CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Rana pretiosa

COMMON NAME: Oregon spotted frog

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: February 2003

STATUS/ACTION (Check all that apply):
____ New candidate
_X_ Continuing candidate
___ Non-petitioned
_X_ Petitioned - Date petition received: 5-4-89
X 90-day positive - FR date: 10-17-89
X 12-month warranted but precluded - FR date: 5-7-93
No Is the petition requesting a reclassification of a listed species?
____ Listing priority change
Former LP: ___
New LP: ___
Latest Date species became a Candidate: 5-7-93
___ Candidate removal: Former LP: ___ (Check only one reason)
___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___ F - Range is no longer a U.S. territory.
___ M - Taxon mistakenly included in past notice of review.
___ N - Taxon may not meet the Act=s definition of Aspecies.@
___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian; Ranidae (True Frogs)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:
Washington, Oregon, California, British Columbia (Canada)

CURRENT STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:
Washington, Oregon, British Columbia (Canada)

LEAD REGION CONTACT (Name, phone number): Scott McCarthy (503/231-6131)

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Western Washington Fish and Wildlife Office, Dr. L. Karolee Owens (360/753-4369)
BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Range/Status

Historically, the Oregon spotted frog (Rana pretiosa)ranged from British Columbia to the Pit River drainage in northeastern California (Hayes 1997; McAllister and Leonard 1997). 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. Only 15 of 59 historic localities, where the species= previous existence can be verified (e.g., museum specimens, photographs, reliable published records), are occupied (Hayes 1997; McAllister and Leonard 1997). Currently, 35 Oregon spotted frog locations are known in Washington (1 historic, 5 new) and Oregon (12 historic, 17 new). Oregon spotted frogs have not been documented in recent surveys in California. In British Columbia, Oregon spotted frogs have been rediscovered at the historic site at South Langley, and found at three new sites in 1996 and 1997 (Hayes 1997; Hayes et al. 1997; McAllister and Leonard 1997; Mark Hayes, Portland State University, pers. comm., 1999; Kelly McAllister, Washington Department of Fish and Wildlife (WDFW), pers. comm., 1999).

Life History

Male Oregon spotted frogs are not territorial and may gather in groups of 10 to more than 25 individuals at specific locations (Leonard et al. 1993; M. Hayes, pers. comm., 2002). Breeding occurs in February or March at lower elevations and as late as May or early June at higher elevations (Leonard et al. 1993; M. Hayes, pers. comm., 2002). Egg-laying occurs at the same general location at a site in successive years (M. Hayes, pers. comm., 2002). Egg masses are generally laid communally in groups of a few to several hundred in shallow, often temporary, pools of water that are easily warmed by the sun, which hastens egg development (Licht 1971; Nussbaum et al. 1983; Cook 1984; Hayes et al. 1997; McAllister and Leonard 1997; Engler and Friesz 1998). Tadpoles metamorphose into froglets during their first summer (Leonard et al.1993). Adults begin to breed by 1B3 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 not known; however, skeleto-chronology studies indicate the species is not long-lived. Individuals 4 years of age or older are rare, and most only reach 2B3 years of age (McAllister and Leonard 1997; M. Hayes pers. comm., 2002).

Habitat

Warmwater microhabitat in different types of marsh and marsh-like habitat appear to be preferred by Oregon spotted frogs. These habitats have been found at elevations from sea level to 1,700 meters (m) (5,500 feet (ft)) in a north-south gradient (Dunlap 1955; Hayes 1997; McAllister and Leonard 1997). The highest elevation known site, however, is not at the most southern end of the species= range; Oregon spotted frogs could occur at higher elevations farther south in the range (M. Hayes, pers. comm., 2002).

