrass would also reduce the number of nectar sources for pollinators. This could reduce the number of pollinators that would be available during the flowering period of Kincaid's lupine, thus impairing the function of PCE (2), the presence of insect pollinators.

Based on current levels of bentgrass invasion, it is anticipated that, as a result of the proposed action, approximately 519 acres (89 percent) of 584 acres of designated Kincaid's lupine critical habitat would be at risk for transfer of glyphosate tolerance to glyphosate intolerant bentgrass (Service 2008a). However, the majority of Kincaid's lupine critical habitat could be managed to control glyphosate tolerant bentgrass with alternative herbicides that are effective and labeled for use in upland areas where most of the critical habitat is located (Trevor Taylor, City of Eugene Parks and Open Spaces, pers. comm., 2008). The increased cost and time associated with the use of these alternatives herbicides is likely to reduce the extent of affected areas that are treated. For that reason, implementation of the proposed action is likely to adversely affect Kincaid's lupine critical habitat, but not result in loss of function of the PCEs.

Nelson's Checkermallow

As noted above in the Status of the Species section of this biological opinion, Nelson's checkermallow occurs around wet prairies in areas slightly drier than those supporting either Bradshaw's lomatium or the Willamette daisy. Nelson's checkermallow tolerates less than ideal conditions, including moderate levels of invasion by non-native species, and somewhat variable hydrology. Although it would be adversely impacted by the deregulation of glyphosate tolerant bentgrass, it is not likely to be affected to the extent of either the Willamette daisy or Bradshaw's

lomatium. The proposed action is likely to result in a loss of functional habitat within at least 119 acres (nine percent) of the 1,350 acres of known Nelson's checkermallow populations through the transfer of the glyphosate tolerant gene to current populations of glyphosate intolerant bentgrass. Even in upland prairie areas where alternative herbicides could be used to control glyphosate tolerant creeping bentgrass around individuals of Nelson's checkermallow, it is anticipated that the added cost and time associated with the use of such herbicides would effectively limit the extent of prairie habitat that can be effectively managed to control the spread of bentgrass. For that reason, some reduction in the number and distribution of Nelson's checkermallow plants is likely to occur throughout its range with implementation of the proposed action. However, this impact on the species is likely to be tempered by the fact that about 91 percent of its currently occupied habitat and additional areas of potential habitat in upland prairie can be effectively managed to control bentgrass through the use of alternative herbicides. Therefore, the extent of this impact is not expected to preclude the potential for recovering this species, although it is likely to delay the timing of that recovery.

Golden Paintbrush

As noted above in the Status of the Species section of this biological opinion, the golden paintbrush was historically known throughout the Willamette Valley and Puget Trough. Extant Washington populations of golden paintbrush are located in upland prairie habitat that can be effectively managed with alternative herbicides if glyphosate tolerant bentgrass were to become established (Andrew Hulting, Oregon State University Extension, pers. comm., 2008). Approximately 13 percent of the current habitat has been invaded by bentgrass plants (Ted Thomas, Service, pers. observation, 2009). If glyphosate tolerant creeping bentgrass were deregulated, it is anticipated that this habitat could be degraded by the transfer of the glyphosate tolerant gene to glyphosate intolerant bentgrass plants. Management, at this point, does not rely extensively on broadcast herbicide application; however, herbicide is used in spot applications to control invasive species.

Herbarium records indicate that, in addition to its current habitat of upland prairie in Washington, golden paintbrush was also found in wet areas in Oregon. Establishment of golden paintbrush populations will be very difficult, if not unlikely, in areas occupied by glyphosate tolerant bentgrass. As discussed above, there are currently no effective alternative herbicides to control glyphosate tolerant bentgrass in wet areas. Imazapyr is the only other herbicide that is labeled for use in wet areas for the purposes of restoration. Its mobility in the soil and toxicity to plants precludes it from being a viable alternative in and around golden paintbrush plants.

Based on the above discussion, implementation of the proposed action is likely to adversely affect the golden paintbrush in upland prairie sites within its current range by potentially increasing the cost and time necessary to effectively control glyphosate tolerant bentgrass plants in extant populations; such factors may result in fewer acres of occupied habitat being treated in a manner that effectively controls invasions of glyphosate tolerant bentgrass. However, because the extant population currently occupies only about 15 acres, that potential is considered to be low at this time. It is also anticipated that re-establishment of the golden paintbrush in the Willamette Valley will be very difficult with implementation of the proposed action unless upland prairie sites can be utilized; re-establishment in the Willamette Valley is considered essential to the recovery of the species (Service 2008b). Overall, most of the golden paintbrush population is in upland prairie habitat where it is likely to persist with proper management, including the use of alternative herbicides to effectively control bentgrass. The presence of

golden paintbrush in upland prairie habitat in Washington creates a likelihood that re-establishment of the golden paintbrush in the Willamette Valley can be successfully done in upland prairie. Therefore, the extent of the impact caused by the proposed action is not expected to preclude the potential for recovering this species, although it may delay the timing of that recovery by increasing the cost and time necessary to effectively control glyphosate tolerant bentgrass plants in extant populations and by making it more difficult to re-establish this species in the Willamette Valley.

Effects of Interrelated and Interdependent Activities

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

Interrelated and interdependent activities for the proposed action involve the increased use of glyphosate. Because glyphosate tolerant creeping bentgrass has been developed to provide a product that can be maintained weed-free by spraying directly over the grass with glyphosate, more of the herbicide will likely be used over the areas where the crop is produced and where the final product is grown. Increased levels of glyphosate use may increase the selection pressure on weedy species, thus promoting glyphosate resistance in an unknown number of potentially undesirable plants. Glyphosate tolerance would allow these plants to out-compete susceptible co-occurring species where glyphosate is used. This may result in the displacement of native species from listed species habitat, including designated critical habitat.

The direct effects of increased use of glyphosate formulations to animal species are difficult to anticipate. It is possible that glyphosate may be minimally detrimental, but that adjuvants associated with certain formulations could be harmful.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Service anticipates that non-Federal, agriculture, commercial and residential development, road construction, and road maintenance actions are reasonably certain to occur in the future within the action area at levels similar to what has occurred in the past. These actions are likely to perpetuate habitat loss and degradation that currently threaten the listed species and critical habitats considered herein.

