U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Rana pretiosa

Common Name:

Oregon Spotted frog

Lead region:

Region 1 (Pacific Region)

Information current as of:

05/09/2011

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

___ Taxon is more abundant or widespread than previously believed or not subject

___ Taxon not subject to the degree of threats sufficient to warrant issuance of

___ Range is no longer a U.S. territory

___ Insufficient information exists on biological vulnerability and threats to s

___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: California, Oregon, Washington
- **US Counties**: Modoc, CA, Shasta, CA, Siskiyou, CA, Benton, OR, Clackamas, OR, Deschutes, OR, Jackson, OR, Klamath, OR, Lane, OR, Linn, OR, Marion, OR, Multnomah, OR, Wasco, OR, Clark, WA, King, WA, Klickitat, WA, Pierce, WA, Skagit, WA, Snohomish, WA, Thurston, WA
- **Countries**: Canada, United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: California, Oregon, Washington
- **US Counties**: Deschutes, OR, Jefferson, OR, Klamath, OR, Lane, OR, Wasco, OR, Klickitat, WA, Skamania, WA, Thurston, WA, Whatcom, WA
- **Countries**: Canada

Land Ownership:

The species currently is known from 44 sites. Of these, 4 are in British Columbia, 8 in Washington, and 32 in Oregon. Land ownership is described below (also see Appendix 1).

In British Columbia, four extant populations of Oregon spotted frog exist in the extreme southwestern corner of the province, an area generally referred to as the Fraser River lowlands. One population occurs on lands owned by the Department of National Defence; two populations occur on private lands; and one occurs on First Nations and private lands.

In Washington, almost all of the Oregon spotted frog sites are in public ownership. In Thurston County, one of the Oregon spotted frog sites occurs on lands owned by the Washington Department of Fish and Wildlife (WDFW), two sites occur on National Wildlife Refuge (NWR) land (Black River Unit of the Nisqually NWR), one occurs on a combination of private and NWR lands, and two occur solely on private property.

The Trout Lake sites in Skamania and Klickitat Counties are on private and public lands, including the Washington Department of Natural Resources' Trout Lake Natural Area Preserve (NAP) and Gifford Pinchot National Forest. The Conboy Lake population occurs predominately within the Conboy Lake NWR, with the remaining portion on privately owned land.

In Oregon, 89 percent of the Oregon spotted frog sites are at least partially in public ownership (U.S. Forest Service (USFS), Bureau of Land Management (BLM), and NWR). Sites in the Deschutes drainage (La Pine, Little Deschutes River, and Sunriver) are under private ownership. Small portions of the Little Deschutes River locality are also managed by the BLM. Fourteen of the remaining sites are within the Deschutes National Forest. One site is managed by the Mount Hood National Forest. All localities in the Willamette drainage are under the management of the Willamette National Forest. These localities include Gold Lake Bog (a Research Natural Area) and several sites within the Three Sisters Wilderness Area. There are nine known occupied sites in the Klamath Basin. The Klamath Marsh NWR is managed by the U.S. Fish and Wildlife Service (FWS), but portions of that population also occur on private lands. The Wood River Wetland includes land managed by BLM and private land. Fourmile Creek includes Fremont-Winema National Forest, Bureau of Reclamation, and private lands. Buck Lake includes private, Klamath Falls BLM, and Fremont-Winema National Forest lands. The Upper Williamson and Jack Creek sites are on the Fremont-Winema National Forest and privately owned land. The Crane Creek site is on privately owned lands. Sevenmile Creek includes Fremont-Winema National Forest and private lands. Parsnip Lakes is in the Cascade-Siskiyou National Monument managed by the Medford BLM. Most potential habitat on private lands adjacent to public lands has not been adequately surveyed for Oregon spotted frogs.

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Biological Information

Species Description:

The Oregon spotted frog is named for the characteristic black spots covering the head, back, sides, and legs. The dark spots have ragged edges and light centers, usually associated with a tubercle or raised area of skin. These spots become larger and darker, and the edges become more ragged with age (Hayes 1994, p. 14). Body color also varies with age. Juveniles are usually brown or, occasionally, olive green on the back and white, cream, or flesh-colored with reddish pigments on the underlegs and abdomen (McAllister and Leonard 1997, pp. 1-2). Adults range from brown to reddish brown but tend to become redder with age. Large, presumably older, individuals may be brick red over most of the dorsal (back) surfaces (McAllister and Leonard 1997, pp. 1-2). Red surface pigments on the adult abdomen also increase with age, and the underlegs of adults are a vivid orange red. Tan to orange folds along the sides of the back (dorsolateral folds) extend from behind the eye to midway along the back (McAllister and Leonard 1997, p. 1). The eyes are upturned; there is a faint mask, and a light jaw stripe extends to the shoulder. Small bumps and tubercles usually cover the back and sides (Leonard et al. 1993, p. 130). The hind legs are short relative to body length, and the hind feet are fully webbed (Leonard et al. 1993, p. 130).

The Oregon spotted frog is a medium-sized frog that ranges from about 44 to 105 millimeters (mm) (1.7 to 4.1 inches (in)) in body length (McAllister and Leonard 1997, p. 1; Rombough et al. 2006, p. 210). Females are typically larger than males; females reach up to 105 mm (4 in) (Rombough et al. 2006, p. 210) and males

to 75 mm (3 in) (Leonard et al. 1993, p. 130).

Morphological characters can be used to distinguish Oregon spotted frogs from other closely related spotted frogs. Mottling with dark pigments and fragmentation of the superficial red or orange-red wash on the abdomen can distinguish the Oregon spotted frog from some Columbia spotted frog populations (Hayes 1997, p. 3; Hayes et al. 1997, p. 1). Coloration of the underlegs and abdomen, size and shapes of spots, groin mottling, eye positions, relative length of hind legs to body size, degree of webbing, behaviors, and other characteristics can be used to distinguish among adults of the closely related species in the Rana boylii group. However, tadpoles are difficult to distinguish among species (Corkran and Thoms 1996, p. 150; McAllister and Leonard 1997, p. 6).

The Oregon spotted frog has a weak call consisting of a rapid series of six to nine low clucking notes described as sounding like a distant woodpecker's tapping. Males will call at any time, both day and night (McAllister and Leonard 1997, p. 12). Males have been documented to call from submerged sites that are physically distant (tens to hundreds of meters) from oviposition sites (Bowerman 2010, p. 85). These submerged calls are inaudible at the surface and begin several days prior to breeding. Submerged calling is more frequent at night, although daytime calling has been recorded during overcast days (Bowerman 2010, pp. 85-86). It is unclear if mate selection is taking place during this period of calling remote from the breeding site, but seems likely (Bowerman 2010, p. 86) This species rarely vocalizes except during the breeding season (Leonard et al. 1993, p. 132); however vocalizations have been heard during the fall (Leonard et al. 1997, pp. 73-74; C. Pearl, USGS, pers. comm. 2010).

Taxonomy:

The common name "spotted frog" and the scientific name *Rana pretiosa* (order Anura; family Ranidae) were first applied to a series of five specimens collected in 1841 by Baird and Girard (1853, p. 378) from the vicinity of Puget Sound. However, two of these specimens were later determined to be northern red-legged frogs (Rana aurora) (Hayes 1994, p. 4; Green et al. 1997, p. 4). Dunlap (1955) demonstrated the morphological differences between northern red-legged frogs, Cascades frogs, and spotted frogs. Subsequently, the "spotted frog" was separated into two species, *Rana pretiosa* and *Rana luteiventris* (Columbia spotted frog) based on genetic analyses (Green et al. 1996, 1997).

Phylogenetic analysis conducted by Funk et al. (2008) sampled Oregon spotted frogs from 3 locations in Washington and 13 locations in Oregon. Results indicate two well-supported clades nested within the R. pretiosa clade: the Columbia clade (Trout Lake NAP and Camas Prairie) and the southern Oregon clade (Wood River and Buck Lake in the Klamath Basin). While the analysis found these clades well supported, there was less than 1 percent mean sequence divergence between them, which suggests relatively recent divergence (Funk et al. 2008, p. 204). Interestingly, the Columbia River does not appear to act as a barrier in R. pretiosa as the two sites that comprise the Columbia clade, one is in Washington (Trout Lake NAP) and the other is in Oregon (Camas Prairie). Haplotype and nucleotide diversity was low for R. pretiosa in general and was very low for the two R. pretiosa nested clades (Funk et al. 2008, p. 203). Only six haplotypes were found across the entire range of R. pretiosa, indicating low genetic variation (Funk et al. 2008, p. 205).

Blouin et al. (2010) performed analyses on Oregon spotted frogs from 23 of the known sites in British Columbia, Washington, and Oregon for variation at 13 microsatellite loci and 298 base pairs of mitochondrial DNA. Their analyses indicate that Rana pretiosa is comprised of six major genetic groups: (1) British Columbia; (2) the Chehalis drainage in Washington, (3) the Columbia drainage in Washington, (4) Camas Prairie in northern Oregon, (5) the central Cascades of Oregon, and (6) the Klamath basin (Blouin et al. 2010, pp. 2184-2185). The levels of genetic variation in the Oregon spotted frog groups are low compared to other ranid frogs, suggesting these populations are very small and/or very isolated (Blouin et al. 2010, p. 2184). Contrary to findings by Funk et al. (2008), the Blouin et al. (2010) findings of high frequency of mitochondrial DNA private alleles (i.e. an allele found in only one site) in the central Cascades and Klamath

Basin groups suggests an historical (rather than recent) isolation among individual sites (Blouin et al. 2010, p. 2189). This private-allele finding also reinforces microsatellite-based conclusions that gene flow among sites has been very low, even on small geographic scales (Blouin et al. 2010, p. 2188). Due to Oregon spotted frogs highly aquatic habits, connectivity between Oregon spotted frog sites depends on the connectivity of streams, rivers, and lakes. Gene flow (based on both microsatellite and mitochondrial analyses) is extremely small beyond 10 kilometers (Blouin et al. 2010, p. 2186 and 2188) and most Oregon spotted frog populations are separated by more than 10 kilometers. Therefore, Blouin et al. (2010, p. 2189) hypothesize that low aquatic connectivity and small population sizes are important causes of the low genetic diversity within sites and the high genetic differentiation among sites.

Habitat/Life History:

Life History

Male Oregon spotted frogs are not territorial and may gather in large groups of 25 or more individuals at specific locations (Leonard et al. 1993, p. 132). Breeding occurs in February or March at lower elevations and between early April and early June at higher elevations (Leonard et al. 1993, p. 132). Males and females probably separate soon after egg laying with females returning to fairly solitary lives. Males may stay at the breeding site, possibly for several weeks, until egg-laying is completed (McAllister and Leonard 1997, p. 13).

Oregon spotted frogs' eggs are extremely vulnerable due to the species' laying habits. Females may deposit their egg masses at the same locations in successive years, indicating the sites may have unique characteristics. For example, marked males and females at Sunriver returned to the same breeding site, some for 3 or more years (J. Bowerman, SunRiver Nature Center, pers. comm. 2006) and at several sites in Oregon and Washington the same oviposition locations have been used for more than a decade (M. Hayes, pers comm. 2008). Traditional egg-laying (oviposition) sites may have limited availability because of unique characteristics, and adults may have limited flexibility to switch sites. This makes the Oregon spotted frog particularly vulnerable to oviposition site modification (Hayes 1994, p. 19). Although egg masses are occasionally laid singly, the majority of egg masses are laid communally in groups of a few to several hundred (Licht 1971, p. 119; Nussbaum et al. 1983, p. 186; Cooke 1984, p. 87; Hayes et al. 1997 p. 3; Engler and Friesz 1998, p. 3). They are laid in shallow, often temporary, pools of water; gradually receding shorelines; on benches of seasonal lakes and marshes; and in wet meadows. These sites are usually associated with the previous year's emergent vegetation, are no more than 35 centimeters (cm) (14 in) deep (Pearl and Hayes 2004, pp. 19-20), and most of these sites dry up later in the season (Joe Engler, FWS, pers. comm. 1999). Shallow water is easily warmed by the sun, and warmth hastens egg development (McAllister and Leonard 1997, p. 8). However, laying eggs in shallow water can result in high mortality rates for eggs and hatchling larvae due to desiccation or freezing.

Licht (1974, pp. 617-625) documented highly variable mortality rates for spotted frog embryos (30 percent), tadpoles (99 percent), and post-metamorphic (after the change, or metamorphosis, from tadpole to adult) frogs (95 percent). Adults had a mortality rate of 36 percent over 2 years of the study, and males had a higher mortality than females (Licht 1974, p. 621). An average between year survival of 37 percent was estimated by a mark-recapture study at Dempsey Creek in Washington between 1997 and 1999 (Watson et al. 2000, p. 19).

Adults begin to breed by 1–3 years of age, depending on elevation and latitude. Males may breed at 1 year at lower elevations and latitudes but generally require a second year to reach maturity at other sites. Females breed by 2 or 3 years of age, depending on elevation and latitude. Longevity of the species is incompletely understood. Observations of lines of arrested growth (LAGs) in bone cross sections suggest younger frogs generally compose the bulk of examined populations, but also indicate longevity can vary between sites and years. Most male Oregon spotted frogs probably only survive to 2–3 years of age (M. Hayes, pers. comm. 2002). However, one adult male, marked as an adult in 1997, was recaptured several times through 2006; indicating his age was at least 11 years (K. McAllister, pers. comm. 2008). Five Oregon spotted frogs marked

in 1997 and recaptured in 1999 at Jack Creek in Oregon were estimated to be from 4 to 5 years old (Forbes and Peterson 1999, p. 17). Several Oregon spotted frogs re-captured at Jack Creek have been full adults for 7 and 8 years (J. Oertley, U.S. Forest Service, pers. comm. 2005). One female near Wickiup reservoir was aged at 3 years in 2000, and subsequently recaptured through fall 2004 (C. Pearl, U.S. Geological Survey Biological Resources Division, pers. comm. 2005; J. Bowerman, pers. comm. 2005).

Tadpoles are grazers, having rough tooth rows for scraping plant surfaces and ingesting plant tissue and bacteria. They also consume algae, detritus, and probably carrion (Licht 1974, p. 624; McAllister and Leonard 1997, p. 13). Tadpoles metamorphose into froglets (about 16–43 mm (0.6–1.75 in) in length) during their first summer (Leonard et al. 1993, p. 132; C. Pearl and J. Bowerman, pers. comm. 2005).

Live animals, primarily insects, are the prey of post-metamorphic Oregon spotted frogs. Important prey groups include leaf beetles (Chrysomelidae), ground beetles (Carabidae), spiders (Arachnidae), rove beetles (Staphylinidae), syrphid flies (Syrphidae), long-legged flies (Dolichopodidae), ants (Formicidae), water striders (Gerridae), spittlebugs (Cercopidae), leaf hoppers (Cicadellidae), aphids (Aphididae), dragonflies/damsel flies (Odonates), and yellowjackets (Vespidae) (Licht 1986, pp. 27-28). Oregon spotted frogs also eat adult Pacific tree frogs (Hyla regilla) and small red-legged frogs and Oregon spotted frogs (Licht 1986, p. 28) and have been observed preying on newly metamorphosed red-legged frogs and western toad (Bufo boreas) juveniles at multiple sites in Oregon (McAllister and Leonard 1997, p. 15; Pearl and Hayes 2002, pp. 145-147; Pearl et al. 2005a, p. 37; M. Hayes, pers. comm. 1999).

Similar to many North American pond-breeding anurans, the abundance of larval and post-metamorphic Oregon spotted frogs can be strongly affected by predation. The heaviest losses to predation are thought to occur shortly after tadpoles emerge from eggs, when they are relatively exposed and poor swimmers (Licht 1974, p. 624). However, the odds of survival appear to increase as tadpoles grow in size and aquatic vegetation matures (Licht 1974, p. 624). Oregon spotted frogs have a number of documented and potential natural predators. These include garter snakes (Thamnophis species (spp.)), great blue herons (Ardea herodias), green-backed herons (Butorides virescens), American bitterns (Botaurus lentiginosus), belted kingfishers (Ceryle alcyon), sandhill cranes (Grus canadensis), raccoons (Procyon lotor), coyotes (Canis latrans), striped skunks (Mephitis mephitis), mink (Mustela vison), river otters (Lutra canadensis), and feral house cats (Felis domesticus) (McAllister and Leonard 1997, p. 13; Hayes et al. 2005, p. 307; Hayes et al. 2006, p. 209). Tadpoles may be preyed upon by numerous vertebrate predators including belted kingfishers, hooded mergansers (Lophodytes cucullatus), common garter snakes, western terrestrial garter snakes (Thamnophis elegans), larval and adult roughskin newts (Taricha granulosa), larval northwestern salamanders (Ambystoma gracile), cutthroat trout (Oncorynchus clarki), Olympic mudminnows (Novumbra hubbsi), and three-spined sticklebacks (Gasterosteus aculeatus) (McAllister and Leonard 1997, p. 14). Subadult Oregon spotted frogs have been observed within dense aggregations of recently hatched Oregon spotted frog tadpoles. Stomach flushing verified that subadult Oregon spotted frogs consumed recently hatched tadpoles (K. McAllister, pers. comm. 2008). Invertebrate predators include dytiscid beetles (Dytiscus spp.), giant water bugs (Lethocerus americanus), backswimmers (Notonecta undulata and N. kirbyi), water scorpions (Ranatra sp.), dragonfly nymphs (Odonata), and worm-leeches (Arhynchobdellida) (McAllister and Leonard 1997, p. 14). Leeches and other invertebrates and roughskin newts are likely egg predators (McAllister and Leonard 1997, p. 14).

The introduction of nonnative species into the historic range of the Oregon spotted frog possibly contributed to the decline of this and other species of frogs (Hayes and Jennings 1986, pp. 491-492, 494-496; Hayes 1994, p. 5; 61 FR 25813; McAllister and Leonard 1997, pp. 25-26; J. Engler, pers. comm. 1999; Pearl et al. 2004, pp. 17-18). Bullfrogs (Lithobates catesbeiana) are known predators of Oregon spotted frogs (M. Hayes, J. Engler, C. Pearl, pers. obs.), and introduced fish such as brook trout (Salvelinus fontinalis) and centrarchids are also likely predators.

Habitat

Watson et al. (2003, p. 298) summarized the conditions required for completion of Oregon spotted frog life cycle as: shallow water areas for egg and tadpole survival, perennial deep moderately-vegetated pools for adult and juvenile survival in the dry season, and perennial water for protecting all age classes during cold wet weather.

The Oregon spotted frog inhabits emergent wetland habitats in forested landscapes, although it is not typically found under forest canopy. Historically, this species was also associated with lakes in the prairie landscape of the Puget lowlands (McAllister and Leonard 1997, p. 16). This is the most aquatic native frog species in the Pacific Northwest. It is almost always found in or near a perennial body of water, such as a spring, pond, lake, sluggish stream, irrigation-type canal, or roadside ditch (J. Engler, pers. comm. 1999). The observation that extant Oregon spotted frog populations tend to occur in larger wetlands led Hayes (1994, Part II pp.5 and 7) to hypothesize that a minimum size of 4 hectares (ha) (9 acres (ac)) may be necessary to reach suitably warm temperatures and support a large enough population to persist despite high predation rates. However, Oregon spotted frogs also occupy smaller sites and are known to occur at sites as small as 1 ha and as large as 1,989 hectares (Pearl and Hayes 2004, p. 11). Oregon spotted frogs have been found at elevations ranging from near sea level in the Puget Trough lowlands in Washington to approximately 1,500 meters (m) (5,000 feet (ft)) in the Oregon Cascades in western Oregon (Dunlap 1955, p. 316; Hayes 1997, p. 16; McAllister and Leonard 1997, pp. 8-10).

Results of a habitat utilization and movement study at Dempsey Creek in Washington indicate that adult frogs made infrequent movements between widely separated pools and more frequent movements between pools in closer proximity (Watson et al. 2003, p. 294), but remained within the study area throughout the year. Home ranges averaged 2.2 ha (5.4 ac) and daily movement was 5-7 meters throughout the year (Watson et al. 2003, p. 295). During the breeding season (February-May), frogs used about half the area used during the rest of the year. During the dry season (June-August), frogs moved to deeper, permanent pools, and occupied the smallest range of any season, then moved back toward their former breeding range during the wet season (September-January) (Watson et al. 2003, p. 295). Individuals equipped with radio transmitters stayed within 800 m (2,600 ft) of capture locations at the Dempsey Creek site (Watson et al. 1998, p. 10) and within 400 m (1,312 ft) at the Trout Lake Wetland NAP (Hallock and Pearson 2001, p. 16).

Recaptures of Oregon spotted frogs in the Buck Lake population in Oregon indicated that adults often move less than 100 m (300 ft) between years (Hayes 1998b, p. 9). However, longer travel distances, while infrequent, have been observed between years and within a single year between seasons. Three adult Oregon spotted frogs (one male and two females) marked in a study at Dempsey Creek and the Black River in Washington moved a distance of 2.4 km (1.5 mi) between seasons along lower Dempsey Creek to the creek's mouth from the point where they were marked (McAllister and Walker 2003, p. 6). Adult female Oregon spotted frogs traveled 437 m (1,434 ft) between seasons from their original capture location at the Trout Lake Wetland NAP (Hallock and Pearson 2001, p. 8). Two juvenile frogs at the Jack Creek site in Oregon were recaptured the next summer 1,245 m (4,084 ft) and 1,375 m (4,511 ft) downstream from where they were initially marked and one adult female moved 2,799 m (9,183 ft) downstream (Cushman and Pearl 2007, p. 13). Oregon spotted frogs at the Sunriver site routinely make annual migrations of 500 to 1,300 m (1,640-4,265 ft) between the major oviposition complex and an overwintering site (J. Bowerman, pers. comm. 2006).

Oregon spotted frogs can make use of a variety of pond types as long as there is sufficient vegetation and seasonal habitat available for breeding, summer feeding, and overwintering (Pearl et. al. 2009, p. 14). Oregon spotted frogs at Dempsey Creek selected areas of relatively shallow water with less emergent vegetation but more submergent vegetation than adjacent habitats. They avoided dry, upland areas of pasture grass (Watson et al. 1998, p. 10; 2000, pp. 54-57; 2003, p. 297). Radio telemetry data indicates Oregon spotted frogs at Dempsey Creek also make extensive use of scrub-shrub wetland habitats adjacent to forested uplands (K. Risenhoover, pers. comm. 2004).

Oregon spotted frogs breed in shallow pools (5–30 cm (2–12 in) deep) that are near flowing water, or which

may be connected to larger bodies of water during seasonally high water or at flood stage. Characteristic vegetation includes grasses, sedges, and rushes, although eggs are laid where the vegetation is low or sparse (McAllister and Leonard 1997, p. 17). While native vegetation is the preferred substrate, the frog may also use short, manipulated canary grass/native vegetation mix (J. Engler, pers. comm. 1999).

After breeding, during the dry season, Oregon spotted frogs move to deeper, permanent pools or creeks (Watson et al. 2003, p. 295). They are often observed near the water surface basking and feeding in beds of floating and submerged vegetation (Watson et al. 2003, p. 291-298; Pearl et al. 2005, p. 36-37).

Throughout most of their range, Oregon spotted frogs remain in warmwater marshes except during the overwintering period. Recent data indicate that overwintering sites are associated with springs or other locations with low-flow conditions. This choice of overwintering site may result from an avoidance of sites that could freeze (M. Hayes, pers. comm. 1999). Oregon spotted frogs apparently burrow in mud, silty substrate, or clumps of emergent vegetation when inactive during periods of prolonged or severe cold (McAllister and Leonard 1997, p. 17). Radio-tracked frogs at Trout Lake NAP were also found within the creek, in woody accumulations within the creek, and holes in the creek bank (Hallock and Pearson 2001, p. 16). This species is thought to be generally inactive during the winter, except on warmer days. However, in central Oregon, where winters generally result in ice cover over ponds, Oregon spotted frogs follow a fairly reliable routine of considerable activity and movement beneath the ice during the first month following freeze-up. Radio-tracked frogs remained active all winter, even under the ice at Trout Lake NAP (L. Hallock, pers comm. 2009) and Conboy NWR (Hayes et al. 2001, pp. 16-19). Movements will also occur anytime during the winter when oxygen levels in the water fall (Hallock and Pearson 2001, p. 15; Hayes et al. 2001, pp. 20-23). Little movement is observed under the ice in January and February, but activity steadily increases in mid-March, even when ice cover persists (J. Bowerman, pers. comm. 2006).

