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Washington State Status Report for the Northern Leopard Frog

by Kelly R. McAllister, William P. Leonard, Dave W. Hays and Ronald C. Friesz

Washington Department of
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Wildlife Management Program

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600 Capitol Way N
Olympia, Washington 98501-1091

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The Washington Department of Fish and Wildlife maintains a list of endangered, threatened and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011, Appendix). In 1990, the Washington Fish and Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297, Appendix). The procedures include how species listing will be initiated, criteria for listing and delisting, public review and recovery and management of listed species.

The first step in the process is to develop a preliminary species status report. The report includes a review of information relevant to the species' status in Washington and addresses factors affecting its status including, but not limited to: historic, current, and future species population trends, natural history including ecological relationships, historic and current habitat trends, population demographics and their relationship to long term sustainability, and historic and current species management activities.

The procedures then provide for a 90-day public review opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any State Environmental Policy Act findings. During the 90-day review period, the Department holds at least two public meeting; one in eastern Washington and one in western Washington. At the close of the comment period, the Department completes the Final Status Report and Listing Recommendation for presentation to the Washington Fish and Wildlife Commission. The Final Report and Recommendation are then released 30 days prior to the Commission presentation for public review.

This is the Final Status Report for the northern leopard frog. **Submit written comments on this report by November 30, 1999 to: Endangered Species Program Manager, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501-1091.** The Department will present the results of this status review to the Fish and Wildlife Commission for action at the December 10-11, 1999 meeting.

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EXECUTIVE SUMMARY

The northern leopard frog is one of the most widely distributed amphibians in North America. Recently, however, declines in the populations of this species have been reported from throughout North America, including the Pacific Northwest. In Washington, museum records indicate that the leopard frog inhabited at least 18 general areas in eastern Washington, many of these along the Columbia River and its major tributaries.

The northern leopard frog has been called the "meadow frog" for its summertime movements away from natal ponds. They may range widely into a wide variety of habitats, even hay fields and grassy woodlands, but apparently require a high degree of vegetative cover for concealment. Leopard frogs require permanent deep water for overwintering, in proximity to seasonal ponds and wetlands for breeding. Tadpoles feed on algae, rotting vegetation, and detritus. Adult frogs feed primarily on insects, but will also eat other frogs (including small leopard frogs), worms, snails, crustaceans, spiders, and other kinds of small animals.

Northern leopard frogs breed in spring, soon after ice and snow have disappeared, usually in March or April, but this varies with altitude and latitude. Males arrive at ponds first and females follow generally 5-7 days later. Egg masses are typically attached to emergent vegetation, including sedges or rushes, but can be unattached. They are generally deposited in water less than 65 cm (26 in) deep and tend to be clumped in areas well exposed to sunlight.

The majority of the mortality among leopard frogs occurs in the tadpole stage. Waterfowl, fish, bullfrogs and aquatic insects are thought to be responsible for much of this mortality. Adults are eaten by snakes during the summer and fall months. Because leopard frogs move from breeding to summer to overwintering habitats, vehicles on roads are a significant mortality source. Roads built between breeding ponds and larger summer, fall, overwintering water bodies can result in large numbers of vehicle-killed leopard frogs.

Bullfrogs, which are native to eastern North America, have the potential to displace native frogs, including northern leopard frogs. Adult bullfrogs are large and will consume almost any moving object which will fit in their mouths. Newly metamorphosed bullfrogs are significantly larger than leopard frogs, and have been documented to eat them.

Sightings of leopard frogs in Washington since 1970 have been from 3 counties; Grant, Whitman, and Pend Oreille. Eighteen Washington locales (from both museum records and historic sightings) were identified in 1992. Surveys were completed in 16 of the 18 areas identified where leopard frogs once occurred. Additional areas were searched by other biologists.

Field surveys conducted since 1992 confirmed the species in only two areas in the state, both of which are in the Crab Creek drainage, Grant County. One historic but unsurveyed area, on the campus of Washington State University, may still be populated by frogs most likely liberated

from laboratory experiments. Four separate leopard frog sites at one area in the Crab Creek drainage, and two separate occupied sites at the other area in the Crab Creek drainage have been located. The number of leopard frogs at each of these localities is not known. The number of occupied sites within areas appears to change over time, with surveys indicating some sites disappearing and some newly located.

There are a variety of factors that have potential to adversely affect remaining leopard frog populations in Washington. It is not known for certain what factors alone may trigger extirpation of leopard frogs from a site. Agricultural chemicals have been implicated in the decline of amphibians in other areas. Rotenone used to control unwanted fish can kill leopard frog tadpoles. The increasing spread of bullfrogs, which are known to prey upon leopard frogs and other amphibians, is a major concern. Introduced fish are known to eat amphibians, and are thought to cause significant declines in leopard frog populations.

A number of habitat-related changes have caused declines in other regions and at other sites, and these are possible factors in Washington. Land use changes, irrigation projects, and development have contributed to changes in the hydrology of many areas, potentially affecting amphibians through rapid changes in water levels during critical embryonic and larval periods. Disease may also have contributed to the decline witnessed in Washington. Research, monitoring, and evaluation of the factors potentially causing the decline of leopard frogs are essential to their conservation.

Future population declines are likely to occur in Washington without management effort. A clear understanding of factors causing the decline of the species is needed, as well as an action plan to protect the remaining populations in Washington. Additional field work will be necessary to determine if the leopard frog has been completely eliminated in the areas of historic occurrence where it was not found during recent surveys, or if it survives in places in significantly reduced numbers.

Due to the significant reduction in range and abundance of leopard frogs in Washington, and the continued threats to the remaining occupied sites, it is recommended that the leopard frog be classified as an endangered species in Washington.

TAXONOMY

The northern leopard frog belongs to the order Anura (frogs and toads), family Ranidae, or true frogs, and to the genus *Rana*, the only genus of true frogs in North America. Twenty-one species of true frogs inhabit North America (six are native to Washington), including the bullfrog, Oregon spotted frog, northern red-legged frog, and the green frog. The species name is *pipiens,* and no subspecies of *Rana pipiens* are currently recognized (Stebbins 1985).

DESCRIPTION

Most frogs of the genus *Rana* have two dorsolateral folds (glandular ridges) and generally have long hind legs and webbed feet. The leopard frog is either green, brown or gray above, and creamy white below. It's coloration is cryptic, tending to match the vegetation where it is usually found. It has dark brown oval spots on the head, back, sides, and legs (Stebbins 1951), although spotting may be absent on recently transformed frogs. It is for this pattern of brown spots that the leopard frog is named. Leopard frogs are easily recognizable by the narrow light border surrounding the dark spots covering the body (Nussbaum et al. 1983). The groin region is light green with small brown spots, and the undersides of the hind legs are cream colored with patches of green and maroon (Leonard et al. 1993). Adults are between 6.4 and 11cm (2 ½ to 4 3/8 in), with females larger than males (Stebbins 1951). The skin is generally smooth. Ears are conspicuous and about 3/4 the size of the eye (Nussbaum et al. 1983).

Tadpoles are generally medium to dark brown and covered with fine gold-colored spots that are often aggregated. Eyes are bronze, and the ventral area of the body is often almost transparent, so that the viscera can be seen through the dark skin (Nussbaum et al. 1983). The fins of the tail are translucent and covered with bronze-like iridescence. Tadpoles grow to approximately 8.5 cm (3.3 inches) in length (Nussbaum et al. 1983).

DISTRIBUTION

North America

The leopard frog is one of the most widely distributed frogs in North America. It is found in all provinces of Canada, and in the United States, across the northern states from New England to Washington. It is found in all the western states east through Colorado, and south to New Mexico and Arizona. In the midwestern states of South Dakota, Colorado, Nebraska, and Iowa, it hybridizes with the plains leopard frog (*Rana blairi*).

Washington

Historical. A summary of museum records for Washington indicates 8 counties where leopard frogs are known to have occurred (Table 1, Fig. 1) (McAllister 1995). The first locality where

Table 1. Northern leopard frog (*Rana pipiens*) museum specimen records for Washington.

County	Source[1]	Date	Location
Benton	PSM 1370-5	4 Sept. 1931	3 mi. NW of Kennewick
Benton	PSM 1948 & 2452	8 April 1937	3 mi. NW of Kennewick
Benton	PSM 2907-8	14 June 1941	8 mi W of Kennewick
Grant	UWBM 2270-3	4 Oct. 1991	North Potholes along Crab Creek channel
Klickatat	PSM 5304	4 June 1946	Alderdale
Okanogan	WSU 58-431-2	15 July 1958	8 mi NW of Tonasket, Spectacle Lk
Okanogan	PSM 9127-8 & 9224	30 Aug. 1958	W end of Spectacle Lake
Pend Oreille	PSM 5351-7	6 June 1946	9 mi. N of Newport
Pend Oreille	PSM 5297	6 June 1946	9 mi. N of Newport
Pend Oreille	MVZ 46442	20 April 1948	14.4 mi. SSE Locke, SR-6
Pend Oreille	WSU 58-407	7 July 1958	9 mi. SSE of Cusick
Pend Oreille	WSU 58-405-6	7 July 1958	11 mi. SE of Cusick
Pend Oreille	PSM 9169-70	29 Aug. 1958	1 mi. N of Usk
Pend Oreille	WSU 59-312-3	18 June 1959	4 mi. SSE Ruby
Pend Oreille	WSU 75-1035-6	18 June 1959	4 mi. S Ruby
Spokane	PSM 9597	26 Nov. 1962	Spokane River Bank
Walla Walla	WWC H01032-40	?	?
Walla Walla	WWC H01025	10 Jan. 1960	?
Walla Walla	WWC H01027	?	?
Walla Walla	WWC H01026	4 Oct.1970	?
Walla Walla	WWC H01031	?	Whitman Mission
Walla Walla	USNM 010922	June 1881	Ft. Walla Walla
Walla Walla	USNM 32044-6	June 1881	Ft. Walla Walla
Walla Walla	WWC H01021	20 Oct. 1900	1 mi. W of College Place
Walla Walla	WWC H01020	20 Oct. 1959	Walla Walla
Walla Walla	WWC H01030	24 Sept. 1962	2 mi. W of College Place
Walla Walla	WWC H01019	28 Sept. 1962	Whitman Mission
Walla Walla	WWC H0129	28 Sept. 1962	Whitman Mission
Walla Walla	WWC H01023-4	7 Oct. 1962	4 mi. W of Walla Walla
Walla Walla	USNM 045367	11 Sept. 1890	Touchet
Walla Walla	USNM 045380	16 May 1891	Touchet
Walla Walla	PSM 1868 &1949	8 April 1937	14.4 mi. W of Walla Walla
Walla Walla	PSM 2476-7	7 Sept. 1938	3 mi. E of Touchet, 14.4 mi W of Walla Walla
Walla Walla	WWC H01028	Oct. 1940	Mud Creek
Walla Walla	PSM 7373-7	2 Aug. 1950	1 mi. W of Touchet
Walla Walla	PSM 9492	8 June 1960	1 mi S of Touchet
Walla Walla	WSU 58-364	23 June 1958	0.5 mi. W of Touchet
Walla Walla	WWC H01022	18 Oct. 1962	2 mi. S of Touchet
Walla Walla	WSU 75-1044	23 June 1958	Columbia River, SW Walla Walla County
Walla Walla	WSU 58-361-3	23 June 1958	0.5 mi N state line, near Walla Walla R. mouth
Walla Walla	PLU A0637-9	30 June 1959	Burbank
Whitman	PSM 9525-6	21 Aug. 1958	0.5 mi. NNW of Lewiston, Idaho

[1] Source abbreviations: MVZ - Museum of Vertebrate Zoology, Berkeley; PLU - Pacific Lutheran University; PSM - Slater Museum of Natural History, Tacoma; USNM - U.S. National Museum, Washington D.C.; UWBM - University of Washington Burke Museum; WSU - Charles R. Conner Museum, Washington State Univ., Pullman; WWC - Walla Walla College (collection now housed at Washington State University).