The extent of these cumulative effects is unknown. However, prairie habitats are expected to continue to become more fragmented as land is converted to other uses, and are likely to continue to be invaded by non-native plants, in part, in response to human-caused land disturbance activities. The effect of these actions on the Fender's blue butterfly and its critical habitat, Willamette daisy and its critical habitat, Bradshaw's lomatium, Kincaid's lupine and its critical habitat, Nelson's checkermallow, and golden paintbrush is likely to be less functional habitat, fewer populations, and reduced numbers of individuals. In the case of the Fender's blue butterfly, future non-Federal actions causing take will need a permit issued by the Service

pursuant to section 10 of the Act in order to legally proceed; that permit process will ensure that the proposed action is compatible with the survival and recovery of the species.

CONCLUSION

After reviewing the current status of the species and critical habitats, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that APHIS's deregulation of glyphosate tolerant creeping bentgrass, as proposed, is likely to jeopardize the continued existence of Bradshaw's lomatium and the Willamette daisy and is likely to destroy or adversely modify critical habitat for the Fender's blue butterfly and the Willamette daisy. The action, as proposed, is not likely to jeopardize the continued existence of the Fender's blue butterfly, Kincaid's lupine, Nelson's checkermallow, or golden paintbrush or to destroy or adversely modify critical habitat for Kincaid's lupine.

We reached these conclusions for the following reasons:

Fender's Blue Butterfly

The proposed action is not likely to jeopardize this species because:

1. Most Fender's blue butterfly populations and habitat occur in upland prairie that can be managed effectively to control glyphosate tolerant bentgrass using existing viable herbicide alternatives. The protections and management afforded these sites pursuant to the take prohibitions, recovery provisions, and the section 7(a)(2) standard of the Act are likely to retain the potential for recovery (i.e., survival) of this species, although the timing of that recovery is likely to be delayed as a result of the proposed action's adverse impacts on the West Eugene population of the butterfly.

Fender's Blue Butterfly Critical Habitat

The proposed action is likely to destroy or adversely modify Fender's blue butterfly critical habitat because:

1. Bentgrass is currently found on 2,602 acres (86 percent) of the 3,010 acres of designated Fender's blue butterfly critical habitat.

2. Individual critical habitat units serve a vital conservation role, and thus each unit is necessary for the Fender's blue butterfly critical habitat to serve its intended conservation function.

3. Three critical habitat units within wet prairie habitat in the West Eugene area are likely to become non-functional due to extensive mats of glyphosate tolerant bentgrass that cannot be effectively managed because no viable herbicide alternative to glyphosate exists, and because mowing, burning, or tilling are ineffective as control methods.

4. It is further anticipated that the extent of bentgrass invasion within the critical habitat is likely to increase due to glyphosate tolerance.

Willamette Daisy

The proposed action is likely to jeopardize Willamette daisy because:

1. Bentgrass currently occupies 107 acres (38 percent) of 283 acres of known Willamette daisy habitat.

2. Willamette daisy is found almost exclusively in wet prairie habitat where no viable herbicide alternative exists to control glyphosate tolerant bentgrass. For that reason, it is likely that almost all of its habitat will be invaded by glyphosate tolerant creeping bentgrass to an extent that those areas will become unavailable for use by this species.

3. For the Willamette daisy to survive and recover: (1) the viability of existing populations needs to be maintained by protecting occupied habitat, controlling encroachment by shrubs and trees, and reducing threats from non-native plants (e.g., bentgrass) on these sites; and (2) the size and distribution of large blocks of protected, high quality prairie habitat needs to be increased within the Willamette Valley that are subject to management including disturbance (i.e., fire) to adequately control encroachment of shrubs and trees and that are effectively managed to reduce threats from non-native plants. Implementation of the proposed action is likely to reduce the viability of existing populations and to reduce the quality of occupied and unoccupied wet prairie habitat throughout its range to an extent that it becomes unavailable for use by this species.

Willamette Daisy Critical Habitat

The proposed action is likely to destroy or adversely modify Willamette daisy critical habitat because:

1. Bentgrass is currently found on 470 acres (66 percent) of 718 acres of Willamette daisy critical habitat.

2. Critical habitat for this species occurs dominantly in wetland and wet prairies where no viable herbicide alternative exists to control glyphosate tolerant bentgrass.

3. The majority of critical habitat of the Willamette daisy is likely to become dominated by glyphosate tolerant bentgrass and unavailable for use by this species, thereby precluding its intended conservation function from being achieved.

4. It is further anticipated that the extent of bentgrass invasion within the critical habitat is likely to increase due to glyphosate tolerance.

Bradshaw's Lomatium

The proposed action is likely to jeopardize Bradshaw's lomatium because:

1. Bentgrass currently occupies 282 acres (33 percent) of 843 acres of known Bradshaw's lomatium habitat.

2. Bradshaw's lomatium is found almost exclusively in wet prairie where no viable herbicide alternative exists to control glyphosate tolerant bentgrass.

3. At least 33 percent of Bradshaw's lomatium habitat is likely to become dominated by glyphosate tolerant bentgrass and unavailable for use by this species with implementation of the proposed action.

4. For Bradshaw's lomatium to survive and recover: (1) the viability of existing populations needs to be maintained by protecting occupied habitat, controlling encroachment by shrubs and trees, and reducing threats from non-native plants (e.g., bentgrass) on these sites; and (2) the size and distribution of large blocks of protected, high quality prairie habitat needs to be increased within the Willamette Valley and the Puget Trough that are subject to management for natural disturbance regimes (i.e., fire) to adequately control encroachment of shrubs and trees and that are effectively managed to reduce threats from non-native plants. Implementation of the proposed action is likely to reduce the viability of existing populations and to reduce the quality of occupied and unoccupied wet prairie habitat throughout its range to an extent that it becomes unavailable for use by this species.

Kincaid's Lupine

The proposed action is not likely to jeopardize this species because:

1. Currently, 67 acres (ten percent) of 700 total acres of known Kincaid's lupine habitat acres are known to be occupied by bentgrass.