Historical Range/Distribution:

Historically, the Oregon spotted frog ranged from British Columbia to the Pit River drainage in northeastern California (Hayes 1997; p. 40; McAllister and Leonard 1997, p. 7). Oregon spotted frogs were documented in 61 historic localities: 3 in British Columbia, 3 in California, 44 in Oregon, and 11 in Washington (Hayes 1997, p. 41; Kym Welstead, Environment Canada, pers. comm. 2009). In British Columbia, historic populations were found near Sumas Prairie in Abbotsford, Nicomen Island in Matsqui, and in Langley Township. In Washington, the species was historically documented in Clark, King, Klickitat, Pierce, Skagit, Snohomish, and Thurston Counties. In Oregon, historic sites were found in Multnomah, Clackamas, Marion, Linn, Benton, Jackson, Lane, Wasco, Deschutes, and Klamath Counties. In California, the species was historically documented in Modoc, Shasta, and Siskiyou Counties.

Current Range Distribution:

Currently, the Oregon spotted frog is found from extreme southwestern British Columbia south through the Puget/Willamette Valley Trough, and in the Cascades Range from south-central Washington at least to the Klamath Basin in Oregon. In British Columbia, this species now occurs in Langley Township, Agassiz, and Morris Valley. Populations are currently known to occur only in Klickitat, Skamania, and Thurston Counties, Washington (Leonard 1997, pp. 4-7; McAllister and Leonard 1997, p. 7). In Oregon, this species now occurs in Deschutes, Klamath, Jackson, Lane, and Wasco Counties (Hayes 1994, pp. 6-9, 1997). In California, this species has not been detected at historic sites and may be extirpated; however, there has not been an adequate survey of potential habitat, so this species may still occur in California.

Population Estimates/Status:

Of the 61 historic localities where the species' previous existence can be verified (e.g., museum specimens, photographs, reliable published records), only 13 have been confirmed as being occupied in recent years

(Hayes 1997, p. 1; McAllister and Leonard 1997, p. 20). The species may no longer occur in as much as 90 percent of its former range when the geographical and elevational biases in the collections of historic specimens are considered (Hayes 1997, p. 1). However, Hayes' (1997) analysis did not include two historic populations in British Columbia reported by Carl and Cowan (1945, p. 53); therefore the rangewide loss is probably higher than 90 percent (Haycock 2000, p. 11) because Oregon spotted frogs can no longer be found at the three historic British Columbia locations.

Egg mass counts are believed to be a good metric of adult population size and are the most time-efficient way to estimate population size (C. Pearl, pers. comm. 2006; Phillipsen et al. 2009, p. 7). Adult females lay one egg mass per year and the breeding period occurs within a reliable and predictable time frame each year (K. McAllister, pers. comm. 2006). Egg mass numbers represent a single survey timed to coincide with the end of the breeding season. An estimate of adult population size can be generated if the egg mass census is complete: 1 egg mass is approximately equivalent to 1 breeding female plus 1-2 adult males (C. Pearl, pers. comm. 2006; Phillipsen et al. 2009, p. 7). Two weaknesses of using egg mass counts to estimate population size are the uncertainty whether adult females breed every year, and the difficulty of distinguishing individual egg masses in large communal clusters.

Egg mass counts, as they are currently conducted at most sites, do not allow for evaluation of trends within a site nor between sites because surveys are not standardized. Survey effort, area coverage, and timing can differ between years at individual sites. In addition, method of survey can differ between years at individual sites and differs between sites. Trend information may become available in the future for a few sites (such as Trout Lake NAP and Conboy Lake) where egg mass surveys have been conducted by the same individuals using the same methods and search effort for many years as long as these efforts continue in the future. Because of the weaknesses associated with the egg mass counts, site estimates derived from egg mass counts are considered to be a minimum estimate and generally should not be compared across years or with other sites.

For the purposes of this document, the terms location and site are not intended to convey any further definition other than the general locations where breeding has been observed. In some cases, a site may be equivalent to an Oregon spotted frog population (e.g. Penn Lake), but others may include multiple breeding locations within wetland complexes where hydrological connections may facilitate movement between breeding areas, but within the complexes movement patterns and genetic conditions are undetermined (e.g. Klamath Marsh NWR). It is for these reasons that a site should not be interpreted to be a population.

Currently, 39 Oregon spotted frog locations (sites) are known in the U.S. including 8 in Washington (1 historic, 7 new) and 31 in Oregon (13 historic, 18 new). Oregon spotted frogs have not been documented in recent surveys in California. The following summarizes basic information and status of the current Oregon spotted frog sites in British Columbia, Washington, and Oregon. More specific site information can be found in Appendix 1.

British Columbia

In British Columbia, seven populations have been documented; however, Oregon spotted frogs cannot be confirmed at the three historic sites and the four recently discovered populations appear to be isolated from one another (Haycock 2000, pp. 13-14; K. Welstead, pers. comm. 2009) and the overall population size has fluctuated over the last 10 years. Currently, Oregon spotted frogs are only known to occur within four sites. However, one (MD Aldergrove) is likely extirpated, as no egg masses have been discovered at the site since 2006. Egg mass counts in 2008 and 2009 at the four sites indicate the minimum population size for all of British Columbia is approximately 300 adults, which is low in comparison to Washington and Oregon. All four of the currently known sites are vulnerable to a wide variety of factors that might interfere with reproduction or survival.

Washington

In the State of Washington, the distribution of Oregon spotted frogs has declined dramatically due to filling and alteration of wetlands (see Threats section). Oregon spotted frogs are only known to occur within the Black River , and Trout Lake Creek drainages, and at Conboy Lake. These Oregon spotted frog sites are isolated from each other and vulnerable to a wide variety of factors that might interfere with reproduction or survival.

Although there are no specific population estimates or trend data available, the Demspey Creek site appears to be stable. The status of Oregon spotted frogs associated with Conboy NWR are declining. The status at the Black River sites of Beaver Creek, 123rd Avenue, Allen Creek/Blooms Ditch, and Salmon Creek, and the Trout Lake NAP and Trout Lake Creek Beaver Ponds is unknown. Oregon spotted frogs appear to be extirpated from the Black River site at 110th Avenue.

Oregon

In the State of Oregon the Oregon spotted frog is presently only known to be extant within the Central Oregon Cascades and the Klamath basin. No connections are known to exist between these two geographic areas and they are considered to be isolated from one another.

Central Oregon Cascades (23 sites)

In the Central Oregon Cascades the Oregon spotted frog is found within a roughly triangular area of approximately 731 square miles in the upper Deschutes Basin and the Willamette drainage. Hayes (1997, p. 16) found that in the Deschutes Basin the range of the Oregon spotted frog has been substantially reduced. Twenty-two of the twenty-three Central Oregon Cascades sites (excluding the outlier occurrence at the Camas Prairie site) are clustered primarily on the east flank of the Cascade Mountains. This area extends from Big Marsh to the south, Hosmer Lake to the north, the Mink Lake Basin sites and Gold Lake Bog just across the divide to the west, and the Deschutes and Little Deschutes River occurrences to the east. Although complete surveys across this entire area have not occurred, surveys of other apparently suitable habitat within this area have only found one new occurrence of Oregon spotted frog (Slough Camp found in 2010). The specific microhabitat requirements of the Oregon spotted frog appear to result in use of only a subset of available aquatic habitat (Pearl and Hayes 2004, p. 17).

Although there are not specific population estimates, survey data indicate that Big Marsh and Sunriver are the largest populations (500 - 2500 breeding females) in the Central Oregon Cascades (see Appendix 1) with consistent survey information. At least 4 less-consistently counted populations appear to be sizeable (>100 breeding females) as of 2006-2009 (Gold Lake, Winopee Lake, Hosmer Lake, Blue Pool) and at least 2 more are likely to be similarly sized (Lava Lake, Little Deschutes complex)(data analyzed for Pearl et al. 2009). Available data suggest at least 6 populations have been in the range of 25 -100 breeding females as of 2006-2009: Little Cultus Lake, Muskrat Lake, Dilman Meadow, Camas Prairie, Penn Lake, Unnamed Marsh (data analyzed for Pearl et al. 2009). Available data indicate that several sites where frogs have been found in the past (e.g., Little Deschutes River/Highway 58 area, Ranger Creek, Odell Creek/Forest Road 4660, Odell Creek/Davis Lake, Wickiup Reservoir, La Pine/Long Prairie, Cultus Creek gravel pit) may represent either small breeding populations or small numbers of adults making occasional use of peripheral habitats (data analyzed for Pearl et al. 2009). Additional data is needed to understand OSF use of these smaller, peripheral habitats.

The Camas Prairie Oregon spotted frogs are the most geographically isolated, carry several alleles that are absent or rare in other sites, and have the lowest genetic diversity (Blouin et al. 2010, p. 2185). The frogs at this location appear to be the only remaining representatives of a major genetic group that is now almost extinct (Blouin et al. 2010, p. 2190).

The status of Oregon spotted frogs associated with Gold Lake Bog, Big Marsh, and Sunriver sites appear to be stable. The status of Oregon spotted frogs at all other Central Oregon Cascades sites is unknown.

Klamath Basin (9 sites)

Surveys for Oregon spotted frogs and egg masses have been conducted in the Klamath Basin of Oregon since 1994. Eight Oregon spotted frog sites have been located to date. Although most surveys occurred on public land, some surveys on private land were also completed (Ross 2000a,b,c,d,e; Ross and Mauser 2000; Ross and Watkins 2000). Extensive Oregon spotted frog surveys to locate additional Oregon spotted frog populations were conducted in the Klamath Basin in 2005 by Forest Service biologists and technicians with spotted frog experience. Twenty-eight different sites in Lake, Klamath and Jackson Counties were surveyed on the Fremont-Winema National Forest, BLM (Lakeview and Ashland Resource Areas), Bureau of Reclamation, and private land. Survey effort comprised over 300 person-hours and no Oregon spotted frogs were found (Oertley 2005).

Klamath Basin data suggests that one population (Jack Creek) has declined since 2000, two populations (Klamath Marsh and Wood River Wetland) appear stable, and five sites do not have enough data to determine trend. The Jack Creek and Buck Lake sites are not connected hydrologically to any other Oregon spotted frog populations and would require overland movement of miles to reach another population. These populations can be considered isolated from other Oregon spotted frogs with a very low chance of genetic interchange or re-colonization. The rest of the known Klamath Basin populations are connected hydrologically to another population with some opportunity for genetic interchange or re-colonization.

Summary

Some Oregon spotted frog sites in Washington and Oregon have considerable survey information, such as Big Marsh and Sunriver in Oregon and Dempsey Creek, Trout Lake NAP, and Conboy NWR in Washington although most sites do not. In addition, survey methods and effort have not been consistent across both states. However, from the information currently available, it appears that the Big Marsh, Sunriver, Gold Lake Bog, Wood River, Klamath NWR, and Dempsey Creek sites may be stable and the Jack Creek, and Conboy Lake NWR sites may be declining. The status is unclear for the other Oregon spotted frog sites; however, the available survey information indicates most of these sites consist of relatively few individuals and in some cases no adults and/or egg masses were found in the most recent surveys. Being located on lands under Federal ownership or protected status, such as Trout Lake NAP, does not appear to have resulted in the elimination or reduction of threats for Oregon spotted frog populations, as many of these populations are continuing to decline due to the threats discussed below.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Threats to the species' habitat include changes in hydrology due to construction of dams and alterations to seasonal flooding; introduction of exotic plant and animal species; plant successional changes; poor water quality; livestock grazing (in some circumstances); and residential and commercial development.

Habitat losses and alterations can affect amphibian species in a variety of ways, including eliminating immigration through losses of adjacent populations (see "Factor E") and effects on critical aspects of the habitat (Hayes and Jennings 1986, pp. 492-494). These critical aspects may include suitable egg-laying and nursery sites, refuges from predation or unfavorable environmental conditions, and suitable temperatures necessary for egg laying, growth, and development (Hayes and Jennings 1986, pp. 492-494).

Several aspects of the Oregon spotted frog's life history make it particularly vulnerable to habitat alterations: (1) communal egg-laying at sites used year after year restricts the number of reproductive sites; (2) the species' warmwater microhabitat requirement results in habitat overlap with introduced warmwater fish

species and other warmwater fauna (e.g., bullfrogs); (3) the active-season warmwater requirement limits suitable habitat in the cool climate of the Pacific Northwest; (4) the species is vulnerable to the potential loss or alteration of springs used for overwintering; and (5) the site complexity (e.g., spatial structure) for overwintering, active season, and breeding habitats is more complex than for other frog species (Hayes et al. 1997, p. 4; M. Hayes, pers. comm. 2002). Breeding habitat is probably the single most important habitat component for many aquatic-breeding amphibians because amphibian embryos and larvae depend on aquatic habitats for survival (Leonard 1997, p. 1).

Loss of Wetlands: Conservative estimates for Washington indicate that over 33 percent of wetlands were drained, diked, and filled between pre-settlement times and the 1980s (Canning and Stevens 1990, p. 23); losses in the historic range of the Oregon spotted frog are even higher McAllister and Leonard 1997, p. 22). Historical losses of wetland in Oregon are estimated at 38 percent (Dahl 1990). Based on surveys of historic sites, the Oregon spotted frog is now absent from at least 76 percent of its former range. The species may be absent from as much as or more than 90 percent of its former range because the collections of historic specimens do not adequately reflect its actual geographic and elevational range (Hayes 1997, p. 41; Haycock 2000, p. 11). Losses of Oregon spotted frog habitat have been greater because of the high degree of development in the low elevations of the Puget Trough. Therefore, this species is now found in the most suitable habitat remaining in its historic range at sites having the least-altered hydrology and the fewest introduced predators (Hayes et al. 1997, p. 5).

Between 1905 and the 1960's, wetlands in the Klamath Basin were reduced from approximately 350,000 acres to 75,000 acres), primarily by the creation of agricultural lands (Bureau of Reclamation 1992). Approximately 80 percent of the wetlands in the Klamath Basin had been drained, diked, and converted to agricultural use, and removed from their historical role in the landscape. The vast majority of this loss was in the southern portion of the Klamath Basin, where extensive portions of Lower Klamath and Tule lakes were converted to agricultural lands in the first half of the twentieth century. Extensive lands in the northern portion of the basin, including wetlands surrounding Upper Klamath Lake, and Sycan and Klamath marshes, have also been converted and drained for agriculture. There are no ongoing losses of wetlands in the Klamath Basin and since 1994, approximately 15,000 acres have been restored. However, to date, Oregon spotted frogs have not been detected in the restored wetlands where they did not occur prior to the restoration.

Oregon spotted frog habitat near the Conboy Lake NWR continues to be modified due to agricultural practices, diking, dredging, and water manipulation (J. Engler, pers. comm. 2006). At minimum, these practices result in seasonal loss of breeding habitat. More than half of the wetlands on the Conboy Lake NWR are jointly managed with private owners of inholdings. In addition, the Conboy Lake NWR has multiple jurisdictional sites where private landowners manage the water on the refuge (J. Engler, pers. comm. 2006).

Wetland losses are expected to continue on private lands but at much lower rates than in the past because of federal and state regulations that pertain to wetlands (see "Factor D").

Hydrological Changes: Most of the currently occupied Oregon spotted frog sites are threatened by changes in hydrology. Twenty-one of twenty-eight (75 percent) sites surveyed have had some human-related hydrological alterations, ranging from minor changes (e.g., local ditching around springs) to substantial changes, including major modifications of historic flow patterns (Hayes 1997, p. 43; Hayes et al.1997, p. 6). Dams in the upper watersheds of the Willamette Valley, the Deschutes drainage, and the Puget Trough have significantly reduced the amount of shallow overflow wetland habitat historically created by natural flooding and used by this species (Cushman and Pearl 2007, pp. 16-17). Inundation of large marsh complexes and habitat fragmentation due to the construction of reservoirs in the Cascades have also eliminated and degraded this species' habitat. To our knowledge no new dams or reservoirs are proposed that would pose a threat to the existing Oregon spotted frog populations in Washington. However, the operation of existing dams and diversions in both Washington and Oregon continues to affect populations of Oregon spotted frogs due to extreme water fluctuations between and within years, resulting in inundation and desiccation of suitable

Oregon spotted frog habitat, and the creation and maintenance of suitable habitat for non-native predaceous fish. The altered hydrology can affect both breeding and wintering habitat (see discussion below).

Other hydrological changes result from the continuing development of homes and roads adjacent to wetlands with Oregon spotted frogs. New development introduces new impervious surfaces which increase the amplitude and frequencies of peak highs and lows in water levels, a hydrologic characteristic that has been implicated in reduced amphibian species diversity in King County wetlands (Richter and Azous 1995, p. 308).

Changing water levels at critical periods in the Oregon spotted frog's life cycle, whether natural or human-induced, can negatively affect the species. Lowered water levels expose individuals to predation by reducing cover and confining them to smaller areas where they are more vulnerable to predators (see "Factor C"). Water level reduction during the breeding season can result in the loss of the entire reproductive effort for the year due to drying out of the egg masses (see "Factor E"). Extensive egg mass stranding associated with receding water levels, both natural and human induced, has been documented in Washington at Trout Lake (Lewis et al. 2001, p. 8) and Conboy Lake NWR (Hayes et al. 2000, pp. 6-7), and in Oregon (Pearl and Hayes 2004, p. 24) and British Columbia (Licht 1971, p. 122).

Drought periods can result in reduced recruitment (addition of young individuals to the adult population) regionally (Licht 1971, p. 122; Licht 1974, p. 623). Several seasons of low water can eliminate populations of Oregon spotted frogs, particularly where a small isolated population occupies a limited marsh habitat that has a high abundance of aquatic predators (Pearl 1999, p. 15). Excessive seasonal flooding at critical periods can result in the loss of shallow wetlands needed for egg-laying and development.

Breeding sites can be quite dynamic and significantly influenced by water conditions. At Conboy Lake NWR in 2002, most egg-laying occurred in a few wetlands considered to be core breeding sites where the refuge maintains some level of water control, thus ensuring water at least through the egg hatching stages. The remainder and bulk of the water on the refuge is controlled locally by agricultural interests with land holdings in or adjacent to the refuge. Surveys since 1998 have documented extensive annual declines in egg mass numbers due to poor water conditions on these lands. In many cases breeding frogs have disappeared from many of these agriculturally-influenced habitats due to annual recruitment failures from early water draw downs and perennially low water. Restoration activities initiated by the refuge in 1999–2001 have enabled the refuge to maintain independent water management of several wetlands, regardless of the water-related impacts of local landowners. In 2002, approximately 60 percent of all egg masses were located on wetland units that have received some level of restoration since 1999. Despite the apparent success of these restoration activities, inadequate water or poorly timed water management activities continue to be the most significant threat to Oregon spotted frog recruitment and survival in the valley (J. Engler, pers. comm. 2003) because restoration occurred on less than half of the refuge and since that time, water management on approximately 2,500 acres (nearly half of the refuge) has been altered as a response to two landowners' dissatisfaction with the refuge's water management (J. Engler, pers. comm. 2006). The impacts of these alterations are unknown at this time.

Development: Development threatens Oregon spotted frog habitat at several sites.

In Washington, counties require setbacks from wetlands, but the private lands surrounding the Oregon spotted frog populations in the Black River drainage (Thurston County) are zoned for residential development. The human populations of all counties in the Puget Sound are growing. Thurston County has the eighth largest population among Washington State's 39 counties and is expected to exceed all other Washington counties in population growth in the next decade (WDFW 2005). Between 2000 and 2005, Thurston County's population increased by 8 percent, over half of which was a result of people moving to the area, and the real estate market grew at unprecedented rates through 2007. The uplands surrounding Dempsey Creek Oregon spotted frog site have considerable potential for residential development. The property previously owned by Wilson Dairy, that includes several breeding locations, has been sold. Given the

location of this property in relation to the growing community of Olympia, residential housing is the likely future land use at this location.

Most of the wetland habitat occupied by the Oregon spotted frog at Beaver Creek in Washington has been purchased by the WDFW (K. McAllister, pers. comm. 2006). The adjacent 700+ acres was purchased by the Ports of Olympia and Tacoma for use as a large shipping/sorting yard for containers (K. McAllister, pers. comm. 2006), but those plans are on hold. The future of this property is uncertain.

Most of the habitat used by Oregon spotted frogs in the Trout Lake system is within the NAP. The SDS site, which is under private ownership,is used for breeding by a small number of Oregon spotted frogs, but surveys at this site are inconsistent due to access issues. There are existing developments adjacent to Oregon spotted frog habitat within the Trout Lake NAP and concerns about reduced water quality resulting from leaking septic systems; however, there is no evidence this is a problem currently (D. Wilderman, pers. comm. 2006).

Development in the Klamath Basin is continuing. The population of Klamath County increased 10.5 percent from 1990 to 2000 (U.S. Census Bureau) and new annual housings starts have more than doubled since 2000 (Klamath County). Much of the growth is outside of the city boundaries and several large residential developments are adjacent to wetlands. The Running Y Ranch has developed 3,600 acres (golf course, 100's of homes and condominiums) adjacent to Upper Klamath Lake and potential Oregon spotted frog habitat in the last 10 years (taken from several Herald and News articles previous to 2006).

Livestock Grazing: In several riparian zones and wetland complexes in Washington and Oregon, livestock grazing coincides with Oregon spotted frog habitat. The effects of livestock grazing vary with the site conditions, livestock numbers, and timing and intensity of grazing. Livestock graze and trample emergent and riparian vegetation, compact soil in riparian and upland areas, and introduce urine and feces to water sources (Hayes 1997, p. 44; Hayes 1998a, p. 8; 61 FR 25813). The resulting increases in temperature and sediment production, alterations to stream morphology, effects on prey organisms, and changes in water quality can negatively affect Oregon spotted frog habitat.

Fourteen of twenty-eight (50 percent) sites surveyed were directly or indirectly influenced by livestock grazing (Hayes 1997, p. 44; Hayes et al. 1997, p. 6; Pearl 1999, p. 16). Severe habitat modification has been caused by cattle at several Oregon spotted frog localities in Oregon. Large numbers of cattle at a site may negatively affect Oregon spotted frog habitat, particularly at springs that possibly are used as overwintering sites (Hayes 1997, p. 44).

Livestock grazing is cited as a specific concern for Oregon spotted frogs at Jack Creek, Klamath County, Oregon (USDA 2004, pp. 56-57). The most recent work monitoring the effects of livestock grazing on Oregon spotted frogs involved grazed and ungrazed treatments at Jack Creek on the Fremont Winema National Forests in Oregon (Shovlain 2005). Shovlain's (p. 11) work suggests Oregon spotted frogs prefer (migrate to) ungrazed livestock exclosures as grazing pressure increases outside the exclosures. Livestock trampling and consumption likely affects the microhabitat preferred by Oregon spotted frogs by reducing emergent and riparian vegetation, which could explain Shovlain's findings. However, the frogs in Shovlain's study did not show a preference for exclosures or controls under lower grazing pressure. Therefore, a moderate degree of grazing does not appear to affect frog behavior, suggesting an intermediate level of disturbance may be conducive to Oregon spotted frog habitat use (Hayes et al. 1997, p. 6, Hayes 1998a, pp. 8-9, McAllister and Leonard 1997, p. 25, Watson et al. 2003, p. 299).

Heavy grazing use by livestock occurs on Jack Creek, Buck Lake, and on the private lands on the Wood River, Williamson River, Fourmile and Sevenmile Creeks, and adjacent to Klamath Marsh NWR. The two primary breeding sites in Jack Creek occur on private land, which is grazed in combination with Forest

Service allotments. Heavy grazing use occurs on these private lands and allotments. Based on Shovlain's (2005) work, it is likely this amount of grazing is degrading the quality of the Oregon spotted frog breeding habitat and reducing reproduction.

Between 2001 and 2005 and in 2007, Oregon spotted frog habitat on the Chemult Ranger District, Fremont-Winema National Forest experienced drought conditions; however, cattle numbers, distribution, and timing of grazing were not adjusted (J. Oertley, pers. comm. 2005; T. Simpson, pers. comm. 2010). Cattle congregated in Oregon spotted frog habitat because nearly every other water source in the allotment went dry. Trampling by cattle and alterations in water quality, bank structure, and loss of protective vegetation compounded the impacts of the reductions of available habitat due to drought conditions on Oregon spotted frog reproduction (USFS unpublished data).

Conversely, moderate livestock grazing may, in some instances (e.g., Dempsey Creek in Washington) benefit the Oregon spotted frog by maintaining openings in the vegetation in highly altered wetland communities (Hayes 1997, p. 44; Hayes et al. 1997, p. 6; McAllister and Leonard 1997, p. 25). Watson et al. (2003, p. 299) found habitat at 78 percent of the Oregon spotted frog locations surveyed at the Dempsey Creek site had signs of grazing. The grazing created penetrable, open habitat that was otherwise too dense for frog use. In the recent past, it appears that grazing was beneficial to Oregon spotted frogs at the Dempsey Creek and 123rd Avenue sites. The 123rd Avenue site is now under the management of the Nisqually NWR and grazing no longer occurs there. Active management by the refuge is required to maintain the Oregon spotted frog habitat at this site, but funding is limited (Marian Bailey, USFWS, pers. comm. 2006). Grazing ceased at the Dempsey Creek site when the Wilson Dairy was sold; however, cows were reintroduced to the Port Blakely Tree Farm and Musgrove (Nisqually NWR) parcels in 2008.