Oregon spotted frogs are more likely to be found in fairly large marshes (approximate minimum size of 4 hectares (ha) (9 acres (ac)) that reach suitably warm temperatures in active-season (summer) microhabitats and can support populations large enough to persist despite high predation rates (Hayes 1994). Oregon spotted frogs have different microhabitat preferences or requirements in the breeding season, the active season, and for overwintering. In the active season, this species inhabits emergent wetland habitats in forested landscapes, although it is not

typically found under forest canopy. It is almost always found in or near a perennial body of water, such as a spring, pond, lake, or sluggish stream. These habitats usually include zones of shallow water and abundant emergent or floating aquatic plants, which are used for basking and escape cover from predators (Leonard et al. 1993; Corkran and Thoms 1996; McAllister and Leonard 1997; Joe Engler, Service, pers. comm., 1999). Breeding microhabitat consists of shallow, marginal shelves associated with the active-season habitat that typically do not retain water year-round. Overwintering habitat is aquatic and appears to be selected on the basis of sufficient dissolved oxygen and sheltering from freezing (M. Hayes, pers. comm., 2002).

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change):

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

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

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

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 (Rana catesbiana)); (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. 1996; 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).

Loss of Wetlands: Conservative estimates for Washington indicate that over 33 percent of wetlands were drained, diked, and filled between presettlement times and the 1980s (Canning and Stevens 1990; McAllister and Leonard 1997). Losses of Oregon spotted frog habitat have been greater because of the high degree of development in the low elevations of the Puget Trough. Similar losses of wetlands have occurred in Oregon (estimated 95 percent in the Willamette hydrographic basin and 98 percent in the Klamath Basin) (Hayes 1997; McAllister and Leonard 1997). 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 90 percent of its former

range because the collections of historic specimens do not adequately reflect its actual geographic and elevational range (Hayes 1997; McAllister and Leonard 1997). 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).

Hydrological Changes: Most of the currently occupied Oregon spotted frog sites are threatened by changes in hydrology. Twenty-one of 28 (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; Hayes et al. 1997; Pearl 1999). 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 (Hayes 1997; Hayes et al. 1997; Pearl 1999). Inundation of large marsh complexes and habitat fragmentation due to the construction of reservoirs in the Cascades also have eliminated and degraded this species= habitat. Relatively small areas of suitable habitat (25 ha (63 ac) or less) remaining at 23 of 28 (82 percent) sites surveyed indicate a number of these sites may be at risk because so little suitable habitat is available (Hayes 1997; Hayes et al. 1997; Pearl 1999). More recently discovered sites have not changed this basic pattern (M. Hayes, pers. comm., 2002).

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 AFactor 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 AFactor E@. Drought periods can result in reduced recruitment (addition of young individuals to the adult population) regionally (Hayes 1997; Pearl 1999). Several seasons of low water can eliminate populations of Oregon spotted frogs, particularly where a small population occupies a limited marsh habitat that has a high abundance of aquatic predators (Pearl 1999). Excessive seasonal flooding at critical periods can result in the loss of shallow wetlands needed for egg-laying and development.

Spring egg mass surveys on the Chemult Ranger District, Winema National Forest, yielded 335 egg masses in 1999 and 320 egg masses in 2000. In 2001, however, 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. Drought conditions persisted in 2002 and, although there were good water depths in the breeding pools, Oregon spotted frogs were restricted to only 50 percent of their typical summertime habitat. Only 60 egg masses were found, and 50 percent of the eggs did not hatch (T. Simpson, pers. comm., 2003).

At Conboy Lake National Wildlife Refuge (NWR), Oregon spotted frog egg mass surveys during March 2002 yielded preliminary total of 1,442 egg masses, compared to 1,630 egg masses in 2001. The reduced egg mass count indicates a continued long-term decline since 1998 when 7,018 egg masses were counted. The Oregon spotted frog population at Conboy Lake NWR has declined over 80 percent since 1998, although preliminary data indicates that over 90 percent of egg masses hatched in 2002, nearly double the estimated hatching success of previous years (J. Engler, pers. comm., 2003).
Breeding sites can be quite dynamic and significantly influenced by water conditions. 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 in-holdings or adjacent landowners. 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 early water draw downs and perennially low water resulting in annual recruitment failures. Restoration activities initiated by the refuge in 1999B2001, 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).

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; Boyer and Grue 1995). 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).

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). 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; Boyer and Grue 1995; Hecnar 1995; Environment Canada 1998; Materna et al. 1995, Northern Prairie Wildlife Research Center 1998).