2. Kincaid's lupine occurs almost exclusively within upland prairie habitat where there are viable herbicide alternatives available to control glyphosate tolerant bentgrass. For that reason, implementation of the proposed action is not likely to reduce the viability of existing lupine populations or preclude increasing the size and distribution of large blocks of protected, high quality upland prairie habitat within the Willamette Valley, both of which are needed for this species to survive and recover.

3. Bentgrass is almost entirely absent from Douglas County which represents the southern extent of the Kincaid's lupine's range; this area supports a functioning network of Kincaid's lupine populations.

Kincaid's Lupine Critical Habitat

The proposed action is not likely to destroy or adversely modify Kincaid's lupine critical habitat because:

1. Kincaid's lupine critical habitat occurs almost exclusively in upland prairie.

2. Upland areas within critical habitat that become dominated by glyphosate tolerant creeping bentgrass can be managed effectively with viable herbicide alternatives. Therefore, implementation of the proposed action is not likely to reduce the functional capability of the critical habitat to support viable populations of Kincaid's lupine.

Nelson's Checkermallow

The proposed action is not likely to jeopardize this species because:

1. About 119 acres (nine percent) of 1,350 acres of known Nelson's checkermallow habitat are currently occupied by bentgrass.

2. Nelson's checkermallow is more tolerant of disturbed and weedy conditions than any of the other listed plants in the Willamette Valley or Puget Trough.

3. Although it is a wetland species, Nelson's checkermallow is found on slightly drier sites where herbicide alternatives are likely to effectively control glyphosate tolerant bentgrass.

4. For the above reasons, implementation of the proposed action is not likely to reduce the viability of existing populations or preclude increasing the size and distribution of large blocks of protected, high quality prairie habitat needed by this species to survive and recover.

Golden Paintbrush

The proposed action is not likely to jeopardize this species because:

1. Two acres (13 percent) of 15 total acres of known golden paintbrush-occupied habitat are currently occupied by bentgrass.

2. Overall, most of the golden paintbrush population is in upland prairie habitat where it is likely to persist with proper management, including the use of alternative herbicides to effectively control bentgrass. The presence of golden paintbrush in upland prairie habitat in Washington creates a likelihood that re-establishment of the golden paintbrush in the Willamette Valley can be successfully done in upland prairie habitat. For these reasons, the extent of the impact caused by the proposed action is not expected to preclude the potential for recovering this species, although it may delay the timing of that recovery by increasing the cost and time necessary to effectively control glyphosate tolerant bentgrass plants in extant populations and by making it more difficult to re-establish this species in the Willamette Valley.

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Personal Communications

Marty Chaney, Natural Resource Conservation Service, pers. comm., 2008 - Chaney, Marty, Agronomist, Natural Resource Conservation Service, Olympia, Washington. Marty and I discussed the broad distribution of Agrostis on our South Sound Prairies. She indicated that at least two species are quite widespread. A. stolonifera, and A. capillaries. She indicated that A. stolonifera was the most common, accounting for up to 25 percent of the Agrostis encountered.

Rex Crawford, Washington Department of Natural Resources, pers. comm., 2009 - Crawford, Rexford, Ph.D. Plant Ecologist, Washington Department of Natural Resources, Natural Heritage Program, Olympia, WA. Discussions on shifts in the composition of prairies brought on by invasion by bentgrass.

Greg Fitzpatrick. 2008. The Nature Conservancy. Email to Mikki Collins, U.S. Fish and Wildlife Service, Portland, Oregon on 30 January 2008. Comparison of Fender's blue butterfly monitoring protocols.

Andrew Hulting. 2008. Oregon State University Extension Service. Email to Kate Norman, U.S. Fish and Wildlife Service, Portland, Oregon on 28 October 2008. Responses to questions about herbicide label restrictions and bentgrass control options.

Trevor Taylor. 2008. City of Eugene, Parks and Open Spaces. Email to Kate Norman, U.S. Fish and Wildlife Service, Portland, Oregon on 11 June 2008. Responses to questions about bentgrass infestation, control, and listed species management.

Ted Thomas, U.S. Fish and Wildlife Service, pers. observation, 2009. Note to file provided on 30 September 2009. Review of sites and their levels of exotic species invasion.

Barbara Wilson, Oregon State University, pers. comm., 2008. Wilson, Barbara, Ph.D. Grass Taxonomist, Consultant. We discussed the widespread nature of Agrostis and how the GMO Agrostis is capable of forming hybrids with several other species of Agrostis.

APPENDICES

APPENDIX A – Service (2008a) Survey Results as summarized from email and phone conversations. Green tables are by site, blue tables are by critical habitat unit, based upon site level information.

Bentgrass Invasion refers to the level of invasion (as assessed by the Contact) of bentgrass found at the site in question. The Bentgrass Invasion scale runs from 1 to 10 (with 1 being absent and 10 being heavily invaded). At the time of these professional opinion surveys, it was believed that the primary bentgrass weed in Oregon and southwest Washington was creeping bentgrass, Agrostis stolonifera. Therefore, the contacts were asked to assess "creeping" bentgrass infestation levels at each of their sites. However, bentgrass species are difficult to distinguish and the taxonomy of the genus has been much debated in the literature. Since the professional opinions where collected, it has been determined that multiple species of bentgrass, including creeping bentgrass, are problem weeds in and around listed species in Oregon and southwest Washington. For that reason, the information in Service (2008a) that reported exclusively Agrostis stolonifera infestation levels has been reported below as non-specific bentgrass species infestation levels.