Changes in Vegetation: Oregon spotted frog oviposition sites are generally characterized by low canopy coverage and a substrate at least partially covered with the previous year's emergent herbaceous vegetation (Leonard 1997, p. 3; Hayes et al. 2000, p. 8; Pearl and Bury 2000, p. 6; Pearl 1999, p. 15). Egg masses are generally found above vegetation coverage and are rarely found above open soil or rocky substrates (Hayes et al. 2000, p. 8, Pearl and Bury 2000, p. 8). Watson et al. (2003, p. 296) found Oregon spotted frog's habitat selection during the breeding season was strongly correlated with sedge habitat at the Dempsey Creek site in Washington. In Oregon, Pearl et al. (2009, p.10) found the dominant vegetation at oviposition sites was sedge-rush.

However, exotic plant invasions, such as reed canary grass (Phalaris arundinacea), may completely change the structure of wetland environments and can create dense areas of vegetation unsuitable as Oregon spotted frog habitat (McAllister and Leonard 1997, p. 23). Reed canary grass competitively excludes other native plant species and limits the biological and habitat diversity of host wetland and riparian habitats (Antieau 1998, p. 2). Reed canary grass also evapotranspires large quantities of moisture, potentially affecting shallow groundwater hydrologic characteristics (Antieau 1998, p. 2). Reed canary grass dominates large areas at lower elevations and is apparently continuing to broaden its range to higher elevations (Hayes 1997, p. 44; Hayes et al. 1997, p. 6). At the Dempsey Creek site, Watson et al. (2003, p. 296) compared the types and amount of habitat used by Oregon spotted frogs and found the frogs used areas of reed canary grass less frequently than available. Given this apparent avoidance of reed canary grass, vegetation shifts to reed canary grass dominance in wetlands occupied by Oregon spotted frogs are likely impacting Oregon spotted frog breeding behavior. Studies conducted at the Beaver Creek site (White 2002, pp. 45-46) and the Conboy Lake NWR (Pearl and Hayes 2004, pp. 22-23) concluded that Oregon spotted frog breeding site quality can be improved by reducing the height of the previous years' emergent vegetation (reed canary grass in these cases). However, at both sites, the improvement in the habitat for Oregon spotted frog breeding was only retained if the vegetation management continued. Reed canary grass is the dominant vegetation at most of the sites in Washington and is colonizing portions of Big Marsh and has also been found at the Wickiup Reservoir, Little Lava Lake, Wood River Wetland, and Buck Lake sites in Oregon.

Loss of natural processes has also resulted in degradation of Oregon spotted frog habitat. Historically, a

number of forces created early successional conditions favorable to Oregon spotted frogs in wetlands: (1) rivers meandered over their floodplains, taking out trees and shrubs and baring patches of mineral soil; (2) beavers felled trees and woody shrubs, trampled shoreline vegetation, and dragged limbs and logs through shallows; and (3) fires in summer burned areas that would be shallow water wetlands during the Oregon spotted frog breeding season in February and March. Today, all of these forces are greatly reduced as a result of human activities, including water level management from operation of dams, fire suppression and beaver removal. In addition, the current wetland management paradigm is generally a hands-off approach that results in a succession to a tree and shrub dominated community that is unsuitable for Oregon spotted frog breeding. Plant succession may be a negative factor at almost all Oregon spotted frog sites, particularly where marsh-to-meadow changes are occurring (Hayes 1997, p. 45). Pearl (1999, p. 15) suggested that the aquatic habitat types necessary for Oregon spotted frog reproductive sites in lake basins only exist within a narrow successional window. As marsh size decreases due to plant succession, shallow warmwater sites required by this species are lost to increased shading by woody vegetation (Pearl 1999, pp. 15-16). Investigations by Hayes (1997, p. 45) and Pearl (1999, p. 16) rank 22 of 28 Oregon spotted frog sites as having a moderate or high threat from vegetation succession. Encroachment around and into marshes by lodgepole pine and other woody vegetation is occurring at multiple sites in Oregon and is likely facilitated by ditching and draining of wetter sites to improve grazing (J. Kittrell, pers. comm. cited in Cushman and Pearl 2007, p. 17).

Summary of habitat or range destruction, modification, or curtailment: Past human actions have destroyed, modified, and curtailed the range and habitat available for the Oregon spotted frog, which is now absent from at least 76 percent of its former range. Wetlands continue to be modified by agricultural and water manipulation in Washington. Operation of existing dams continues to impact Oregon spotted frogs through inundation, desiccation, and creation of habitat for non-native predaceous species. In the last several years new residential and road developments adjacent to wetlands continue to modify the hydrology. The timing and intensity of livestock grazing, or lack thereof, continues to reduce the quality of Oregon spotted frog breeding habitat in both Oregon and Washington. And last, but not least, exotic plant invasions and plant succession continues to modify and reduce the amount and quality of both breeding and overwintering habitat available to Oregon spotted frogs. No new additional threats from habitat destruction or modification are known.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Intentional collection of Oregon spotted frogs and vandalism of their habitat are not presently known to be a problem.

C. Disease or predation:

Most Oregon spotted frog populations are small, and small populations already stressed by other factors, such as drought or low food availability, are more vulnerable to random, naturally occurring events (see "Factor E"). Amphibians are affected by a variety of diseases, and some diseases are known to negatively affect declining amphibian species. Diseases that are currently known to occur in Oregon spotted frogs and have the potential to affect populations are briefly discussed below.

Disease: The specific effects of disease and parasitism on Oregon spotted frogs are not well-documented. Red-leg syndrome has been identified in several declining amphibian species but is not known to be a significant problem for the Oregon spotted frog (Andrew Blaustein, Oregon State University, pers. comm. 1999).

Chytrid fungus (Batrachochytrium dendrobatidis) has been implicated in the decline and extinction of numerous amphibian species in multiple locations around the world (Speare and Berger 2004). In the United States, 7 families including 18 amphibian species have been diagnosed as infected with chytrid fungus (Speare and Berger 2004). Chytrid fungus infection has been documented in at least 7 ranid frogs from the

Pacific Northwest, including Oregon spotted frogs (Adams et al. 2010, p. 295; Pearl et al. 2009, p. 212; Hayes et al. 2009, p. 149). Chytridiomycosis is a cutaneous infection that "results in a severe diffuse dermatitis characterized by epidermal hyperplasia, hyperkeratosis, and variable degrees of cutaneous ulceration and hyperemia" (Bradley et al. 2002, p. 206). Clinical signs can include lethargy, abnormal posture, loss of the righting reflex, and death (Daszak et al. 1999, p. 737). The fungal organism is likely transmitted by release of zoospores into the water that eventually contact a susceptible animal, penetrating the skin, and establishing an infection (Pessier et al. 1999, p. 198; Bradley et al. 2002, p. 206). Dermal infections by chytrid fungus are thought to cause mortality by interfering with skin functions, including maintaining fluid and electrolyte homeostasis, respiration, and the skin's role as a barrier to toxic and infectious agents (Pessier et al. 1999, p. 198; Bradley et al. 2002, p. 206). In 2007 and 2008, USGS sampled Oregon spotted frogs at sites across Washington and Oregon; chytrid fungus was confirmed at all locations sampled (Pearl et al. 2009, p. 212). Even though Pearl et al. (2009, p. 216) detected chytrid fungus at 100 percent of the sites sampled, they did not observe morbidity or mortality that could be attributed to chytrid fungus infection. In addition, chytrid fungus has been confirmed in Oregon spotted frogs near Sunriver in central Oregon (J. Bowerman, pers. comm. 2005) and Conboy Lake NWR (Hayes et al. 2009, p. 149) in Washington. Pearl et al. (2007, p. 147) detected chytrid fungus more frequently in highly aquatic species, such as Oregon spotted frogs, than in species with more terrestrial adult stages and shorter larval periods, suggesting that Oregon spotted frogs may be experiencing elevated exposure and infection due to their highly aquatic life history. In addition, modeling done by Pearl et al. (2009, p. 213) indicates that juvenile Oregon spotted frogs that test positive are more likely to have a poorer body condition after overwintering than individuals that test negative. Alone, chytrid fungus may not be a concern for healthy amphibian populations; however, most of the Oregon spotted frog populations in Oregon and Washington are dealing with stressors, such as predation, competition from non-native species, and water quality degradation and the effects of chytrid fungus are likely to be exacerbated by these interactions (e.g. Parris and Baud 2004, pp. 346-347; Parris and Cornelius 2004, pp. 3388-3390; Parris and Beaudoin 2004, p. 628). In addition, chytrid fungus has been found in non-native species that co-occur with Oregon spotted frogs in central Oregon (Pearl et al. 2007, p. 147); in particular, bullfrogs may serve as a host to chytrid fungus while experiencing limited negative effects. The detection of chytrid fungus at all Oregon spotted frog sites sampled, combined with the lack of observed mortality, indicates Oregon spotted frogs may be able to persist with chytrid fungus (Pearl et al. 2009, p. 216). However, in light of the numerous amphibian extinctions attributed to chytrid fungus, it could easily pose a threat to individual Oregon spotted frog populations.

The oomycete water mold Saprolegnia has been suggested as one of the causes of amphibian declines in the Pacific Northwest (Kiesecker and Blaustein 1997, p. 218). McAllister and Leonard (1997, p. 25) reported destruction of developing Oregon spotted frog egg masses by this fungus, but not to the extent observed in other amphibian eggs. Genetic analysis confirmed oomycetes of multiple genera on amphibian eggs in the Pacific Northwest, including Oregon spotted frogs (Petrisko et al. 2008, p. 174-178) It is unclear what threat Saprolegnia may present to Oregon spotted frog populations, but it has been shown to destroy Oregon spotted frog egg masses and could pose a threat to individual Oregon spotted frog sites.

Amphibians exposed to ultraviolet-B radiation (UV-B), a type of solar radiation that can cause damage to plants and animals, may be more susceptible to pathogens and parasites that can interfere with normal development and increase mortality. Experimental tests conducted by Blaustein et al. (1999, p. 1102) found the hatching success of Oregon spotted frogs was unaffected by UV-B. However, Kiesecker and Blaustein (1997, pp. 217-218) found increased mortality associated with the fungus identified as Saprolegnia ferax in amphibian embryos exposed to UV-B, especially susceptible were amphibians that lay eggs in communal egg masses. This suggests the possibility that mortality is increased by the combined effects (synergism) of the fungus and UV-B.

The North American Reporting Center for Amphibian Malformations (NBII 2005) documents amphibian malformations throughout the United States. Malformations of several Rana species, including the Cascades frog (Rana cascadae), red-legged frog (Rana aurora), foothill yellow-legged frog (Rana boylii), and bullfrog, have been reported within the current and historic range of the Oregon spotted frog in Washington, Oregon,

and California. There is one report from Thurston County, Washington, of an Oregon spotted frog with an extra forelimb (NBII 2005) and there are reports of malformations from Deschutes (Johnson et al. 2002, p. 157; Bowerman and Johnson 2003, pp. 142-144), Douglas, and Lane (NBII 2005) Counties in Oregon. There is growing evidence that the high frequencies of severe limb malformations may be caused by a parasitic (Ribeiroia ondatrae) infection in amphibian larvae (Johnson et al. 2002, p. 162). Recent investigations also indicate small fish and certain libellulid and corduliid dragonfly larvae attack developing tadpoles and can cause high incidences of missing-limb deformities, including complete amputation (Ballengee and Sessions 2009; Bowerman et al. 2010).

Aquatic snails (Planorbella spp.) are the exclusive intermediate host for Ribeiroia (Johnson and Chase 2004, p. 523) and are found in a diversity of habitats, including ephemeral ponds, montane lakes, stock ponds, oxbows, drainage canals, and reservoirs (Johnson et al. 2002, p. 164). Johnson et al. (2002, p. 165) postulate that the dramatic and widespread alterations of aquatic ecosystems, particularly the construction of small impoundments or farm ponds, may have created environments that facilitate high densities of Planorbella snails and the resulting infections from Ribeiroia. Many of the sites with high frequencies of malformations were impacted heavily by cattle and supported dense Planorbella snail populations. Malformations in multiple amphibian species were found in Washington ponds that had a history of grazing that extended back at least 50 years (Johnson et al. 2002, p. 165). Johnson et al. (2002, p. 166) found the frequency of malformations in larval amphibians was significantly higher than in transformed amphibians from the same system, suggesting that malformed larvae experience greater mortality prior to and during metamorphosis. High levels of Ribeiroia infection and the resulting malformations may increase mortality in wild amphibian populations and may represent a threat to amphibian populations already in decline. Johnson et al. (2002, p. 157) and Bowerman and Johnson (2003, pp. 142-144) have found deformities in Oregon spotted frogs caused by this parasite. Most of the malformations found in anuran frogs were around the hind limbs, where they are more likely to be debilitating (Johnson et al. 2002, p. 162) or expose the frog to increased risk of predation. While the effects of these parasite-induced malformations are clear at the individual scale, population-level effects remain largely uninvestigated. However, Biek et al. (2002, p. 731) found that a reduction in juvenile or adult survival of pond-breeding amphibians is more likely to lead to population declines than reductions in other portions of frog life cycles. Therefore, it is reasonable to infer that where Planorbella snails coincide with Oregon spotted frogs, malformations will occur that will likely result in mortality of juvenile frogs, which can result in an Oregon spotted frog population decline at that location.

Predation: Introduced fish species within the historic range of the Oregon spotted frog may have contributed to losses of populations. Oregon spotted frogs, which are palatable to fish, did not evolve with these introduced species and may not have the mechanisms to avoid the predatory fish that prey on the tadpoles. The warmwater microhabitat requirement of the Oregon spotted frog, unique among native ranids of the Pacific Northwest, exposes it to a number of introduced fish species (Hayes 1994, p. 25), such as smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), pumpkinseed (Lepomis gibbosus), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), brown bullhead (Ameriurus nebulosus), black crappie (Pomoxis nigromaculatus), warmouth (Lepomis gulosus), brook trout (Salvelinus fontinalis), rainbow trout (Oncorhynchus mykiss), and fathead minnow (Pimephales promelas) (Hayes and Jennings 1986, pp. 494-496; Hayes 1997, pp. 42-43; Hayes et al.1997; McAllister and Leonard 1997, p. 14; J. Engler, pers. comm. 1999). Surveys from 1993 to 1997 in British Columbia, Washington, and Oregon documented at least one introduced predator in 20 of 24 sites (Hayes et al. 1997, p. 5). Brook trout was the most frequently recorded introduced predator. Although differences in temperature requirements between the two species may limit their interactions, brook trout apparently occur with the Oregon spotted frog at coldwater springs, where the latter species probably overwinters and where cooler water is favorable to brook trout (Hayes et al. 1997, p. 5). During drought years, dropping water levels results in overlap in habitat use between these two species. As wetland refuges are reduced, Oregon spotted frogs become concentrated and the larval stages are exposed to brook trout predation (Hayes et al.1997, p. 5; Hayes 1998b, p. 15), resulting in lower Oregon spotted frog recruitment (Pearl 1999, p. 18). In addition to effects in breeding habitat, Pearl et al. (2009, p. 13) found substantial evidence for a negative effect on overwintering Oregon spotted frogs from non-native fish with access to spring and channel habitats.

Demographic data suggest introduced fish have a negative effect on Oregon spotted frogs because sites with significant numbers of brook trout and/or fathead minnow have a disproportionate ratio of older spotted frogs to juvenile frogs (i.e., poor recruitment) (Hayes 1997, pp. 42-43, 1998a). While experimental data are sparse, field surveys involving other western amphibians (e.g., Adams 1999, p. 1168; Monello and Wright 1999, pp. 299-300; Bull and Marx 2002, pp. 245-247; Vredenberg 2004; Knapp 2005, pp. 275-276; Pearl et al. 2005, pp. 82-83) and other closely related frog species strongly suggest that introduced fish represent a significant threat to Oregon spotted frogs (Pearl 1999, pp. 17-18). A study of the impacts of introduced trout on Columbia spotted frog (Rana luteiventris) populations in Idaho revealed that, although fish and adult frogs coexisted at many of the stocked lakes, most stocked lakes contained significantly lower densities of all amphibian life stages (Pilliod and Peterson 2001, p. 326). Other factors probably complicate the apparent cause and effect relationship between introduced fish and the Oregon spotted frog. Field experiments have demonstrated that smallmouth bass in combination with introduced bullfrogs negatively affect red-legged frogs by influencing their microhabitat use, growth, and development (Kiesecker and Blaustein 1998, p. 782). In addition, non-native fish facilitate distribution and abundance of bullfrogs (Adams et al. 2003, p 349), another Oregon spotted frog predator.

Bullfrogs introduced from eastern North America into the historic range of the Oregon spotted frog may have contributed to losses of populations. The introduction of bullfrogs may have played a role in the disappearance of Oregon spotted frogs from the Willamette Valley and the Puget Sound area in Washington (Nussbaum et al. 1983, p. 187). Bullfrogs share similar habitat and temperature requirements with the Oregon spotted frog, and overlap in time and space between the two species is probably extensive (Hayes 1994, p. 25; Hayes et al. 1997, p. 5). Bullfrogs can reach high densities due to large numbers of eggs per breeding female and unpalatability (and high survivorship) of larvae (Kruse and Francis 1977, pp. 251-252). Bullfrog larvae can outcompete or displace native larvae from their habitat or optimal conditions (Kupferberg 1997, pp. 1741-1746, Kiesecker and Blaustein 1998, pp. 783-784, Kiesecker et al. 2001a, pp. 1966-1967). Bullfrog adults achieve larger size than native western ranids and even juvenile bullfrogs can consume native frogs (Hayes and Jennings 1986, p. 492; Pearl et al. 2004, p. 16). The digestive tracts of a sample of 25 adult bullfrogs from Conboy Lake contained nine Oregon spotted frogs, including seven adults (McAllister and Leonard 1997, p. 13). A later examination of the stomachs of two large bullfrogs revealed two adult or subadult Oregon spotted frogs in one stomach and four in the second (M. Hayes, pers. comm. 1999).

Research indicates that Oregon spotted frogs are more susceptible to predation by bullfrogs than are northern red-legged frogs (Pearl et al. 2004, p. 16). Oregon spotted frogs and northern red-legged frogs historically coexisted in areas of the Pacific Northwest that are now invaded by bullfrogs. However, the Oregon spotted frog has declined more severely than the northern red-legged frog. Pearl et al. (2004, p. 16) demonstrated in laboratory experiments that the more aquatic Oregon spotted frog juveniles are consumed more than northern red-legged frog juveniles by bullfrogs, which prefer aquatic microhabitats. Oregon spotted frogs and northern red-legged frogs also differ in their ability to escape bullfrogs, with Oregon spotted frogs having shorter mean and maximum jump distances than northern red-legged frogs of equal size. Bullfrogs, therefore, pose a greater threat to Oregon spotted frogs. Microhabitat use and escape abilities may be limiting Oregon spotted frog distributions in historic lowland habitats where red-legged frog populations are more stable (Pearl et al. 2004, pp. 17-18).

Bullfrogs, however, have probably coexisted with Oregon spotted frogs for nearly 50 years in the Glenwood Valley, which includes Conboy Lake NWR (Engler and Hayes 1998, p. 1). The coexistence of these two species at this site may be related to differences in seasonal and permanent wetland use. Some female spotted frogs reach a larger size at Conboy Lake than anywhere within the species' range and do not appear to be vulnerable to bullfrog predation. Bullfrogs, however, tend to be smaller at Conboy Lake than elsewhere in their range. There is also some evidence that winterkill may be a factor in controlling the bullfrog population at Conboy Lake (Engler and Hayes 1998, p. 2).

Summary of disease and predation: Saprolegnia, chytrid fungus, and Ribeiroia have been found in Oregon spotted frogs and compounded with other stressors, such as UV-B exposure, degradation of habitat quality, or

increased predation pressure, can contribute to population declines. Chytrid fungus and Ribeiroia, in particular, infect post-metamorphic frogs and reductions in these life stages are more likely to lead to population declines in pond-breeding amphibians. At least one non-native predaceous species has been detected at most Oregon spotted frog sites. Introduced fish prey on tadpoles, negatively effect overwintering habitat, and can significantly threaten Oregon spotted frog populations, especially during droughts. Bullfrogs prey on juvenile and adult Oregon spotted frogs and bullfrog larvae can outcompete or displace Oregon spotted frog larvae, effectively reducing all Oregon spotted frog life stages and posing a significant threat to Oregon spotted frog populations. Disease continues to be a concern and more information is needed to determine the severity diseases may be having on Oregon spotted frog populations. Predation continues to threaten Oregon spotted frogs at most sites.

D. The inadequacy of existing regulatory mechanisms:

The Oregon spotted frog was listed as a State endangered species in Washington in August 1997 (Watson et al. 1998, p. 1; 2003, p. 292; WAC 232–12–014). Although there is no State Endangered Species Act in Washington, the Washington Fish and Wildlife Commission has the authority to list species (RCW 77.12.020). State listed species are protected from direct take, but their habitat is not protected (RCW 77.15.120). Under the Washington State Forest Practices Act the Washington State Forest Practices Board has the authority to designate critical wildlife habitat for State listed species affected by forest practices (WAC 222–16–050, WAC 222–16–080). However, critical wildlife habitat has not been designated by the Washington State Forest Practices Board for the Oregon spotted frog. Washington has prepared a Comprehensive Wildlife Conservation Strategy (CWCS) (WDFW 2005). The plan is a non-regulatory statewide approach to conservation in Washington and fulfills a requirement to access two new Federal grant programs. The CWCS identifies the Oregon spotted frog as a "species of greatest conservation need" with a high number of threats, a high vulnerability, and a partly adequate amount of current protection. The strategy describes the basic biology and distribution, general and specific problems, and general conservation strategies for the Oregon spotted frog. It also identifies specific conservation actions including protecting known sites and potential habitat, controlling bullfrogs and predatory fish, conserving beaver populations and dynamic stream process, and investigating limiting factors. Development of the Washington CWCS has proceeded on a parallel track with completion of ecoregional assessments for nine ecoregions within Washington. For each ecoregion, WDFW will complete Wildlife Action Plans that will include the species-specific proposed conservation actions. The Wildlife Actions Plans are anticipated to be completed sometime in the future. However, it is unknown what actions will be proposed or when such actions will be implemented.

Oregon has a State Endangered Species Act, but the Oregon spotted frog is not State listed. Although this species is on the Oregon sensitive species list and is considered critically sensitive, this designation provides little protection (ODFW 1996, OAR 635–100–0040). Once an Oregon “native wildlife” species is federally listed as threatened or endangered, it is included as a State listed species and receives some protection and management, primarily on State owned or managed lands (OAR 635–100–0100 to OAR 635–100–0180; ORS 496.171 to ORS 496.192). Oregon has prepared a Comprehensive Conservation Strategy. The plan is a non-regulatory statewide approach to conservation in Oregon and fulfills a requirement to access two new Federal grant programs. The strategy identifies the Oregon spotted frog as a “strategy species”. Strategy species are rare and at-risk species and the plan targets conservation actions for the most at-risk species. The strategy generally identifies special habitat needs, limiting factors and data gaps for the Oregon spotted frog. It also identifies general conservation actions including maintaining vegetation buffers around known populations, controlling bullfrogs and invasive fish at priority sites, careful management of livestock grazing at occupied montane wet meadows, and the need for feasibility studies to guide specific conservation actions and management decisions for reintroductions. The strategy also identifies ecoregion opportunity areas. For example, Big Marsh is identified as an ecoregion opportunity area, and Oregon spotted frogs are a key

species for this opportunity area. Identified conservation actions include "maintain or enhance in-channel watershed function, connection to riparian habitat, flow and hydrology". However, it is unknown how and when this strategy will be implemented.

Washington adopted revised water quality standards for temperature and intergravel dissolved oxygen in December 2006 and Environmental Protection Agency (EPA) approved these revised standards in February of 2008 (EPA 2008). Although candidate species were not the focus, it was believed that the proposed standards would likely protect native aquatic species. The temperature standards are intended to restore thermal regimes to protect sensitive native salmonids and if temperature is not a limiting factor in sustaining viable salmonid populations, other native species would likely be protected (EPA 2007, p. 14). However, as of 2008, portions of Beaver Creek in the Black River drainage and the upper portion of Trout Lake Creek were listed by the Washington Department of Ecology as not meeting water quality standards for multiple parameters. Washington is in the process of updating their water quality assessment, but it is not yet available.