For example, 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) demonstrated negative effects (inactivity, convulsive actions, and death) of one widely used synthetic pyrethroid pesticide, esfenvalerate, on leopard frog (Rana 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 (Rana utriculata), 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).

Poor water quality and water contamination have probably played a role in the decline of Oregon spotted frogs, although data specific to this species is 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 there. In 2002, algal blooms, poor water quality, and low dissolved oxygen added to the impacts of drought conditions that affected Oregon spotted frogs= reproduction on the Chemult Ranger District, Winema National Forest (T. Simpson, pers. comm., 2003).

Kirk (1988) documented spotted frog mortality due to forest spraying of DDT in 1974. Marco (1997) 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).

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. The role of rotenone treatments in the disappearance of Oregon spotted frogs from historic sites, however, is unknown (Hayes 1997).

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 mosquitos. Due to the concerns about the use of methoprene, an informal meeting of biologists from the Deschutes National Forest, Oregon Department of Fish and Wildlife (ODFW), the Fish and Wildlife Service (Service), and Four Rivers Vector Control addressed the possible effects of the mosquito abatement program on the Oregon spotted frog. To reduce impacts to the species, the company is not permitted to use the chemical on the Deschutes National Forest and is voluntarily restricting its use to a few sites. Multiagency surveys were initiated in 1999 to further determine the species= distribution in this area. Additional recommendations on the use of methoprene in the Sunriver area may be issued in the future (Carol Morehead, Deschutes National Forest, pers. comm. 1999; Dede Steele, Service, pers. comm., 1999).

Development threatens Oregon spotted frog habitat at several sites. The uplands surrounding an Oregon spotted frog site at Dempsey Creek in Washington have considerable potential for residential development. Potential development at the more recently discovered Beaver Creek site in Washington includes a gravel extraction operation, golf course, and housing development (McAllister and Leonard 1997; K. McAllister, pers. comm., 1999). Development at these sites would likely result in habitat loss and hydrological changes, as well as changes in water quality and introduction of contaminants into the aquatic environment. Although the Washington Department of Natural Resources established the Trout Lake Natural Area Preserve and The Nature Conservancy also purchased some land at Trout Lake, the remaining land is not secure and is vulnerable to subdivision. In Oregon, the LaPine Creek site landowner has expressed a desire to develop the property. Future widening of U.S. Highway 97 may remove a substantial portion of a breeding pond located in an Oregon Department of Transportation right-of-way.

Livestock Grazing: The effects of livestock vary with the site, livestock numbers, and the

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; Hayes 1998a; 61 FR 25813). The resulting increases in temperature and sediment production, alterations to stream morphology, effects on prey organisms, and changes in water quality have the potential to negatively affect Oregon spotted frogs.

Fourteen of 28 (50 percent) sites surveyed were directly or indirectly influenced by livestock grazing (Hayes 1997; Hayes et al. 1997; Pearl 1999). Severe habitat modification has been caused by too many 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). Preliminary results from exclosure studies at two sites in Oregon show significant improvement in vegetation where cattle are excluded (M. Hayes, pers. comm., 1999). However, 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 disturbed wetland communities (Hayes 1997; Hayes et al. 1997; McAllister and Leonard 1997). Fencing to exclude livestock to protect the riparian corridor at Jack Creek in Oregon also excludes native grazers, such as elk, and may be resulting in the loss of Oregon spotted frog habitat to succession (changes in plant communities) (Hayes 1998a).

Cattle numbers, distribution, and time of grazing were not adjusted for drought conditions in Oregon spotted frog habitat on the Chemult Ranger District, Winema National Forest, in 2001 and 2002. Cattle congregated in the 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 (T. Simpson, pers. comm., 2003).

Changes in Vegetation: Exotic plant invasions, such as reed canarygrass (*Phalaris arundinacea*), may completely change the structure of wetland environments and can create dense areas of vegetation that are unsuitable as Oregon spotted frog habitat (McAllister and Leonard 1997). Exotic vegetation was found at 20 of 28 (71 percent) sites surveyed. Reed canarygrass dominates large areas at lower elevations and is apparently continuing to broaden its range to higher elevations (Hayes 1997; Hayes et al. 1997; Pearl 1999).