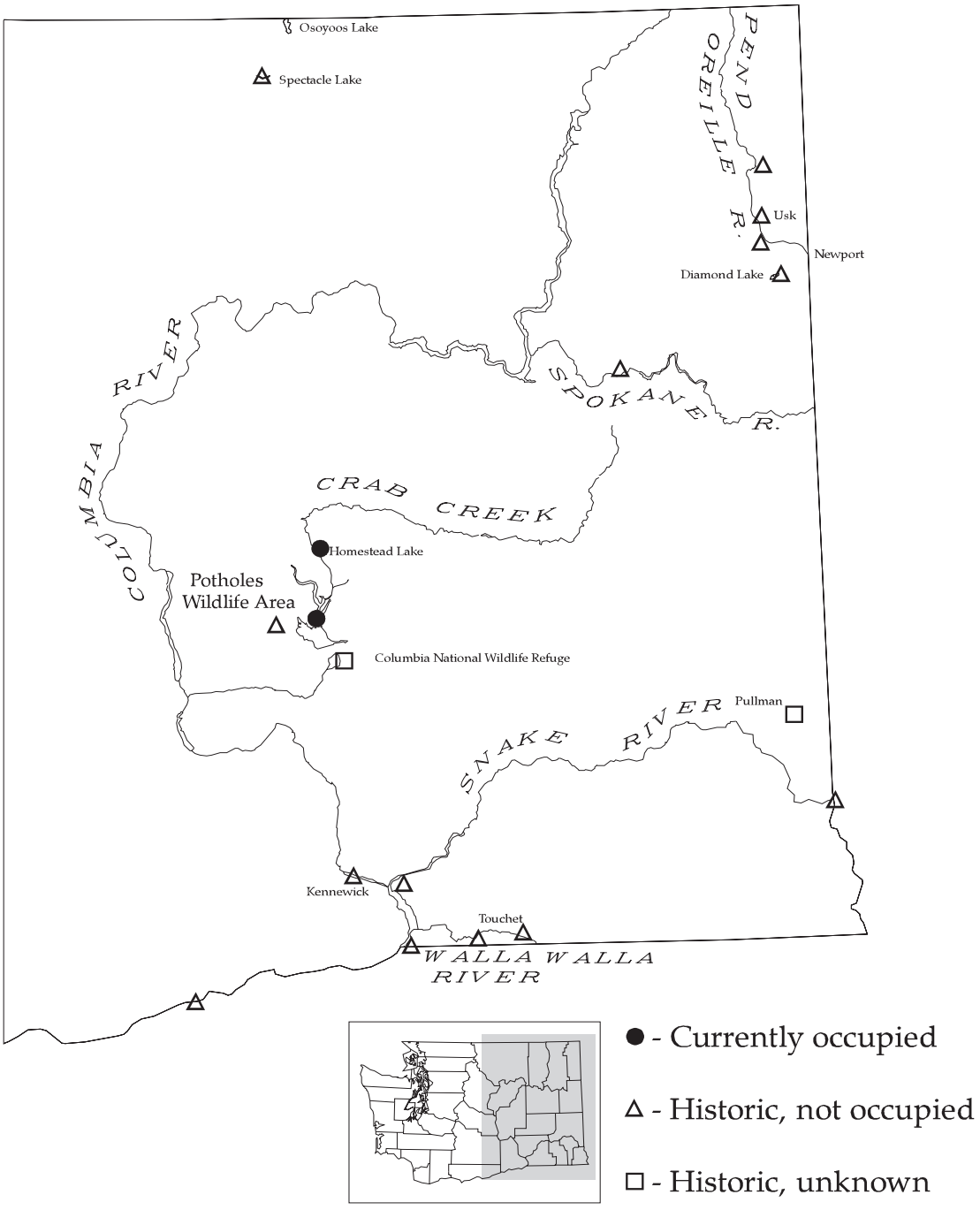

Figure 1. Historic and current distribution of leopard frogs in Washington.

leopard frogs were collected in Washington was Fort Walla Walla in 1881 (Table 1). Leonard et al. (1999) queried museums throughout North America for leopard frog specimens from Washington State. Out of more than 100 institutions queried, specimens of northern leopard frogs from Washington were found in six: the U.S. National Museum, Washington D.C.; Slater Museum of Natural History, Tacoma; Pacific Lutheran University, Tacoma; University of Washington Burke Museum, Seattle; Washington State University Conner Museum, Pullman; and the University of California Museum of Vertebrate Zoology, Berkeley. Leonard et al. (1999) visited the Slater Museum of Natural History and Pacific Lutheran University to examine specimens. At their written request, other museums shipped specimens for inspection. They examined all Washington specimens to verify the accuracy of identification.

Current. Field surveys conducted since 1992 confirmed the species in only two areas in the state, both of which are in the Crab Creek drainage, Grant County (Fig. 1). One historic area, the Columbia National Wildlife Area, was not surveyed by Leonard et al. (1999) because surveys between 1986-1989 by refuge biologists revealed no leopard frogs (W. Radke, pers. comm.). An additional historic area, on the campus of Washington State University, may still be populated by frogs, most likely liberated from laboratory experiments.

NATURAL HISTORY

Reproduction

No studies of the reproductive cycle of leopard frogs have been conducted in Washington. Nussbaum et al. (1983) report that northern leopard frogs breed in spring, soon after ice and snow have disappeared, usually in March or April, but this varies with altitude and latitude (Fichter and Linder 1964). Males arrive at ponds first and females generally follow 5-7 days later (Hine et al. 1981).

Onset of reproduction varies among sites and between years, likely as a function of climate. Oviposition in Wyoming followed the onset of male chorusing by two or three days and corresponded to periods of warm weather (daytime high air temperatures higher than 15º C (59ºF) and low air temperatures at or above 0º C (32º F)(Corn and Livo 1989). Onset of reproduction (male chorusing) typically began between March and May in Wyoming (Corn and Livo 1989). In Quebec, onset of male chorusing occurred when water temperatures reached 8º C (46º F), and oviposition peaked when water temperatures reached 10º C (50º F)(Gilbert et al. 1994). Hine et al. (1981) also report breeding to occur when air and water temperatures are near or above 10º C (50º F) in Wisconsin. Males tend to congregate and call in limited areas of the breeding waters, usually in shallows near shore where there is bottom vegetation (Nussbaum et al. 1983). Leopard frogs breed from April to June in Idaho, depending upon elevation (Fitcher and Linder 1964). In general most leopard frogs mature at age 2, although some mature at ages 1 and 3, and the number of eggs laid increases with body size (Gilbert et al. 1994; Merrill 1977).

Eggs of leopard frogs are typically deposited in a flattened spherical mass, approximately 7-15

cm (3-6 inches) by 5-7 cm (2-3 in), in open marshy expanses near the surface, usually attached to grasses or other vegetation (Stebbins 1951). Generally 2,000 to 6,500 eggs are laid per cluster, but smaller clusters have been reported (Corn and Livo 1989, Gilbert et al. 1994).

Sex ratios. Hine et al. (1981) and Merrell (1968) found breeding sex ratios skewed decidedly to males, while fall surveys indicated equal proportions of males and females. Hine et al. (1981) speculated that females are under-represented in spring surveys due to their secretive breeding habitats.

Mortality

Merrell (1977) reports that the majority of the mortality among leopard frogs occurs in the tadpole stage. Waterfowl, fish, bullfrogs and aquatic insects are thought to be responsible for much of this mortality. Adults are eaten by snakes during the summer and fall months. Garter snakes (*Thamnophis* spp.) are thought to be a common predator of leopard frogs (Merrell 1977). Because leopard frogs migrate from breeding to summer to overwintering habitats, vehicles on roads are a significant mortality source. Roads built between breeding ponds and larger summer, fall, and overwintering water bodies can result in large numbers of vehicle-killed leopard frogs (Merrell 1977). The lack of oxygen in water inhabited by overwintering leopard frogs has resulted in large winter kills (Merrell 1977).

Tadpoles may be killed and eaten by numerous vertebrate and invertebrate predators. Among the vertebrates are belted kingfishers (*Ceryle alcyon*), hooded mergansers (*Lophodytes cucullatus*), common garter snake (*Thamnophis sirtalis*), western terrestrial garter snakes (*Thamnophis elegans*), neotonic tiger salamanders (*Ambystoma tigrinum*). Turtles may also prey upon tadpoles.

Many introduced species, including largemouth bass (*Micropterus salmoides*), pumpkinseed (*Pomoxis gibbosus*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), carp (*Cyprinus carpio*), and rainbow trout (*Oncorhynchus mykiss*) have been introduced to waters within the historic range of the leopard frog and may have played a role in losses of leopard frog populations (see Hayes and Jennings 1986 for a thorough discussion). Hayes (1994a) also mentioned the potential for harm from an introduced warmwater crayfish (*Procambarus clarkii*) which has not been verified to occur in Washington (C. Burley, pers. comm.).