Oregon adopted revised water quality standards for temperature, intergravel dissolved oxygen, and antidegradation in December 2003 and EPA approved these revised standards in March of 2004 (EPA 2004). Although candidate species were not the focus, it was believed that the proposed standards would likely protect native aquatic species. The proposed temperature standards are intended to restore thermal regimes to protect sensitive native salmonids and if temperature is not a limiting factor in sustaining viable salmonid populations, other native species would likely be protected (EPA 2004). However, as of January 2006, many of the streams associated with Oregon spotted frog habitat are listed by the Oregon Department of Environmental Quality as not meeting water quality standards for multiple parameters. The Upper Deschutes/Wickiup Reservoir and two water bodies in the Little Deschutes River have been proposed by the Oregon Department of Environmental Quality for addition to the 303d list (Environmental Protection Agencies list of water bodies that do not meet water quality standards) in their 2010 Integrated Report of Water Bodies; however, this list has not yet been finalized (ODEQ 2011). No water bodies with Oregon spotted frogs were proposed for removal from the 303d list.

Only species that have been proposed for listing are covered by the conference provision under section 7(a)(4) of the Act. However, FWS policy requires candidate species be treated as proposed species for purposes of intra-FWS consultation where FWS's actions may affect candidate species (e.g., candidate species on NWR). This provides some measure of protection for the Oregon spotted frog on FWS lands and from FWS activities.

Although the Act does not provide protection to candidate species, we recommend that Federal agencies confer with us on candidates, but there is no requirement that they do so. Because this species is a candidate, both the BLM and Forest Service are subject to laws, regulations, and land management plans applicable to their agencies that address the need to protect sensitive, candidate, and federally listed species, as well as their habitat. The Oregon spotted frog is listed on the Oregon BLM Special Status Species List (February 2008) and on the Forest Service Region 6 Regional Forester's Sensitive Animal List (2008). Federal management for this species follows Region 6 Forest Service Sensitive Species policy, and OR/WA BLM Special Status Species policy. For Region 6 Forest Service administered lands, the Sensitive Species policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" (FSM 2670.32) for any identified sensitive species. However, this decision is made at the District level, which may not ensure consistent application of the policy.

Section 404 of the Clean Water Act is the primary Federal law that is relevant to the Oregon spotted frog's aquatic habitat. Through a permit process under section 404, the U.S. Army Corps of Engineers (Corps) regulates the discharge of all fill into waters of the United States, including navigable waters and wetlands. In Washington and Oregon current section 404 regulations allow the issuance of nationwide permits for projects

involving the permanent loss of less than 1.2 ha (3 ac) of headwaters or isolated waters, including wetlands, unless a listed species may be jeopardized. Projects under a nationwide permit receive minimal public and agency review; additionally, agency notification is not required for all nationwide permits. Individual permits, which are subject to a more rigorous review, could be required for projects that have more than minimal impacts. The Corps, however, rarely requires an individual permit when a project qualifies under a nationwide permit, unless a threatened or endangered species or other resources are significantly and adversely affected by the project, although an adverse affect, alone, does not warrant an individual permit. Oregon spotted frog habitat could be affected by a project requiring an individual or nationwide permit from the Corps. For nationwide permits, depending upon the project type and the amount of wetland to be impacted, Corps notification may not be required or the impacts to wetlands may be allowed with no compensatory mitigation. For example, a single-family residence can fill up to 0.25 acre of wetland with no requirement for compensatory mitigation. If compensatory mitigation is required, although preferred, in kind mitigation is not required. Therefore, an activity that fills Oregon spotted frog habitat could mitigate by restoring and or creating riparian habitat suitable for fish, but which is not suitable for frogs. In general, most riparian habitat restoration in Washington is targeted towards salmon species and does not include floodplain depression wetlands. Furthermore, projects that occur adjacent to or that may negatively change the hydrology of Oregon spotted frog habitat are not subject to section 404 unless dredging or filling of a wetland or waterway is part of the project. Habitat can also be affected by agricultural practices that are exempt from regulation under section 404 of the statute, such as maintenance of existing agricultural drainage systems and other activities associated with an ongoing farming operation in existing cropped wetlands.

In summary, there continue to be ongoing threats to the species due to the inadequacy of existing regulatory mechanisms. Although both Washington and Oregon have completed Comprehensive Conservation Strategies, it remains unclear when and how the strategies will be implemented and result in on-the-ground conservation actions for Oregon spotted frogs. Water quality continues to be an issue in Washington and Oregon even though the States have adopted revised water quality standards. Regulations pertinent to Federal agencies, such as the FWS, Forest Service, BLM, or Corps, provide limited benefits to the species.

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

Site size and isolation: Most species' populations fluctuate naturally in response to weather events, disease, predation, or other factors. These factors, however, have less impact on a species with a wide and continuous distribution. Smaller, isolated populations are generally more likely to be extirpated by stochastic events and genetic drift (Lande 1988, p. 1456-1458).

Funk et al (2008, p. 205) found low genetic variation in Oregon spotted frogs, which likely reflects small effective population sizes, historic or current genetic bottlenecks, and/or low among population gene flow. Genetic work by Blouin (2011) indicates low genetic diversity within and high genetic differentiation among each of the six Oregon spotted frog groups (British Columbia, Chehalis and Columbia drainages, Camas Prairie, central Oregon Cascades, and the Klamath basin), is likely caused by low connectivity between sites and naturally small populations sizes. Gene flow is very limited between most sites, especially if separated by 10 kilometers or more and at the larger scale, genetic groups have the signature of complete isolation (Blouin et al. 2011, p. 2187). At least two of the sites sampled by Blouin et al. (2011) (Camas Prairie and Trout Lake) show indications of recent genetic drift. Therefore, the small sizes and isolation of the majority of Oregon spotted frog sites increases their vulnerability of extirpation from factors such as fluctuating water levels, disease, and predation.

Egg mass count data suggests there is a significant link between site size and Oregon spotted frog breeding population size (Pearl and Hayes 2004, p. 12) and larger sites are more likely to provide the seasonal microhabitats required by Oregon spotted frogs, have a more reliable prey base, and include overwintering habitat. The minimum amount of habitat thought to be required to maintain an Oregon spotted frog population is about 4 ha (10 ac) (Hayes 1994, Part II pp.5 and 7). Smaller sites generally have a small number

of frogs and, as described above, are more vulnerable to extirpation. Some sites in Oregon are at or below the 4-ha threshold; however, Pearl and Hayes (2004, p. 14) believe that these sites were historically subpopulations within a larger breeding complex and Oregon spotted frogs may only be persisting in these small sites because the sites interact or seasonal habitat needs are provided nearby.

Movement studies suggest Oregon spotted frogs are limited in their overland dispersal and potential to recolonize sites. Movements (greater than 1 kilometer) have been documented within large wetland complexes (Watson et al. 2003, pp. 294-295) and linear riparian systems (Pearl and Hayes 2004, p. 15), but these are likely rare (see Biological Information section). Most Oregon spotted frog movements are associated with aquatic connections (Watson et al. 2003, p. 295; Pearl and Hayes 2004, p. 15). However, 24 of 28 sites evaluated by Hayes (1997) and Pearl (1999) are isolated and separated by considerable distances (at least 16 kilometers (10 miles) in some cases) and in many cases the intervening habitat lacks the substantial hydrological connections (Hayes 1997, pp. 42 and 45) that would allow Oregon spotted frog movement. Even in the instances where there is a hydrological connection between sites, gene flow is extremely low between sites separated by 10 kilometers or more (Blouin et al. 2010, p. 2187). In addition, widespread predaceous fish introductions within these corridors pose a very high risk to frogs that do try to move between sites. Therefore, should a stochastic event occur that results in the extirpation of a population, natural recolonization is unlikely unless another site is hydrologically connected and within 3 kilometers (see Biological Information section).

Population Turnover Rates: Modeling across a variety of amphibian taxa suggests pond-breeding frogs have high population variance and high local extinction rates relative to other groups, and that smaller frog populations experience disproportionately large population fluctuations (Green 2003, pp. 339-341). The vulnerability of Oregon spotted frog egg masses to fluctuating water levels (Hayes et al. 2000, pp. 10-12; Pearl and Bury 2000, p. 10), the vulnerability of post-metamorphic stages to predation (Hayes 1994, p. 25), and low overwintering survival (Hallock and Pearson 2001, p. 8) can contribute to relatively rapid population turnovers and suggest Oregon spotted frogs may be vulnerable to extirpation from stochastic and chronic sources of mortality (Pearl and Hayes 2004, p. 11).

Breeding Effort Concentrations: Oregon spotted frogs focus a large proportion of their breeding effort in relatively few locations (Hayes et al. 2000, pp.5-6; McAllister and White 2001, p. 11). For example, Hayes et al. (2000, pp. 5-6) found that 2 percent of breeding sites accounted for 19 percent of the egg masses at the Conboy Lake NWR and similar breeding concentrations have been found elsewhere in Washington and in Oregon. A stochastic event at any one of these productive sites could significantly reduce the Oregon spotted frog population associated with that site.

Fluctuating Water Levels: Changes in water levels due to drought, which have been exacerbated by human modification, can cause seasonal loss of habitat and degradation of essential shoreline vegetation. Hayes (1997, p. 44) assessed 9 of 24 (38 percent) Oregon spotted frog sites as having a moderate to high risk from drought. Drought risk was based on the potential for a drop in water level that could reduce or eliminate the species' habitat. Sites with the greatest risk included those depending on surface flow rather than flows from springs, and sites having low precipitation levels. Sites with the greatest risk from drought are in the Klamath and Deschutes basins of Oregon (Hayes 1997, p. 44; Hayes et al. 1997, p. 6). The impact of a drought on an Oregon spotted frog population depends on the amount of complex marsh habitat at a site, the availability of alternative breeding and rearing areas, and the abundance of aquatic predators (Pearl 1999, p. 15). Both Hayes (1997, p. 43) and Pearl (1999, pp. 17-18) hypothesized that low water conditions have the potential to increase the overlap between Oregon spotted frogs and non-native predators, such as brook trout and bullfrogs. Such increased overlap is likely to result in greater losses of Oregon spotted frogs to predation (Pearl et al. 2004, pp. 17-18). Low water in breeding habitat can also potentially expose eggs to increased UV radiation and higher mortality associated with pathogens (Kiesecker et al. 2001b, p. 682). The Klamath Basin has had below-normal streamflows since 2000, which has resulted in reduced water quality and reduced

Oregon spotted frog reproduction due to dessication (see population status). Inadequate water or poorly timed water management activities are a significant threat to Oregon spotted frog recruitment and survival on the Conboy Lake NWR (J. Engler, pers. comm. 2003).

Although the Chemult Ranger District, Fremont-Winema National Forest, in Oregon documented 335 egg masses in 1999 (Forbes and Peterson 1999, p. 6) and 320 egg masses in 2000 (T. Simpson, pers. comm. 2003), adverse water conditions impacted the Oregon spotted frog populations in two subsequent years. In 2001, severe low water conditions due to low winter snowpack and drought limited Oregon spotted frogs to three small, disjunct areas representing less than 25 percent of their typical habitat. Although there were good water depths in the breeding pools in 2002, only 60 egg masses were found and 50 percent of the eggs did not hatch. The impacts of the drought were further complicated by limitations of Oregon spotted frogs to only 50 percent of their typical summertime habitat, algal blooms, poor water quality, low dissolved oxygen, loss of protective habitat, and alteration of the bank condition (USFS unpublished data).

Water Quality and Contamination: Water acidity (low pH) can inhibit fertilization and embryonic development in amphibians, reduce their growth and survival through physiological alterations, and produce developmental anomalies (Hayes and Jennings 1986, pp. 498-499; Boyer and Grue 1995, p. 353). A low pH may enhance the effects of other factors, such as activating heavy metals in sediments. An elevated pH, acting singly or in combination with other factors such as low dissolved oxygen, high water temperatures, and elevated un-ionized ammonia levels, may have detrimental effects on developing frog embryos (Boyer and Grue 1995, p. 354).

Studies comparing responses of amphibians to other aquatic species have demonstrated that amphibians are as sensitive, and often more sensitive, than other species when exposed to aquatic contaminants (Boyer and Grue 1995, p. 353). Immature amphibians absorb contaminants during respiration through the skin and gills. They may also ingest contaminated prey. Pesticides, herbicides, heavy metals, nitrates and nitrites, and other contaminants introduced into the aquatic environment from urban and agricultural areas are known to negatively affect various life stages of a wide range of amphibian species, including ranid frogs (Hayes and Jennings 1986, p. 497; Boyer and Grue 1995, pp. 353-354; Hecnar 1995, pp. 2133-2135; Materna et al.1995, pp. 616-618; NBII 2005).

The use of synthetic pyrethroids for insect pest control, including use in agricultural and aquatic systems, has increased. Although pyrethroids are relatively nontoxic to birds and mammals, they are extremely toxic to aquatic organisms, including fish and invertebrates. Their effects on amphibians, however, are less well-known. Materna et al. (1995, pp. 616-618) demonstrated negative effects (inactivity, convulsive actions, and death) of one widely used synthetic pyrethroid pesticide, esfenvalerate, on leopard frog (Lithobates spp.) tadpoles in laboratory and field experiments. Methoprene, another chemical widely applied to wetlands for mosquito control, has been linked to abnormalities in southern leopard frogs (Lithobates utricularia), including completely or partially missing hind limbs, discoloration, and missing eyes. Missing eyes and delayed development in northern cricket frogs (Acris crepitans) have also been linked to methoprene (Donald W. Sparling, Patuxent Wildlife Research Center, pers. comm. 1999).

In 1999, Four Rivers Vector Control planned to apply pyrethroids, methoprene, and other pesticides in wetlands and other bodies of water within the range of the Oregon spotted frog. This company is funded primarily by homeowners, homeowner associations, and businesses in the Sunriver area of Oregon to control mosquitoes. Due to the concerns about the use of methoprene and the possible effects of the mosquito abatement program on the Oregon spotted frog, the company is not permitted to use the chemical on the Deschutes National Forest and is voluntarily restricting its use to a few sites. Similar proposals are possible in the future.

Poor water quality and water contamination have probably played a role in the decline of Oregon spotted frogs, although data specific to this species are limited. Eutrophic (nutrient-rich) conditions, characterized by blooms of algae that can produce a high pH and low dissolved oxygen, have increased in Upper Klamath

Lake and may have contributed to the absence of Oregon spotted frogs. Beginning in 2002, algal blooms, poor water quality, and low dissolved oxygen were documented in Jack Creek. A decline in Oregon spotted frog reproduction was also documented during this time (T. Simpson, pers. comm. 2003; J. Oertley, pers. comm. 2005).

Johnson and Chase (2004, p. 522) point to elevated levels of nutrients (particularly phosphorus) from agricultural fertilizers and cattle grazing in freshwater ecosystems as the cause of shifting the composition of aquatic snails from small species to larger species that serve as intermediate hosts for a parasite that causes malformations in amphibians (see Disease).

Marco et al. (1999, p. 2838) demonstrated the strong sensitivity of Oregon spotted frog tadpoles to nitrate and nitrite ions and suggested that nitrogen-based chemical fertilizers may have contributed to the species' decline in the lowland areas of its distribution. Recommended levels of nitrates and nitrites in drinking water are moderately to highly toxic for Oregon spotted frogs, indicating EPA water quality standards do not protect sensitive amphibian species (Marco et al. 1999, p. 2838).

Although the effects on amphibians of rotenone, used to remove undesirable fish from lakes, are poorly understood, mortality likely occurs at treatment levels used on fish (McAllister et al. 1999, p. 21). The role of rotenone treatments in the disappearance of Oregon spotted frogs from historic sites, however, is unknown. Some studies indicate amphibians might be less sensitive and be capable of recovering from exposure to rotenone (Mullin et al. 2004, pp. 305-306; Walston and Mullin 2007, p. 65); however, these studies did not measure the effects on highly aquatic amphibians, like the Oregon spotted frog.

Hybridization: Hybridization between Oregon spotted frogs and closely related frog species is unlikely to affect the survival of the Oregon spotted frog. Hybridization between Oregon spotted frogs and Cascade frogs has been demonstrated experimentally and verified in nature (Haertel and Storm 1970, pp. 436-444 ; Green 1985, p. 263). However, the offspring are infertile, and the two species seldom occur together. Hybridization between Oregon spotted frogs and red legged frogs has also been confirmed (I.C. Phillipsen, K. McAllister, and M. Hayes unpublished data), but it is unknown if the hybrids are fertile. Oregon spotted frog and Columbia spotted frog populations are not known to occur together.

Climate Change: The climate in the Pacific Northwest (PNW) has already experienced a warming of 0.8 degrees Celsius during the 20th century (Mote et al. 2008, p.3). Using output from eight climate models the PNW is projected to warm further by 0.6 to 1.9 degrees Celsius by the 2020s, and 0.9 to 2.9 degrees Celsius by the 2040s (Mote et al. 2008, pp.5-6). Additionally, the majority of models project wetter winters and drier summers (Mote et al. 2008, p.7), and of greatest consequence, a reduction in regional snowpack, which supplies water for ecosystems during the dry summer (Mote et al. 2003). The small summertime precipitation increases projected by a minority of models do not change the fundamentally dry summers of the PNW and do not lessen the increased drying of the soil column brought by higher temperatures (Mote et al. 2003, p.8).

Watersheds that are rain dominated (such as the Black River) will likely experience higher winter streamflow because of increases in average winter precipitation, but overall will experience relatively little change with respect to streamflow timing. Transient basins (mixed rain- and snowmelt-dominant usually in mid elevations) will likely experience significant shifts, becoming rain dominant as winter precipitation falls more as rain and less as snow. Snowmelt-dominated watersheds (such as Trout Lake Creek) will likely become transient, resulting in reduced peak spring streamflow, increased winter streamflow and reduced late summer flow (Littell et al. 2009, p. 8).

Water temperatures for western Washington are generally cooler and projected increases in thermal stress are significant but less severe - the duration of temperatures greater than 21 degrees Celsius (70 degrees Farenheit) will increase but such temperatures are still projected to be relatively rare for all but the warmest

water bodies in Washington. In snowmelt-dominated watersheds that prevail in the higher altitude catchments and in much of the interior Columbia Basin, flood risk will likely decrease and summer low flows will decrease in most rivers under most scenarios (Littell et al. 2009, p. 13).

Although there are no specific predictions of climate change impacts on Oregon spotted frogs, it is likely that short- and long-term changes in precipitation patterns and temperature regimes will affect wet periods, winter snow pack, and flooding events (Chang and Jones 2010). These changes are likely to affect amphibians through a variety of direct and indirect pathways, such as range shifts, breeding success, survival, dispersal, breeding phenology, aquatic habitats availability and quality, food webs, competition, spread of diseases, and the interplay among these factors (Blaustein et al. 2010; Hixon et al. 2010, p. 274; Corn 2003). Amphibians have species-specific temperature tolerances and exceeding these thermal thresholds may reduce survival (Blaustein et al. 2010, pp. 286-287). Earlier spring thaws and warmer ambient temperatures may result in earlier breeding, especially at lower elevations in the mountains where breeding phenology is driven more by snow pack than by air temperature (Corn 2003, p. 624). Shifts in breeding phenology may also result in sharing breeding habitat with species not previously encountered and/or new competitive interactions and predator/prey dynamics (Blaustein et al. 2010. pp. 288 and 294). Amphibians are susceptible to many types of pathogens including trematods, copepods, fungi, oomycetes, bacteria, and viruses. Changes in temperature and precipitation could alter host-pathogen interactions and/or result in range shifts resulting in either beneficial or detrimental impacts on the amphibian host (Blaustein et al. 2010, p. 296). Because Oregon spotted frogs occupy habitats at a wide range of elevations, frogs at each site are likely to respond to changes in temperature and precipitation differently. Therefore, a more thorough analysis by site should be completed.

Correlated factors: Amphibian declines may frequently be associated with multiple correlated factors (Adams 1999, pp. 1167-1169). Two of the greatest threats to freshwater systems in western North America, exotic species and hydrological changes, are often correlated. In addition, occurrence and abundance of bullfrogs may be linked with invasions by nonnative fish (Adams et al. 2003, p. 349). Adams (1999) examined the relationships among introduced species, habitat, and the distribution and abundance of red-legged frogs in western Washington. Red-legged frog occurrence in the Puget lowlands was more closely associated with habitat structure and exotic fish than with the presence of bullfrogs (Adams 1999, pp. 1167-1168), and similar associations were found in a recent study in Oregon's Willamette Valley (Pearl et al. 2005, p. 16). The spread of exotics is correlated with a shift toward greater permanence in wetland habitats regionally (e.g. Kentula et al. 1992, p. 115). Exotic fish and bullfrogs are associated with permanent wetlands. Conservation of more ephemeral wetland habitats may have direct benefits for native amphibians and may reduce the threat of exotic fish and bullfrogs (Adams 1999, pp. 1169-1170).

Summary of other natural or manmade factors: The small sizes and isolation of the majority of the Oregon spotted frog sites, population turnover rates, and breeding effort concentrations continue to make each of the sites vulnerable to extirpation from a stochastic event. Fluctuating water levels continue to reduce or eliminate habitat and increase the overlap with non-native predators. Contaminants are known to negatively affect various life stages of a wide range of amphibian species and may be contributing to Oregon spotted frog declines.

Conservation Measures Planned or Implemented :

British Columbia

Past and ongoing conservation activities at Maintenance Detachment Aldergrove comprise three general categories: habitat evaluation and rehabilitation; research; and surveys and population augmentation. Habitat evaluation and rehabilitation activities include: habitat construction (1,300 m2 pilot project and 18,000 m2 full project); habitat evaluation and identification of important habitat; design and site preparation for habitat rehabilitation; removal of reed canarygrass; monitoring water levels and ambient temperature; removal of bullfrogs; and development of a beaver management plan. Research activities include: radiotelemetry;

bullfrog gut analysis; growth study; skeletochronology; mark–capture–recapture study; bullfrogs as predators and disease reservoirs; and monitoring of embryos for signs of predation, parasitic infection, fungal infection, and other maladies. Surveys and population augmentation activities include: egg mass enumeration; population augmentation with captive reared metamorphs (from wild collected eggs); and protection of hatchlings from bullfrog predation.

Past and ongoing conservation activities at Maria Slough include: egg mass enumeration; habitat construction (1,500 m2); habitat rehabilitation (1,000 m2); post egg-laying and summer season radiotelemetry; invasive grass species management; translocation of 30,000 embryos to habitat construction site; population augmentation with captive reared metamorphs (from wild collected eggs); post metamorph release monitoring; and monitoring of embryos for signs of predation, parasitic infection, fungal infection and other maladies.

Past and ongoing conservation activities at Mountain Slough include: egg mass enumeration; radiotelemetry; habitat construction (1,800 m2); habitat rehabilitation including garbage removal, native riparian vegetation restoration, and a landowner stewardship contact program that encourages stewardship activities; and monitoring of embryos for signs of predation, parasitic infection, fungal infection and other maladies.

Past and ongoing conservation activities at Morris Valley include: egg mass enumeration; embryonic survival monitoring; and monitoring of embryos for signs of predation, parasitic infection, fungal infection and other maladies.

Past and ongoing survey efforts outside of the above four main sites include: inventory of wetlands in the Fraser River Lowlands (1996, 1997); surveys at a historically occupied site (2000); surveys in potential habitat in the Lower Fraser Valley (1996, 1997, annual ongoing surveys since 2008); and habitat and ecological community assessments (including invasive species and disease profiles) in potential reintroduction sites (ongoing since 2009).

Captive rearing (i.e. headstarting) has been a part of the British Columbia Oregon spotted frog strategy for a number of years. Wild eggs are collected mainly at Maria and Mountain Sloughs and are captive reared to metamorphosis at the Greater Vancouver Zoo and Mountain View Conservation Center. Metamorphic Oregon spotted frogs are released back into Aldergrove and Maria Slough. Frogs were successfully overwintered in outdoor mesocosms, enabling a spring release of juveniles in 2009. Captive rearing is guided by a captive husbandry manual, which is in the process of being updated with data from density, temperature, and feeding experiments conducted at the captive rearing institutions between 2005 and 2009. A reintroduction plan, utilizing the captive husbandry program, is being developed and captive assurance populations have been initiated at the Vancouver Aquarium and Toronto Zoo.

Washington:
Beginning in 2008, under a cooperative agreement between WDFW, TNC, Port Blakely Tree Farm, and the Service, research was begun to determine an appropriate method for controlling reed canary grass in the Black River system. Treatments include mowing, burning, and cattle grazing. Treatments are being undertaken at the Beaver Creek and Dempsey Creek sites.

In 2002, restoration planning came to fruition on the 110th Avenue and 123rd Avenue sites. The hydrology at the 110th Avenue site was enhanced by excavating soil to create ponded surface water that would remain wet through mid-summer. The 123rd Avenue site was enhanced by removing the reed canary grass root mat and removing enough soil to bring the elevation to the same level as existing nearby wetland marsh areas. In addition, small areas were excavated deeper (1 – 2 feet) to provide surface water in dry years. Between the two sites, a maximum of 15 acres was enhanced for Oregon spotted frogs. However, reed canary grass has re-invaded both sites and Oregon spotted frogs no longer breed at 110th Avenue.