Plant succession may be a factor at almost all Oregon spotted frog sites, particularly where marsh-to-meadow changes are occurring (Hayes 1997). Pearl (1999) suggested that, in lake basins with a variety of aquatic habitats available, reproductive sites only exist within a narrow successional window, although a broader range of habitat types is used by adults in the nonbreeding season. 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). Recent succession-related losses of Oregon spotted frog habitat apparently have been considerably greater than succession-related habitat gains (Hayes 1997; Hayes et al. 1997). Such succession-related losses may be accelerated by human activities, livestock grazing, altered hydrology, and development.

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. Simply listing a species as endangered or threatened publicizes the species= rarity, however, and can precipitate both legal and illegal commercial or scientific interest. The species can be threatened by unauthorized and uncontrolled collection for commercial and scientific purposes, by researchers, or by curiosity seekers. Listing the Oregon spotted frog as endangered increases the vulnerability of a species that has an easily identifiable and accessible habitat.

C. Disease or predation.

Most Oregon spotted frog populations are small, and small populations that are already stressed by other factors, such as drought or low food availability, are more vulnerable to random, naturally occurring events. Amphibians are affected by a variety of diseases, and some diseases are known to negatively affect declining amphibian species.

Disease: The specific effects of disease and parasitism on Oregon spotted frogs is not well-documented. Red-leg syndrome has been identified in several declining amphibian species (Berger 1999). However, this syndrome is not known to be a significant problem for the Oregon spotted frog (Andrew Blaustein, Oregon State University, pers. comm., 1999). The fungus Saprolegnia has been suggested as one of the causes of amphibian declines in the Pacific Northwest and is probably a much more significant threat to the Oregon spotted frog. McAllister and Leonard (1997) reported destruction of developing Oregon spotted frog egg masses by this fungus. Saprolegnia was documented on Oregon spotted frog eggs by using DNA analysis (Chris Pearl, USGS Biological Resources Division, pers. comm., 2003).

Amphibians exposed to ultraviolet-B radiation (UV-B), a type of solar radiation that causes damage to plants and animals, may be more susceptible to pathogens and parasites that can interfere with normal development and increase mortality. Kiesecker and Blaustein (1997) found increased mortality associated with the fungus Saprolegnia ferax in amphibian embryos exposed to UV-B. This suggests the possibility that mortality is increased by the combined effects (synergism) of the fungus and UV-B. Field experiments conducted in the Oregon Cascade Mountains determined that ambient levels of UV-B from the sun can cause high rates of mortality and deformities in embryos of some amphibian species (Blaustein et al. 1997). Amphibian species, such as the Oregon spotted frog, that lay their eggs in areas with little vegetative cover will experience greater exposure to UV-B. Oregon spotted frog hatching success, however, was not affected in one study of the effects of ambient levels of UV-B. Additional experimental tests at various life stages are warranted as changing atmospheric conditions and fluctuating UV-B levels may decrease hatching success at the study sites at different times or in other regions (Blaustein et al. 1997).

Recent studies have examined the effects of dissolved organic matter in pond water on the exposure of amphibian eggs to UV-B (Palen et al. 2002), and how exposure to UV-B varies as a result of differences in timing of breeding (e.g., earlier breeding in dry years reduces exposure to UV-B, which increases during the spring) (Corn and Muths 2002). Palen et al. (2002) concluded that dissolved organic matter in pond water, which affects the spectral characteristics of natural waters, likely mediates the physiological effects of UV-B on amphibian eggs in all but the cleanest waters. Corn and Muths (2002) concluded that embryos of the boreal chorus frogs

(Pseudacris maculata) have not been exposed to an increase in UV-B because of a variation in the timing of breeding, despite a recent trend of increasing UV-B in Colorado during a time when amphibians are breeding. How these results may apply to the effects of UV-B on Oregon spotted frogs specifically has yet to be examined.