Drought is apparently an important source of mortality as well. Corn and Fogleman (1984) document local extirpation of leopard frogs when drought dried ponds in the fall and winter months. Hine et al. (1981) found 2 of 5 breeding ponds to not produce young because they dried up prior to metamorphosis one year. He also found that in 1976, during the worst drought in a century, only 4 of 23 ponds that had breeding activity produced frogs.

Behavioral Characteristics

Voice. The leopard frog voice is described by Stebbins (1985) as:

> "a low "motorboat" or snorelike sound interspersed with grunting and chuckling, lasting about 1-5 seconds. Choruses are a medley of moaning, grunting, and chuckling that suggests the sounds made by rubbing a well-inflated rubber balloon. Individuals may squak when jumping into water or scream when caught"

Mating behavior. Male leopard frogs appear not to be very discriminating when selecting a mate, seizing both males and females during mating. If a male is seized by another male, he gives a "release call" and is then released (Merrell 1977). If a gravid female is seized, she will remain silent, but may attempt to gain her release. When the female mates, she normally extrudes her entire egg complement in a single mating, and the male generally releases her within one minute after oviposition. The males and females will then generally leave the breeding pond after mating and not breed again that year. If seized by a male after release of eggs, the female will emit a release call, and then will be released by the male (Merrell 1977).

Foraging. Tadpoles are grazers. Their mouth parts are equipped with rough tooth rows that allow them to scrape plant surfaces and ingest plant tissue and bacteria. They also consume algae, detritus and, probably, carrion. At metamorphosis, leopard frogs become carnivorous, and will take only moving prey (Merrell 1977). They do not eat under water.

Home range. Dole (1965) showed that the concept of home range can be applied to leopard frogs. He showed that adult frogs establish a home range and tend to return to it year after year, indicating a strong affinity for a particular area. Home ranges varied from $15m^2$ ($18yds^2$) to $600m^2$ ($700\ yds^2$). Home ranges varied significantly between different habitats, and appeared to depend upon distribution of water, amount and distribution of suitable habitat, and size and age of frogs. Permanence of occupancy of home range also varied between study sites.

Escape. Leopard frogs use their cryptic coloration as a defense from predators. They escape notice by remaining motionless, but if disturbed enough, they give a series of explosive jumps for cover of water or vegetation, and then freeze (Merrell 1977). If leopard frogs jump into water, they burrow into crevices or vegetation for concealment. They usually creep along the ground or in water after jumping, presumably to avoid predators focused on their landing spot (Merrell 1977). Hine et al. (1981) report that during light periods (daylight or full moon) leopard frogs showed an increased wariness to disturbance on both land and in water.

Interspecific Relationships

Bullfrogs, which are native to eastern North America, have the potential to displace native frogs, including northern leopard frogs. Adult bullfrogs are large and will consume almost any moving object which will fit in their mouths. Newly metamorphosed bullfrogs are significantly larger

than native ranids and will eat newly metamorphosed leopard frogs (McAlpine and Dilworth 1989). Bullfrogs co-evolved with many of the warmwater fish that now inhabit Washington waters. As is typical for amphibians which breed in waters inhabited by predatory fish, bullfrogs developed defenses against these predators. Bullfrog larvae are unpalatable to fish (Kruse and Francis 1977). Fish avoid eating bullfrog tadpoles and will generally not eat them unless starved. It appears that piscivorus birds are similarly unwilling to eat bullfrog tadpoles. Radke (pers. comm.) monitored an abundance of piscivorus birds visiting drying ponds on the Columbia National Wildlife Refuge in Adams County. These birds fed daily at the ponds until there were no more sunfish or other small fish in the ponds. The birds then ceased visiting the ponds despite an abundance of bullfrog tadpoles remaining. At least one species, the common garter snake, will readily eat bullfrog tadpoles (Leonard, pers. obs.). However, common garter snakes are probably unusual in this regard. They are among the few predators that can eat the highly toxic rough-skinned newt with little or no ill effect (Brodie 1968). Interestingly, the ovarian eggs of bullfrogs are palatable and readily eaten by a variety of predators (Licht 1969a).

There are also behavioral interactions that may bear upon the survival of native ranids sympatric with bullfrog populations. Bullfrog tadpoles were shown in experiments to displace red-legged frog tadpoles from the warmer, shallower waters that provide optimal conditions for growth. In the presence of bullfrog tadpoles, red-legged frog tadpoles frequented deeper water, grew more slowly, and metamorphosed at lower body weight (Kiesecker pers. comm.). There is also evidence that bullfrogs are more resistant to the effects of toxicants (e.g. pesticides and heavy metals) than some other ranid frogs. Bullfrog tadpoles are tolerant of numerous pesticides (see review in Hayes and Jennings 1986). All of the aforementioned factors combine to favor bullfrogs in many environments formerly suitable for other frogs. One of the key problems with assigning the blame for frog declines to introduced bullfrogs is the potential that habitat alterations are at least as responsible as bullfrogs for creating conditions in which native species are lost and bullfrogs become abundant (Hayes and Jennings 1986).

It has been generally recognized that introduced predatory fish have caused local extirpation of native frogs in some situations (Hayes and Jennings 1986, Bradford et al. 1993, Monello and Wright 1999). Predatory fish can reduce the abundance of amphibians, eliminate sub-populations or cause local extinctions, and can alter distribution patterns and behavior (Bradford et al. 1993, Kiesecker and Blaustein 1998). Hecnar and M'Closkey (1997) studied 178 ponds in Ontario, Canada, comparing species richness and presence/absence of amphibians classified by the type of fish present. Amphibian species richness was significantly lower at ponds having predatory fish present than at non-predatory, or fish-free ponds. They found that the leopard frog occurred less frequently when predatory fish were present than without predatory fish.

Kiesecker and Blaustein (1998) demonstrate adverse impacts of smallmouth bass (*Micropterus dolomieui*) on red-legged frogs when bullfrogs are present as well. They found that red-legged frogs made behavioral changes in the presence of bullfrogs, that in turn made them more suceptible to predation by smallmouth bass. Carp may displace leopard frogs through the habitat changes brought about as a result of its feeding activity. Carp can destroy emergent vegetation, increase turbidity, and eliminate or greatly reduce algal and invertebrate populations. In addition,

introduced fish may exert indirect effects by introducing pathogens that can be transmitted to amphibians (Blaustein et al. 1994a).

Food

The leopard frog is considered an opportunistic forager, taking food indiscriminately, with choice largely determined by size (McAlpine and Dilworth 1989). Tadpoles feed on algae, rotting vegetation, and detritus (Licht 1974), apparently deriving significant nutritional benefit from the bacteria present in some of these foods. Adult frogs feed primarily on insects, but will also eat other frogs (including small leopard frogs), worms, snails, crustaceans, spiders, and other kinds of animals.

HABITAT REQUIREMENTS

General

The northern leopard frog has been called the "meadow frog" (Conant and Collins 1993) for its summertime movements away from natal ponds. They may range widely into a wide variety of habitats, even hay fields and grassy woodlands (Nussbaum et al. 1983), but apparently require a high degree of vegetative cover for concealment. In southern and eastern Idaho they occur from lowlands to mountain tops, but in Washington and Oregon are confined to valleys (Nussbaum et al. 1983). They breed in a variety of waterways where there is an abundance of vegetation to provide cover (Leonard et al. 1993).

Breeding Habitat

In Minnesota, the typical breeding pond of leopard frogs is described as "a temporary pond ... with a maximum depth of 1.5-2 m (5-6.5 ft), that does not support a fish population, is not connected with any other body of water, and dries up periodically every few years" (Merrell 1977). Merrell (1977) noted that the distance between overwintering and breeding sites was often 1-2 km (0.6-1.2 mi) in Minnesota. Hine et al. (1981) used a simple model to identify potential leopard frog breeding habitat. They first located potential overwintering ponds (permanent, deep water), and then surveyed all temporary ponds within 1.6 km (1 mi) of these potential overwintering sites.

As a result of a two year study of breeding habitat in Wisconsin, Hine et al. (1981) summarized 7 important breeding pond characteristics: 1) less than 1.6 km (1 mi) from overwintering sites, 2) 1.5 m (5 ft) or more deep, 3) emergent vegetation on approximately 2/3 of the circumference of a pond to provide escape from predators; submergent vegetation on approximately half of the surface area to provide cover for escape, a site for attachment of egg masses, and a source of food for tadpoles, 4) a gradual slope to the bottom, which provides a greater area of emergent vegetation, and in turn more cover, 5) open water that is exposed, which will warm ponds faster,

6) areas surrounding the ponds in hay, unmowed pasture, shallow marshes, or meadow. 7) ponds that maintain water most years but dry up periodically and eliminate fish.

In Wyoming, Corn and Livo (1989) report that egg masses are typically attached to emergent vegetation, including sedges (*Carex* spp.) or rushes (*Scirpus* spp.), but can be unattached. Mean water depth at 39 egg mass sites in Wyoming was 12.9 cm (5 in)(Corn and Livo 1989), and in Quebec, all egg masses were deposited at a water depth less than 65 cm (25 in) (Gilbert et al. 1994).

Egg masses are not deposited uniformly across the breeding pond. They tend to be clumped in areas well exposed to sunlight (Gilbert et al. 1994). Merrell (1977) noted that the egg masses are generally concentrated at the sites where males gather to call for mates at the beginning of the season.

Seasonal Habitat

Summer. After breeding adult leopard frogs move away from ponds to a variety of habitats nearby. The distribution appears to be related to a variety of factors, including available food, adequate cover, and moisture. They can be anywhere from a few meters from a pond to as much as 1.6 km (1 mi) away (Merrell 1977, Hine et al. 1981). They avoid areas with grass over 1 m tall, wooded areas, open areas lacking vegetation, or heavily grazed or mowed areas (Merrell 1977). In Minnesota, adult leopard frogs are found in vegetation 15-30 cm (6-12 in) high, whether it be meadow, pasture, or roadside ditch. Merrell (1977) suggests that leopard frogs are more abundant along ecotones. Merrell (1970) also suggests that the larger the frog, the further they travel from water. Leopard frogs usually move at night, and will make greater summer movements on rainy days.

After metamorphosis, young frogs may emigrate from their breeding ponds to a more permanent water source, like a lake or stream. Small frogs often congregate along the shores of these water sources. They appear to segregate from larger frogs by remaining at the water's margin. Emigration occurs in late July in Minnesota and early July in Iowa (Bovbjerg 1965, Merrell 1977).