The Nisqually NWR is in active acquisition status at the Black River Unit, which encompasses most of the

Dempsey Creek site and all of the 110th and 123rd Avenue sites. One of the goals of acquiring parcels within this unit is to protect Oregon spotted frog habitat.

In 1995, Ridgefield NWR Complex initiated a series of distributional surveys for a variety of species, including the Oregon spotted frog, at Conboy Lake NWR. Subsequent research at Conboy Lake, in cooperation with Dr. Marc P. Hayes, has included demographic studies, egg mass surveys, and a bullfrog diet study to assess the impacts of bullfrog predation on Oregon spotted frogs. In 19992002, Conboy Lake NWR initiated several wetland restoration projects to restore natural hydrological processes to portions of the refuge. This enabled the refuge to maintain independent water management of several wetlands, regardless of the water-related impacts of local landowners. Approximately 60 percent of all egg masses in 2002 were located on wetland units that have received some level of restoration since 1999. This restoration activity has included lowering and reshaping dikes, constructing spillways and swales in lieu of water control structures, installing new water control structures where applicable, and filling drainage ditches. Despite the apparent success of these restoration activities, the vast majority of the refuge and adjacent private wetlands have nonviable subpopulations of Oregon spotted frogs, and some have disappeared from these habitats since 1998. In 2001, the refuge signed an agreement with several of the local landowners to maintain adequate water levels until June to facilitate spotted frog metamorphosis and recruitment on approximately 810 ha (2,000 ac) of wetlands. Unfortunately, this agreement is now defunct.

In 1997, Port Blakely Tree Farms, WDFW, and the FWS initiated a cooperative study in response to the interest of private landowners to better manage and protect property for the Oregon spotted frog at the Dempsey Creek site. The goals of this study were to examine this species' habitat use patterns, especially as they relate to hydrology and cattle grazing, and to estimate the size of this population, develop an index to monitor population trends, determine seasonal movements, and identify sexual differences in movement patterns (Watson et al. 2000). The information gathered in the study is being used by Port Blakely Tree Farms towards maintaining the habitat condition as it was described in the study.

A cattle grazing permit was not renewed at Trout Lake Natural Area Preserve when the overall results of a monitoring study indicated that cattle grazing showed no apparent positive effect on the Oregon spotted frog population trends indicating that either it was not an effective tool for reed canarygrass management at this site or that perhaps reed canarygrass was not as threatening to breeding frogs at this site as previously thought. In this site, winter snow pack compresses the reed canarygrass leaving no vertical stems from the previous season during the Oregon spotted frog breeding season. The observed negative consequences of grazing, while perhaps acceptable if there was clear benefit to the Oregon spotted frog populations, were not compatible with other site management goals and posed a limitation to future restoration on the site (Wilderman and Hallock 2004, p. 14). Instead, problematic areas of reed canarygrass are being managed using ground barriers and occasional fall mowing (L. Hallock, pers. comm. 2009).

Oregon:
A partnership of several Federal agencies (Bureau of Reclamation (BOR), Forest Service, FWS, and USGS), the ODFW, the Sunriver Nature Center, and North Unit Irrigation District are currently cooperating in an effort to conserve an Oregon spotted frog population that occupied a drainage ditch at the base of Wickiup Dam near Bend, Oregon. Activities associated with the reinforcement of the dam eliminated the ditch that provided breeding, rearing, and adult habitat for a small population of Oregon spotted frogs. A conservation plan was developed that included habitat creation, population relocation, and biological monitoring for the period immediately following translocation. In 2000, explosives were used to create six ponds in nearby Dilman Meadows on the Deschutes National Forest. Nine egg masses were moved from the ditch to the ponds in spring 2001; adult and juvenile frogs were captured by trapping and dip netting and transferred in early summer. Eight adult frogs received transmitters to monitor their locations, and data indicated none left the ponds. Young frogs were found in ponds where the egg masses had been introduced. Juvenile and adult frogs were found aggregating in one deep, flowing spring at the beginning of winter (Korson and Pearl 2002, p. 27; C. Pearl, pers. comm. 2003). The original ponds are revegetating at a rapid rate, reducing depth and the amount of open water habitat. Three additional ponds were excavated in 2004, in hopes that they will better

resist vegetation establishment and allow direct maintenance if required (Sandra Ackley, FWS, pers. comm. 2004; C. Pearl, pers. comm. 2005; Adams et al. 2006, p. 12). In November 2008, seven of the ponds were re-excavated to remove the accumulated vegetation mat, resulting in recovery of 20 to 40 percent of the originally created open water. In addition, pond edges were sculpted to enhance their utility for frogs (Kathleen Cushman, Bureau of Reclamation, pers. comm. 2008).

In 2007 and 2008, students and other volunteers installed fencing around the Camas Prairie meadow in order to restrict livestock. Unfortunately, sections of the fence still permit cattle to enter. It is unknown when the fencing will be completed to exclude cattle.

In July 2000, the FWS entered into a Conservation Agreement with the Forest Service and ODFW. The objective of the Conservation Agreement is the protection and conservation of the two Oregon spotted frog populations in the Mink Lake Basin in the Three Sisters Wilderness Area of the Willamette National Forest. Survey, monitoring, management, and education activities are being conducted during this 10-year agreement and are being used to address threats that include site size, introduced fish (i.e., brook trout), effects of drought, habitat succession, and isolation of these populations. Monitoring at one of these sites (Penn Lake) by the USGS was expanded in 2000 to include data collection on Oregon spotted frog movement patterns at montane sites using PIT tagged individuals. Two Oregon spotted frog projects funded in 2000 by the Species-at-Risk Program of the Biological Resource Division of the USGS included a genetics study and a study of a population's status, effects of introduced fish, and habitat associations.

The Deschutes National Forest has drafted site management plans for: Lava Lake (Dec 2009), Little Cultus Lake (January 2009), Muskrat Lake (January 2009), Hosmer Lake (January 2009), Davis Lake and Tributaries (Aug 2009) and Big Marsh (Sept 2008). These plans provide site specific information about the condition of the habitat and recommend management and restoration actions that will improve habitat for and reduce threats to the Oregon spotted frog.

Big Marsh in the Oregon Cascades Recreation Area, upper Deschutes basin, hosts one of the largest remaining Oregon spotted frog populations. Habitat restoration activities at the site are ongoing. Restoring wetland values and providing for semi-primitive recreation are goals for this area. In 1996 and 1997 restoration efforts involved installation of dams and breaches in the west ditch, which successfully restored water to an area of the marsh that previously was dry year round. In a wildfire area that received water from the restoration efforts, small ponds created by fire burning into roots and peat held Oregon spotted frogs. In 2003, closures of the west-side and east-side ditches began, including allowing water to flow into the marsh log jam installation, and pond creation. Prescribed burns were conducted by the Forest Service over most of the marsh to remove thatch, and benefit native grasses, sedges, and willows. Planting of native vegetation began in 2006. Egg mass surveys have been conducted every year from 2001 through 2010, and are useful as one potential measure of the effectiveness of the restoration efforts. Between 2001 and 2007, egg mass numbers increased from 230 to 2,611 (see Appendix 1), presumably as a result of the restoration activities; however, egg mass numbers dropped in 2008 and 2009 and increased to 1,514 in 2010.

The Fremont-Winema National Forest is currently working on several efforts to recover Oregon spotted frogs. In June 2008, the Forest constructed a fence to prevent livestock grazing in occupied Oregon spotted frog habitat at Jack Creek (no cattle were allowed inside this fenced area during the 2008 grazing season).

The Fremont-Winema National Forest and the FWS are working collaboratively with the private landowners of Jack Creek and Buck Lake to begin cooperative restoration of the frog habitat on both federal and private lands.

The FWS (Klamath Falls Fish and Wildlife Office), Forest Service, BLM, BOR, and the Nature Conservancy are actively involved in restoring and enhancing wetlands in the Klamath Basin. The Klamath Falls Fish and Wildlife Office has participated in restoration of approximately 2,023 ha (5,000 ac) and enhancement of another 17,000 ha (42,000 ac) of wetlands on Federal and private lands since 1997. The Nature Conservancy

has a large project of approximately 3,238 ha (8,000 ac) in progress along the north side of Upper Klamath Lake. More than 50 percent of the restored wetlands would be considered potential Oregon spotted frog habitat. However, the only one currently known to be occupied is the Wood River area, which was occupied prior to restoration activities.

Restoration activities being undertaken at the Wood River Wetland (WRW) Oregon spotted frog site, which is managed by the Klamath Falls Resource Area BLM, include removal of bullfrogs and non-native fish. From 2007 to 2010, over 592 bullfrogs and over 800 non-native fish have been removed from the site. In the future, non-native removal, water management and site enhancements will remain a high priority for the BLM at the WRW site. In 2009, six additional staff gauges were installed to improve water level monitoring within the site. Planned projects for 2011 to 2014 include continuing bullfrog/non-native fish removal, water control structure replacements, and breeding habitat creation.

The development of a Comprehensive Conservation Plan (CCP) was started in 2006 for the Klamath Marsh NWR. The CCP will guide long term management for the next 15 years and will include alternatives for restoring the natural hydrology of the wetland habitats and subsequently should benefit the Oregon spotted frog population. Completion of the plan is estimated for 2009. Actual restoration work is not anticipated to happen until funding for design and construction can be secured (2012 or later).

A large, cooperative restoration project began in 2007 to restore riparian, wetland and pond habitats for Oregon spotted frogs along Crane Creek, a spring-fed tributary to Sevenmile Creek and Upper Klamath Lake. Like many other private lands in this area, Crane Creek had been drained, diked and converted to wet pasture to facilitate livestock grazing: flow through the historic channel has been cut off and is now conveyed via an 8,000 foot, straight diversion ditch. Stream channel reconnection and the creation of off-channel habitat created over 2 miles of habitat and should enhance connectivity between existing breeding populations to the north (Sevenmile Creek) and south (Fourmile Creek). The project is largely on private land and is a collaboration between the landowner, Klamath Basin Rangeland Trust (KBRT), and USFWS. A small portion of the project will involve reconnection of Crane Creek to Mares Egg Spring on the Fremont-Winema NF. Site restoration in 2007 involved excavation of material from the historic channel, placement of spawning gravel for salmonids, levee and fish barrier removal, and rewatering with all the flow from the diversion ditch. The existing diversion ditch was filled with excavated material but includes numerous ponds which should provide excellent habitat for Oregon Spotted Frogs, as well as a variety of other wildlife. These ponds were hydrologically disconnected from the new channel but allow for unimpeded movement for animals between the wetlands and the stream channel. The population of frogs (80+ individuals) that occupied the historic channel of Crane Creek was captured prior to restoration of the historic channel and later released into the constructed wetlands. At least 22 frogs survived the reintroduction (Adams et al. 2010, p. 15) Egg masses have been documented in the restored areas every year since 2008 (Adams et al. 2010, p. 15). In addition, grazing has been excluded from the flood plain of Crane Creek and the private landowner is entering the property into a conservation easement. In 2010, bullfrogs were documented in the restored area. In 2011, the USGS will continue to study the use of restored habitats by the frogs and will be monitoring to assess the status of the bullfrog invasion. This project is a unique opportunity to document Oregon spotted frog breeding, recruitment, and movement in restored pond habitats. Lessons learned from this project will help inform planned habitat creation and restoration for Oregon spotted frogs along the Williamson River on the Klamath Marsh NWR and other Klamath Basin locations.

In May 2010, the Klamath Falls Office of the USFWS entered into a Conservation Agreement with the Klamath Marsh NWR, the Lakeview District of the BLM, The Medford District of the BLM and the Fremont-Winema National Forest. The purpose of this Conservation Agreement is to formally document the intent of the parties involved to protect and contribute to the conservation of the Oregon spotted frog by implementing conservation actions for the species and its habitat on federal lands in the Klamath Basin. This Conservation Agreement is intended to guide strategic planning, project development, management, conservation actions, and research studies for Oregon spotted frog in the Klamath Basin.

The BLM has acquired all wetlands and ponds in the Parsnips Lake vicinity. In addition, grazing leases were bought out, which has removed the threat from grazing (S. Godwin, BLM, pers. comm. 2010).

Summary of Threats :

The Oregon spotted frog faces a number of threats, and most populations are subjected to multiple threats which cumulatively pose a risk to individual populations. Suitable habitat is continuing to be impacted and/or destroyed by human activities that result in the loss of wetlands, hydrologic changes, livestock grazing, vegetation encroachment or succession, and contaminants. The oomycete water mold *Saprolegnia*, chytrid fungus, and *Ribeiroia* have been documented in Oregon spotted frogs and compounded with other stressors can contribute to population declines. Introduced fish species and bullfrogs prey on Oregon spotted frogs, particularly juveniles, which results in poor Oregon spotted frog recruitment. Non-native bullfrogs also outcompete or displace Oregon spotted frogs from their habitat. Low connectivity among sites, in addition to small population sizes, appears to be an important cause of low genetic diversity within sites and high genetic differentiation among sites. The small sizes and isolation of the majority of Oregon spotted frog sites makes Oregon spotted frog populations vulnerable to fluctuating water levels, disease, predation, poor water quality, and extirpation and makes natural recolonization unlikely. The States of Oregon and Washington have both included the Oregon spotted frog in their Comprehensive Conservation Strategies; however, it is unknown how and when these strategies will be implemented. Federal land management actions are not supposed to create a significant trend toward federal listing; however it is unclear what level of protection Oregon spotted frogs have been afforded under this policy. A legacy of past effects which has led to a highly fragmented distribution, combined with the current threats and the biological sensitivity of the Oregon spotted frog to these threats, leads to the conclusion that this species continues to meet the definition of a candidate. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

The Service completed a Spotlight Species Action Plan for the Oregon spotted frog in 2009. This plan was developed to identify conservation goals and tasks that are needed to improve this species' conservation over the next several years. This plan can be found on the Service's website at: *http://ecos.fws.gov/docs/action_plans/doc3086.pdf*. Specific tasks from that action plan are identified below.

- Implement activities that will facilitate adequate water levels at Conboy Lake and in the surrounding valley necessary for Oregon spotted frog life stages.
- Implement vegetation management and/or removal of exotic vegetation.
- Reduce/control heavy livestock grazing, in particular at Jack Creek and Buck Lake.
- Assess chytrid fungus effects to Oregon spotted frogs.
- Evaluate methods to reduce or eliminate nonnative predaceous fish and bullfrogs.
- Work with adjacent private landowners to provide adequate buffers to Oregon spotted frog habitat.
- Washington's 110th Avenue site would benefit from management that increases open water habitat.
- Support restoration plans for wetland and riverine habitat on the Klamath Marsh NWR.
- Work with private landowners to revise land stewardship guidelines for Upper and Little Deschutes Rivers to include best management practices for Oregon spotted frogs.
- Create additional breeding habitat at Wood River Wetland.
- Construct additional breeding habitat at Sevenmile Creek.

- Construct ponds at Ryan Meadows Ranch
- Reconstruct floodplain and breeding habitat at Casey Tract (Little Deschutes).
- Implement restoration actions that will result in increasing the Oregon spotted frog population at Camas Prairie.

Priority Table

Magnitude	Immediacy	Taxonmomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	**2**
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

There is a high magnitude of threat to this species for a variety of reasons. It is absent from at least 76 percent of its historic range, and remaining populations in Oregon, Washington, and British Columbia are typically small and isolated. The number of Oregon spotted frogs at only 6 sites can be considered stable, whereas 3 sites are declining and the status at the remaining sites is undetermined. Many of the small sites are at risk of extirpation from stochastic events, either natural or human-caused. In addition, there is no genetic interchange between the six groups designated by Blouin et al. (2010) due to the distance separating them and lack of aquatic habitat available for dispersal. In Washington, all of the sites are threatened by development, fluctuating water levels, and/or lack of management of exotic vegetation and predators. In Oregon, all of the sites are subject to one or more of the following threats: fluctuating water levels, non-native predaceous species, exotic vegetation encroachment, vegetation succession, and livestock grazing. In addition, chytrid fungus was detected at all sites sampled in Washington and Oregon. While the risk to an individual site from each of these factors may vary, the cumulative risk of these threats to each site is high. This is reflected in declining and/or small populations which constitute the majority the Oregon spotted frog’s distribution.

Imminence :

Although some conservation measures, including habitat restoration, are being initiated for some sites, most continue to be unmanaged. Wetland habitat continues to be modified by development, agricultural practices, and water manipulation. Historic hydrological changes reduced or eliminated Oregon spotted frog habitat and

continued operations of water diversions result in inundation, dessication, and continued destruction of habitat through vegetation succession. New hydrological changes occur as developments are placed adjacent to Oregon spotted frog habitat. Past introductions of non-native predaceous species continue to place predation pressure on the remaining Oregon spotted frog populations. Past introductions of exotic vegetation continue to encroach upon and reduce Oregon spotted frog habitat. Therefore, the threats to this species are imminent because they are ongoing.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Although there are few populations, each facing a variety of threats, there are no threats likely to occur to all of the populations simultaneously to result in immediate extinction of the entire species before completion of the expected normal course of the listing process.

Description of Monitoring:

FWS has funded and participated in surveying and monitoring activities at a number of Oregon spotted frog sites. We maintain contact with the responsible agencies and species experts in Oregon and Washington and annually request their reviews, comments, and updates to the candidate assessment forms during the revision process. Relevant literature and data for this species are obtained principally from contacts with responsible agencies and experts and their reports. Periodic literature searches for this species are also completed.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

California,Oregon

State Coordination:

Literature Cited:

Adams, M.J. 1999. Correlated factors in amphibian decline: exotic species and habitat change in western Washington. Journal of Wildlife Management 63:1162–1171.

Adams, M.J., C.A. Pearl, and R.B. Bury. 2003. Indirect facilitation of an anuran invasion by non-native fishes. Ecology Letters 6:343-351.

Adams, M.J., C.A. Pearl, S. Galvan, B. McCreary, N. Chelgren, T. Graham, and D. Pilliod. 2006. Amphibian research and monitoring initiative, Pacific Northwest Region 2006 annual report. Unpublished report. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center. November 17, 2006.

Adams, M.J., C.A. Pearl, S. Galvan, B. McCreary, N. Chelgren, R. Klaver, and D. Pilliod. 2007. Amphibian research and monitoring initiative, Pacific Northwest Region 2007 annual report. Unpublished report. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center. December 19, 2007.

Adams, M.J., C.A. Pearl, S. Galvan, B. McCreary, N. Chelgren, and D. Pilliod. 2010. Amphibian research and monitoring initiative, Pacific Northwest Region 2010 annual report. Unpublished report. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center. December 20, 2010.

Antieau, C.J. 1998. Biology and management of reed canarygrass, and implications for ecological restoration. Unpublished report. Washington State Department of Transportation, Seattle, Washington. 13 pp.

Baird, S.F., and C. Girard. 1853. Communication regarding *Rana pretiosa* and *Bufo columbiensis*. Proceedings of the Academy of Natural Sciences Philadelphia 6:378–379.

Ballengee, B. and S.K. Sessions. 2009. Explanation for missing limbs in deformed amphibians. Journal of Experimental Zoology (Mol. Dev. Evol.) 312B:1-10.

Biek, R., W.C. Funk, B.A. Maxell, and L.S. Mills. 2002. What is missing in amphibian decline research: insights from ecological sensitivity analysis. Conservation Biology 16(3):728-734.

Blaustein, A.R., J.B. Hays, P.D. Hoffman, D.P. Chiavers, J.M. Kiesecker, W.P. Leonard, A. Marco, D.H. Olson, J.K. Reaser, and R.G. Anthony. 1999. DNA repair and resistance to UV-B radiation in western spotted frogs. Ecological Applications 9(3):1100-1105.

Blaustein, A. R., S. C. Walls, B. A. Bancroft, J. J. Lawler, C. L. Searle, and S. S. Gervasi. 2010. Direct and indirect effects of climate change on amphibian populations. Diversity 2:281-313.

Blouin, M., I.C. Phillipsen, and K.J. Monsen. 2010. Population structure and conservation genetics of the Oregon spotted frog, *Rana pretiosa*. Conservation Genetics 11:2179-2194.

Bowerman, J. 2010. Submerged calling by Oregon Spotted Frogs (*Rana pretiosa*) remote from breeding aggregations. Reptiles and Amphibians 17: 84-87.

Bowerman, J., and L. Flowerree. 2000. A survey of the Oregon spotted frog in the area between Sunriver and La Pine, Oregon. Unpublished report prepared for U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, and Sunriver Owners Association. 6 pp.

_____, and P.T.J. Johnson. 2003. Timing of trematodes-related malformations in Oregon spotted frogs and Pacific treefrogs. Northwestern Naturalist 84:142-145.

_____, P.T.J. Johnson, and T. Bowerman. 2010. Sublethal predators and their injured prey: linking aquatic predators and severe limb abnormalities in amphibians. Ecology 91(1):242-251.

Boyer, R., and C.E. Grue. 1995. The need for water quality criteria for frogs. Environmental Health Perspectives 103:352.

Bradley, G.A., P.C. Rosen, M.J. Sredl, T.R. Jones, and J.E. Longcore. 2002. Chytridiomycosis in native Arizona frogs. Journal of Wildlife Diseases 38(1):206-212.

Bull, E.L., and D.B. Marx. 2002. Influence of fish and habitat on amphibian communities in high elevation lakes of northeastern Oregon. Northwest Science 76:240–248.

Bureau of Reclamation. 1992. Biological Assessment on Long Term Project Operations. Klamath Basin Office.

Bureau of Land Management. 1998. Wood River Spotted Frog Survey. 1pp.

Canning, D.J., and M. Stevens. 1990. Wetlands of Washington: a resource characterization. Shorelands and Coastal Zone Management Program, Wash. Department of Ecology, Olympia. 54 pp.

Carl, G.C., and I.M. Cowan. 1945. Notes on some frogs and toads of British Columbia. Copeia 1945:52–53.

Chang, H. and J. Jones. 2010. Climate Change and Freshwater Resources in Oregon. Chapter 3, Oregon Climate Change Research Institute (2010), Oregon Climate Assessment Report, K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR.

Cooke, F.R. 1984. Introduction to Canadian amphibians and reptiles. National Museum of Natural Science, National Museum of Canada.

Corkran, C.C., and C.R. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia, a field identification guide. Lone Pine Publishing, Edmonton, Alberta. 175 pp.

Corn, P. S. 2003. Amphibian breeding and climate change: Importance of snow in the mountains. Cons. Biol. 17(2):622-625.

Cushman, K.A. and C.A. Pearl. 2007. A conservation assessment for the Oregon spotted frog (*Rana pretiosa*). U.S. Department of Agriculture Forest Service Region 6, U.S. Department of Interior Bureau of Land Management Oregon and Washington. 46 pp.

Dahl, Thomas E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13 pp.

Daszak, P., L. Berger, A.A. Cunningham, A.D. Hyatt, D.E. Green, and R. Speare. 1999. Emerging infectious diseases and amphibian population declines. Emerging Infectious Diseases 5(6)735-748.

Dunlap, D.G. 1955. Inter- and intraspecific variation in Oregon frogs of the genus Rana. American Midland Naturalist 54:314–331.

Engler, J., and D.C. Friesz. 1998. Draft 1998 Oregon spotted frog breeding surveys, Conboy Lake National Wildlife Refuge, Klickitat County, Washington. Unpublished Report. 5 pp.

Engler, J., and M.P. Hayes. 1998. The Oregon spotted frog and bullfrog: habitat partitioning and species interactions at Conboy Lake National Wildlife Refuge 1998 progress report. Unpublished Report. 3 pp.

Environment Canada. 2005. Species at risk – Oregon Spotted Frog website. http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=614. Downloaded September 23, 2005.

Environmental Protection Agency (EPA). 2004. Biological evaluation of the revised Oregon water quality standards for temperature, intergravel dissolved oxygen, and antidegradation: amended final. U.S. Environmental Protection Agency, Region 10, Oregon Operations Office, Portland, Oregon. February 4, 2004.

EPA. 2007. Biological evaluation of the revised Washington water quality standards. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. April 10, 2007.

EPA. 2008. EPA approval of the 2003/2006 revisions to the Washington water quality standards regulations. Letter to David C. Peeler, Program Manager, Department of Ecology, Olympia, Washington. February 11, 2008.

Forbes, T., and L. Peterson. 1999. Jack Creek population of the Oregon spotted frog (Rana pretiosa) on Chemult Ranger District, Winema National Forest (Klamath Co, Oregon). Unpublished report. U.S. Forest Service, Chemult Ranger District, Winema National Forest. 38 pp.

Funk, W.C., C.A. Pearl, H.M. Draheim, M.J. Adams, T.D. Mullins, and S.M. Haig. 2008. Range-wide phylogeographic analysis of the spotted frog complex (*Rana luteiventris* and *Rana pretiosa*) in the northwestern North America. Molecular Phylogenetics and Evolution 46:198-210.