The North American Reporting Center for Amphibian Malformations (Northern Prairie Wildlife Research Center 1997) 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 (Northern Prairie Wildlife Research Center 1997).

Predation: 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). Introduced fish species within the historic range of the Oregon spotted frog may have contributed to losses of populations. These species include smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), pumpkinseed (Lepomis gibbosus), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), brown bullhead (Ameiurus 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; Hayes 1997; Hayes et al. 1997; McAllister and Leonard 1997; J. Engler, pers. comm., 1999). Oregon spotted frogs, which are palatable to fish, did not evolve with these introduced species and may not have the mechanisms to avoid predatory fish that prey on the tadpoles of native amphibians.

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). Brook trout, occurring at 18 sites, 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). Brook trout predation may have affected Oregon spotted frog populations during the 1992 and 1994 droughts (Hayes et al. 1997). Brook trout are likely to prey on Oregon spotted frog larval stages under drought conditions. Dropping water levels cause overlap in habitat use between these two species by reducing refuges and concentrating vulnerable life stages of the Oregon spotted frog (Hayes et al. 1997; Hayes 1998b).

Demographic data suggest introduced fish have a negative effect on Oregon spotted frogs because sites with a disproportionate ratio of older spotted frogs to juvenile frogs (i.e., poor recruitment) also have significant numbers of brook trout and/or fathead minnow (Hayes 1997, 1998a). Field experiments are needed to accurately determine the role of predation by introduced fish on Oregon spotted frogs. There are, however, relevant studies of the relationship between introduced fish and closely related frog species. 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 fewer than 10 adult frogs and no egg masses or tadpoles (Pilliod and Peterson 1997). 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). Pearl (1999) concluded that brook trout are probably the most significant threat to one population in Oregon and, when combined with low water conditions, can lower recruitment in drought years. Although, there are no experimental data, observations and evidence from other amphibian species strongly suggest introduced fish represent a significant threat to Oregon spotted frogs (Pearl 1999).

Bullfrogs have been introduced into the Pacific Northwest from eastern North America. Bullfrogs will eat native frogs and can outcompete or displace them from their habitat or optimal conditions (Kiesecker and Blaustein 1998). They are able to outcompete native frogs because (1) bullfrogs have evolved with many of the introduced fish species and developed defenses against these predators; (2) bullfrog tadpoles are not palatable to fish or birds (Kruse and Francis 1997; McAllister and Leonard 1997); (3) bullfrog tadpoles may displace tadpoles of other frog species from warmer water where conditions are optimal to cooler water, which slows development (Hayes 1994; Kiesecker and Blaustein 1998); and (4) bullfrog tadpoles are more resistant to the effects of pesticides and heavy metals than other ranid frogs (Hays and Jennings 1986). Recent research indicates that Oregon spotted frogs are more susceptible to predation by adult bullfrogs than are red-legged frogs. This may be one factor limiting Oregon spotted frog distributions in historic lowland habitats, where red-legged frog populations are more stable (C. Pearl, pers. comm., 2003).

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; Hayes et al. 1997). 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). The digestive tracts of a sample of 25 adult bullfrogs from Conboy Lake contained 9 Oregon spotted frogs, including 7 adults (McAllister and Leonard 1997). 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).

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). 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).

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, WAC 232B12B014). 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 do not provide protection for their habitat (RCW 77.15.120). Under the State Forest Practices Act, however, the

Washington State Forest Practices Board has the authority to designate critical wildlife habitat for State listed species affected by forest practices (WAC 222B16B050, WAC 222B16B080). Critical wildlife habitat has not been designated by the Forest Practices Board for the Oregon spotted frog.

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 635B100B0040). Once an Oregon Anative 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 635B100B0100 to OAR 635B100B0180; ORS 496.171 to ORS 496.192).

The Environmental Protection Agency (EPA) recently approved new water quality standards for temperature, dissolved oxygen, and pH that Oregon proposed in 1996. The EPA examined the effects of implementing these standards on the Oregon spotted frog, as well as other candidate and proposed species. The EPA concluded, however, that there is too little available information to make a determination of the effects on this species. These water quality standards may change again within the next 2 years to improve habitat conditions for salmonids and warmwater fish. It is uncertain, however, if the Oregon spotted frog will be considered as part of the review and approval process for these new standards (Elizabeth Materna, Service, pers. comm., 1998, 1999).