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
BENTON	Blakesly Creek Road	ICICFE	Yes	Private			0.00
BENTON	Butterfly Meadows	ICICFE	Yes	Private	Blakeley-Smith, M.	1	47.50
BENTON	Butterfly Meadows	ICICFE	Yes	State	Blakeley-Smith, M.	1	47.50
BENTON	Butterfly Meadows	LUSUK	Yes	Private	Blakeley-Smith, M.	1	47.50
BENTON	Butterfly Meadows	LUSUK	Yes	State	Blakeley-Smith, M.	1	47.50
BENTON	Caldwell Hill Roadside	ICICFE	Yes	Private			0.00
Benton	E.E. Wilson Wildlife Management Area	LUSUK	Yes	Oregon Department of Fish and Wildlife	Fiori, R.	8	0.13
BENTON	E.E. Wilson Wildlife Management Area	SINE2	Yes	Oregon Department of Fish and Wildlife	Fiori, R.	6	0.13
Benton	Finley NWR	LOBR	Yes	Private	Beall, J.	3	21.33
Benton	Finley NWR	LOBR	Yes	United States Fish and Wildlife Service	Beall, J.	3	21.33

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
Benton	Finley NWR	SINE2	Yes	Private	Beall, J.	5	21.33
Benton	Finley NWR	SINE2	Yes	United States Fish and Wildlife Service	Beall, J.	5	21.33
Benton	Jackson Frazier Wetland	LOBR	Yes	Private	Smith, S.	7	1.57
Benton	JACKSON-FRAZIER WETLAND	LOBR	Yes	Private	Smith, S.	7	20.80
Benton	WREN PRAIRIE PRESERVE	LUSUK	Yes	Private	Smith, S.	6	3.75
Clark	Camas Meadows	LOBR	Yes		Thomas, T.		30.30
DOUGLAS	Callahan Meadows	LUSUK		Bureau of Land Management	Friedman, S.	1	0.21
Douglas	Callahan Meadows	LUSUK		Private	Friedman, S.	1	0.21
Douglas	CALLAHAN RIDGE	LUSUK		United States Department of Agriculture Forest Service	Friedman, S.	1	1.93
Douglas	Callahan Ridge, Forest Service	LUSUK		United States Department of Agriculture Forest Service	Friedman, S.	1	0.14
DOUGLAS	China Ditch	LUSUK		Bureau of Land Management	Friedman, S.	1	2.58
DOUGLAS	Corner Brass Cap	LUSUK		Bureau of Land Management	Friedman, S.	1	0.93
Douglas	Dahl population, along Ollala Road.	LUSUK		Private	Friedman, S.	2	0.18
DOUGLAS	Dickerson	LUSUK		Bureau of Land Management	Friedman, S.	1	0.06
Douglas	Dickerson Heights	LUSUK		Bureau of Land Management	Friedman, S.	1	0.06

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
Douglas	Doe Creek	LUSUK		Bureau of Land Management	Friedman, S.	1	0.76
Douglas	DOE CREEK	LUSUK		Private	Friedman, S.	1	0.76
Douglas	Drain Hills	LUSUK		Private	Friedman, S.	1	0.01
Douglas	Leticia Creek	LUSUK		Bureau of Land Management	Friedman, S.	1	0.41
Douglas	Leticia Creek	LUSUK		Private	Friedman, S.	1	0.41
DOUGLAS	Letitia Creek	LUSUK		Bureau of Land Management	Friedman, S.	1	7.23
DOUGLAS	Letitia Creek	LUSUK		Private	Friedman, S.	1	7.23
Douglas	Loose Laces II	LUSUK		Bureau of Land Management	Friedman, S.	1	2.81
Douglas	Loose Laces II	LUSUK		Private	Friedman, S.	1	2.81
Douglas	Milo population	LUSUK		Private	Friedman, S.	1	0.19
Douglas	Nickel Mountain Quad	LUSUK		Bureau of Land Management	Friedman, S.	1	1.93
Douglas	Nickel Mountain Quad	LUSUK		Private	Friedman, S.	1	1.93
DOUGLAS	North Catching & Russel Creeks	LUSUK		Bureau of Land Management	Friedman, S.	1	0.24
DOUGLAS	North Catching & Russel Creeks	LUSUK		Private	Friedman, S.	1	0.24
Douglas	Ollala Creek	LUSUK		Private	Friedman, S.	2	0.59
DOUGLAS	Riser	LUSUK		Private	Friedman, S.	1	2.92
DOUGLAS	South Catching & Russel Creeks	LUSUK		Bureau of Land Management	Friedman, S.	1	3.11
DOUGLAS	Stouts	LUSUK		Bureau of Land Management	Friedman, S.	1	3.55

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
DOUGLAS	Stouts	LUSUK		Private	Friedman, S.	1	3.55
Douglas	Stouts Creek	LUSUK		Bureau of Land Management	Friedman, S.	1	1.88
Douglas	Stouts Creek	LUSUK		Private	Friedman, S.	1	1.88
DOUGLAS	Tenmile	LUSUK		Private	Friedman, S.	1	0.03
Douglas	Tiller Quad	LUSUK		Bureau of Land Management	Friedman, S.	1	1.09
Douglas	Tiller Quad	LUSUK		Private	Friedman, S.	1	1.09
Douglas	Tiller Quad	LUSUK		United States Department of Agriculture Forest Service	Friedman, S.	1	1.09
Lane	Buford Park	LOBR	Yes	Private	Taylor, T.		1.76
LANE	Cheryl's East Population	ICICFE	Yes	Local Government	Schultz, C.		4.40
LANE	Cheryl's North Population	ICICFE	Yes	Private	Schultz, C.		15.40
LANE	Cheryl's Restorable Pops: ACE Big Spires West	ICICFE	Yes	Private	Schultz, C.	6	17.58
LANE	Cheryl's Restorable Pops: ACE Big Spires West	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	6	17.58
LANE	Cheryl's Restorable Pops: ACE Spires to Eaton fiel	ICICFE	Yes	Private	Schultz, C.	7	27.57
LANE	Cheryl's Restorable Pops: ACE Spires to Eaton fiel	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	7	27.57
LANE	Cheryl's Restorable Pops: BLM Royal East	ICICFE	Yes	Bureau of Land Management	Villegas, S.	5	10.00
LANE	Cheryl's Restorable Pops: BLM Royal Rest Exp95	ICICFE	Yes	Bureau of Land Management	Villegas, S.	5	9.32
LANE	Cheryl's Restorable Pops: Briggs - Private Restora	ICICFE	Yes	Local Government	Schultz, C.		4.86