Fall and Winter. Movements in the fall begin with cooler weather, often in September (Merrell 1970). Movement generally takes place at night, but frogs may move on dark rainy days as well. Overwintering occurred between the months of October and April in Minnesota (Merrell 1977). Overwintering habitats are larger lakes and streams that do not freeze completely during winter. Leopard frogs do not hibernate during winter, but activity levels are much reduced. Frogs can be found wintering among stones or sunken logs, in leaf litter or vegetation depressions along the bottom (Emery et al. 1972, Cunjak 1986).

POPULATION STATUS

Past

The Walla Walla River drainage is an area of Washington where leopard frogs were collected very early (late 1800's) and persisted until at least the late 1950's (Table 1, Fig. 1). Metter (1960) collected numerous specimens in this drainage and describes the species as abundant in the places he found it (D. E. Metter, pers. comm.).

The Snake River and its associated flood plain wetlands may have provided an aquatic corridor to historically abundant leopard frog populations in Idaho and Montana. In addition to the Walla Walla River populations, the link may have been responsible for colonization along the Columbia River downstream to Fort Dalles, Oregon (Cooper and Suckley 1860, USNM #3375).

Although Slevin (1928) mentions a pre-1865 collection of a leopard frog in Stevens County, Washington, Slipp (1940) presented convincing evidence that these animals had probably been collected in Idaho. However, populations known from the Pend Oreille River drainage are a logical extension of the leopard frog populations known from British Columbia and the Idaho panhandle. The last sighting of leopard frogs in the Pend Oreille River drainage was a 1970 observation of an apparently small population at Diamond Lake (D. Paulson, pers. comm.) (Fig. 1).

In 1960, Metter discovered a population at Spectacle Lake in Okanogan County and suggested that it had resulted from human introduction. Carl (1949) reported on a population in British Columbia at the north end of Lake Osoyoos, approximately 30 km north of Spectacle Lake. Given both the isolation of these two sites from other populations and the past widespread practice of using frogs and tadpoles as fish bait, these populations appear most likely to have resulted from human introductions (Stan Orchard, pers. comm.). A specimen from the Spokane River in Spokane County is likely associated with the Pend Oreille River populations, but could have resulted from human introduction.

Additional details concerning the historic distribution and relative abundance of leopard frogs in Washington were provided by Metter (1960). At one slough near the Oregon border in Walla Walla County, Metter observed leopard frog adults and young closely spaced around the entire shoreline. Two different sloughs in Pend Oreille County had numerous adult leopard frogs sitting in the tall grass. During the period of Metter's field work (1958-59), leopard frogs were found at relatively few localities but the species was sometimes very abundant (Metter pers. comm.) He noted “For a frog apparently as highly adaptable as leopard frogs, it is surprising there are so few published records from the study area”.

After Metter's field work there are few recorded sightings of leopard frogs in Washington. At Columbia National Wildlife Refuge, leopard frogs were plentiful in 1962 (G. Orians pers.

comm.) and apparently remained plentiful through at least the summers of 1972-73 (D. Paulson pers. comm.). The last sighting at the Columbia National Wildlife Refuge is from 1985 (L. Beletsky, pers. comm.). The leopard frog is still found in the upper Crab Creek drainage, north of the refuge. Leopard frogs in upper Crab Creek were first recorded in 1975, on the Desert Unit of the Columbia Basin Wildlife Area in Grant County (P. Cheney, pers. comm.) and have been observed periodically in the adjacent Potholes Unit.

Present

Leonard et al (1999) compiled a list of 1960-1995 sightings of leopard frogs through communications with zoologists and others working within the historic range of the leopard frogs (Table 2). They accepted sight records only from observers with well-established credibility and from others who could document their sightings with photographs.

Table 2. Northern leopard frog (*Rana pipiens*) sight records for Washington.

County	Date	Observer	Location
Grant	9/16/80	R. Friesz	North Potholes, isolated ponds (T18N R28E S7)
Grant	10/8/88	W. Radke	North Potholes (T18N R27E)
Grant	8/10/89	W. Radke	North Potholes (T18N R27E)
Grant	8/17/89	W. Radke	North Potholes (T18N R27E)
Grant	8/2/93	C. Thoms C. Corkran	Crab Creek channel, Potholes Reservoir
Grant	4/10/94	C. Corkran	Crab Creek channel, Potholes Reservoir
Grant	9/94	G. Lavoy	Potholes Wildlife Area, S of Mae Valley exit off I-90
Grant	5/12/95	P. Bartels	Potholes Reservoir dike (T18N R27E S15)
Grant	5/18/95	P. Bartels	Potholes Reservoir West Arm (T18N R27E S8)
Grant	1962	G. Orions	Columbia N.W.R.
Grant	1972	D. Paulson	Columbia N.W.R.
Grant	1985	L. Beletsky	Columbia N.W.R.
Grant	5/78	M. Brady	Small ponds below dike of Soda Lk. (T17N R29ES19)
Grant	5/21/75	P. Cheney	Dodson Road Rest Area (T18N R26E S15)
Grant	4/95	M. Monda	Homestead Lake
Pend Oreille	7/17/70	D. Paulson	Diamond Lake
Whitman	1985	P. Bartels	Lake DePuddle near Washington St. Univ. Campus

After reviewing museum and sight records, Leonard et al. (1999) grouped occurrences of leopard frogs into eighteen geographic areas where records were located within 8 km (5 mi) of one another. These eighteen areas are shown in Table 3 and Fig. 2. Locations that were very general, e.g., Walla Walla, were lumped with more specifically described locations in the same vicinity. One area, the Spokane River bank, was imprecise and there were no specific localities nearby. Surveys in this area covered the suitable habitat that could be found in a broad area around the Spokane River. National Wetland Inventory (NWI) maps were used to locate wetland and riparian habitats in the vicinity of each leopard frog area. The locations of these habitats were recorded on base maps used during field surveys. Additional habitats were located in the

field.

Sightings of leopard frogs in Washington since 1970 have been from 3 counties; Grant, Whitman, and Pend Oreille (Table 2). Leonard et al. (1999) began surveying the 18 locales for leopard frogs in Washington in 1992 through 1996. They completed surveys in 16 of the 18 areas (Fig. 2). All of their searches were conducted between March through October, the season when the leopard frog is likely to be active and visible (Table 3). During 1992-96, field searches consisted of walking along the edges of streams and ponds and wading through wetlands with a long-handled dip net searching for adult and larval forms. The net was used to sweep shallow, vegetated areas for tadpoles. Visual searches were made in different habitat components, although the most time was spent searching emergent plant communities. They attempted to capture all adult amphibians encountered. All amphibians and reptiles encountered were identified and recorded. They did not survey two areas: Lake DePuddle, near Washington State University in Pullman and Columbia National Wildlife Refuge (USFWS).

Table 3. Dates of surveys for northern leopard frogs by Leonard et al. (1999).

Area No	County	Location	Date(s)
1	Benton	W of Kennewick	25 April 1992
2	Grant	Potholes Unit, Col. Basin Wildl. Area	8 Oct. 1993*; 26 March 1994*; 23 April 1995; 24 April 1995*; 16 June 1995
3	Grant	Columbia N.W.R.	Not Surveyed
4	Grant	Desert Unit, Col. Basin Wildl. Area	26 March 1994
5	Grant	Homestead Lake, Gloyd Seeps Unit	24 April 1995; 20 July 1995*
6	Klickitat	Alderdale	19 Aug. 1994; 20 Aug. 94; 22 Sept. 1994; 23 Sept. 1994
7	Okanogan	Spectacle Lake	30 May 1993
8	Pend Oreille	Pend Oreille River, Dalkena/Furport area	19 April 1995; 18 June 1995
9	Pend Oreille	Pend Oreille River, Usk vicinity	18 June 1995
10	Pend Oreille	Pend Oreille River, SE of Ruby	8 July 1993; 19 April 1995; 18 June 1995
11	Pend Oreille	Diamond Lake	19 April 1995
12	Spokane	Spokane River Bank	9 July 1993
13	Walla Walla	Whitman Mission/Walla Walla vicinity	15 July 1993; 23 Sept. 1994
14	Walla Walla	Touchet vicinity	23 Sept. 1994
15	Walla Walla	Along Columbia R., so. of Walla Walla R.	23 Sept. 1994
16	Walla Walla	Burbank	1996
17	Whitman	NW of Lewiston, Idaho	23 June 1995
18	Whitman	Lake DePuddle, W.S.U. vicinity	Not Surveyed

***** Searches that were successful in finding leopard frogs.

Extant populations of leopard frogs were located at the Potholes Reservoir and Gloyd Seeps

Units of the Columbia Basin Wildlife Area in Grant County (Fig. 2). Four separate leopard frog sites at the Potholes Reservoir were located, while two separate occupied sites at Gloyd Seeps were located. The number of leopard frogs at each of these localities is not known. The number of occupied sites at the north end of the Potholes Reservoir appears to change over time, with surveys indicating some sites disappearing and some newly located.

Lake DePuddle reportedly had a small breeding population during 1985. This human-made pond is close to Washington State University and these animals likely came from liberated biology lab frogs (P. Bartels, pers. comm.). Leonard et al. (1999) did not survey the Columbia National Wildlife Refuge. The refuge biologist, William Radke, had searched most, if not all, of the wetlands and ponds on the refuge between 1987 and 1989 for northern leopard frogs (W. Radke, pers. comm.) without success. Additional searches for northern leopard frogs on the Columbia National Wildlife Refuge were conducted by Department of Fish and Wildlife biologists during the 1990's (P. Bartels, pers. comm.). Radke believed that introduced and thriving populations of bullfrogs were likely responsible for the demise of leopard frogs on the refuge. William Radke also searched ponds on the Saddle Mountain National Wildlife Refuge for northern leopard frogs.

Other surveys. Since the work by Leonard et al. (1999) the Department of Fish and Wildlife has followed up on a number of reports of leopard frogs in Pend Oreille and Spokane Counties and did not find leopard frogs (Zender, pers. comm.). Surveys for leopard frogs were conducted in and adjacent to the Pend Oreille river from the Box Canyon Dam to Albeni Falls Dam in 1997 and 1998 (Nyman, pers. comm.). Additional riparian wildlife studies in the Pend Oreille valley coordinated by Margaret O'Connell did not find leopard frogs (pers. comm. to K. McAllister). Lianna Aker also conducted amphibian surveys in northeastern Washington as part of her master's thesis and did not discover leopard frogs (Zender pers. comm.).