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. Species that have been proposed for listing are covered by the conference provision under section 7(a)(4) of the Act. For example, the Oregon spotted frog is not considered a sensitive species by the Bureau of Land Management (BLM) or USDA Forest Service (Forest Service). Because this species is a candidate, however, both of these Federal agencies are subject to laws, regulations, and land management plans that address the need to protect sensitive, candidate, and federally listed species, as well as their habitat. Service policy requires candidate species be treated as proposed species for purposes of intra-Service consultation where Service actions may affect candidate species (e.g., candidate species on NWR). Listing the Oregon spotted frog as an endangered species would provide protection for this species under sections 4,7, 9, and 10 of the Act.

Section 404 of the Clean Water Act is the primary Federal law that could provide protection for 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. 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. Oregon spotted frog habitat could be affected by a project requiring only a nationwide permit from the Corps. 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.

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

Most species= populations are cyclic in nature, responding to such natural factors as weather events, disease, and predation. These factors, however, have less impact on a species with a wide and continuous distribution. Populations that are small, fragmented, or isolated by habitat loss, water development, water diversion, and other human-related factors are more vulnerable to extirpation by natural randomly occurring events and cumulative effects. The small sizes and isolation of the majority of Oregon spotted frog populations makes them even more vulnerable to drought, disease, and predation. Natural recolonization is unlikely in 23 of 28 (82 percent) Oregon spotted frog sites due to their high degree of isolation (Hayes 1997; Hayes et al. 1997; Pearl 1999).

Changes in water levels due to drought can cause seasonal loss of habitat and degradation of essential shoreline vegetation. Hayes (1997) 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; Hayes et al. 1997). 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).

Egg mass surveys of Jack Creek Oregon spotted frog population on the Chemult Ranger District, Winema National Forest, yielded counts of 335 egg masses in 1999 and 320 egg masses in 2000. 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. In 2002, although there were good water depths in the breeding pools, 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, alteration of the bank condition, and trampling by cattle (T. Simpson, pers. comm., 2003).

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; Green 1985). The offspring are infertile, however, and the two species seldom occur together. No Oregon spotted frog and Columbia spotted frog populations are known to occur together.

FOR RESUBMITTED PETITIONS:

a. Is listing still warranted? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. Is a proposal to list the species as threatened or endangered in preparation? Yes

d. If the answer to c. above is no, provide an explanation of why the action is still precluded: Since publication of the 2002 CNOR, the publication of a proposed rule to list this species has been precluded by other higher priority listing actions, and based on work scheduled we expect that will remain the case for the remainder of Fiscal Year 2004. Almost the entire national listing budget has been consumed by work on various listing actions taken to comply with court orders and court-approved settlement agreements, emergency listing, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of the Oregon spotted frog as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify nonprivate owners):

In Washington, two Thurston County Oregon spotted frog populations occur on private land, and one population occurs on NWR land (Black River Unit of the Nisqually NWR). The two Trout Lake sites are on both private and public land, including the Washington Department of Natural Resources= Trout Lake Natural Area Preserve and Gifford Pinchot National Forest. The Conboy Lake population occurs predominately within the Conboy Lake NNWR, with the remaining portion on privately owned land.

In Oregon, 89 percent of the Oregon spotted frog populations are at least partially in public ownership (Forest Service, BLM, and the Service). Only two sites in the Deschutes drainage, La Pine and Little Deschutes River, are primarily 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, with a small portion of it on privately owned land. 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. The five sites in the Klamath Basin are under both Federal and private management. The Klamath Marsh NWR is managed by the Service, but portions of that population also occur on private lands. The Wood River Wetlands locality includes land managed by BLM and private land. The Fourmile Creek and Buck Lake localities include private, BLM, and Winema National Forest lands. The Jack Creek population is on the Winema National Forest and privately owned land. Five more recently discovered sites include three on Forest Service land, and two that are partly on BLM land and partly on private land.

PRELISTING (Describe status of conservation agreements or other conservation activities):

In July 2000, we entered into a Conservation Agreement with the Forest Service and the 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 will be used in this 10-year agreement to address the threats that include site size, introduced fish (i.e., brook trout), effects of drought, habitat succession, and isolation of these populations. USGS Biological Resources Division continues working with the Forest Service and ODFW and hopes to expand the work in 2003. Plans include additional surveys in remote basins and continuation

of fish removal efforts where reestablishment of Oregon spotted frogs is planned (C. Pearl, pers. comm., 2003).

Surveys were conducted in the Sunriver area near Crescent, Oregon, in 1999. These surveys were part of a multiagency effort to learn more about the Oregon spotted frog=s distribution and make a determination on whether the chemical methoprene should continue to be used for mosquito control in this area (see AFactor A@).

The Big Marsh site in Oregon, which has the largest population of Oregon spotted frogs, is currently undergoing modification to restore historic habitat conditions. Big Marsh is included in the Oregon Cascades Recreation Area. Restoring wetland values and providing for semi-primitive recreation are goals for this area. Restoration efforts, involving installation of dams and breaches in the west ditch, have 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, Oregon spotted frogs were found in small ponds that had been created by fire burning into roots and peat. Continued monitoring of the effectiveness of the restoration efforts is needed (J. Kittrell, pers. comm., 2003).

In 1995, Ridgefield NWR 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. However, analysis of 2000-2001 breeding season telemetry data has not been completed, and analysis of refuge data on longevity, demographics, and growth via pit tagging studies has not yet been initiated. A full analysis of annual shifts in breeding locations and the identification of causal factors in the long-term population decline have also not been initiated (J. Engler, pers. comm., 2003). The final report on the oviposition aspects of the study was completed in 2000 (Hays et al. 2000).

In 1999-2001, 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. 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. 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 have disappeared from these habitats since 1998. 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).

In Spring 2001, personnel from Nisqually NWR and WDFW observed Oregon spotted frogs on a parcel of land purchased by the refuge for the Black River Unit of the Nisqually NWR. Oregon

spotted frogs were observed in an emergent wetland dominated by spikerush (Eleocharis sp.). However, much of the surrounding wetlands are dominated by reed canarygrass. A wetland restoration and enhancement project for this site has been developed by the refuge.

In 1997, Port Blakely Tree Farms, L.P., WDFW, and the Service 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. A final report on the ecology of this remnant population was completed in 2000 (Watson et al. 2000). In 2002, WDFW and Port Blakely Tree Farm personnel captured 241 Oregon spotted frogs; 86 (36 percent) had been marked in 2001. Egg mass surveys located 124 egg masses (K. McAllister, pers. comm., 2003). The Dempsey Creek population was found to occupy a considerably larger area than previously recognized as a result of reconnaissance of the Williams Pipeline Company pipeline crossing of the Black River upstream of the mouth of Dempsey Creek (K. McAllister, pers. comm., 2003). A pilot project was initiated to attempt to find Oregon spotted frogs between known breeding sites in the Black River drainage, but this initial trapping effort did not detect Oregon spotted frogs in the Black River corridor between the breeding sites. A more intensive effort will be conducted in 2003 (K. McAllister, pers. comm., 2003).

In 1997 and 1998, the Oregon spotted frog population at Trout Lake Natural Area Preserve and the Trout Lake beaver dam wetlands were surveyed in a study to determine breeding size and the relative size of this population. Research and monitoring continues at this site.

Several habitat-use studies were conducted in 2000B2001 to establish movements of Oregon spotted frogs between active-season habitat and overwintering habitat. Using uniquely marked (PIT tags), individuals were followed at Dempsey Creek, Trout Lake, and Conboy Lake NWR from September 2000 to February 2001.

Graduate thesis research, initiated in 2000 at the Beaver Creek site in Washington, includes a habitat manipulation study. Studies of the Penn Lake population in Oregon by the Service and the U. S. Geological Survey 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 U.S. Geological Survey included a genetics study and a study of a population=s status, effects of introduced fish, and habitat associations.