Green, D.M. 1985. Natural hybrids between the frogs *Rana cascadae* and *Rana pretiosa* (Anura:Ranidae). Herpetologica 41:262–267.

_____. 2003. The ecology of extinction: population fluctuation and decline in amphibians. Biological Conservation 111:331-343.

_____, T.F. Sharbel, J. Kearsley, and H. Kaiser. 1996. Postglacial range fluctuation, genetic subdivision and speciation in the western North American spotted frog complex, *Rana pretiosa*. Evolution 50:374–390.

_____, H. Kaiser, T.F. Sharbel, J. Kearsley, and K.R. McAllister. 1997. Cryptic species of spotted frogs, *Rana pretiosa* complex in western North America. Copeia 1997:1–8.

Haertel, J.D., and R.M. Storm. 1970. Experimental hybridization between *Rana pretiosa* and *Rana cascadae*. Herpetologica 26:436–446.

Hallock, L., and S. Pearson. 2001. Telemetry study of fall and winter Oregon spotted frog (*Rana pretiosa*) movement and habitat use at Trout Lake, Klickitat County, Washington. Unpublished report to Washington State Department of Transportation and Washington Department of Natural Resources Natural Areas Program. 20 pp.

Haycock, R.D. 2000. COSEWIC status report on the Oregon spotted frog, *Rana pretiosa*, in Canada. Report to the Committee on the Status of Endangered Wildlife in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. 19 pp.

Hayes, M.P. 1994. The spotted frog (Rana pretiosa) in western Oregon. Part I. Background. Part II. Current status. Oregon Department of Fish and Wildlife Technical Report 94–1–01. Unpublished Report.

_____. 1995a. Status of the spotted frog (*Rana pretiosa*) in the Crescent Ranger District, Deschutes National Forest: Headwaters of the Deschutes River System. Final report prepared for the Nature Conservancy and sponsored by the Crescent Ranger District, Deschutes National Forest as part of a cost-share in which Bureau of Land Management, the Deschutes National Forest, the Oregon Department of Fish and Wildlife, Pacificorp, the Weyerhaeuser Company, and the Winema National Forest were partners. 9 pp.

_____. 1995b. The Wood River spotted frog population. Final report prepared for the Nature Conservancy and sponsored by the Bureau of Land Management and Oregon Department of Fish and Wildlife as part of a cost-share in which Bureau of Land Management, the Oregon Department of Fish and Wildlife, Pacificorp, the Weyerhaeuser Company, and the Winema National Forest were participants. 18 pp.

_____. 1996. The Wood River spotted frog population. Final report prepared for the Bureau of Land Management. 17 pp.

_____. 1997. Status of the Oregon spotted frog (*Rana pretiosa sensu stricto*) in the Deschutes basin and selected other systems in Oregon and northeastern California with a rangewide synopsis of the species' status. Final report prepared for The Nature Conservancy under contract to the U.S. Fish and Wildlife Service, Portland, Oregon. Unpublished Report. 57 pp.

_____. 1998a. The Jack Creek population of the Oregon spotted frog (*Rana pretiosa*) Chemult Ranger District, Winema National Forest (Klamath County, Oregon). Final report prepared for The Nature Conservancy under contract to the Winema National Forest. Unpublished Report 14 pp.

_____. 1998b. The Buck Lake Oregon spotted frog (*Rana pretiosa*) population (Spencer Creek System, Klamath County, Oregon). Final report prepared for the Bureau of Land Management and The Nature Conservancy under contract to Winema National Forest. Unpublished Report. 22 pp.

_____. 1998c. The Oregon spotted frog (*Rana pretiosa*) in the vicinity of Jack and Fourmile Springs in 1996-7 (Cherry-Fourmile Creek Drainages, Klamath County, Oregon). Final report prepared for the Bureau of Land Management and The Nature Conservancy under contract to Winema National Forest. Unpublished Report. 14 pp.

_____. 1998d. The Wood River spotted frog population, Klamath County, Oregon. Prepared for the Bureau of Land Management, Klamath Falls District Office, Klamath Falls, Oregon. 24pp.

_____, and M.R. Jennings. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology 20:490–509.

_____, J.D. Engler, R.D. Haycock, D.H. Knopp, W.P. Leonard, K.R. McAllister, and L.L. Todd. 1997. Status of the Oregon spotted frog (*Rana pretiosa*) across its geographic range. Oregon Chapter of the Wildlife Society, Corvallis, Oregon.

_____, _____, D.C. Friesz, and K. Hans. 2000. Oregon spotted frog (*Rana pretiosa*) oviposition at Conboy National Wildlife Refuge (Klickitat County, Washington): management implications of embryonic mortality. Final report to U.S. Fish and Wildlife Service. Lacey, Washington. 14 pp.

_____, _____, S.Van Leuven, D.C. Friesz, T. Quinn, and D.J. Pierce. Overwintering of the Oregon spotted frog (*Rana pretiosa*) at Conboy Lake National Wildlife Refuge, Klickitat County, Washington, 2000-2001. Final Report to Washington Department of Transportation. June 2001. 86 pp.

_____, C.J. Rombough, C.B. Hayes, and J.D. Engler. 2005. *Rana pretiosa* (Oregon spotted frog). Predation. Herpetological Review 36(3):307.

_____, C.J. Rombough, G.E. Padget-Flohr, L.A. Hallock, J.E. Johnson, R.S. Wagner, and J.D. Engler. 2009. Amphibian chytridiomycosis in the Oregon spotted frog (*Rana pretiosa*) in Washington State, USA. Northwestern Naturalist 90:148-151.

_____, J.D. Engler, and C.J. Rombough. 2006. *Rana pretiosa* (Oregon spotted frog). Predation. Herpetological Review 37(2):209-210.

Hecnar, S.J. 1995. Acute and chronic toxicity of ammonium nitrate fertilizer to amphibians from southern Ontario. Environmental Toxicology and Chemistry 14:2131–2137.

Hixon, M.A., S.V. Gregory, W.D. 2010. Oregon's Fish and Wildlife in a Changing Climate. Chapter 7, Oregon Climate Change Research Institute (2010), Oregon Climate Assessment Report, K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR.

Johnson, P.T.J. and J.M. Chase. 2004. Parasites in the food web: linking amphibian malformations and aquatic eutrophication. Ecology Letters 7:521-526.

Johnson, P.T.J., K.B. Lunde, E.M. Thurman, E.G. Ritchie, S.N. Wray, D.R. Sutherland, J.M. Kapfer, T.J.

Frest, J. Bowerman, and A.R. Blaustein. 2002. Parasite (*Ribeiroia ondatrae*) infection linked to amphibian malformations in the western United States. Ecological Monographs 72(2):151-168.

Kentula, M.E., J.C. Sifneos, J.W. Wood, M. Rylko, and K. Kunz. 1992. Trends and patterns in Section 404 permitting requiring compensatory mitigation in Oregon and Washington, USA. Environmental Management 16:109-119.

Kiesecker, J.M., and A.R. Blaustein. 1997. Influences of egg laying behaviour on pathogenic infection of amphibian eggs. Conservation Biology 11:214–220.

_____, _____. 1998. Effects of introduced bullfrogs and smallmouth bass on microhabitat use, growth, and survival of native red-legged frogs (*Rana aurora*). Conservation Biology 12:776–787.

_____, _____, and C.L. Miller. 2001a. Potential mechanisms underlying the displacement of native red-legged frogs by introduced bullfrogs. Ecology 82:1964-1970.

_____, _____, and _____. 2001b. Complex causes of amphibian population declines. Nature 410:681-683.

Kittrell, J. 2002. FY2002 Oregon spotted frog spring egg mass survey results for Big Marsh. Unpublished report. U.S. Forest Service, Crescent Ranger District, Crescent Oregon. 5 pp.

Knapp, R.A. 2005. Effects of nonnative fish and habitat characteristics on lentic herpetofauna in Yosemite National Park, USA. Biological Conservation 121:265-279.

Korson, C., and C. Pearl. 2002. Seeing spots in a Cascade meadow. Birdscapes Spring/summer 2002:26.

Kruse, K.C., and M.G. Francis. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Transactions of the American Fisheries Society 106:248–252.

Kupferberg, S.J. 1997. Bullfrog (*Rana catesbeiana*) invasion of a California river: the role of larval competition. Ecology 78:1736–1751.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241:1455-1460.

Leonard, W. P. 1997. Oregon spotted frog (*Rana pretiosa*) monitoring at Trout Lake Natural Area Preserve and vicinity, Klickitat and Skamania Counties, Washington. Unpublished Report, Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia. 22 pp.

_____, H.A. Brown, L.L.C. Jones, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, Washington. 168 pp.

_____, K.R. McAllister, and L.A. Hallock. 1997. Autumn vocalizations by the red-legged frog (*Rana aurora*) and the Oregon spotted frog (*Rana pretiosa*). Northwestern Naturalist 78:73-74.

Lewis, J.C., D.P. Anderson, and S. Van Leuven. 2001. Oviposition ecology of the Oregon spotted frog at Trout Lake Marsh, Washington. Washington Department of Fish and Wildlife. Olympia. 13 pp.

Licht, L.E. 1971. Breeding habits and embryonic thermal requirements of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* in the Pacific Northwest. Ecology 52:116–124.

_____. 1974. Survival of embryos, tadpoles, and adults of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* sympatric in southwestern British Columbia. Canadian Journal of Zoology 52:613–627.

_____. 1986. Food and feeding behavior of sympatric red-legged frogs, *Rana aurora*, and spotted frogs, *Rana pretiosa*, in Southwestern British Columbia. Canadian Field Naturalist 100:22-31.

Littell, J.S., M. McGuire Elsner, L.C. Whitely Binder, and A.K. Snover (eds). 2009. The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate - Executive Summary. In: The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate,Climate Impacts Group, University of Washington, Seattle, Washington.

Marco, A., C. Quilchano, and A. Blaustein. 1999. Sensitivity to nitrate and nitrite in pond-breeding amphibians from the Pacific Northwest, USA. Environmental Toxicology and Chemistry 18: 2836–2839.

Materna, E.J., C.F. Rabeni, and T.W. LaPoint. 1995. Effects of the synthetic pyrethroid insecticide, esfenvalerate, on larval leopard frogs (*Rana spp*.). Environmental Toxicology and Chemistry 14:613–622.

McAllister, K.R., and W.P. Leonard. 1997. Washington State status report for the Oregon spotted frog. Washington Department of Fish and Wildlife, Olympia. 38 pp.

_____, _____, D.W. Hays, and R. C. Friesz. 1999. Washington state status report for the northern leopard frog. WDFW, Olympia. 36 pp.

_____, and M. Walker. 2003. An inventory of Oregon spotted frogs (*Rana pretiosa*) in the upper Black River drainage, Thurston County, Washington. Unpublished report. Washington Department of Fish and Wildlife, Olympia. 12 pp.

_____, T. Schmidt, and M. Walker. 2004. An inventory of Oregon spotted frogs (*Rana pretiosa*) in the upper Black River drainage, Thurston County, Washington. Unpublished report. Washington Department of Fish and Wildlife, Olympia. 12 pp.

_____, and H.Q. White. 2001. Oviposition ecology of the Oregon spotted frog at Beaver Creek, Washington. Unpublished report. Washington Department of Fish and Wildlife, Olympia. 24 pp.

Monello, R.J., and R.G. Wright. 1999. Amphibian habitat preferences among artificial ponds in the Palouse region of northern Idaho. Journal of Herpetology 33:298–303.

Mote, P.W., E.A. Parson, A.F. Hamlet, W.S.Keeton, D. Lettenmaier, N. Mantua, E.L. Miles, D.W. Peterson, D.L. Peterson, R. Slaughter, and A.K. Snover. 2003. Preparing for climate change: The water, salmon, and forests of the Pacific northwest. Climate Change 61: 45-88.

Mote, P., E. Salathe, V. Duliere, and E. Jump. 2008. Scenarios of future climate for the Pacific Northwest. A report for the Climate Impacts Group, University of Washington, Seattle, Washington. 12pp.

Mullin, S.J., J.B. Towey, and R.E. Szafoni. 2004. Using rotenone to enhance native amphibian breeding habitat in ponds (Illinois). Ecological Restoration 22(4):305-306.

National Biological Information Infrastructure (NBII). 2005. North American Reporting Center for Amphibian Malformations. Retrieved 19 October 2005, from http://frogweb.nbii.gov/narcam/index.html.

Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. University of Idaho Press, Moscow.

Oertley, J. 2005. Progress report to ISSSSP committee for spotted frog surveys in Oregon. Unpublished

report.

Oregon Department of Environmental Quality. Last modified April 6, 2005. Water Temperature Criteria.

White, H.Q. 2002. Oviposition habitat enhancement and population estimates of Oregon spotted frogs (*Rana pretiosa*) at Beaver Creek, Washington. Master's Thesis, The Evergreen State College, Olympia, Washington. March 2002.

Wilderman, D. and L. Hallock. 2004. Trout Lake Natural Area Preserve prescribed livestock grazing assessment. Washington Department of Natural Resources. Unpublished assessment. March 2004.

APPENDIX 1

Table 1. Summary of most recent information on current number of known occupied sites, land ownership, estimated adult population, estimated eggmasses, and comments regarding the status of the Oregon spotted frog.

Site and Ownership	Adults	Egg Masses Counted	Comments –see threats discussion	Data Sources	Presumed Status
British Columbia – 4 sites[13]					
MD Aldergrove – Department of National Defence	1 calling male (2009) Previous years assumed to be twice the number of egg masses.	0 (2009) 0 (2008) 0 (2007) 8 (2006) 7 (2005) 10 (2004) 12 (2003) 34 (2002) 31 (2001) 29 (2000) 90 (1997)	Threats include habitat loss, insufficient habitat size, bullfrogs, exotic invasive vegetation; hydrological alterations, genetic isolation, and risk of drought.	Kym Welstead, Environment Canada, pers comm. 2009 Purnima Govinjaradulu, British Columbia Ministry of Environment, pers comm. 2009, 2010 Canadian Oregon spotted frog recovery team 2010.	Declining – Approach-ing extirpation
Mountain Slough – Private		45 (2009) 50 (2008) 37 (2007) NA (2006) 49 (2005) 62 (2004) 54 (2003) 96 (2002-incomplete survey) 70 (2001-incomplete survey) 43 (2000) 16 (1997)	Threats include habitat loss, hyrdological alterations, insufficient habitat size, exotic invasive vegetation, green frogs, genetic isolation, and risk of drought.		Unknown
Seabird Island/ Maria Slough – First Nations and private		45 (2009) 67 (2008) 21 (2007) 99 (2006) 125 (2005) 117 (2004) 127 (2003) 144 (2002) 71 (2001) 75 (2000) 38 (1997)	Threats include habitat loss, hydrological alterations, insufficient habitat size, exotic invasive vegetation, green frogs, bull frogs, genetic isolation, and risk of drought.		Unknown
Chehalis/Morris Valley - Private		63 (2009) 77 (2008)	Threats include habitat loss, hydrological alterations, insufficient habitat size, genetic isolation, and risk of drought		Unknown

Site and Ownership	Adults	Egg Masses Counted	Comments –see threats discussion	Data Sources	Presumed Status
Washington – 8 sites					
Black River Population Cluster					
Beaver Creek/ West Rocky Prairie –WDFW		76 (2010) 57 (2009) 26 (2008) N/A (2007) 61 (2006) 59 (2001) 123 (2000) 28 (1999)	Primary threat is from reed canarygrass vegetation succession. Bullfrogs are present nearby, but they currently do not access the sites (extensive surveys in 2009 and 2010 failed to detect any bullfrog life stages.	WDFW OSF database White 2002, p. 44 McAllister and White 2001, p. 6	Unknown
Dempsey Creek, Thurston Co. – USFWS (Nisqually	356 captured in 2006 406 captured in 2005	The Forbes: 384 (2010) 296 (2009) 170 (2008)	Survey in 2003 found the populations occupied a larger area than previously recognized	K. McAllister, WDFW, pers comm. 2007, 2008 WDFW OSF database	Stable

(Nisqually NWR), private (Tree Farm and former Wilson dairy), Capitol Land Trust Consists of 3 main breeding areas: The Forbes, Stony Creek, and Pipeline Crossing	2005 386 captured in 2004 304 captured in 2003 241 captured in 2002	176 (2008) 192 (2007) 146(2006) 173 (2005) 186 (2004) 150 (2003) 124 (2002) 187 (2001) 222 (2000) 183 (1999) 119 (1998) 125 (1997) 169 (1996) Stony Creek: 36 (2008) 20 (2005) Pipeline Crossing: 0 (2010) 15 (2009) 64 (2008) 108 (2004) 94 (2003)	recognized Threats include nonnative predators, such as pumpkinseed sunfish and largemouth bass; reed canarygrass vegetation succession; and residential development. Evidence of bullfrog presence appeared in 2010 (a very large tadpole was taken from the margin of Dempsey Creek and a dead tadpole was also found in the Parking Lot oviposition pool.	WDFW OSI database; M. Bailey, USFWS Watson et al. 2000, p. 17	
110th Avenue – USFWS (Nisqually NWR)	2 in 2005; 4 captured in 2004	0 (2010) 0 (2009) 0 (2008) 0 (2007) 1 (2005) 1 (2004) 0 (2003) 2 (2002) 4 (2001)	This site was discovered in 2001. Threats include vegetation succession by reed canary grass and nonnative predaceous fish and bullfrogs.	M. Bailey, USFWS WDFW OSF database McAllister and Walker 2003, p. 1 McAllister et al. 2004, p. 7 K. McAllister pers. comm. 2006	Possible Extirpated
123rd Avenue – USFWS (Nisqually NWR)	240 captured in 2004	574 (2010) 685 (2009) 384 (2008) 101 (2007) 2 (2006) 5 (2005) 127 (2004) 32 (2003) 10 (2002) 32 (2001)	This site was discovered in 2001. Threats include reed canarygrass vegetation succession. High variability in egg mass numbers is likely due to survey effort.	M Bailey, USFWS K. McAllister, WDFW J. Lewis, WDFW McAllister and Walker 2003, p. 1	Unknown
Allen Creek-Blooms Ditch - private		76 (2010) ≥25(2008)	Adult frogs were seen in this area in 2007. 2008 egg mass count taken from photo. Threats include drought and grazing.	WDFW OSF Database L. Salzer, WDFW	Unknown
Salmon Creek – private		27 (2010)	New site discovered in 2010. Threats include reedcanary grass vegetation succession.	B. Blessing, L. Hallock	Unknown
Trout Lake Population Cluster					
Trout Lake Natural Area Preserve - State		East of Creek - North, Middle, and South 503 (2010) 258 (2009) 135 (2008)	Threats include reed canary grass East of Creek and on the West Side and potential development on private ownership lands adjacent to NAP	1997 data from Leonard (1997); 1998-1999 data collected by W.P. Leonard and L. Hallock; 2000 and 2002-2010 data collected by L. Hallock; 2001 data collected	Unknown – egg mass numbers appear to be improving at

		196 (2007) 144 (2006) 174 (2005) 157 (2004) 232 (2003) 182 (2002) 277 (2001) 606 (2000) 388 (1999) 432 (1998) 289 (1997) East of Creek - Interior 73 (2010) 169 (2009) 58 (2008) 135 (2005) 88 (2002) 43 (2001) West Side - Elk Meadows 78 (2010) 49 (2009) 52 (2008) 12 (2007) 75 (2006) 102 (2005) 108 (2004) 154 (2003) 139 (2002) 66 (2001) 185 (2000) 183 (1999) 179 (1998) 125 (1997) West Side - Clarksville 43 (2010) 38 (2009) 15 (2008) 0 (2007) 36 (2006) 72 (2005) 84 (2004) 93 (2003) 103 (2002) 126 (2001) 168 (2000) 193 (1999) 245 (1998) 156 (1997) Beaver Pond (North Wetland) 47 (2010) 28 (2009) 35 (2008) 50 (2007) North Pond 30 (2010)	Beaver Pond property purchased by NAP in 2007. North Pond, Southeast, and Tree Snag are new breeding areas discovered in 2010.	by J. Lewis and S. VanLeuven.	breeding locations to the east of Trout Lake Creek after declining between 2006 and 2008. Breeding locations west of Trout Lake Creek are not continuing to decline.

		Southeast 14 (2010) Tree Snag ≥ 111 (2010)			
Trout Lake Creek Beaver Ponds - Gifford Pinchot NF and private		22 (2010) 0 (2009) 0 (2008) 0 (2007) 85 (2005) 60 (2003) 117 (2001) 2 (1997)	Primary threat is related to the beaver population and their ability to maintain the dam that holds water within the wetland. 2007 winter flooding damaged beaver dam resulting in wetland being reduced to about 1/3 of previous size. Surveys in 2007-2009 may have only checked historic breeding areas and not searched potential breeding habitat. Metamorphs were captured at the Beaver Ponds in July 2009, indicating breeding did occur in 2009, although unknown at what level.	M. Wainwright, USFS L. Hallock, WDNR and WDFW Leonard (1997)	Unknown
SDS Property - Private		26 (2010) 28 (2009) 17 (2008) 9 (2007) 16 (2001)	Threats include vegetation succession. A male Cascades Frog was found at this site (D. Anderson, WDFW); therefore, the egg mass numbers at this site are somewhat suspect because they may not be Oregon spotted frogs. Surveys at SDS site are limited due to access issues and egg mass counts may not include all breeding areas associated with this site	L. Hallock, WDNR and WDFW	Unknown
Conboy Lake Population Cluster					
Conboy Lake – USFWS (Conboy Lake NWR) and private		1,706 (2010) 1,435 (2009) <500 (2008) 444 (2007) 511 (2006) Surveys in 2006 through 2008 were restricted to 4 focus areas, unlike pre- and post-years efforts. 3,404 (2005) 3,898 (2004) 2,085 (2003) 1,442 (2002)	Threats include nonnative predators, brook trout, bullhead and bullfrog; vegetation succession, including reedcanary grass; limited distribution in some of the seasonally flooded breeding areas due to irregular water management and limited seasonal water storage capacity due to channelized water system.	M. Hayes, WDFW	Declining

		1,630 (2001) 4,666 (2000) 5,434 (1999) 7,018 (1998)			
Site and Ownership	**Adults**	**Egg Masses Counted**	**Comments –see threats discussion**	**Data Sources**	**Presumed Status**
Oregon – 32 sites					
Central Oregon Cascades -23 sites					
Camas Prairie - Mt. Hood NF	3 larvae, 23 juv, 17 >36 mm (1996)[6]	41 (2008) [23] 9 (2007) [23] 23 (2006) [23] 24 (2005) [23] < 30 (2004) [23] 38 (1999) [23]	Camas Prairie is an isolated marsh in the upper White River system (a tributary to the Deschutes River). Threats include susceptibility to drought, hydrology modifications, grazing impacts, vegetation succession, and effects of isolation.	[6] Hayes (1997) [23] A. Dyck, USFS, email. comm. 2009.	Unknown
Penn Lake/ Cabin Meadows site – Willamette NF	245 ± 15 SE (2010 estimated adult population)[24] 148 ± 11 SE (2009 estimated adult population) [19] 89 (2008 estimated adult population)[14] 134 (2007 estimated adult population)[12]	No survey (2008) 76.5 (2007)[12] 127 (2006)[8, 16] 76 (2005) [8] Average of 34 over 4 years[4]	Threats include nonnative predaceous fish, susceptibility to drought, and vegetation succession. Separated from any other known occupied site. Nearest breeding site ~ 1 mile straight line distance.[22]	[8] Adams et al. (2006) [12] Adams et al. (2007) [14] Adams et al. 2008, p. 13 [16] USGS 2006 survey database [19] Adams et al. 2009 [22] C. Pearl, pers. comm.. 2010 and 2011 [24] Adams et al. 2010	Unknown
Unnamed Marsh north of Mink Lake – Willamette NF	60 ± 7 SE (2010 estimated adult population)[24] 46 ± 6 SE (2009 estimated adult population) [19] 43 (2008 estimated adult population)[14] 134 (2007 estimated adult population)[12]	No survey (2008) 36.5 (2007)[12] 60 (2006) [8, 16] 52 (2005) [8] Average of 34 over 4 years[4]	Threats include nonnative predaceous fish. Vegetation succession is a potential threat. Separated from any other known occupied site. Nearest breeding site ~ 1 mile straight line distance.[22]	[8] Adams et al. (2006) [12] Adams et al. (2007) [14] Adams et al. 2008, p. 13 [16] USGS 2006 survey database [19] Adams et al. 2009 [22] C. Pearl, pers. comm.. 2010 and 2011 [24] Adams et al. 2010	Unknown
Gold Lake Bog (Research Natural Area) - Willamette NF		729 (2007) 912 (2006)[16]	Threats include non-native predaceous fish and isolation. [4] Vegetation succession is a potential threat.	[16] USGS 2006 survey database [4] C. Pearl, pers. comm. 2006	Stable
Winopee Lake Deschutes NF	Adults and juveniles confirmed in 2007[22]	Winopee Lake: 330 (2006) [16] Breeding confirmed	Threats include non-native predaceous fish and susceptibility to drought. Because it is a shallow marsh	[16] USGS 2006 survey database [22] C. Pearl, pers. Comm. 2010	Unknown