Amphibian surveys have increased in the past few years on the Wenatchee National Forest by district biologists and students from Central Washington University, under the direction of professor David Darda. Rhonda Little (ENSR Consulting and Engineering 1995) conducted extensive amphibian surveys on the Yakima Training Center. Dana Visalli and Ann Sprague coordinated and conducted amphibian inventories in the Methow Valley and parts of Okanogan County. Department of Fish and Wildlife staff conducted amphibian surveys in small ponds and lakes in Grant and Douglas counties, principally locations potentially occupied by tiger salamanders (Friesz, pers. comm.). Leonard and Friesz (pers. comm.) conducted amphibian surveys in Klickitat, Yakima, Grant, Lincoln, Spokane, Okanogan, and Chelan counties in 1998 and 1999. They found a single dead frog in Grant County, in one of the two areas currently occupied by leopard forgs.

Hallock (pers. comm.) conducted a number of amphibian surveys in eastern Washington between 1996-1998 for the Department of Natural Resources Natural Heritage Program. She surveyed the Hanford Nuclear Reservation for amphibians at virtually every area that had suitable breeding sites, including sloughs and inlets on the Columbia River, ponds associated with the irrigation

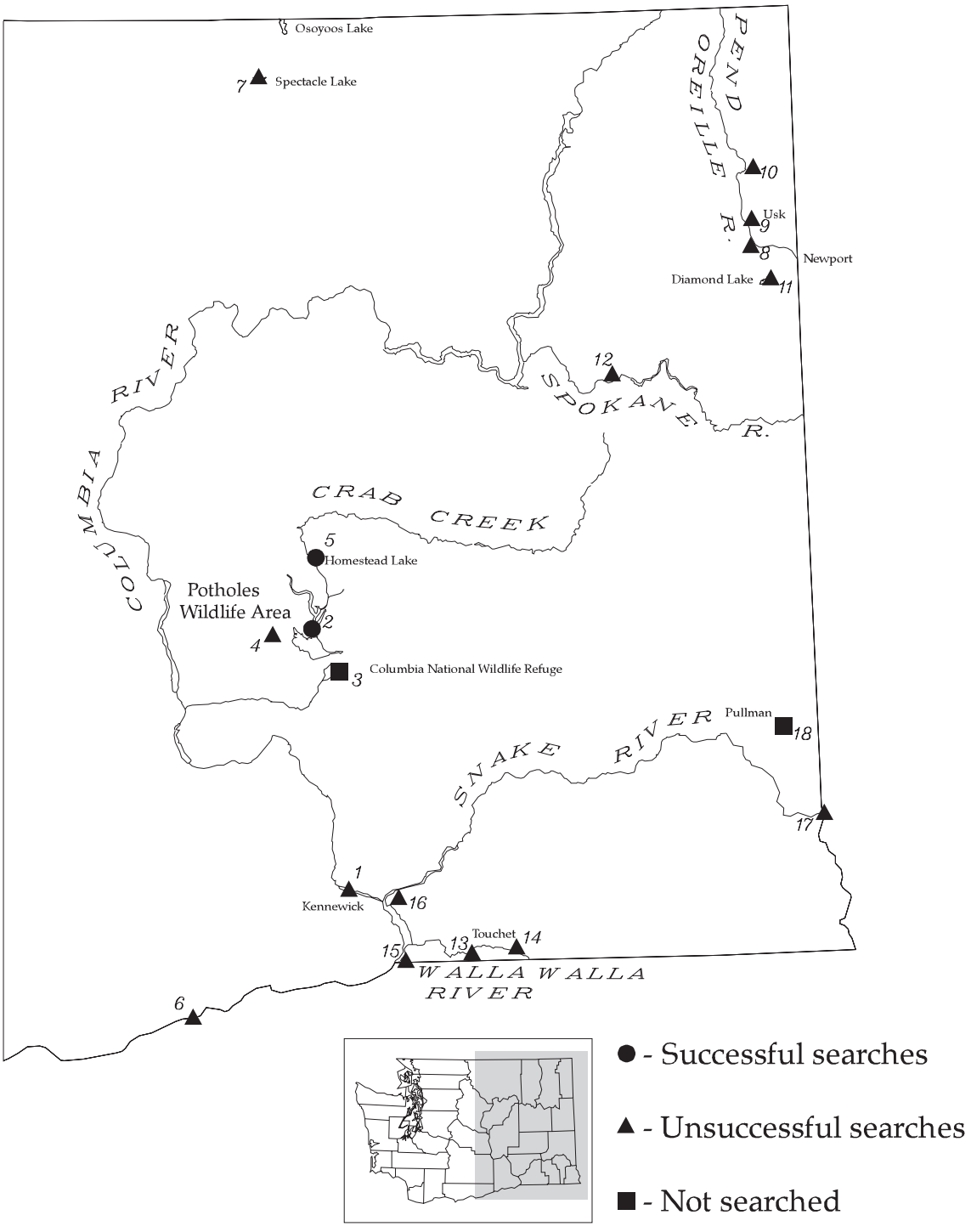

Figure 2. Surveys of northern leopard frog historic locales by Leonard et al. (1999).

system, and associated springs. No leopard frogs were found. Additionally, in 1998, she surveyed the Cow Creek Watershed from Sprague Lake south to Finnel Lake in Lincoln and Adams counties; BLM lands in Douglas Creek; a variety of other BLM properties in Lincoln County; areas along Crab Creek in the Beverly area; and near Marcellus Rd. and Tokio Rd. in Grant County. She did not locate any leopard frogs. Additional surveys, conducted by Lee Folliard and John Larsen, Jr. from Washington State University as part of a striped whipsnake (*Masticophis taeniatus*) research project, documented amphibian locations at Hanford, but no leopard frogs.

In summary, leopard frogs have been located at 2 of 18 historic locales in surveys conducted since 1992. Prior to and during this period, a number of other surveys were conducted in likely leopard frog habitat that did not find leopard frogs. Additional field work will be necessary to determine if the leopard frog has been completely eliminated from 16 of the 18 historic areas surveyed by Leonard et al. (1999) and subsequent surveyors; or, if it survives in some places in significantly reduced numbers. In any case, surveys indicate a precipitous decline in distribution and abundance from historic areas, and no evidence of colonization of new areas.

Future

Reasons for the apparent decline of the leopard frog in Washington may have ties to a broader decline of the species throughout its western range. A review of information from adjacent states and provinces indicates a similar situation. Though never widespread in Oregon, the species has not been observed in recent years (St. John 1985; Stebbins 1995; C. Corkran, R. M. Storm pers. comm.). Groves and Peterson (1992) used a mail questionnaire to obtain information on declines of Idaho amphibian populations. The leopard frog was the species most frequently described as having experienced population losses in Idaho. Eight of nine respondents (78%) who indicated an observed trend for this species reported a decline. Koch and Peterson (1995) stated that the leopard frog was gone from their study area, which included Yellowstone and Grand Teton National Parks and the adjacent Targhee National Forest. In fact, leopard frogs appear to have seriously declined throughout the Rocky Mountains region. One study reported the species gone from nearly 85% of the sites where it occurred historically in eastern Wyoming and Colorado (Corn et al. 1989). Similarly, local extinctions were reported as prevalent in the Rocky Mountains of Montana, though populations in the eastern plains region of the state may be healthy (Genter, pers. comm.).

In 1979, complete losses of populations in portions of the species' range in Alberta were noted (Roberts 1992, Stebbins and Cohen 1995). Similar declines are believed to have occurred in British Columbia (Orchard 1992). Clarkston and Rorabaugh (1989) report steep declines in four species in the leopard frog complex in Arizona and southeastern California. Populations in Wisconsin had experienced significant declines by the 1970's (Hine et al. 1981).

Future population declines are likely to occur in Washington without management effort. A clear understanding of factors causing the decline of the species is needed, as well as an action plan to

protect the remaining populations in Washington. The population at the Potholes provides a valuable research opportunity to monitor population trends and perhaps to determine what factors are contributing to the apparent loss of this species from Washington's native fauna.

HABITAT

Past

The historic distribution of leopard frogs in Washington closely follows the Columbia River and several of its tributaries; the Walla Walla River, Crab Creek, the Snake River, the Okanogan River, and the Spokane River (Fig. 1). These rivers may have formed the links between leopard frog populations in British Columbia, other states and Washington. The larger streams and rivers may have provided overwintering and dispersal habitat for leopard frogs, while the many sloughs, adjacent small ponds and backwater areas of these systems may have historically provided breeding sites. Populations in the Walla Walla River drainage were probably situated in the most extensive wetland and riparian habitats (Metter 1960). Populations known from the Pend Oreille River drainage are a logical extension of the leopard frog populations known from British Columbia and the Idaho panhandle.

The Potholes and Gloyd Seeps region, the two known currently occupied leopard frog sites in Washington, historically included approximately 8,000 acres of wetland that formed the headwaters of Crab Creek (Foster et al. 1984). The Columbia Basin Project, developed in 1952, criss-crossed this region with a series of water distribution systems. Irrigation return flow is collected in the Potholes Reservoir, and ground-water input from the project increased the acreage covered by water to approximately 53,000 acres (Foster et al. 1984). The change in habitat in the Potholes region may have been beneficial or detrimental. Leopard frogs, however, were not known from the region prior to the Columbia Basin Project.

Present

The Potholes and Gloyd Seeps sites, as discussed above, are altered habitats as a result of the Columbia Basin Project. Leopard frogs at the Potholes site breed in ponds and wetlands adjacent to the Potholes Reservior, and may possibly overwinter in the reservoir. Habitat ownership of currently occupied sites is public: the Federal Bureau of Reclamation and State Department of Fish and Wildlife.

A recent water quality study in the Columbia Plateau indicates that the physical habitat has been greatly altered (Williamson et al. 1998). The study showed that most streams lacked riparian vegetation. About 70 percent of the streams suffered from bank erosion caused in part by the reduction of riparian vegetation from agricultural practices and development. This erosion has facilitated the release into water of DDE, a byproduct of DDT historically sprayed in the region.

Dams on the Columbia, Snake, and Pend Oreille rivers have converted these formerly free-flowing rivers to a series of reservoirs. Over-bank pools and sloughs that likely provided historic breeding habitat along these rivers are now submerged. The changed lentic habitat found along the shorelines today may be unsuitable for breeding by leopard frogs.