In Oregon, a Conservation Agreement has been developed between the Service, ODFW, the Sunriver Nature Center, and the communities of Sunriver, Crosswater, and Vandevert Acres. The purpose of the conservation agreement is to join these communities to implement conservation measures for the Oregon spotted frog. The conservation area includes 188 ha (465 ac) within the 1,214 ha (3,000 ac) ownership area. In 1999, survey results suggested a total Oregon spotted frog population within the conservation area in excess of 4,000 adult frogs. Conservation measures to be implemented include providing information to local residents and property owners, using Integrated Pest Management strategies for wildlife pest and weed control,

limiting application or release of chemicals to Oregon spotted frog water bodies to those approved by the Service, preventing or reducing bullfrog colonization, and monitoring Oregon spotted frog populations and water quality.

A partnership of several Federal agencies, the ODFW, the Sunriver Nature Center, and North Unit Irrigation District have been 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. The Bureau of Reclamations= need to restore the dam, because of public safety concerns, would eliminate a drainage ditch that provided breeding, rearing, and adult habitat for 40B50 Oregon spotted frogs. A conservation plan was developed that included populations studies, habitat creation, population relocation, and biological monitoring. In 2000, explosives were used to create new habitat, consisting of six ponds, in a meadow in the Deschutes National Forest. Nine egg masses were moved from the ditch to the ponds in the spring; 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 indicates that 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. Two years of monitoring have been completed, and the population will be monitored at least into 2003 (Korson and Pearl 2002; C. Pearl, pers. comm., 2003).

Microsatellite and mitochondrial DNA analyses from Oregon spotted frogs from 20 of the known populations in Oregon and Washington were surveyed for variation at 13 microsatellite loci. Fifteen of the populations and a sample from British Columbia were surveyed for mtDNA variation. Analyses indicate that Rana pretiosa is subdivided into four main groups, with the Klamath basin group being the most distinct. The low numbers of alleles per locus and low heterozygosities in each population suggest low effective sizes in these Oregon spotted frog populations, with some populations much smaller and more isolated than others (e.g., Camas Prairie). Genetic connectedness is low on a small geographic scale. Results indicate that low movement and/or substantial genetic drift occurs among populations. The Klamath basin, central Cascades and two Washington groups should be treated as four separate units for management purposes. The Camas Prairie group may be the last representative of a fifth genetic group (Blouin 2001).

Designation of conservation units assists the Service and other agencies in identifying priority areas for conservation planning under the consultation (section 7) and recovery (section 4) programs. The Service has identified eight conservation units within the historic range of the Oregon spotted frog that are considered essential to the survival and recovery of the species:

(1)Puget Trough
(2) Willamette Valley below 500 m (1,500 ft)
(3) Southwest Washington Cascades
(4) West Oregon Cascades, 500 m (1,500 ft) to the crest
(5) East Oregon Cascades, (i.e., Deschutes Hydrographic Basin)
(6) Klamath Hydrographic Basin
(7) Closed Interior basins of Oregon and northern California
(8) Pit River drainage

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LISTING PRIORITY (place * after number)

THREAT

Magnitude	Immediacy	Taxonomy	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	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: The high magnitude of threat is due to small populations with patchy and isolated distributions; there are a wide range of threats to both individuals and their habitats. Some populations are more vulnerable than others, and a loss of any populations will significantly reduce the range and genetic diversity of the species. Habitat restoration and management actions have not prevented a decline in the reproductive rates in some populations.

Imminence: Although some conservation measures, including habitat restoration, are being initiated for some populations, other populations continue to decline in spite of management actions. Each population is faced with multiple actual and potential threats that could seriously reduce or eliminate any of these isolated populations and further reduce the range of the species.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Rowan Gould March 6, 2003
Acting Regional Director, Fish and Wildlife Service Date

Concur: Steve Williams April 5, 2004
Director, Fish and Wildlife Service Date

Do not concur:
Director, Fish and Wildlife Service Date

Director's Remarks: _____

_____

_____

Date of annual review: February 2003

Conducted by: L.K. Owens

Comments:

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