	2007	Breeding confirmed in late 1990s	cause it is a shallow marsh, vegetation succession is an issue of concern. Ponds and Lakes within 200m of Winopee used sporadically by frogs. Snowshoe Lakes – 1 report of 1 frog but no evidence of breeding[22]. Repeated surveys by USGS found no frogs and the habitat is not breeding habitat	C. Pearl, pers. comm. 2010	
Muskrat Lake – Deschutes NF	Observed larvae (2008) and adult (2009)[17] Adults and juveniles found in 2007[22]	20-40 breeding females over several surveys 2002-2004[4] 31 (2006) [16]	Threats include high density of non-native predaceous fish, fluctuating water levels, and lodgepole encroachment. High recreational use occurs in this area and horsepacking exacerbates spread of non-native weeds.	[16] USGS 2006 survey database [17] USDA Forest Service 2009a	Unknown
Little Cultus Lake - Deschutes NF	<30 breeding females (2005) [4] 15 larvae 2 > 51 mm (1995) [4]	Little Cultus Lake/ Little Cultus Pond: 36 (2006) [16] <10 (2005) [4]	Threats include small population size, non-native predaceous fish, vegetation succession, and drought. High recreational use of nearby areas.	[4] C. Pearl, pers. comm. 2006 [16] USGS 2006 survey database	Unknown
Hosmer Lake – Deschutes NF	3 juv, 5 > 36 mm (1996) [6] 62 mostly juv (1995) [6]	129 (2006) [16]	Threats include non-native predaceous fish, and vegetation succession	[6] Hayes (1997) [16] USGS 2006 survey database	Unknown
Lava Lake - Deschutes NF	6 larvae (1995) 6	43 (2010) [22] 33 (2009) [18] 99 (2006) [16]	Threats include non-native predaceous fish, substantial water fluctuations, and drought. Lava Lake has high recreational use.	[6] Hayes (1997) [16] USGS 2006 survey database; this included breeding area in NW portion of lake, an area which was not surveyed or reflected in 2009 or 2010 surveys (C. Pearl, pers. obs.). [18] L. Turner U.S. Forest Service, pers. comm.. 2010 [22] C. Pearl, pers. Comm.. 2010 and 2011	Unknown
Little Lava Lake - Deschutes NF	12 subadults (2009) [17] 10 larvae (1995) [6] 10 adults (Blue Lagoon area in mid 1990s)	22 (2006) [16]	Threats include non-native predaceous fish and heavy recreational use (angling, camping, vehicles). Reed canarygrass is present near the lake outlet.	[6] Hayes (1997) [3] Crescent Ranger District Record, U.S. Forest Service [16] USGS 2006 survey database [17] USDA Forest Service 2009c	Unknown
Blue Pool (Lower and Upper) – Deschutes NF		210 (2006) [16]			Unknown
Crane Prairie – Reservoir and associated wetlands - Deschutes NF	1 larvae, 3 > 36 mm (1996) [6] 8 > 36 mm (1995)[6]	Breeding confirmed in northern area. (2009, 2010) [22] Breeding found in	Population appears to have declined in last 25-30 years based on observational accounts[22]. Main threat is likely non-native preda-	[6] Hayes (1997) [22] C. Pearl, pers. Comm.. 2010 and 2011	Unknown

		widely scattered areas along western, northern, and eastern shallows (2006) [22]	ceous fish. Fluctuating water levels could also be a factor. Heavy recreational use occurs in this area.		
Cultus Creek Gravel Pit - Deschutes NF	No current information 9 juv, 1>36mm (1995)[6]		Threats include abundant, stocked, non-native predaceous fish	[6] Hayes (1997)	Unknown
Wickiup Reservoir - Deschutes NF	0 (1996-partial survey) [6] 0 (1995-partial survey) [6]	Limited breeding found ca. 2002-2003 in northeastern portion of reservoir pool (<10 egg masses) [4]	Threats include fluctuating water level that vary greatly between and within years, abundant non-native predaceous fish, and high recreational use. Frogs found in the ditch below the dam in 1996[6]. This habitat no longer appears to be viable due to dam removal in 2001[2].	[6] Hayes (1997) [4] C. Pearl, pers. comm. 2006	Unknown
Dilman Meadow - Deschutes NF	227 (2007 estimated adult population)[12] 50 breeding females (2005) [4]	42 (2010) [24] 38 (2009) [19] 33 (2008) 56.5 (2007)[12] 41.5 (2006)[8]	40 frogs were translocated from Wickiup ditch site to created habitat in 2001. Population has increased from 11 to 50 breeding females. [4] Habitat succession will affect longevity of the site due to pond filling in. Intervention may be necessary to keep open water. [4]	[4] C. Pearl, pers. comm. 2006 [8] Adams et al. (2006) [12] Adams et al. (2007) [19]Adams et al. 2009 [24] Adams et al. 2010	Unknown
Davis Lake/ Odell Creek and associated wetlands – Deschutes NF (4 locations surveyed) Odell Creek/ Davis Lake Odell Creek/NF 4660 RD Ranger Creek	0 frogs on Davis Lake proper in 1994 [5] and 2001 [4] 4 (near inflow to lake) and 8 (4660 Rd) frogs on lower Odell Cr in 2 surveys (1994)[5] 2 sub-adults found near outlet of Odell Creek into Davis Lake (2004) [9] 1 adult lower Odell Cr (4660 Rd)(2004) [4] 2 frogs on Ranger Cr (1994) [5] 2 adults on lower Ranger Cr (2006) [16]	7 egg masses in lake near Odell Cr inflow (2000) [4] 0 egg masses found on lower Ranger and Odell Cr (2006) [16]	Historical records of frogs on 2 inflows to Davis Lake (Ranger and Odell Creeks) imply breeding nearby: in absence of beaver, Davis Lake is most suitable breeding habitat and last confirmed breeding. Threats include non-native predaceous fish, loss of beaver, low water levels, and heavy recreational use. This area burned in 2004, but effects on local OSF are not known	[5] Hayes (1995a) [4] C. Pearl, pers. comm. 2006 [9] J. Kittrell, U.S. Forest Service, in lit. 2007 [16] USGS 2006 survey database [17] USDA Forest Service 2009	Unknown

Scotty Big Boy Fen/upper Odell Creek - Deschutes NF	0 frogs found in 1 survey of Ranger and lower Odell Creeks (2009)[17] One adult, 5 sub-adults and 40 larvae (2009)[17]	>24 (2010) [22] One egg mass observed (2009)[17]	Site discovered in 2009. Lentic habitat suitability is related to beaver activity.	[22]C. Pearl, pers. comm.. 2010 and 2011	
Big Marsh – Deschutes NF	147 (1999)* 383 (1998)[21]* 283 (1997) * 27 larvae, 203 juv, 79>36 mm (1994) [6] *Adult and juvenile survey	1,514 (2010)[25] 27 (2009)[25]*** 427 (2008) [20]*** 2,611 (2007) [9] 1,736 (2006)[9] 1,254 (2005) [9]** 173(2004) [9]*** 694 (2003) [9] 490 (2002)[9] 230 (2001) 80 (1998)[21] **Incomplete survey on east side ***Incomplete survey, too late in season	Big Marsh (2,000 ac) was historically ditched to increase grazing area. Deschutes NF has initiated restoration to return the marsh to historical conditions. Invasive reed canarygrass is present, and lodgepole pine encroachment is a concern. Seasonal water fluctuations have impacted egg mass survival. Nonnative predator is brook trout.	[6] Hayes (1997) [9] USDA Forest Service Crescent RD (2002 – 2008) [20] USDA Forest Service 2008 [21] USFWS data report [25] L. Turner, USFS, pers. comm. 2011.	Stable
Little Deschutes River/Highway 58 area - Deschutes NF	Current status unknown, only known surveys documented two adult frogs in 2001[4]	Upper Oxbow: 4 (2006) [16] Mowich Log Pond: 2 (2006) [16]	Heavy willow vegetation in riparian zone. Extent of population and connection to lower sites is not well known. Habitat suitability is likely dependant on beaver and fluvial activation of oxbows.[4]	[4] C. Pearl, pers. comm. 2006 [16] USGS 2006 survey database	Unknown
Little Deschutes River complex between Gilchrist and Sunriver - BLM Deschutes NF, and private	2 (2006)[1] 4 ad, 3 juv (2005) [1] 0 (2003) [1] 1 ad (2002) [1] 0 ad,110+ larvae (2001) [1] 4 juv. (2000) [1] Many larvae (1999) [1] 3 ad, 5 juv. (1998) [1] 2 subad, 2 juv (1997) [1] 1 ad (1995) [1] 12 ad (1994)[1] Casey Tract: 0 ad,200 juv	8 (1999) [1] 11 (2000) [1] 9 (2002) [1] 6 (2003) [1] 9 (2005) [1] Breeding confirmed in more than 10 ponds in this reach in 2006[16]. Progressing upstream: Crosswater: 86 in 5 ponds (2006) [16] Casey Tract: 11 (2010) [22] 8 (2006) [16] 293+ (2001) [1] 16 (2000) [1] 2 (2002) [1]	Threats include bullfrogs, drought, non-native predaceous fish, fluctuating water levels, and locally heavy recreational use. No survey data for private lands	[1] Prineville District Record, Bureau of Land Management [16] USGS 2006 survey database [22]C. Pearl, pers. comm.. 2010 and 2011	Unknown

	(1999) [1] 2 ad, 35 juv (2000) [1] 20 larvae (2001) [1] 1 sub-ad (2002) [1] 0 (2003) [1]	0 (2003) [1] 3) La Pine: 7 (2006) [16] 4) 62 rd Oxbow: 8 (2006) [16] 5) 100 rd Oxbow: 35 (2006) [16]			
Crescent Creek Prineville BLM Deschutes NF	8 juv. (2003) [1] 8 ad (1994) [1]	21 (2006) [16] 11 (2009) [3] 34 (2003) [1] 56 (2005) [1] 2 (2006) [1] Near Rt. 58: >15 (2010) [22] 27 (2009) [22]	Several sites along Crescent Creek. Extent of occupied habitat in unknown. Breeding confirmed near 62RD [22] New breeding site confirmed near Hwy 58 and County RD 61 [3]	[1] Prineville District Record, Bureau of Land Management [3] Crescent Ranger District Record, U.S. Forest Service (2009) [16] USGS 2006 survey database [22] C. Pearl, pers. comm.. 2010 and 2011	Unknown
La Pine/Long Prairie - BLM [1] private	1 dead ad (2005) [1] 2 ad, 1 juv (2003) [1] 1 juv (2002) [4] 0 (2001) 2 ad,1 larvae (2000) [1] 2 ad (1998) [1] 9 larvae, 42 >36mm (1996) [6]	1 (2006) Long Prairie [16] 0 (2005) [1] 12 (2003) [4] 20 (2001) [1] 14 (2000) [1]	Extent of occupied area is unknown. Extensive private land throughout. OSF documented at upper and lower ends of system. Intervening system is heavily altered (drained), so connectivity among sites may be limited. Threats include hydrological and vegetation alteration, drought, grazing, and nonnative predaceous fish and bullfrogs.	[1] Prineville District Record, Bureau of Land Management [4] C. Pearl, pers. comm. 2006 [6] Hayes (1997) [16] USGS 2006 survey database	Unknown
Sunriver [2] - Private	294 ad, 111 juv (2005) [7] 429 ad, 68 juv (2004) [7] 470 ad, 211 juv (2003) [7] 45 ad, 142 juv (2002) [7] 163 ad, 49 juv (2001) [7] 497 ad, 49 juv (2000) [7] 796 ad, 340 juv (1999) [7] All data based on fall movement data	1,132 (2009) [2] 797 (2008) [2] 631 (2007) [2] 1,163 (2006) [2] 637 (2005) [7] 357 (2004) [7] 477 (2003) [7] 698 (2002) [7] 1,182 (2001) [7] 619 (2000) [7]	Threats include non-native predaceous fish, and bullfrogs. In 2000 and 2001 weirs that helped maintain water levels in the entire lake/marsh system failed leading to a sudden drop in water level that affected reproduction. [7] However, egg mass estimates appear to have rebounded back to near record historic counts in 2006 and 2009.	[2] J. Bowerman, pers comm. 2010. [7] J. Bowerman, SRNC, pers. comm. 2005	Stable

Slough Camp – Deschutes NF	21 adults and 21 juveniles observed (2010) [25]		New site discovered in 2010. 7.5 miles down-stream of Sunriver. Threats include water level fluctuations as a result of irrigation demands on Wickiup Reservoir.	[25]L. Turner, pers. comm. 2011	Unknown
Klamath Basin 9 sites:					
Klamath Marsh NWR – USFWS and private lands	*52 (2001) 19 (2000) *50 adults collected for deformity study	183 (2008) 110 (2007) 54 (2006) 30 (2005) 3 (2004) 4 (2003) 142 (2002) 189 (2001) 191 (2000) * Wide variation in survey effort/coverage/ timing among years.	Adults, juveniles and metamorphs were documented at 46 of 95 surveyed sites Threats include non-native predaceous fish. Bullfrogs not recently found, but reports occurred in the last 20 years. Water diversions are prominent and drought can affect large portions of the Marsh.	Ross and Mauer 2000 Ross et al. 2000	Stable
Wood River Wetland – BLM and private land	106 (1998) BLM (adults, juveniles, and metamorphs) 177 (1997) 164 (1995) 124 (1994)	44 (2010) 45 (2009) 14-35 (2008)* * incomplete survey- most of egg masses had hatched by survey date 86 (2007) 75 (2006) 83 (2004) 84 (2003) 75 (2002) 171 (2000)	2000 survey was brief but documented frogs at different locations. Threats include non-native predaceous fish, bullfrogs, reed canarygrass and water fluctuations.	R. Roninger, pers. comm. 2009, 2010, 2011. Ross and Watkins 2000 Hayes 1995b; 1996	Stable
Fourmile Creek/ Springs, Crystal Spring, – Private, BOR, and NF	Fourmile Creek/ Spring 0 (2009) 0 (2005) 19 (2000) 21 (1997) 53 (1996) (adults, juveniles, and metamorphs) Crystal Spring was searched in 2000, but 0 frogs were seen.	Fourmile Creek: ≥5 (2010) [22] 0 (2009) 20 (2006) [16]	Most of the surveys have been done on Fourmile Creek/Spring site. Apparently suitable, unsurveyed habitat also exists on private land near Fourmile Creek This population may have been historically connected with the Wood River population Currently unclear how Oregon spotted frogs from these sites interact. Threats include alteration of hydrologic function, non-native predaceous fish, vegetation succession, and grazing.	A. Markus, USFS, pers comm. 2010 USGS 2006 survey database Oertley, BLM 2005 Ross 2000a, b Hayes 1998c [22]C. Pearl, pers. comm.. 2010 and 2011	Unknown
Sevenmile Creek –	2 (2009)	Seven Mile:	Threats include alteration of	A. Markus, USFS, pers comm.	Unknown

NF and private		48 (2010)[22] 33 (2009) 13 (2006)[16]	hydrologic function, non-native predaceous fish, vegetation succession, and grazing. Forest Service population is highly dependent upon habitat conditions related to stable water supply and ongoing beaver activity. Loss of either would pose a serious threat to this population.	2010 USGS 2006 survey database [22]C. Pearl, pers. comm.. 2010 and 2011	
Crane Creek - private	144 adult, subadult, and juvenile frogs documented (2010)[20] 76 frogs (adults and subadults) were captured by U.S. Geological Survey (USGS) and FWS prior to restoration work on private land at Crane Creek, individually marked, and released upon completion of habitat construction in fall 2007.	7 (2010)[24] 13 (2009)[19] 18 (2008)[14]	Threats include non-native predaceous fish and vegetation succession. Bullfrogs documented in restored reach in 2010.	[14] Adams et al. 2008, p. 13 [19]Adams et al. 2009 [24] Adams et al. 2010, p. 15	Unknown
Buck Lake – Private, BLM, and NF	0 (2009) 0 (2005) 27 (2001) 176 (1997) 84 (1996) 72 (1995) 25 (1994) (adults, juveniles, and metamorphs)	38 (2010) 16 (2009) 25 (2008) No Survey (2007) 24 (2006)[16]	Marc Hayes population estimate of about 400 (1995-1996). Most (90 percent) of the habitat is private 20 miles to nearest Oregon spotted frog population. Threats include non-native predaceous fish, exotic vegetation encroachment, grazing, vegetation succession, water diversion, and habitat alteration.	A. Markus, USFS, pers comm. 2010 and 2011 USGS 2006 survey database Ross 2001 unpublished data Hayes 1998b	Unknown
Jack Creek – Private and NF	Little or no recruitment in 2004, 2005, or 2006 5 (2006) 11 (2005) 25 (2004) 41 (2003) 33 (2002) 111 (2001) xx (2000) 82 (1999) Population estimate of 300 – 1,000 adults in 1999 (Forbes and Peterson 1999, p. 17).	18 (2010)[22] 15 (2009) 21 (2008) 11 (2007) 17 (2006) No egg mass surveys in 2004-2005 71 (2003) 60 (2002) 167 (2001) 320 (2000) 335 (1999)	Decline in egg masses in 2002 may be attributed to drought. >15.0 miles to nearest Oregon spotted frog population. Threats include succession toward woody vegetation types, livestock grazing, low water/ drought, and loss of beavers[10].	[22]C. Pearl, pers. comm.. 2010 and 2011 A. Markus, USFS, pers comm. 2008, 2010 J. Oertley, pers. comm. 2005 T. Simpson, pers. comm. 2007 Jack Creek annual egg mass survey records and A. Shovlain 2003-2004 telemetry data, Chemult Ranger District	Declining

Upper Williamson River –Private and NF	0 (2009) 0 (2006)[4] 0 (2005)[10] 12 (2000)	2 (2010, late surveys) 5 (2009) 6 (2008) 0 (2005) 0 (2004)	Severely low water levels in 2005 dried oxbows, sloughs and marshes, effectively eliminating breeding habitat (T. Simpson, pers. comm.). Egg mass surveys conducted south of Rocky Ford. Threats include irrigation diversions, non-native predaceous fish.	A. Markus, USFS, pers comm. 2008, 2010, and 2011 C. Pearl, pers. comm. 2006 Dave Ross, USFWS, pers. comm. 2005 Ross 2000c	Unknown
Parsnip Lakes vicinity - Medford BLM	< 20 breeding females	20 (2008)[15] 15 (2007) 16 (2006) 15 (2005) 13 (2004) 11 (2003)	Breeding restricted to one wetland cluster, with >75% of egg masses in one pond. Threats include isolation and small population size, loss of beaver and muskrat, vegetation succession, and sediment run-off.	[15] Parker 2009, p. 12	Unknown

SITE NARRATIVE

Washington

Beaver Creek

The Beaver Creek site is a complex of emergent marsh, stream, beaver pond, drainage ditch, and riparian habitat. The wetlands occur on property known as the old Pacific Powder site, formerly an explosives manufacturing site which is currently owned by WDFW. Egg masses were found at 11 locations within the complex, but 2 of the locations accounted for 59 percent of all the egg masses located in 2001. One of these locations was a vegetation treatment circle where all of the vegetation had been removed in late summer. The other was in tire tracks of a vehicle that had driven through the wetland prior to the 2000 breeding season, flattening the reed canary grass and exposing shallow, open water (McAllister and White 2001, p. 11). As of 2008, egg masses were only found at 4 locations and 1 location accounted for 64 percent of all egg masses found in the complex. The current status of this site is unknown.

Dempsey Creek

Oregon spotted frogs inhabit the Dempsey Creek wetlands along most of the creek's length, all of the way to the mouth of the creek at the Black River. They also inhabit the margins of the Black River upstream and downstream of the mouth of Dempsey Creek. This site occurs on public (Nisqually NWR) and private lands, including a proposed residential development and Port Blakely Tree Farm. After the Wilson Dairy was sold, cows were removed and reed canary grass encroachment resulted in a deterioration of breeding habitat. Cows have been put back on portions of Port Blakely and Nisqually NWR properties in 2009. Monitoring of Oregon spotted frogs has occurred at this site since 1996, indicating this population contains several hundred breeding adults; however, numbers began to decline at the pipeline breeding area and as of 2010, there was no evidence of breeding. a (Watson et al. 2000, p. 17; K. McAllister, pers comm. 2007, 2008). This site appears to be stable.

110th and 123rd Avenues

In 2001, two new breeding sites were located along the Black River downstream of Dempsey Creek (McAllister and Walker 2003, p. 1). While there is an aquatic corridor to connect these two sites to the Dempsey Creek site, there are lengthy segments unsuitable for prolonged occupation by Oregon spotted frogs. The conclusion reached by McAllister et al. (2004, p. 10) is that movement of frogs between the Dempsey Creek, 110th Avenue, and 123rd Avenue sites does not occur or occurs so infrequently as to be an insignificant factor in the population dynamics at any of the three sites; therefore, the three sites likely comprise separate and distinct populations. All of the Oregon spotted frog habitat associated with the 110th

Avenue site and most (perhaps all) of the habitat associated with the 123rd Avenue site is within the Black River Unit of the Nisqually NWR.

The 110th Avenue population is small with only 1 egg mass seen in 2004 (McAllister et al. 2004, p. 7), 1 in 2005 (K. McAllister pers. comm. 2006), and none since 2005 (Marian Bailey, USFWS, per comm. 2009 and 2011). In addition, typical breeding habitat no longer occurs at this site. Therefore, Oregon spotted frogs may no longer occur at this site.

The 123rd Avenue site egg mass surveys have been inconsistent in effort and area covered; therefore year-to-year egg mass counts cannot be compared to detect an overall status for this area. The majority of this site contains reedcanary grass and provides breeding habitat only when the grass has been mowed during the prior fall or laid over by winter snowfall. The two larger communal oviposition locations are along the edge of pools that are being encroached upon by reed canary grass. Therefore, the status of the 123rd Avenue population is unclear.

Allen Creek-Blooms Ditch
In summer of 2007, adults and juveniles were detected at a new location on private lands in the Black River drainage. In 2008, surveys detected egg masses in a pond in the middle of a cow pasture. While wetlands in this pasture are extensive, by late summer, Oregon spotted frogs are likely restricted to some ditches and small ponds. At this time it is unclear how or if the frogs associated with this site are hydrologically connected to other sites within the Black River drainage. The current status of this site is unknown.

Salmon Creek
The Salmon Creek site was confirmed to be an Oregon spotted frog breeding location in 2010. Salmon Creek is a tributary to the Black River, that drains into the River between Dempsey Creek and the 110th site. The oviposition site is approximately 1.6 miles (2.6 km) (creek distance) upstream from the confluence with the Black River. The site has had historical and recent human alteration, including dredging of a channel, creation of pond(s), and a dirt road that bisects the wetland. Beaver are currently active at the site. Some rush and sedges are present at the site, but the dominant vegetation is reed canary grass. The site is on private lands. The current status of this site is unknown.

Trout Lake Natural Area Preserve
The Trout Lake NAP site is part of a large (greater than 1,000 acres) wetland and riparian system that contains large expanses of emergent and scrub-shrub wetlands and riparian forest associated with Trout Lake Creek (Leonard 1997, p. 1). Leonard (1997) found five breeding areas within the main wetland. Three of the breeding areas are on the eastern edge of the NAP and the other two sites are on the western edge of the NAP. All five of these breeding areas have been surveyed annually since discovery. The highest number of egg masses was recorded in 2000 (959 egg masses), declined to 202 in 2008, and increased to 624 in 2011. Egg mass numbers have been increasing since 2008, with numbers on the eastern side of the NAP having recovered to levels documented in the 1990s. However, the decline in the western area of the preserve was much more severe with a drop to 12 egg masses and recovery is taking longer. Within the Trout Lake Creek system, no flow diversions are present upstream of the NAP; therefore, the variation observed in the number of egg masses is most likely natural. For example, in 2003, due to snowmelt and rain, water levels rose and receded dramatically at one site after egg masses had been laid. Almost all the egg masses were stranded on dry land far from water, resulting in little or no recruitment at that site that year (L. Hallock, pers comm. 2006).