Future

Without a clear understanding of factors affecting habitat for leopard frogs, future habitat status and conditions cannot be predicted. It will be important to develop an approach to manage the remaining occupied sites that minimizes potential impacts. Habitat changes need to be monitored at the remaining occupied sites, including the use of pesticides and introduction and abundance of introduced species. Currently, the few occupied leopard frog sites do not contain bullfrogs. The continuing spread of bullfrogs in the region (R. Friesz, pers. comm.) will need to be monitored.

CONSERVATION STATUS

Legal Status

In Washington State, the northern leopard frog is a State Candidate species under evaluation for possible listing as endangered, threatened, or sensitive. Under the provisions of the Wildlife Code of Washington the species is unclassified and unprotected, and can be legally killed at any time without a permit.

Management Activities

Surveys. One of the most important management activities is the continuation of surveys for northern leopard frogs. It is extremely important for the conservation of leopard frogs in Washington to find additional occupied habitat, if it occurs. A number of people are looking for leopard frogs as part of their normal work as wildlife, habitat or wetland biologists, as part of college projects, or because of an interest in amphibians and reptiles. It is possible that new populations may be found in areas that have not been searched yet. Ponds that are occupied by leopard frogs should be mapped, monitored and evaluated. Annual or biennial egg mass counts should be performed. Transects should also be established for late summer or early fall surveys to sex, age, and count leopard frogs. Although these techniques have not been validated as being accurate indices of population size or trend, they are the only techniques currently available that can be accomplished with low to moderate cost. Overwintering sites should be located, as well as important dispersal routes.

Research. Currently, no research is being conducted on leopard frogs in Washington. As more

is learned about leopard frog populations, it may be possible to design research to test various hypotheses concerning the causes of observed declines. A better understanding of these causes will be vital to conservation efforts. Additional important research topics include: the relationship between breeding and overwintering habitat; factors affecting leopard frogs during migration, understanding the dynamics of leopard frog populations over a number of years at Washington sites; evaluation of the effects of pesticides and herbicides on reproduction and survival of leopard frogs; evaluation of the effects of bullfrogs and introduced fish on leopard frogs; an evaluation of habitat structure of leopard frog breeding and overwintering sites; and the effects of introduced wetland plants on that habitat structure. It is important to map and monitor the continuing spread of bullfrogs in the region. If and when bullfrogs colonize a leopard frog site, research and monitoring of their interactions should occur. Management actions should be taken to reduce or eliminate bullfrogs from leopard frog sites.

A genetic analysis of leopard frogs in Washington should be performed, and comparisons should be made between leopard frogs at Washington State University and those at the Potholes and Crab Creek drainage. Also genetic information should be compared with that of leopard frogs in other states. This may help us better understand the historical relationship between leopard frogs in Washington and those in British Columbia, Idaho, and Oregon.

One research issue concerning leopard frogs is an evaluation of the effect and timing of rotenone application to control introduced fish. Rotenone application is performed periodically in the Crab Creek system. Research on rotenone application would determine the times of the year when adverse impacts may be avoided. Effects of rotenone on bullfrogs should be evaluated as well. If adverse effects are found, it may provide an important management tool in controlling bullfrogs in the Columbia Basin.

Habitat protection and enhancement. Currently occupied habitat of the northern leopard frog is managed by the Washington Department of Fish and Wildlife. As we learn more about the habitat needs of leopard frogs, enhancement of habitat can occur. There is enough evidence of the detrimental effects of bullfrogs on native ranid populations to prohibit further introductions of this species in Washington. It seems unlikely that measures to eradicate established populations of bullfrogs will ever be discovered but, if they are, historic leopard frog habitats should be considered for treatment.

The Department is currently planning to eliminate non-native fish from selected wetlands in the Potholes Area to enhance waterfowl populations. Leopard frogs may colonize or be introduced to these wetlands once the introduced fish have been eradicated.

Information and education. The Department provides the public and other agencies information about the management needs of leopard frogs through the Department's *Priority Habitat and Species Management Recommendations*.

FACTORS AFFECTING CONTINUED EXISTENCE

There are a variety of factors that have potential to adversely affect remaining leopard frog populations in Washington. It is not known for certain what factors alone may trigger extirpation of leopard frogs from a site. A number of habitat-related changes have caused declines in other regions and at other sites, and these are possible factors in Washington. Land use changes, irrigation projects, and development have contributed to changes in the hydrology of many areas, potentially affecting amphibians through rapid changes in water levels during critical embryonic and larval periods (Richter and Azous 1995). Native wetlands and riparian plant communities have both been destroyed and degraded. Sedge meadows have been destroyed for agricultural fields and urban and residential developments on large tracts in eastern Washington. Nonnative plants, such as purple loosestrife *(Lythrum salicaria)*, reed canarygrass (*Phalaris arundinacea)*, and Eurasian milfoil (*Myriophyllum spicatum)* are now found in and adjacent to aquatic environments in eastern Washington. All have the ability to dramatically alter the structure of wetland environments. Russel and Bauer (1993) and Corn et al. (1997) suggest that drought may have played a role in the disappearance of leopard frogs in the Rocky Mountains. Drought, if associated with loss of breeding and overwintering habitat, may have also contributed to the decline witnessed in Washington. Research, monitoring, and evaluation of the factors potentially causing the decline of leopard frogs is essential to their conservation.

Red-leg Disease

A die-off of northern leopard frogs began in the early 1970's in the midwestern states and quickly spread to Canada and Mexico (Bishop and Petit 1992). All frogs had symptoms of kidney failure. The condition was called “red-leg”, because of the red color of accumulated body fluid in the legs. The cause of red-leg was found to be bacterial, with a number of different species of bacteria responsible (Bishop and Pettit 1992). Although this condition has not been reported in leopard frogs in Washington, it has been found in Oregon spotted frogs. Because causative organisms have been found in healthy animals, red-leg may be triggered by a variety of environmental factors (Bishop and Pettit 1992). Red-leg may have occurred in Washington and gone unreported and/or it may occur in the future.

Bullfrogs

The bullfrog is an introduced species frequently implicated in declines of native frog populations, particularly ranids (Hayes and Jennings 1986, Kiesecker and Blaustein 1997, 1998). Bullfrogs may contribute to the decline of leopard frogs through direct predation, or by altering their activity levels and habitat use (Kiesecker and Blaustein 1997, 1998). In Oregon field experiments, native red-legged frogs that altered their habitat use to avoid predation by bullfrogs had increased predation by smallmouth bass (Kiesecker and Blaustein 1998).

In some areas of Washington, bullfrogs are exceedingly abundant in habitats formerly occupied by leopard frogs. On the Columbia National Wildlife Refuge, leopard frogs disappeared during a period of time when bullfrogs colonized and became exceedingly abundant (W. Radke, pers. comm.). The bullfrog is known to prey upon leopard frogs in other regions (McAlpine and Dilworth 1988), but conclusive evidence of population extirpation by bullfrogs has not been produced. The presence of bullfrogs in many of the areas where leopard frogs have apparently been extirpated, and the apparent absence of bullfrogs where leopard frog populations are extant suggests two possibilities: 1) bullfrogs are responsible for the extirpation of leopard frogs or 2) bullfrogs are not susceptible to whatever factor(s) led to the extirpation of leopard frogs, and may, in fact, benefit from changes that have been harmful to leopard frogs.

Conservation of leopard frogs in Washington will depend upon a clearer understanding of the threat of bullfrogs. If bullfrogs are confirmed to displace leopard frogs, saving leopard frogs in Washington will require a good understanding of the habitat relationships of bullfrogs and leopard frogs.

Introduced Predatory Fish

The introduction of predatory fish into waterways occupied by leopard frogs is a likely contributer to the decline of the leopard frog in Washington. There are many introduced predatory fish in areas inhabited and formerly inhabited by leopard frogs: largemouth bass, black crappie, yellow perch, and brown bullhead are just a few of the many introduced fish that now thrive in warmwater habitats of eastern Washington. Most introduced fish are likely predators on the eggs, larvae, and metamorphs of leopard frogs (Hayes and Jennings 1986), and leopard frogs have been found to be negatively affected by the presence of predatory fish in Ontario, Canada (Hecnar and M'Closkey). In long-term studies of leopard frogs in Wisconsin, Hine et al. (1981) concluded that "predation by fish can substantially reduce a (leopard) frog population", and described "ideal" leopard frog breeding ponds as "without fish". Monello and Wright (1999) found a variety of amphibians (leopard frogs not included) were excluded from ponds with introduced fish, and only the bullfrog was able to reproduce in ponds with introduced fish. Introduced fish have been implicated in the extirpation of the mountain yellow-legged frog *(Rana mucosa)* from Sequoia and Kings Canyon National Park in California (Bradford et al. 1993).

Although implicated in the declines of leopard frog and other species, it is not known if there are fish that are more likely responsible for predation on leopard frogs than others. Friesz (pers. comm.) has been unable to locate leopard frog tadpoles in 1999 at ponds known to be occupied in past years. He speculated that newly introduced mosquitofish (*Gambusia affinis*) may be responsible. These fish are often introduced to provide mosquito control.

Chemical Applications

Contaminants and general water quality deterioration are potentially detrimental factors, and may have been contributing factors in the historic decline of leopard frogs, especially where there has been a tremendous increase in irrigated agricultural lands and urbanization in historically occupied areas. Historically, chemicals have been used for a great variety of purposes in eastern Washington: fertilizers to promote crop growth; DDT and other insecticides to kill insect pests; herbicides like 2,4, D and xyline to control weeds and improve water flow in irrigation systems; rotenone applications to kill unwanted fish; and more. In a study of the effects of commonly used agricultural pesticides, Berrill et al. (1997) concluded that larval stages of amphibians are vulnerable to low-level pesticide contamination and that local declines or extinctions of populations were likely in areas in close proximity to heavy or frequent pesticide use.

Rotenone, a common fish toxicant used in the Columbia Basin, has been found to be toxic to leopard frog tadpoles (Hamilton 1941) at concentrations normally used in fish control. Rotenone has also been found to be toxic to a variety of other amphibians and reptiles (Fontenot et al. 1994). Various factors may affect the toxicity of rotenone to amphibians and reptiles, including temperature, pH, alkalinity, flow rate, turbidity, rotenone formulation and dosage (Fontenot et al. 1994). As leopard frogs use different habitats for breeding and wintering, applications could occur when leopard frogs are not present. Fall application of rotenone may have less negative affect on leopard frogs, when they have completely metamorphosed (Bradbury 1986).

A recent study found DDE, a residual breakdown product of DDT, present in all parts of the Columbia Plateau except the headwaters of Crab Creek and the Palouse River Basin (Williamson et al 1998). The study suggests that agricultural pesticides may be a concern for aquatic life. Elevated levels of copper have been found in organisms in the bottom sediments of irrigation systems, indicating probable past applications of copper sulfate to control plant growth (L. Block pers. comm.). Ammonia nitrate, a common water residual in agricultural areas from nitrogen based fertilizers, has been found to be toxic to leopard frogs at concentrations that are commonly exceeded in agricultural areas (Hecnar 1995). Leopard frogs exposed to pH levels of 5.5 (acidic conditions) experienced a high incidence of mortality (Vatnick et al. 1999). Leopard frogs are especially sensitive to acidic conditions when emerging from hibernation (Vatnick et al. 1999).

Mosquito Control

Mosquito control operators in Grant County sprayed DDT in the 1960s and also sprayed diesel fuel on wetlands to suffocate mosquito larvae (J. Thompson pers. comm.). In the Laramie Valley in Wyoming, mosquito control accomplished through the use of Baytex® (Fenthion) has been implicated in declines of both leopard frogs and the Wyoming toad *(Bufo hemiophrys baxteri)* (Stebbins and Cohen 1995). In Washington, Baytex® has been used in the past but was discontinued in favor of *Bacillus thuringiensis* and another biological control product, Altosid® (J. Thompson pers. comm.). The effects of this application on leopard frogs is not known.

Ultraviolet-B Radiation

A variety of other environmental changes may have played a role in the decline of leopard frogs. Ultraviolet-B radiation, which may be increasing due to depletion of the Earth's ozone layer, has recently been shown to harm developing amphibian embryos (Blaustein et al. 1994b). There may be interactions between the effects of UV-B and the fungus *Saprolegnia* which has also been found to cause considerable losses of developing amphibian embryos (Blaustein et al. 1994a). A recent study of the effect of both UV-B and pH showed that neither pH nor UV-B alone had a detectable effect on the survival of leopard frog embryos. Ultraviolet-B and pH acting in concert, however, led to a significant decrease in embryo survival (Long et al. 1995).

Adequacy of Existing Regulatory Mechanisms

There are no regulatory mechanisms in place to prevent killing of leopard frogs or protect leopard frog habitat. Protection of leopard frogs from direct killing may be of some help in protecting the remaining populations, but key factors affecting populations are unknown.

CONCLUSIONS AND RECOMMENDATION

The paucity of sightings of leopard frogs during field surveys suggests that it may have been extirpated from most of its former range in Washington. Field surveys conducted since 1992 have found them in only three areas of the state - two in the Crab Creek drainage in Washington and one at the Washington State University campus. Leopard frogs at ponds at Washington State University are thought to be liberated from classroom laboratory experiments. Results of field surveys indicate a decline from 18 areas known in 8 counties to the 2 areas known today in one county.

The remaining sites occupied by leopard frogs in Washington are entirely on public lands managed by Washington Department of Fish and Wildlife. Major threats to leopard frogs, however, occur from factors outside the direct control of the Department. Bullfrogs, not currently co-habitating with the remaining leopard frogs, are spreading rapidly throughout the Columbia Basin. Predation and competition by other introduced species and the effects of agricultural chemicals are threats as well.

Due to the significant reduction in range and abundance of leopard frogs in Washington, and the continued threats to the remaining occupied sites, it is recommend that the leopard frog be classified as an endangered species in Washington.

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REFERENCES CITED

Berrill M. S. Bertram, and B. Pauli. 1997. Effects of pesticides on amphibian embryos and larvae. *In* D.M. Green, editor. Amphibians in decline: Canadian studies on a global problem. Herpetological Conservation 1:233-245.

Bishop, C. A. and K. E. Pettit. 1992. Declines in Canadian amphibian populations: designing a national strategy. Occ. Pap. No. 76. Can. Wildl. Serv. Ottawa, Ontario. 120pp.

Blaustein, A. R., D. G. Hokit, R. K. O'Hara, and R. A. Holt. 1994a. Pathogenic fungus contributes to amphibian losses in the Pacific Northwest. Biol. Cons. 67:251-254.

))))), P. D. Hoffman, D. G. Hokit, J. M. Kiesecker, S. C. Walls, and J. B. Hays. 1994b. UV repair and resistance to solar UV-B in amphibian eggs: A link to population declines? Proc. Nat. Acad. Sci. 9:1791-1795.

Bovbjerg, R.V. 1965. Experimental studies on the dispersal of the frog, *Rana pipiens*. Proc. Iowa Acad. Sci. 72:412-418.

Bradbury, A. 1986. Rotenone and trout stocking. Washington Dept. Of Game, fish management report 86-2, Olympia WA. 181p.

Bradford, D. F., F. Tabatabai, and D. M. Graber. 1993. Isolation of remaining populations of the native frog, *Rana muscosa*, by introduced fishes in Sequoia and Kings Canyon National Parks, California. Cons. Bio. 7(4):882-888.

Brodie, E. D., Jr. 1968. Investigations on the skin toxin of the adult rough-skinned newt, *Taricha granulosa*. Copeia 1968:307-313.

Conant, R. and J. T. Collins. 1993. A field guide to reptiles and amphibians - eastern and central North America. Houghton Mifflin Co., Boston. 450pp.

Carl, G. C. 1949. Extensions of known ranges of some amphibians in British Columbia. Herpet. 5:139-140.

Cooper, J. G. and G. Suckley. 1860. The natural history of Oregon and Washington. Bailliere Brothers, New York. 399pp.

Corn, P.S., and J.C. Fogleman. 1984. Extinction of montane populations of the northern leopard frog (*Rana pipiens*) in Colorado.

))))), and L.J. Livo. 1989. Leopard frog and wood frog reproduction in Colorado and Wyoming. Northwestern Naturalist 70:1-9.

))))), W. Stolzenburg, and R. B. Bury. 1989. Acid precipitation studies in Colorado and Wyoming: Interim report of surveys of montane amphibians and water chemistry. Biol. Rep. 80(40.26). Air Pollution and Acid Rain Report No. 26. 57pp.

))))), M.L. Jennings, and E. Muths. 1997. Survey and assessment of amphibian populations in Rocky Mountain National Park. Northwestern Naturalist 78:34-55.

Cunjak, R.A. 1986. Winter habitat of northern leopard frogs, *Rana pipiens*, in a southern Ontario stream. Can. J. Zool. (64):255-257.

ENSR Consulting and Engineering 1995. Herpetofauna baseline assessment of the Yakima Training Center. United States Army, Yakima, WA.

Emery, A.R., A.H. Berst and K. Kodaira. 1972. Under-ice observations of wintering sites of leopard frogs. Copeia (1):123-126.

Fichter, E., and A.D. Linder 1964. The amphibians of Idaho. Special Publication, Idaho State University Museum.

Fontenot, L.W.. G.P. Noblet, and S.G. Platt. 1994. Rotenone hazards to reptiles and amphibians. Herpetological Review 25(4):150-153,156.

Foster, J.H., W.E. Tillett, W.L. Myers, and J.C. Hoag. 1984. Columbia Basin wildlife/irrigation development study. USDI Bureau of Reclamation, Applied Science Branch, Engineering and Research Center, Denver, CO. REC-ERC-83-6. 226P.

Gilbert, M., R. LeClair Jr, and R. Fortin. 1994. Reproduction of the northern leopard frog in floodplain habitat in the Richelieu River, Quebec, Canada. J. of Herpet. 28(4):465-470.

Groves, C. R. and C. Peterson. 1992. Distribution and population trends of Idaho amphibians as determined by mail questionnaire. Unpubl. Rept. Idaho Department of Fish and Game. Boise. 16pp.

Hamilton, H.L. 1941. The biological action of rotenone of fresh-water animals. Proc. of Iowa Acad. Science, vol XLVIII:467-479.

Hayes, M. P. and M. R. Jennings. 1986. Decline of ranid frogs in western North America: are bullfrogs (*Rana catesbeiana*) responsible? J. of Herpet. 20(4):490-509.

Hecnar, S. J. 1995. Acute and chronic toxicity of ammonium nitrate fertilizer to amphibians from southern Ontario. Environmental Toxicology and Chemistry 14(12):2131-2137.

.))))), and R. T. M'Closkey. 1997. The effects of predatory fish on amphibian species richness and distribution. Biological Conservation 79:123-131.

Hine, R.L., B. L. Les, and B.F. Hellmich. 1981. Leopard frog populations and mortality in Wisconsin, 1974-1976. Wisconsin Dept. of Natural Resources, Technical Bulletin No. 122, Madison.

Kiesecker, J. M. and A.R. Blaustein. 1997. Population differences in responses of red-legged frogs (*Rana aurora*) to introduced bullfrogs. Ecology, 78(6):1752-1760.

))))), 1998. Effects of introduced bullfrogs and smallmouth bass on microhabitat use, growth, and survival of native red-legged frogs (*Rana aurora*). Conservation Biol. 12(4):776-787.

Koch, E. D. and C. R. Peterson. 1995. Amphibians and reptiles of Yellowstone and Grand Teton National Parks. Univ. of Utah Press, Salt Lake City. 188pp.

Kruse, K. C., and M. G. Francis. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Trans. Am. Fish. Soc. 106(3):248-252.

Lardie, R. L. 1963. A brief review of the bullfrog as a conservation problem with particular reference to its occurrence in Washington State. Tricor 3(1):7-9.

Licht, L. E. 1969a. Palatability of *Rana* and *Hyla* eggs. Amer. Midl. Nat. 82:296-298.

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

))))) and K.R. McAllister 1996. Past distribution and current status of the northern leopard frog. Unpubl. Report. Washington Department of Fish and Wildlife, Olympia.

))))), K.R. McAllister, and R.C. Friesz 1999. Survey and assessment of northern leopard frog (*Rana pipiens*) populations in Washington. Northwestern Naturalist 80:51-60.

Long, L.E., L.S. Saylor, and M.E. Soule. 1995. A pH/UVB synergism in amphibians. Conservation Biol. 9(5):1301-1303.

McAllister, K. R. 1995. Distribution of amphibians and reptiles in Washington State. Soc. for Northwestern Vert. Biol., Northwest Fauna 3:81-112.

McAlpine, D.F. and T.G. Dilworth. 1989. Microhabitat and prey size among three species of *Rana* (Anura: Ranidae) sympatric in eastern Canada. Can. J. Zool. 67:2242-2252

Merrell, D.J. 1968. A comparison of the estimated and "effective size" of breeding populations of the leopard frog, *Rana pipiens*. Evolution 22(2):274-283.

))))), 1970. Migration and gene dispersal in *Rana pipiens*. Amer. Zool. 10:47-52.

))))), 1977. Life history of the leopard frog, *Rana pipiens*, in Minnesota. Bell Museum of Natural History, Occ. Paper No. 15, Univ. of Minnesota.

Metter, D. E. 1960. The distribution of amphibians of eastern Washington. M. S. Thesis, Wash. State Univ., Pullman. 89pp.

Monello, R. J. and R. G. Wright 1999. Amphibian habitat preferences among artificial ponds in the Palouse region of northern Idaho. J. of Herpt. 33(2):298-303.

Nussbaum, R. A., E. D. Brodie, Jr., and R. M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Univ. of Idaho Press, Moscow. 332pp.

Orchard, S. A. 1992. Amphibian population declines in British Columbia. Pp 10-13 *In* Bishop, C. A. and K. E. Pettit. 1992. Declines in Canadian amphibian populations: designing a national strategy. Occ. Pap. No. 76. Can. Wildl. Serv. Ottawa, Ontario. 120pp.

Richter, K. O. and A. L. Azous. 1995. Amphibian occurrence and wetland characteristics in the Puget Sound basin. Wetlands 15(3):305-312.

Roberts, W. 1992. Declines in amphibian populations in Alberta. Pp 14-16 *In* Bishop, C. A. and K. E. Pettit. 1992. Declines in Canadian amphibian populations: designing a national strategy. Occ. Pap. No. 76. Can. Wildl. Serv. Ottawa, Ontario. 120pp.

Slater, J. R. 1955. Distribution of Washington amphibians. Occas. Paper Dept. of Biol. Coll. Puget Sound 16:122-153.

Slevin, J. R. 1928. The amphibians of western North America. Calif. Acad. Sci., San Francisco. 152pp.

Slipp, J. 1940. An alligator lizard in Idaho. Occas. Paper Coll. Puget Sound 6:35-36.

St. John, A. D. 1985. The herpetology of the Owyhee River drainage, Malheur County, Oregon. Oregon Dept. Fish and Wildl. Nongame Wildl. Prog., Tech. Rep. No. 85-5-03.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. 336pp.

))))) and N. W. Cohen. 1995. A natural history of amphibians. Princeton Univ. Press. Princeton. 316pp.

Vatnick, I, M.A. Brodkin, M.P. Simon, B.W. Grant, C.R. Conte, M. Gleave, R. Meyers, and M. M. Sadoff. 1999. The effects of exposure to mild acidic conditions on adult frogs (*Rana pipiens* and *Rana clamitans*) mortality rates. Journal of Herpetology 33(3):370-374.

Williamson, A.K., M.D. Munn, S.J. Ryker, R.J. Wagner, J.C. Ebbert, and A.M. Vanderpool. 1998. Water quality in the Central Columbia Plateau: Washington and Idaho, 1992-1995. Denver, CO: U.S. Geological Survey Circular 1144. 35p.

Appendix

Washington Administrative Codes 232-12-011, 232-12-014, 232-12-297

Appendix. Washington Administrative Codes.

WAC 232-12-011 Wildlife classified as protected shall not be hunted or fished.

Protected wildlife are designated into three subcategories: Threatened, sensitive, and other.
(1) Threatened species are any wildlife species native to the state of Washington that are likely to become endangered within the foreseeable future throughout a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as threatened include:

Common Name	Scientific Name
western gray squirrel	*Sciurus griseus*
Steller (northern) sea lion	*Eumetopias jubatus*
North American lynx	*Lynx canadensis*
Aleutian Canada goose	*Branta Canadensis leucopareia*
bald eagle	*Haliaeetus leucocephalus*
ferruginous hawk	*Buteo regalis*
marbled murrelet	*Brachyramphus marmoratus*
green sea turtle	*Chelonia mydas*
loggerhead sea turtle	*Caretta caretta*
sage grouse	*Centrocercus urophasianus*
sharp-tailed grouse	*Phasianus columbianus*

(2) Sensitive species are any wildlife species native to the state of Washington that are vulnerable or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats. Protected wildlife designated as sensitive include:

Common Name	Scientific Name
Gray whale	*Eschrichtius gibbosus*
Larch Mountain salamander	*Plethodon larselli*
Pygmy whitefish	*Prosopium coulteri*
Margined sculpin	*Cottus marginatus*

(3) Other protected wildlife include:

Common Name	Scientific Name
cony or pika	*Ochotona princeps*
least chipmunk	*Tamius minimus*
yellow-pine chipmunk	*Tamius amoenus*
Townsend's chipmunk	*Tamius townsendii*
red-tailed chipmunk	*Tamius ruficaudus*
hoary marmot	*Marmota caligata*
Olympic marmot	*Marmota olympus*
Cascade golden-mantled ground squirrel	*Spermophilus saturatus*
golden-mantled ground squirrel	*Spermophilus lateralis*
Washington ground squirrel	*Spermophilus washingtoni*
red squirrel	*Tamiasciurus hudsonicus*

Douglas squirrel	*Tamiasciurus douglasii*
northern flying squirrel	*Glaucomys sabrinus*
wolverine	*Gulo gulo*
painted turtle	*Chrysemys picta*
California mountain kingsnake	*Lampropeltis zonata;*

All birds not classified as game birds, predatory birds or endangered species, or designated as threatened species or sensitive species; all bats, except when found in or immediately adjacent to a dwelling or other occupied building; all wildlife within Titlow Beach Marine Preserve Area and the conservation areas defined in chapter 220-16 WAC; mammals of the order *Cetacea,* including whales, porpoises, and mammals of the order *Pinnipedia* not otherwise classified as endangered species, or designated as threatened species or sensitive species. This section shall not apply to hair seals and sea lions which are threatening to damage or are damaging commercial fishing gear being utilized in a lawful manner or when said mammals are damaging or threatening to damage commercial fish being lawfully taken with commercial gear.

[Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-011, filed 11/6/98, effective 12/7/98. Statutory Authority: RCW 77.12.040. 98-10-021 (Order 98-71), § 232-12-011, filed 4/22/98, effective 5/23/98. Statutory Authority: RCW 77.12.040 and 75.08.080. 98-06-031, § 232-12-011, filed 2/26/98, effective 5/1/98. Statutory Authority: RCW 77.12.020. 97-18-019 (Order 97-167), § 232-12-011, filed 8/25/97, effective 9/25/97. Statutory Authority: RCW 77.12.040, 77.12.020, 77.12.030 and 77.32.220. 97-12-048, § 232-12-011, filed 6/2/97, effective 7/3/97. Statutory Authority: RCW 77.12.020. 93-21-027 (Order 615), § 232-12-011, filed 10/14/93, effective 11/14/93; 90-11-065 (Order 441), § 232-12-011, filed 5/15/90, effective 6/15/90. Statutory Authority: RCW 77.12.040. 89-11-061 (Order 392), § 232-12-011, filed 5/18/89; 82-19-026 (Order 192), § 232-12-011, filed 9/9/82; 81-22-002 (Order 174), § 232-12-011, filed 10/22/81; 81-12-029 (Order 165), § 232-12-011, filed 6/1/81.]

WAC 232-12-014 Wildlife classified as endangered species. Endangered species include:

Common Name	Scientific Name
pygmy rabbit	*Brachylagus idahoensis*
fisher	*Martes pennanti*
gray wolf	*Canis lupus*
grizzly bear	*Ursus arctos*
sea otter	*Enhydra lutris*
sei whale	*Balaenoptera borealis*
fin whale	*Balaenoptera physalus*
blue whale	*Balaenoptera musculus*
humpback whale	*Megaptera novaeangliae*
black right whale	*Balaena glacialis*
sperm whale	*Physeter macrocephalus*
Columbian white-tailed deer	*Odocoileus virginianus leucurus*
woodland caribou	*Rangifer tarandus caribou*
American white pelican	*Pelecanus erythrorhynchos*
brown pelican	*Pelecanus occidentalis*
peregrine falcon	*Falco peregrinus*
sandhill crane	*Grus canadensis*
snowy plover	*charadrius alexandrinus*
upland sandpiper	*Bartramia longicauda*
spotted owl	*Strix occidentalis*
western pond turtle	*Clemmys marmorata*
leatherback sea turtle	*Dermochelys coriacea*

Oregon silverspot butterfly	*Speyeria zerene hippolyta*
Oregon spotted frog	*Rana pretiosa*

[Statutory Authority: RCW 77.12.020. 98-23-013 (Order 98-232), § 232-12-014, filed 11/6/98, effective 12/7/98; 97-18-019 (Order 97-167), § 232-12-014, filed 8/25/97, effective 9/25/97; 93-21-026 (Order 616), § 232-12-014, filed 10/14/93, effective 11/14/93. Statutory Authority: RCW 77.12.020(6). 88-05-032 (Order 305), § 232-12-014, filed 2/12/88. Statutory Authority: RCW 77.12.040. 82-19-026 (Order 192), § 232-12-014, filed 9/9/82; 81-22-002 (Order 174), § 232-12-014, filed 10/22/81; 81-12-029 (Order 165), § 232-12-014, filed 6/1/81.]

WAC 232-12-297 Endangered, threatened, and sensitive wildlife species classification.

Purpose

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

Definitions

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long term survival of the population in Washington.

Listing criteria

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological

status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

Delisting criteria

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

Initiation of listing process

5.1 Any one of the following events may initiate the listing process.

5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.

5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.

5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

Initiation of delisting process

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall

either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

Species status review and agency recommendations

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends

7.1.2 Natural history, including ecological relationships (e.g. food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g. survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

Public review

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

8.1.2 The agency will hold at least one Eastern Washington and one Western Washington public meeting during the public review period.

Final recommendations and commission action

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

Periodic species status review

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

Recovery and management of listed species

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives

11.1.2 Criteria for reclassification

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within 5 years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed

interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

Classification procedures review

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

Authority

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC 232-12-014, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC 232-12-011, as amended.

[Statutory Authority: RCW 77.12.040. 98-05-041 (Order 98-17), § 232-12-297, filed 2/11/98, effective 3/14/98. Statutory Authority: RCW 77.12.020. 90-11-066 (Order 442), § 232-12-297, filed 5/15/90, effective 6/15/90.]