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	Cheryl's Restorable Pops: Briggs - Private Restora	ICICFE	Yes	Private	Schultz, C.		4.86
LANE	Cheryl's Restorable Pops: TNC Hayfield Rest Exp95	ICICFE	Yes	Private	Schultz, C.	4	43.20
LANE	Cheryl's Restorable Pops: TNC Hayfield West	ICICFE	Yes	Private	Schultz, C.	4	13.39
LANE	Cheryl's Restorable Pops: TNC Main Butterfly South	ICICFE	Yes	Private	Schultz, C.	4	3.79
LANE	Cheryl's Restorable Pops: TNC Out-of-Lupine field	ICICFE	Yes	Private	Schultz, C.	4	4.30
LANE	Cheryl's Restorable Pops: TNC Priority Purchase (R	ICICFE	Yes	Private	Schultz, C.		39.37
LANE	Cheryl's Restorable Pops: TNC Willow Corner 2000	ICICFE	Yes	Private	Schultz, C.	4	0.02
LANE	Cheryl's Restorable Pops: TNC Willow Corner North	ICICFE	Yes	Private	Schultz, C.	4	1.24
LANE	Cheryl's Restorable Pops: WEWP Dragonfly Bend	ICICFE	Yes	Private	Schultz, C.		6.92
LANE	Cheryl's Restorable Pops: WEWP Isabelle Poperty	ICICFE	Yes	Bureau of Land Management	Villegas, S.	5	0.16
LANE	Cheryl's Restorable Pops: WEWP North of Parkway	ICICFE	Yes	Bureau of Land Management	Villegas, S.		2.46
LANE	Cheryl's Restorable Pops: WEWP Racetrack Create Up	ICICFE	Yes	Bureau of Land Management	Villegas, S.	2	3.79

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	Cheryl's Restorable Pops: WEWP South of Parkway 1	ICICFE	Yes	Bureau of Land Management	Villegas, S.		4.37
LANE	Cheryl's Restorable Pops: WEWP South of Parkway 1	ICICFE	Yes	Oregon Department of State Lands	Villegas, S.		4.37
LANE	Cheryl's Restorable Pops: WEWP South of Parkway 1	ICICFE	Yes	Private	Schultz, C.		4.37
LANE	Cheryl's Restorable Pops: WEWP South of Parkway 2	ICICFE	Yes	Bureau of Land Management	Villegas, S.		4.01
LANE	Cheryl's Restorable Pops: WEWP South of Parkway 2	ICICFE	Yes	Local Government	Villegas, S.		4.01
LANE	Cheryl's Restorable Pops: WEWP West of Oxbow West	ICICFE	Yes	Bureau of Land Management	Villegas, S.		1.75
LANE	Cheryl's Restorable Pops: WEWP West of Oxbow West	ICICFE	Yes	Private	Villegas, S.		1.75
LANE	Cheryl's West Population	ICICFE	Yes	Bureau of Land Management	Villegas, S.	8	13.99
LANE	Cheryl's West Population	ICICFE	Yes	Private	Villegas, S.	8	13.99
LANE	Coburg North	ICICFE	Yes	Private	Fitzpatrick, G.		14.05
LANE	Coburg Saddle	ICICFE	Yes	Private	Fitzpatrick, G.		48.13
LANE	Coburg South Slope (Baldy)	ICICFE	Yes	Private	Fitzpatrick, G.		34.51

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	East Coyote	ERDED	Yes	Private		3	4.63
LANE	East Coyote	ERDED	Yes	United States Corps of Engineers	Messinger, W.	3	4.63
LANE	East Shore	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	5	0.05
LANE	East Shore	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	5	0.05
LANE	East Spires	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	7	0.04
LANE	East Spires	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	7	0.04
Lane	FERN RIDGE DAM	LOBR	Yes	United States Corps of Engineers	Messinger, W.		4.65
Lane	FERN RIDGE RESERVOIR	LOBR	Yes	United States Corps of Engineers	Messinger, W.		6.97
LANE	Fern Ridge Reservoir - Amazon	LOBR	Yes	United States Corps of Engineers	Messinger, W.	7	67.33
LANE	Fern Ridge Reservoir - Amazon Dike #2	LOBR	Yes	United States Corps of Engineers	Messinger, W.	7	2.46
LANE	Fern Ridge Reservoir - East Coyote Dikes	LOBR	Yes	Private	Messinger, W.	3	1.55
LANE	Fern Ridge Reservoir - East Coyote Dikes	LOBR	Yes	United States Corps of Engineers	Messinger, W.	3	1.55
LANE	Fern Ridge Reservoir - Kirk Pond	LOBR	Yes	United States Corps of Engineers	Messinger, W.	5	0.09
LANE	Fern Ridge Reservoir - Royal Amazon	LOBR	Yes	United States Corps of Engineers	Messinger, W.	6	4.00

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	Fir Butte	ICICFE	Yes	Bureau of Land Management	Villegas, S.	8	17.24
LANE	Fir Butte	ICICFE	Yes	Local Government	Villegas, S.	8	17.24
LANE	Fir Butte	ICICFE	Yes	Private	Villegas, S.	8	17.24
LANE	Fir Butte	LUSUK	Yes	Bureau of Land Management	Villegas, S.	8	17.24
LANE	Fir Butte	LUSUK	Yes	Local Government	Villegas, S.	8	17.24
LANE	Fir Butte	LUSUK	Yes	Private	Villegas, S.	8	17.24
LANE	Fisher Butte	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	8	11.72
Lane	Fisher Butte	LOBR	Yes	United States Corps of Engineers	Messinger, W.	8	11.72
Lane	Fisher Butte Dike	LOBR	Yes	Private	Messinger, W.	3	5.90
LANE	Fisher Butte Dike	LOBR	Yes	United States Corps of Engineers	Messinger, W.	3	5.90
LANE	Fisher Butte West	ERDED	Yes	Private	Villegas, S.	4	5.37
LANE	Hazel	ERDED	Yes	Private	Villegas, S.		0.00
LANE	Hillaire Road	ICICFE	Yes	Private	Villegas, S.		0.01
LANE	Horkelia Prairie	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	8	0.01
LANE	Isabelle	ICICFE	Yes	Bureau of Land Management	Villegas, S.	5	0.74
LANE	Isabelle	ICICFE	Yes	Private	Villegas, S.	5	0.74
LANE	Lanel Substation	ERDED	Yes	Private	Norman, K.		0.02
LANE	Long Tom ACEC	LOBR	Yes	Bureau of Land Management	Villegas, S.	2	0.38

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
Lane	LONG TOM RIVER	LOBR	Yes	Bureau of Land Management	Villegas, S.	1	7.18
Lane	LONG TOM RIVER	LOBR	Yes	Private	Smith, S.	6	7.18
Lane	NEILSON RD SUBSTATION SITE	LOBR	Yes	Private	Messinger, W.		6.03
Lane	NEILSON RD SUBSTATION SITE	LOBR	Yes	United States Corps of Engineers	Messinger, W.		6.03
LANE	North Eaton	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	4	2.91
LANE	North Eaton	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	4	2.91
LANE	North Green Oaks	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	9	2.96
LANE	North Green Oaks	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	9	2.96
LANE	North Greenhill	ERDED	Yes	Bureau of Land Management	Villegas, S.	1	3.08
LANE	North Greenhill	ERDED	Yes	Oregon Department of State Lands		1	3.08
LANE	North Greenhill	ERDED	Yes	Private		1	3.08
LANE	North Taylor	LOBR	Yes	Private			0.04
LANE	Oxbow West	ERDED	Yes	Bureau of Land Management	Villegas, S.	3	11.91
LANE	Oxbow West	ERDED	Yes	Oregon Department of State Lands		3	11.91
LANE	Oxbow West	ICICFE	Yes	Bureau of Land Management	Villegas, S.	3	11.91
LANE	Oxbow West	ICICFE	Yes	Private		3	11.91

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	Royal Amazon	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	6	7.20
Lane	ROYAL AVENUE	LOBR	Yes	Private	Messinger, W.	6	6.53
Lane	ROYAL AVENUE	LOBR	Yes	United States Corps of Engineers	Messinger, W.	6	6.53
LANE	Sanford Road	ERDED	Yes	Private	Norman, K.		0.00
LANE	Schultz Experimental Site 2	ICICFE	Yes	Bureau of Land Management	Villegas, S.	2	22.37
LANE	Schultz Experimental Site 2	ICICFE	Yes	Private	Schultz, C.	2	22.37
LANE	Schultz Experimental Site 2	LUSUK	Yes	Bureau of Land Management	Villegas, S.	2	22.37
LANE	Schultz Fitzpatrick Experimental Sites	ICICFE	Yes	Private	Schultz, C.		2.09
LANE	Schultz Fitzpatrick Experimental Sites	LUSUK	Yes	Private	Villegas, S.		2.09
LANE	South Eaton	ICICFE	Yes	Private	Messinger, W.	5	0.19
LANE	South Eaton	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	5	0.19
LANE	South Eaton	LUSUK	Yes	Private	Messinger, W.	5	0.19
LANE	South Eaton	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	5	0.19
LANE	South Green Oaks	ICICFE	Yes	Private	Villegas, S.	6	2.13
LANE	South Green Oaks	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	6.5	2.13
LANE	Speedway	ERDED	Yes	Bureau of Land Management	Villegas, S.	4	16.17
LANE	Speedway	ERDED	Yes	Local Government	Villegas, S.	4	16.17

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	Speedway	ERDED	Yes	Private	Villegas, S.	4	16.17
LANE	Spencer Creek	ERDED	Yes	Private			0.07
Lane	Spores, Ron (Mowhawk Valley Ranch)	LOBR	Yes	Private	Smith, S.	8	56.65
LANE	Turtle Swale	ICICFE	Yes	Bureau of Land Management	Villegas, S.	2	0.91
LANE	Turtle Swale	LUSUK	Yes	Bureau of Land Management	Villegas, S.	2	0.91
LANE	Veneta	LOBR	Yes	Private	Garner, K.		2.79
LANE	Vinci	ERDED	Yes	Bureau of Land Management	Villegas, S.	5	1.66
LANE	Vinci	ERDED	Yes	Oregon Department of State Lands		5	1.66
LANE	Vinci	ERDED	Yes	Private		5	1.66
LANE	Wallis Street	ERDED	Yes	Private	Garner, K.		7.04
LANE	West 11	ERDED	Yes	Bureau of Land Management	Villegas, S.	2	8.51
LANE	West 11	ERDED	Yes	Private		2	8.51
Lane	WEST FERN RIDGE	LOBR	Yes	Bureau of Land Management	Villegas, S.	3	10.99
Lane	WEST FERN RIDGE	LOBR	Yes	Private		7	10.99
Lane	WEST FERN RIDGE	LOBR	Yes	United States Corps of Engineers	Messinger, W.	7	10.99
LANE	West Lawn Cemetery	ICICFE	Yes	Private			0.70
LANE	West Lawn Cemetery	LUSUK	Yes	Private			0.70
LANE	West Shore	ICICFE	Yes	Private	Messinger, W.	5	4.79

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LANE	West Shore	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	5	4.79
LANE	West Shore	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	5	4.79
LANE	West Spires	ICICFE	Yes	Private		5	3.88
LANE	West Spires	ICICFE	Yes	United States Corps of Engineers	Messinger, W.	5	3.88
LANE	West Spires	LUSUK	Yes	Private		5	3.88
LANE	West Spires	LUSUK	Yes	United States Corps of Engineers	Messinger, W.	5	3.88
Lane	WILDROSE LANE	LOBR	Yes	Private			10.19
Lane	WILDROSE LANE	LOBR	Yes	United States Corps of Engineers	Messinger, W.		10.19
Lane	WILLOW CREEK	LOBR	Yes	Private	Nuckols, J.	4	33.86
LANE	Willow Creek Bailey Hill	ERDED	Yes	Private	Nuckols, J.	4	4.57
LANE	Willow Creek Bailey Hill	ICICFE	Yes	Private	Nuckols, J.	4	4.57
LANE	Willow Creek Bailey Hill	LUSUK	Yes	Private	Nuckols, J.	4	4.57
LANE	Willow Creek Daisy	ERDED	Yes	Private	Nuckols, J.	4	28.29
LANE	Willow Creek Daisy	ICICFE	Yes	Private	Nuckols, J.	4	28.29
LANE	Willow Creek Fir Grove	ICICFE	Yes	Private	Nuckols, J.	4	1.34
LANE	Willow Creek Fir Grove	LUSUK	Yes	Private	Nuckols, J.	4	1.34
LANE	Willow Creek Main	ICICFE	Yes	Private	Nuckols, J.	4	5.98
LANE	Willow Creek Main	LUSUK	Yes	Private	Nuckols, J.	4	5.98
LANE	Willow Creek North	ICICFE	Yes	Private	Nuckols, J.	4	2.71
LANE	Willow Creek North	LUSUK	Yes	Private	Nuckols, J.	4	2.71
LEWIS	Boistfort	LUSUK	Yes	Private			0.54
Linn	Kingston Meadows	LOBR	Yes	Private	Fitzpatrick, G.		5.83

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LINN	Kingston Meadows Preserve	ERDED	Yes	Private	Fitzpatrick, G.		10.85
Linn	Smith/Rand, Alice	ERDED	Yes	Private	Smith, A.	10	0.02
Marion	SUBLIMITY GRASSLAND	LOBR	Yes	Private	Fitzpatrick, G.		2.79
MARION	Sublimity Grasslands	ERDED	Yes	Private	Fitzpatrick, G.		3.03
MARION	Sublimity Grasslands	LOBR	Yes	Private	Fitzpatrick, G.		3.03
POLK	Baskett Butte North	ERDED	Yes	United States Fish and Wildlife Service	Beall, J.	6	96.83
POLK	Baskett Butte North	ICICFE	Yes	Private	Smith, S.	6	96.83
POLK	Baskett Butte North	ICICFE	Yes	United States Fish and Wildlife Service	Beall, J.	6	96.83
POLK	Baskett Butte South	ERDED	Yes	United States Fish and Wildlife Service	Beall, J.	3	138.14
POLK	Baskett Butte South	ICICFE	Yes	United States Fish and Wildlife Service	Beall, J.	3	138.14
POLK	Dallas	ICICFE	Yes	Private	Seal, C.		7.01
POLK	Dallas	LUSUK	Yes	Private	Seal, C.		7.01
POLK	Mill Creek	ICICFE	Yes	Private	Gisler, S.	2	2.97
POLK	Mill Creek	ICICFE	Yes	State	Gisler, S.	2	2.97
POLK	Mill Creek	LUSUK	Yes	Private	Gisler, S.	2	2.97
POLK	Mill Creek	LUSUK	Yes	State	Gisler, S.	2	2.97
POLK	Monmouth - Falls City Road	ICICFE	Yes	Private	Seal, C.		15.88
POLK	Wainright	ICICFE	Yes	Private	Smith, S.	6	16.25
YAMHILL	Berthelsdorf	LUSUK	Yes	Private	Smith, S.	7	0.31

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
YAMHILL	Fairdale - Flying M Meadow	SINE2	Yes	Private	Smith, S.	??	16.39
YAMHILL	Fairdale - Weyerhauser	SINE2	Yes	Private	Smith, S.	??	45.49
YAMHILL	Gahr Farm	SINE2	Yes	Private	Smith, S.	8	11.25
YAMHILL	Goodwin, Charles & Julie	ICICFE	Yes	Private	Smith, S.	7	0.45
YAMHILL	Goodwin, Charles & Julie	LUSUK	Yes	Private	Smith, S.	6	0.45
YAMHILL	Goodwin, Charles & Julie-Roadside	LUSUK	Yes	Private	Smith, S.	6	0.01
YAMHILL	Gopher Valley Dupee Road	ICICFE	Yes	Private	Smith, S.	7	0.16
YAMHILL	Gopher Valley Dupee Road	LUSUK	Yes	Private	Smith, S.	7	0.16
YAMHILL	Herbert, Carol	ICICFE	Yes	Private	Smith, S.	6	18.36
YAMHILL	King, Marvin & Donna	ICICFE	Yes	Private	Smith, S.	7	1.76
YAMHILL	King, Marvin & Donna	LUSUK	Yes	Private	Smith, S.	5	1.76
YAMHILL	King, Marvin & Donna-Roadside	LUSUK	Yes	Private	Smith, S.		0.01
YAMHILL	Nielsen	ICICFE	Yes	Private	Norman, K.		20.58
YAMHILL	Nielsen	LUSUK	Yes	Private	Norman, K.		20.58
YAMHILL	Oak Ridge North	ICICFE	Yes	Private	Smith, S.	5	0.10
YAMHILL	Oak Ridge North	LUSUK	Yes	Private	Smith, S.	5	0.10
YAMHILL	Oak Ridge South	ICICFE	Yes	Private	Smith, S.	6	1.90
YAMHILL	Oak Ridge South	LUSUK	Yes	Private	Smith, S.	7	1.90
YAMHILL	Sheridan	LUSUK	Yes	Private	Gisler, S.	2	1.06
ERDED =	Willamette daisy						
ICICFE =	Fender's blue butterfly						
LUSUK =	Kincaid's lupine						

SURVEY RESULTS BY POPULATION AND SPECIES, Service 2008a							
County	Site Name	Species	Core Population	Management	Contact	Bentgrass Invasion	Acres
LOBR =	Bradshaw's lomatium						
SINE2 =	Nelson's checkermallow						

SURVEY RESULTS BY SPECIES AND CRITICAL HABITAT UNIT, Service 2008a

State	County	Species	Critical Habitat Unit ID	Acres	Bentgrass Present?
Washington	Lewis	Kincaid's lupine	KL-1	4.04	Unknown
Oregon	Benton	Kincaid's lupine	KL-10	17.89	Unknown
Oregon	Lane	Kincaid's lupine	KL-11A	5.91	Yes
Oregon	Lane	Kincaid's lupine	KL-11B	9.37	Yes
Oregon	Lane	Kincaid's lupine	KL-11C	15.07	Yes
Oregon	Lane	Kincaid's lupine	KL-11D	17.06	Yes
Oregon	Lane	Kincaid's lupine	KL-11E	17.19	Yes
Oregon	Lane	Kincaid's lupine	KL-12A	22.37	Yes
Oregon	Lane	Kincaid's lupine	KL-12B	0.37	Yes
Oregon	Lane	Kincaid's lupine	KL-12C	4.02	Unknown
Oregon	Lane	Kincaid's lupine	KL-12D	60.37	Yes
Oregon	Lane	Kincaid's lupine	KL-12E	54.00	Yes
Oregon	Lane	Kincaid's lupine	KL-13	16.23	Unknown
Oregon	Yamhill	Kincaid's lupine	KL-2A	6.24	Yes
Oregon	Yamhill	Kincaid's lupine	KL-2B	14.12	Yes
Oregon	Yamhill	Kincaid's lupine	KL-3	50.99	Yes
Oregon	Yamhill	Kincaid's lupine	KL-4A	55.84	Yes
Oregon	Yamhill	Kincaid's lupine	KL-4B	12.74	Yes
Oregon	Yamhill	Kincaid's lupine	KL-5	1.69	Yes
Oregon	Polk	Kincaid's lupine	KL-6	3.66	Yes
Oregon	Polk	Kincaid's lupine	KL-7	12.28	Unknown
Oregon	Benton	Kincaid's lupine	KL-8	11.46	No
Oregon	Benton	Kincaid's lupine	KL-9	171.60	Yes
Oregon	Yamhill	Fender's blue butterfly	FBB-1A	6.24	Yes
Oregon	Yamhill	Fender's blue butterfly	FBB-1B	14.12	Yes
Oregon	Lane	Fender's blue butterfly	FBB-10A	50.38	Yes
Oregon	Lane	Fender's blue butterfly	FBB-10B	276.15	Yes
Oregon	Lane	Fender's blue butterfly	FBB-10C	54.91	Yes
Oregon	Lane	Fender's blue butterfly	FBB-10D	46.62	Unknown
Oregon	Lane	Fender's blue butterfly	FBB-10E	59.28	Unknown
Oregon	Lane	Fender's blue butterfly	FBB-11A	15.40	Unknown
Oregon	Lane	Fender's blue butterfly	FBB-11B	13.99	Yes
Oregon	Lane	Fender's blue butterfly	FBB-11C	22.37	Yes
Oregon	Lane	Fender's blue butterfly	FBB-11D	29.29	Yes
Oregon	Lane	Fender's blue butterfly	FBB-11E	4.40	Unknown
Oregon	Lane	Fender's blue butterfly	FBB-11F	28.76	Yes
Oregon	Lane	Fender's blue butterfly	FBB-11G	4.60	Yes
Oregon	Lane	Fender's blue butterfly	FBB-11H	58.56	Unknown
Oregon	Lane	Fender's blue butterfly	FBB-11I	51.47	Yes

SURVEY RESULTS BY SPECIES AND CRITICAL HABITAT UNIT, Service 2008a

State	County	Species	Critical Habitat Unit ID	Acres	Bentgrass Present?
Oregon	Lane	Fender's blue butterfly	FBB-12A	60.37	Yes
Oregon	Lane	Fender's blue butterfly	FBB-12B	54.00	Yes
Oregon	Lane	Fender's blue butterfly	FBB-13	132.50	Unknown
Oregon	Yamhill	Fender's blue butterfly	FBB-2	50.99	Yes
Oregon	Polk	Fender's blue butterfly	FBB-3	3.66	Yes
Oregon	Polk	Fender's blue butterfly	FBB-4A	748.37	Yes
Oregon	Polk	Fender's blue butterfly	FBB-4B	416.06	Yes
Oregon	Polk	Fender's blue butterfly	FBB-5	12.28	Unknown
Oregon	Polk	Fender's blue butterfly	FBB-6A	2.42	Unknown
Oregon	Polk	Fender's blue butterfly	FBB-6B	15.88	Unknown
Oregon	Benton	Fender's blue butterfly	FBB-7	11.46	No
Oregon	Benton	Fender's blue butterfly	FBB-8	716.71	Yes
Oregon	Benton	Fender's blue butterfly	FBB-9	48.50	Unknown
Oregon	Polk	Willamette daisy	WD-1A	8.72	Yes
Oregon	Polk	Willamette daisy	WD-1B	32.48	Yes
Oregon	Marion	Willamette daisy	WD-2	12.23	Unknown
Oregon	Linn	Willamette daisy	WD-3A	5.78	Unknown
Oregon	Linn	Willamette daisy	WD-3B	15.75	Unknown
Oregon	Linn	Willamette daisy	WD-3C	36.76	Unknown
Oregon	Benton	Willamette daisy	WD-4A	4.71	Unknown
Oregon	Benton	Willamette daisy	WD-4B	4.56	Unknown
Oregon	Benton	Willamette daisy	WD-5	38.49	Unknown
Oregon	Lane	Willamette daisy	WD-6A	79.72	Yes
Oregon	Lane	Willamette daisy	WD-6B	0.22	Yes
Oregon	Lane	Willamette daisy	WD-6C	3.37	Yes
Oregon	Lane	Willamette daisy	WD-6D	2.13	Unknown
Oregon	Lane	Willamette daisy	WD-7A	22.34	No
Oregon	Lane	Willamette daisy	WD-7B	143.37	Yes
Oregon	Lane	Willamette daisy	WD-8A	127.85	Yes
Oregon	Lane	Willamette daisy	WD-8B	8.09	Unknown
Oregon	Lane	Willamette daisy	WD-8C	2.49	Unknown
Oregon	Lane	Willamette daisy	WD-8D	58.02	Yes
Oregon	Lane	Willamette daisy	WD-8E	16.74	Yes
Oregon	Lane	Willamette daisy	WD-9A	89.96	Unknown
Oregon	Lane	Willamette daisy	WD-9B	0.34	Unknown
Oregon	Lane	Willamette daisy	WD-9C	0.73	Unknown
Oregon	Lane	Willamette daisy	WD-9D	1.08	Unknown
Oregon	Lane	Willamette daisy	WD-9E	1.95	Unknown