Since Leonard's original survey in 1997, five additional breeding areas have been found within the NAP. Egg mass surveys at these sites have been conducted irregularly since discovery. Three of these breeding areas support small breeding aggregations (50). In 2007, one of these sites was completely dry, making it unlikely that breeding was successful; however, a similar number of egg masses (~ 35-47) have been found every year since. A new site found in 2001 near the eastern breeding areas has been monitored five times since its discovery. Egg mass numbers have fluctuated between 43 to169. Based on the proximity of this site to the

eastern breeding areas, there may be some exchange of breeding frogs between these areas especially in extreme high and low water years . A breeding site found in 2010 in the center of the NAP had >100 egg masses, indicative of a healthy-sized breeding population.

While the 2009 and 2010 egg mass counts indicate that Oregon spotted frog numbers may be rebounding within the eastern portions of the NAP, the numbers in the western portion continue to be less than half of the estimates from the 1990s. Therefore, the current status of Oregon spotted frogs at this site appears to be unknown.

Trout Lake Creek Beaver Ponds

One of the Trout Lake Creek Beaver Ponds is located within the Gifford-Pinchot National Forest, along an unnamed tributary of Trout Lake Creek. This site was approximately 10 acres in size formed by a series of beaver dams across an unnamed tributary (Leonard 1997, p. 2). Egg mass counts have been sporadic at this site. The highest egg mass count was 117 in 2001. In late 2007, the beaver dam was damaged by winter floods, reducing the wetland to about one-third of its previous size (L. Hallock, pers comm. 2008) and no egg masses were found in 2008 an 2009 (B. Scott, USFS, pers. comm. 2008 and 2009). However, L. Hallock captured two Oregon spotted frog metamorphs with tail remnants indicating that breeding had occurred at this site in 2009. In 2010, L. Hallock surveyed the site and found twenty-two egg masses; indicating egg masses were most likely missed during the 2008 and 2009 surveys because the frogs were no longer using the traditional breeding areas and instead, the egg masses were scattered around the site in small pockets of suitable oviposition habitat. This site is matrix lands under the Northwest Forest Plan and is managed as deer and elk winter range and a roaded natural area. Therefore, development for additional recreational use could occur, but none is currently proposed. The lands upstream of the beaver ponds are managed for timber. This site is hydrologically connected to Trout Lake Creek and to the Trout Lake NAP site; however, it is unknown if frogs move between these two sites.

The other occupied beaver pond was discovered in 2001 and is located on private land. Egg mass surveys have been sporadic at this location. In most years, the surveys have focused on verifying on-going occurrence rather than on accurate egg mass counts. Little is known about land use or threats to this breeding location.

The current status of Oregon spotted frogs at the Trout Lake Creek Beaver Ponds is unknown.

Conboy Lake

At Conboy Lake NWR, Oregon spotted frog egg mass surveys suggest a continued long-term decline since 1998 when 7,018 egg masses were counted. The Oregon spotted frog population at Conboy Lake NWR declined over 80 percent between 1998 and 2002 Beginning in 2002, annual egg mass hatch rate increased to over 95 percent, and the population increased from 2002 through 2004 (M. Hayes, pers. comm. 2008). Data from 2006 through 2008 are based on only a portion of the units surveyed in previous years, but data on these units suggests a precipitous decline occurred between 2004 and 2006 (Hayes et al. 2009) and egg mass numbers continued to decline in 2007. Despite the apparent success of restoration activities at Conboy Lake NWR (see Conservation Measures Planned or Implemented), a significant portion of the refuge and adjacent private wetlands have nonviable subpopulations of Oregon spotted frogs, which are unlikely to persist. Some of these subpopulations have already disappeared from these habitats since 1998. The current status of Oregon spotted frogs at this site is considered to be declining.

Oregon

Central Oregon Cascades

Camas Prairie

Camas Prairie is a 33-ha marsh site located in the White River system in the Deschutes drainage. The Camas Prairie has an isolated small population thought to be especially distinct because frogs from this population have low genetic diversity and appears to be the only remaining representative of a major genetic group that

is now almost extinct (Blouin 2010, p. 2190). Parts of Camas Prairie have been ditched in order to drain the marsh. Heavy livestock grazing has resulted in siltation and dense aquatic vegetation in the stream channel and spring pool where frogs were historically located. The current status of this site is unknown.

Lakes north of Crane Prairie

The Oregon spotted frog habitats north and west of Crane Prairie include Little Cultus Lake, Cultus Creek gravel pit, Muskrat Lake, Winopee Lake, Mink Lake Basin (Penn Lake/Cabin Meadows and unnamed marsh north of Mink Lake), Lava Lake and Little Lava Lake, Blue Pool, and Hosmer Lake). The current status of these sites is unknown.

Little Deschutes River/Highway 58 area

This floodplain area is primarily willow (Salix spp.), with mature lodgepole pine (Pinus contorta) on the surrounding uplands. The suitability of wetlands in this area is likely linked to beaver activity and lateral cutting by the Little Deschutes River. One old mill pond has limited Oregon spotted frog use and is experiencing vegetation succession. There is no current estimate of population size.

Wickiup Reservoir area

Wickiup Reservoir has a small number of frogs in the northeastern area of the reservoir, with less than 10 egg masses observed in surveys over several years (C. Pearl, pers. comm. 2006). Sporadic surveys in the western portion of Wickiup Reservoir imply it may be unoccupied or used by a few or transient frogs (Hayes 1997; C. Pearl, pers. comm. 2006).

Eggs, juveniles, and adult Oregon spotted frogs on Bureau of Reclamation land at the base of Wickiup Dam that were to be destroyed by reconstruction of the dam were translocated to nine constructed ponds in nearby Dilman meadow on the Deschutes National Forest (C. Pearl and J. Bowerman, pers. comm. 2005; Adams et al. 2006, p. 12). The original site at the base of the dam no longer appears to provide viable habitat due to dam reconstruction work in 2001 which eliminated suitable habitat at the base of the dam. In the 2 years prior to translocation, the original population had produced 11 and 9 egg masses. Since translocation, the Dilman population has increased (Adams et al. 2010, p. 13). Breeding has been confirmed in eight of the ponds (including two of the excavated ponds), juvenile recruitment documented in six of the ponds, and adults have been detected in all nine ponds (Adams et al. 2007, p. 12; Adams et al. 2008, p. 12). However, some ponds are losing open water to vegetation encroachment, and site maintenance is likely to be necessary in the future. The status of Oregon spotted frogs at this site has yet to be determined.

Gold Lake area

Gold Lake and bog are located in the 188-ha Gold Lake Bog Research Natural Area on the upstream end of Gold Lake on the Willamette National Forest. The Gold Lake Bog site consists of three small ponds (totaling 1.5 ha) within a larger bog where three major streams converge and flow through the bog. Oregon spotted frogs were collected at this site in 1961, 1966, 1982, and 1984. In 1991, juvenile spotted frogs were observed near the Salt Creek outflow of Gold Lake, which is at the opposite end of the historic locality (Hayes 1994, p. 26). This area is considered to have a stable population based on periodic monitoring by United States Geological Survey (USGS) and the Willamette National Forest.

Davis Lake/Odell Creek area

The Davis Lake/Odell Creek basin includes four localities where Oregon spotted frogs have been found: three in the vicinity of Davis Lake (Ranger Creek near where it joins Davis Lake, Odell Creek near where it joins Davis Lake, Odell Creek near Forest Service Road 4660), and one recently documented site further up the Odell Creek drainage (Scotty Big Boy Fen). Surveys by M. Hayes, Crescent Ranger District USFS staff, and USGS have detected small numbers of Oregon spotted frogs at all three sites associated with Davis Lake (1994, 2002, 2004, 2006); evidence of recent breeding in this area is limited to the detection of 7 egg masses near the Odell Creek inflow around 2000 (C. Pearl, pers. comm. 2006). No frogs were found at the Davis Lake area sites in 2009. Introduced predaceous fish and fluctuating/low water levels are likely to interact and negatively affect Oregon spotted frog occupancy at Davis Lake. This is particularly the case now that beaver

maintenance of off-lake habitats is limited or non-existent (C. Pearl, pers. obs.). Habitat at all three Davis Lake area sites (i.e., confluence of Odell Creek and Davis Lake; FS Road 4660 and Ranger Creek) was affected by the Davis Fire of 2003, which killed most of the mature lodgepole pine. However, riparian associated shrubs have responded well post-fire along Odell and Ranger Creeks (USDA Forest Service 2007. Page 238). There is no estimate of the Oregon spotted frog population in the Davis Lake/Odell Creek sites; thus, the current status of Oregon spotted frogs at these sites is unknown.

In 2009, Oregon spotted frogs (i.e., sub-adults, tadpoles and 1 adult) were identified at Scotty Big Boy Fen, located on a tributary to Odell Creek, approximately 6 miles upstream from Davis Lake. This wetland is characterized by many beaver created ponds and exhibits good habitat for Oregon spotted frogs (USDA Forest Service 2009d, pp 6 and 10). Additional surveys will help clarify the status of Oregon spotted frogs in these habitats.

Crescent Creek area
There is one documented breeding site used by Oregon spotted frogs along Crescent Creek on land managed by the Bureau of Land Management (Prineville BLM) (R. Demmer pers. Comm. 2010). In 2009, a new breeding site was confirmed on land managed by the Deschutes National Forest near Hwy 58 and County RD 61 (P. Miller pers. comm.. 2010). Most of the habitat where Oregon spotted frog breeding has been detected are on or near the floodplain of Crescent Creek and are characterized as oxbows and sloughs with predominately sedge vegetation. The extent of occupied habitat along Crescent Creek is unknown.

Little Deschutes River
Sites used by Oregon spotted frog are scattered along the Little Deschutes system from its confluence with the Deschutes River southward to near La Pine (Bowerman and Flowerree 2000, p. 6; J Bowerman, pers comm. (2010); C. Pearl. pers comm. (2010). Most of these sites are oxbow habitats, but Oregon spotted frogs also have been found associated with beaver activities, golf course ponds, and small anthropogenic impoundments. Most of the habitats where Oregon spotted frogs have been detected are on or near the floodplain of the Little Deschutes River and are characterized as oxbow scars with mainly sedge and willow vegetation. Nearby upland vegetation is predominately lodgepole pine.

Historically, it was likely that Oregon spotted frogs existed over much of Long Prairie, a marshy tributary of the Little Deschutes that is now bisected by Route 97. Recently, Oregon spotted frogs are known from the lowest portion of that habitat (just above the confluence with Little Deschutes River) and a BLM parcel near the upper end of this low-relief drainage (R. Demmer pers comm. 2010, C. Pearl, pers comm. 2010). The Long Prairie area has been drained and modified extensively, and the condition of Oregon spotted frogs in that vicinity is difficult to assess given the prevalence of unsurveyed private lands.

The status of Oregon spotted frogs at these areas has yet to be determined.

Sunriver/Deschutes River
The Sunriver site consists of an extensive complex of wetland habitat ranging from wet meadows and vernal pools to marshes and oxbows (Bowerman and Flowerree 2000, p. 3). Surveys of known and suspected Oregon spotted frog habitat were conducted in 1999 in the Sunriver area along the Deschutes and Little Deschutes Rivers from Sunriver south to LaPine. This survey was largely qualitative, noting presence and absence, while documenting 400 to 700 egg masses from 2 locations and an additional 100 egg masses widely scattered along a 3 km waterway that extends between these two major oviposition sites (Bowerman and Flowerree 2000, pp. 3-4). Subsequent surveys conducted by Bowerman utilized a fall capture and spring movement methodology, as well as surveying for egg masses (J. Bowerman, pers. comm. 2006). Fall/spring movement data represent the frogs captured moving through a major over-wintering site to a major breeding and foraging site and returning. This information does not represent all survey information, but has been consistently collected from 1999 through 2009. For two consecutive years (2000 and 2001) two weirs alternately failed, leading to a sudden drop in water levels in the middle of fall migration and the breeding season respectively, leading to low recruitment (J. Bowerman, email comm. 2006). The weirs were replaced

in 2002 and the numbers of migrating frogs and egg mass counts have returned to pre-failure levels (J. Bowerman, pers. comm. 2010). The Oregon spotted frog population at Sunriver is considered to be stable.

Slough Camp

The Slough Camp site is found on the east side of the Deschutes River in a series of wetland habitat and vernal pools that are likely inundated in the spring and become more shallow in the late summer. Edges of the habitat consist of pine encroaching upon quaking aspen stands. This site is approximately 7.5 miles downstream of Sunriver, below Benham Falls. A formal survey was not conducted but the population was detected during project implementation. Approximately 42 frogs were found during a site trip in September 2010 (21 adults with 3 being positively identified as breeding females and 21 juveniles). Multiple pools and wetland areas were checked. No egg masses were found

This was a previously unknown site. Habitat availability is similar to that described for Sunriver (wetlands, sloughs, oxbows). No other frog species were found. Threats to frogs may come from natural predators (herons, predators at larval forms). Water level fluctuations as a result of irrigation demands on Wickiup Reservoir can strand frogs in some of the sloughs and oxbows. This was evidenced in 2010 when surveys documented subadults in a shallow ditch that had water the week before, but seven days later it was dry due to the holding back of water to fill Wickiup Reservoir. The status of frogs at this site is unknown.

Big Marsh

Big Marsh is a 2,000-acre high elevation wet meadow and marsh complex managed by the Deschutes National Forest. The marsh is dominated by several sedge species. Historically the marsh was privately owned and was ditched to maximize forage production.

Sporadic surveys for Oregon spotted frogs at Big Marsh on the Deschutes National Forest have been conducted between 1994 and 2008. Hayes surveyed the site in 1994 and the Forest Service has conducted surveys annually since 2001. Seasonal water fluctuations in 2004 and 2005 negatively impacted egg mass survival (USDA Forest Service 2002-2008); however, the Oregon spotted frog population at Big Marsh is considered to be stable.

Klamath Basin

Klamath Marsh NWR

The 40,646-acre Klamath Marsh NWR is a large natural marsh along the upper portion of the Williamson River managed primarily for waterfowl and wetland habitat. The marsh hydrology is supported by the Williamson River, ground water, and a series of intermittent springs. Along the west side, the Klamath Marsh NWR is bordered primarily by private grazing lands. The Fremont Winema National Forest abuts the marsh on the north, south, and east sides.

Surveys in 2000 for adults, juveniles, and metamorphs documented Oregon spotted frogs at 46 of 95 sites surveyed in two general areas of the refuge: Big Springs Creek and the eastern portion east of Military Crossing. Tadpoles were documented at eight sites, although adults were the focus of the surveys (Ross et al. 2000). Survey efforts have varied from year to year, but in 2006 Klamath Marsh NWR staff believed the population had declined (Dave Mauser, USFWS, pers. comm. 2006); however, egg mass numbers were up in 2007 and 2008. Private lands surrounding the Refuge appear to have suitable habitat and likely contain egg masses. At this time, permission to survey on private lands has not been obtained. The status of Oregon spotted frogs associated with this site appears to be stable.

Wood River and Wood River Wetland

Oregon spotted frogs were discovered about 2 miles upstream of the mouth of Wood River in 1994 on the 3,000-acre Wood River Wetland. This site used to be managed as a private cattle ranch, but is currently managed as a wetland by the BLM Klamath Falls Resource Area. Surveys were conducted in 1994 and 1995 to determine the extent of the Wood River Wetland spotted frog population (Hayes 1995b; 1996). Surveys in

1997-98 resulted in an encounter rate almost double the 1994–1995 surveys (Hayes 1998d, p. 6). Survey results appear to have identified a change in demography from predominately juveniles to predominantly adults and sub-adults.

Egg mass surveys were conducted each spring from 1999 through 2010, although survey effort, locations and results varied. Surveys of the Wood River Wetland in 2000 documented 171 egg masses at 26 sites (1 to 29 egg masses/site) along the Wood River Canal, a small parallel ditch, and 3 sites in a pond adjacent to the canal (Ross and Watkins 2000). In 2002, an additional 23 egg masses were found approximately four miles upstream from the known population on BLM lands (David Ross, USFWS, pers. comm. 2002). It is unknown whether this represents a new population or an extension of the known population. The Oregon spotted frogs on the Wood River Wetland appear to be adjusting to shifts in the hydrologic regime, bullfrog presence, and vegetation succession (BLM 1998; Rob Roninger, BLM, pers comm. 2005, 2011). Restoration efforts, such as staff plate installation, water control structure replacement, bullfrog control, and breeding habitat creation continue within the Wood River Wetland site. The status of Oregon spotted frogs associated with this wetland appears to be stable.

Fourmile Creek, etc. complex

The Fourmile Creek, Fourmile Spring, Crystal Spring, Sevenmile Creek, Crane Creek complex(es) include a large amount of potential Oregon spotted frog habitat. In 1996 and 1997, fieldwork completed by Marc Hayes determined that Oregon spotted frogs were broadly distributed in the Fourmile Springs and Fourmile Creek areas. This habitat may have been historically connected with the Wood River habitat, though the populations may be currently isolated by the Sevenmile Canal and intervening inhospitable habitat.

Sporadic surveys for Oregon spotted frogs in Fourmile and Sevenmile Creeks have observed frogs in the margins and channels associated with beaver ponds (USGS 2006 database; Oertley 2005; Ross 2000a; Ross 2000b; Hayes 1998c, pp.4-6).

In 2007, approximately 76 Oregon spotted frogs (adults and sub-adults) were captured by USGS and FWS prior to implementation of a Partners for Fish and Wildlife restoration project on private land at Crane Creek. Habitat reconstruction involved filling of a central ditch and reestablishing stream flow in a native, meandering channel. This work included construction of several ponds and increasing water supply in riparian wetlands in order to provide Oregon spotted frog habitat. Captured frogs were held in tanks, given unique identification codes, and released upon completion of the habitat reconstruction work. USGS has been monitoring Oregon spotted frog breeding, recruitment, and movement responses to the repatriation. Reproduction has been documented at the site since 2008 (Adams et al. 2010; p. 15). Bullfrogs were documented in the restored reach in 2010.

Potential habitat near Crystal Spring was searched but no frogs were seen during the August 2000 surveys (Ross 2000).

The status of Oregon spotted frogs associated with this complex is unknown at this time.

Buck Lake

Buck Lake is located approximately 21 miles west of Klamath Falls and 6 miles south of Lake of the Woods. This site is at least 20 miles from any of the other known spotted frog populations in the Klamath Basin. Historically, this habitat was likely a large shallow marsh fed by springs and streams. Currently, Buck Lake is mainly a meadow with drainage ditches, and at least two impounded areas fed by springs and two creeks (Tunnel Creek and Spencer Creek). Most of the historic lake (over 90 percent) is in private ownership, and has been managed in various ways, most recently for cattle grazing. Areas adjacent to Buck Lake are administered by the BLM and the Fremont-Winema National Forest.

Between 1995 and 1997, Marc Hayes conducted a mark-recapture study in Buck Lake, which resulted in a population estimate of about 1,130 adults (range of less than 0 to 2,379, 95 percent CI) (Hayes 1998b, p. 10).

Demographic information from this study showed limited evidence of recruitment even though there was high water availability during these wet years. Hayes attributed this lack of substantial recruitment to the presence of resident brook trout (Salvelinus fontinalis).

The status of Oregon spotted frogs associated with Buck Lake is unknown at this time.

Jack Creek

The Jack Creek Oregon spotted frog population was discovered in 1996 on the Chemult Ranger District, Fremont-Winema National Forest. This was verified as the highest elevation extant population (5,440 feet) of Oregon spotted frogs. The habitat consists of low gradient stream segments that flow through a series of willow wetlands, moist meadows and shrub/forest wetlands. Numerous fen/seeps along the riparian corridor along with annual precipitation (mostly snowpack runoff) support perennial creek flow through most of the occupied OSF habitat.

Evidence in the form of old lodges, burrows, remnant dams, chewed vegetation, and pictures suggest beavers were once extensive along Jack Creek and its tributaries, but they have since been removed from the Jack Creek system (T. Simpson, USFS, pers. observation). The last known sighting of beaver was in 2000 (J.Dorr, USFS, soil scientist, pers. observation). Evidence of 13 beaver dams have been found within the current known Oregon spotted frog habitat (T. Simpson, pers. observation). All have been breached, but three continue to provide some shallow off-channel pool habitat; some of which is being used as breeding and tadpole habitat, as well as adult summer basking habitat (Jack Creek annual egg mass survey records and A. Shovlain 2003-2004 telemetry data, Chemult Ranger District).

From 1997 to 2002 a mark-recapture program was conducted in all occupied habitat at Jack Creek, including the private lands, to estimate approximate population size. In 1998, although egg masses were not found, breeding did take place and many young frogs were produced (Forbes and Peterson 1999, p. 5). Spring egg mass surveys have been conducted across much of the potentially suitable habitat in upper Jack Creek to estimate the number of adult breeding females. Egg mass counts exceeded 300 in 1999 and 2000, but total counts have varied between 11 and 22 egg masses from 2006 to 2010 (C. Pearl, pers. comm. 2011)

Numbers of adult Oregon spotted frogs appeared to be lower in comparison with other Oregon spotted frog populations in the Klamath Basin. The low numbers may be due to the elevation and temperature limitations of the Jack Creek site (Hayes 1998a, pp. 9-10). The 1999 population estimates for the number of adults in Jack Creek ranged from about 300 to about 1,000 Oregon spotted frogs (Forbes and Peterson 1999, p. 17). However, it appears the number of adults has declined and there was little or no recruitment in 2004, 2005, or 2006 (J. Oertley, pers. comm. 2005; T. Simpson, pers. comm. 2007).

The Jack Creek population was severely impacted by low water levels and drought in 2001 and 2002. Previous egg-laying habitat, at edges of snow melt along the Jack Creek floodplain, was not present due to low snowpack in 2003 and 2004. The egg-laying sites shifted to localized areas in several inches of standing or flowing water, including water-filled livestock trails, where they had not been observed in previous spring surveys. These trails were very ephemeral sources of water and most likely dried up before eggs could hatch or tadpoles could swim to perennial water sources (J. Oertley, pers. comm. 2005).

Jack Creek watershed has been in an extended drought since 2001 (source Klamath Basin Surface Water Supply Index, NRCS). The Surface Water Supply Index (SWSI) is used as a measure of drought. It shows a downward trend since 1980 for the Klamath Basin. The SWSI has dropped below -1.6 (drought threshold) in 8 of the last 9 years. Low water levels have limited available breeding habitat and stranded egg masses (T. Simpson, personal observation). While there were once dozens of oviposition sites clustered in 4 general areas spread out over 5.7 miles of the Jack Creek riparian corridor, now there are fewer than a dozen oviposition sites on less than 1.2 miles of the creek. Reduced amounts and more ephemeral nature of off-channel habitat used by tadpoles has also likely had a negative impact, but the degree of impact is unknown (T. Simpson opinion).

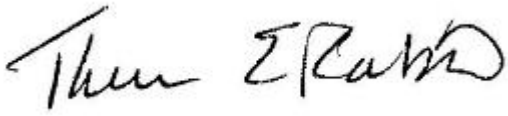
The status of Oregon spotted frogs in Jack Creek appears to be declining.

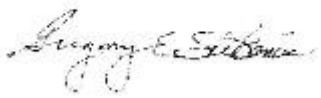
Upper Williamson River
Above the Klamath Marsh NWR, the Williamson River has oxbows, spring fed sloughs, marshes, and ditches that provide suitable Oregon spotted frog habitat. The river in this area connects with the NWR during high runoff events. In 2000, 12 adult frogs were found along sections of the Upper Williamson River between Rocky Ford and the Klamath Marsh NWR, approximately 16 km (10 mi) upstream from Klamath Marsh NWR (Ross 2000c). During 2004 and 2005, egg mass surveys were conducted south of Rocky Ford although no egg masses were found (Dave Ross, USFWS, pers. comm. 2005) and surveys in 2005 and 2006 found no adults (Oertley 2005; C. Pearl, pers. comm. 2006). Severely low water levels in 2005 dried oxbows, sloughs and marshes, effectively eliminating breeding habitat (T. Simpson, USFS, pers. comm. 2005). The status of Oregon spotted frogs associated with the Upper Williamson River is unknown at this time.

Parsnips Lake vicinity
In 2003, Dr. Michael Parker and his herpetology students discovered egg masses in the vicinity of Parsnip Lakes in Jackson County, Oregon (Parker 2009, p. 1). Subsequent surveys have confirmed the existence of a small number of adults, probably less than 20 breeding females. Parsnips Lakes are a group of emergent wetlands and wetland ponds that are separated into two clusters. The wetlands and ponds were historically maintained by beavers and muskrats, which no longer occur in this area. Oregon spotted frogs are currently restricted to one cluster of wetland ponds, with one pond serving as the primary breeding site (Parker 2009, p. 5). In addition to isolation and small population size, threats in this area include vegetation succession and loss of open-water habitat as a result of removal of beaver and muskrat. Introduced vegetation, fish, and bullfrogs do not appear to be a problem for the Parsnip Lakes population thus far. The status of Oregon spotted frogs associated with Parsnips Lake is unknown at this time.

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/01/2011
Date

Concur:  10/07/2011
Date

Did not concur: _____ _____
Date

Director's Remarks: