Northern Leopard Frog

Rana pipiens

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Species Information

Taxonomy

The Northern Leopard Frog belongs to the family Ranidae (true frogs) and the genus *Rana*. No subspecies are currently recognized (Green 1999).

Description

The Northern Leopard Frog is a medium-sized (50–100 mm snout-vent-length [svl]), semi-terrestrial frog. Distinguishing characteristics include two conspicuous cream-coloured dorsolateral folds that extend the length of the back and large, distinct, solid dark brown or olive spots with smooth pale borders on head, back, sides, and legs (Green and Campbell 1984); legs are long, and webbing does not extend to tips of toes. Typically the dorsal surface is green or brown and the ventral surface is white. Tadpoles are ~25 mm svl, dark brown and speckled with gold spots. The eyes are bronze-coloured. The height of the dorsal fin is equal to or less than the thickness of tail trunk at its base. See detailed description in Corkran and Thoms (1996).

Distribution

Global

The Northern Leopard Frog is part of a group of anurans (the Leopard Frog complex) that is widely distributed throughout North America. In Canada, populations exist from southeastern British Columbia east to the Maritimes, while in the United States, the species ranges south to California and New Mexico and east to South Carolina (Stebbins and Cohen 1995). In parts of the mid-West and western portions of its range, however, populations of Northern Leopard Frog have disappeared or declined significantly (Hine et al. 1981; Roberts 1992; Seburn 1992; Corn and Fogleman 1994; McAllister et al. 1999).

British Columbia

In British Columbia, the Northern Leopard Frog historically occurred in the Kootenay and Columbia River valleys and in the Rocky Mountains east of Fernie near Corbin (Seburn and Seburn 1998). The species was also reported from Osoyoos Lake in the Okanagan Valley (Carl 1949). The most northerly location was Bush Arm, 70 km north of Golden, with other sightings in marshes and ponds along the Columbia and Kootenay River systems from Golden south to Newgate near the U.S. border (Seburn and Seburn 1998). None have since been recorded at these locations although surveys were carried out in the late 1990s (Ohanjanian and Teske 1996; Gillies and Franken 1999). Today the Northern Leopard Frog is known from only one site in the Creston Valley Wildlife Management Area (Ohanjanian 1997; Waye and Cooper 1999). An population which is believed to have been introduced in the 1930s (Green 1978) was found at Parksville (Hamilton Marsh) on Vancouver Island in 1976. The current status of this population is not known (L. Friis, pers. comm.).

Forest region and districts

Coast: South Island (introduced)

Southern Interior: Columbia, Kootenay Lake (extant), Okanagan Shuswap (Penticton – historic), Rocky Mountain

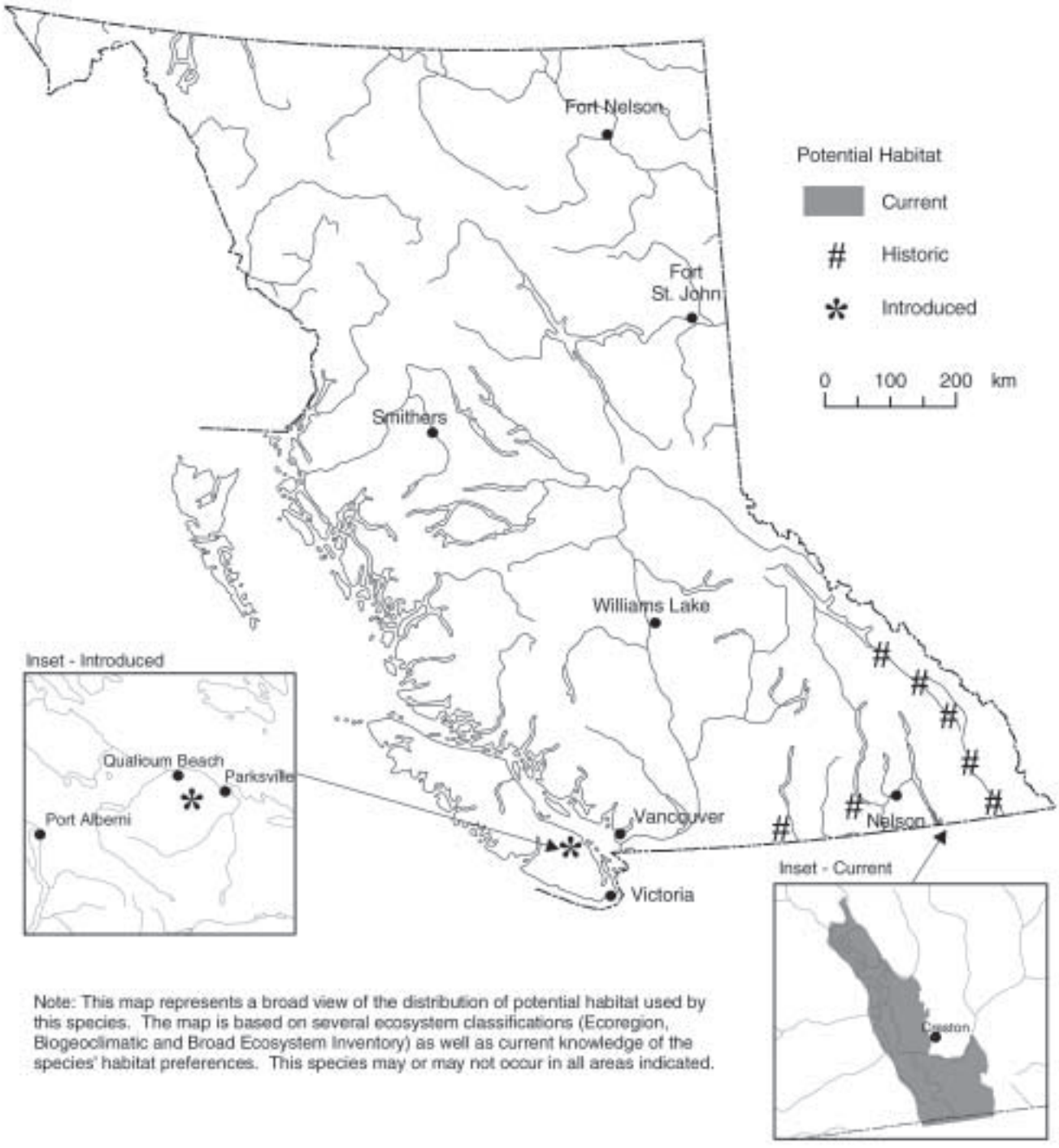
Ecoprovinces and ecosections

GED: NAL (introduced)

SIM: EKT (historic), FLV (historic), SCM (current), UCV (historic)

SOI: NOB (historic), OKR (historic), SOB (historic)

Northern Leopard Frog
(Rana pipens)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated.

Biogeoclimatic units

BG: xh1 (historic)
CDF: mm (introduced)
ICH: xw (current)
ICH: dw, mk1 (historic), mw2
IDF: dm2 (historic)
MS: dk (historic)
PP: xh1 (historic)

Broad ecosystem units

CF, CR, LS, OW, RR, WL, WR

Elevation

82–1400 m

Life History

Diet and foraging behaviour

The Northern Leopard Frog is an opportunistic forager. Its diet consists of a variety of prey including insects, arachnids, worms, crustaceans, and other small vertebrate prey (McAllister et al. 1999). Adults and juveniles forage primarily on land. Tadpoles graze on phytoplankton, algae, periphyton, and detritus.

Reproduction

Sexual maturity is most commonly reached in 2 years, but this may vary from 1 to 3 years. Generally, courtship begins in mid-April after adult frogs have left overwintering habitat and arrived at breeding sites. Males congregate in the shallow waters at breeding sites and begin calling in mid-April. This may last until June (Waye and Cooper 1999). The time of egg deposition varies with latitude and elevation (Fichter and Linder 1964), and in British Columbia this occurs most often in April and May (Orchard 1984; Waye and Cooper 1999). Females deposit a single egg mass, which may contain between 600 and 7000 eggs (Corn and Livo 1989). Females tend to deposit egg masses close to each other, where two to several dozen egg masses may occur over a small area (Nussbaum et al. 1983; Wright and Wright 1995). Egg masses are attached to submerged vegetation in shallow water but may occasionally be deposited on the surface (Hine et al. 1981; Corkran and Thoms (1996). A variety of plant species are used, including sedges (*Carex* spp.), bullrushes (*Scirpus* spp.) (Hine et al. 1981; Corn and Livo 1989), cattails, twigs, or even grass (Wright and Wright 1995). In British Columbia, spikerush (*Eleocharis palustris*) is used (Waye 2000). Eggs hatch within 9 days and metamorphosis can occur in as little as 2 months (68.2–86.0 days; Corn 1981). Metamorphosis occurs in July and August (Orchard 1984; Waye and Cooper 1999). A number of environmental factors, including water temperature, can influence development rates at all stages.

Site fidelity

Northern Leopard Frogs appear to exhibit strong site fidelity to breeding and overwintering sites (Waye and Cooper 1999; T. Antifeau, pers. comm.), while greater flexibility is probable with respect to foraging areas (M.A. Beaucher, pers. comm.).

Home range

Adults maintain small home ranges ranging from 15 to 600 m^2 (Dole 1965). Radio-telemetry work suggests that frogs prefer to spend long periods at the edge of water bodies (Waye and Cooper 1999).

Movements and dispersal

Movements can occur at night or during the day (Merrell 1977; Seburn et al. 1997). Generally, adult Northern Leopard Frogs do not move very far (i.e., 5–10 m but occasionally 100 m) (Doyle 1965). Waye (2000) found that radio-tagged leopard frogs would not move for several days, then move 5–50 m away but return to their original location. On a seasonal basis, leopard frogs move greater distances. Northern Leopard Frogs move from overwintering sites in April to breeding ponds. The distance between breeding and overwintering locations can be a few metres or up to several kilometres (Merrell 1977). If breeding sites are ephemeral, the frogs will move, after breeding, to more permanent wetlands for the remainder of the summer (Nussbaum et al. 1983; Cannings et al. 1999). Metamorphs typically remain within 20 m of shoreline although some disperse before metamorphosis is complete. Metamorphs dispersing from natal sites generally

disperse within a couple of kilometres but have been recorded to disperse up to 8 km from natal sites (Seburn et al. 1997) and can move up to 800 m a night (Dole 1971). Migration back to overwintering sites may begin as early as August (M.A. Beaucher, pers. comm.) with the bulk of the movement occurring in September and October.

Habitat

Structural stage

2a–d: herb
3a: low shrub

Important habitats and habitat features

Aquatic

Aquatic habitats are needed for breeding and overwintering. The Northern Leopard Frog breeds in a variety of temporary and permanent aquatic habitats. Shallow water depths, abundant emergent vegetation, and absence of predatory fish species are important characteristics of most successful breeding sites (Merrell 1977; Leonard et al. 1993). Temporary aquatic habitats that hold water until late July or August or permanent ponds will reduce the risk that eggs or larvae may die as water levels drop. On the other hand, wetlands that dry up every few years prevent the establishment of fish populations. In Minnesota, preferred aquatic habitats were temporary ponds with a water depth of 1.5–2 m where fish were absent (Merrell 1968). In British Columbia, however, leopard frogs use wetland areas with shallow (20–30 cm), open water and beds of spikerush for breeding (Waye and Cooper 1999).

Deeper water that does not freeze to the bottom is required for overwintering sites. Northern Leopard Frogs typically spend the winter on the bottom of wetlands or streams often in organic debris or leaf litter, or under logs. Overwintering habitats must also maintain sufficient oxygen to prevent the water from becoming anoxic (Merrell 1977; Cunjak 1986).

Terrestrial

Terrestrial habitats are important for foraging and dispersal. This species forages in moist terrestrial environments, typically riparian habitats, but may move farther during wet periods. Although it may forage in a variety of terrestrial habitats, habitats with short (15–30 cm tall) vegetation appear to be preferred and tall (>1 m) grass areas are avoided, as are wooded areas, open areas, and heavily grazed or mowed areas (Merrell 1977).

Riparian habitat may be important, particularly in drier environments, for dispersal (Seburn et al. 1997).

Conservation and Management

Status

The Northern Leopard Frog is on the provincial *Red List* in British Columbia. In Canada, the southern mountain population is designated as *Endangered* (COSEWIC 2002). (See Summary of ABI status in BC and adjacent jurisdictions at bottom of page.)

Trends

Population trends

The Northern Leopard Frog has undergone a significant and widespread population decline in the last 20 years in western Canada and the United States (Bishop and Pettit 1992; Seburn and Seburn 1998). In British Columbia, only one extant site remains and the current estimated population is 1000 adults (Waye and Cooper 1999).There are at least 12 historic sites (Waye 2000). These records indicate a much wider distribution and abundance in the 1940s through 1970s than has been observed since that time. In the 1970s the species was described as

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

AB	BC	CA	ID	MT	OR	WA	Canada	Global
S2S3	S1	S2	S3	S3S4	S2?	S1	N5	G5

being numerous in the Creston area but by the early 1980s it was considered uncommon (Ohanjanian 1996). Surveys conducted from 1988 to 1990 (Orchard 1992) and 1995 (Ohanjanian and Teske 1996) were largely unsuccessful at locating leopard frogs. Northern Leopard Frogs have only been consistently reported, although in relatively low numbers (4 in 1991, 7 in 1996, 37 in 1997, 116 in 1998, 150 in 1999), from one area (i.e., Creston Wildlife Management Area) (Orchard 1992; Ohanjanian 1996; Waye 2000).

Significant declines have also been experienced in jurisdictions adjacent to British Columbia including Alberta, Idaho, Montana, and Washington. In Washington, the Northern Leopard Frog was historically known from eight counties but is currently only known from one (McAllister et al. 1999). Populations in southern and central Alberta have also declined dramatically (Roberts 1992; Wagner 1997), and in southern Idaho (Koch et al. 1996) and Montana (Reichel et al. 1996).

Habitat trends

Within the historic range of the Northern Leopard Frog, land use changes have resulted in the loss and alteration of some aquatic and riparian habitats. This is particularly true of Osoyoos Lake, which has seen increased urbanization and agricultural development since the late 1940s. The flooding of the Kinbasket Reservoir has altered habitat in the Bush Arm area. Much of the Columbia Marshes, however, have remained relatively unchanged. In the Creston Valley Wildlife Management Area (CVWMA), approximately 4500 ha of 6970 ha have been dyked (Frazier 1996). Dyking at the CVWMA created permanent ponds which tend to favour predatory fish populations and probably created barriers to seasonal frog movements. These negative effects may have been partially offset by the creation in some areas of relatively stable water levels and development of submergent and emergent plant communities in areas that had previously been exposed mud flats.

Threats

Population threats

There is only one extant site remaining in British Columbia (Cannings et al. 1999) which makes this species vulnerable to extirpation.

Non-native predatory fish, such as bass (*Micropterus* spp.), black bullhead (*Ameiurus melas*), and sunfish (*Lepomis* spp.), may displace and prey on native frog eggs, tadpoles, and metamorphs (Orchard 1992; Hayes and Jennings 1986). The introduction of predatory fish and bullfrogs into habitats occupied by Northern Leopard Frogs has contributed to the decline of leopard frogs in Washington (McAllister et al. 1999) and California (Hayes and Jennings 1986), and have been found to negatively impact Northern Leopard Frogs in Ontario (Hecnar and M'Closkey 1997). In addition, introduced plant species, such as purple loosestrife, can also alter wetland habitats making them less suitable or increasing the rate of eutrophication.

The role of infectious agents in amphibian declines and their interaction with stressed immune systems is currently under intense study. Diseases, such as Red-leg disease (a common bacterial infection in amphibians and fish), is believed to be implicated in a die-off of Northern Leopard Frogs in the 1970s (Bishop and Pettit 1992). Chytridiomycosis and other fungi have been shown to cause mortality associated with amphibian declines (Blaustein et al. 1994b; Berger et al. 1998) around the world. Rana-viruses too could be having an impact on herpeto-fauna globally, and may be contributing to the observed decline in amphibian numbers in some areas (Cullen and Owens 2000).

Numerous chemical applications are used in urban and agricultural environments. Fertilizer (ammonium nitrate) has been found to be toxic to Northern Leopard Frogs (Hecnar 1995), and larval amphibians are vulnerable to low levels of pesticides (Berrill et al. 1997). Possible effects on amphibian populations may be lowered reproductive capacity, deformities, and reduced ability to avoid predators.

In dry years, temporary aquatic habitats may be less available or dry up earlier resulting in reduced reproductive success and increased mortality (Hine et al. 1981). Drought, which can result in breeding habitats drying up, has been suggested as contributing to the disappearance of Northern Leopard Frogs in the Rocky Mountains (Corn and Fogleman 1984), but this does not appear to have been the case in British Columbia. The long-term local effects of global climate change in the Columbia basin are not known.

Increased UV-B radiation has been shown to affect developing amphibian embryos (Blaustein et al. 1994a); the degree to which this may be naturally offset by environmental factors (such as dissolved organic matter) is currently under study.

Historically this species was commercially collected in large numbers for scientific and educational studies.

Habitat threats

The loss, fragmentation, and alteration of wetland habitat is the primary threat to habitats of the Northern Leopard Frog.

Livestock grazing may impact leopard frog populations through the loss or alteration of riparian vegetation and habitats. In addition, cattle can trample egg masses in shallow waters. Livestock defecation within aquatic or riparian habitats may also alter water conditions. Northern Leopard Frogs rarely occur in heavily grazed areas (Merrell 1977).

Conversion of wetlands into croplands, such as hay or grain, has a negative impact. Not only is wetland habitat lost, but terrestrial foraging may be hampered by thick stands of alfalfa or cereal crops.

Urban development usually results in the draining of wetlands, the dumping of road wastes into wetlands, and destruction of riparian zones. Even if the wetlands *per se* are maintained, roads that are constructed between breeding, foraging, and/or overwintering habitats results in increased road mortality during seasonal migrations (Merrell 1977).

Alterations to hydrological regimes brought about by channelling, dyking, irrigating, and draining can have severe impacts on Northern Leopard Frogs. Overuse of aquifers by domestic wells and irrigation can lower the water table and reduce the occurrence of temporary wetlands (Corn and Fogleman 1984). Streamside aquatic vegetation may be affected by channelling, which in turn may affect both the prey base and the quantity of cover available. Hydrological changes can result in lower available dissolved oxygen in wintering sites, a factor that is crucial for overwintering survival (Cunjak 1986). Canals and ditches may connect previously isolated wetlands to those with predatory fish populations. Conversely, dyking may strand tadpoles in areas where water levels dry out (Wagner 1997) and steep slopes may impede movements of metamorphs and adults.

Legal Protection and Habitat Conservation

The Northern Leopard Frog is protected, in that it cannot be killed, collected, or held in captivity without special permits, under the provincial *Wildlife Act*.

Northern Leopard Frogs require the protection of aquatic breeding and overwintering habitat and terrestrial foraging habitat.

The only extant site remaining in British Columbia is within the Creston Valley Wildlife Management Area (6970 ha). The Creston Valley is listed by the International Convention on Wetland Protection as a wetland of international importance (Frazier 1996). Suitable habitat is also included within the Columbia National Wildlife Area (Cannings et al. 1999). Approximately 82 720 ha of wetland habitat is included within National Wildlife Areas, Wildlife Management Areas, and other unofficial areas managed for wildlife in the Columbia Valley. However some industrial and recreational activities are permitted within these areas.

Under the results based code (RBC), riparian buffers are required on lakes, wetlands, and streams.

However, small non-classified wetlands and small fishless streams do not receive any protection. The most critical components for terrestrial habitat are sufficient cover and, on a larger scale, connectivity between wetlands and overwintering sites to maintain metapopulation dynamics in the landscape. Connectivity of habitats is not explicitly addressed under the RBC but may occur through landscape level planning.

The Northern Leopard Frog Recovery Team is currently developing recommendations for reintroducing populations into suitable habitat. The intent is to establish five viable populations of Northern Leopard Frog within 10 years in the Kootenay, Columbia, and Creston valleys. In 2001and 2002, 480 and 2300 metamorphs, respectively, were reintroduced into another area of the CVWMA (M.A. Beaucher, pers. comm.).

Identified Wildlife Provisions

Wildlife habitat area

Goal

Maintain suitable habitat for reintroduction of Northern Leopard Frogs.

Feature

Establish WHAs at suitable sites as determined by the provincial recovery team or action group. The WHA should encompass all necessary attributes including aquatic breeding habitat, terrestrial foraging habitat, and overwintering habitat.

Size

Based on research on the only extant population in British Columbia, a WHA that is 1 × 2 km is recommended.

Design

The WHA should include a wetland breeding site, adjacent terrestrial foraging habitat, and an overwintering site. This last feature should be within 1.7 km of the breeding/foraging habitat, and <800 m where possible. The WHA should generally include a 50 m management zone surrounding the habitat features of the WHA (wetland, riparian habitats, overwintering site). When selecting and designing the boundaries of the WHA, maintain or restore connectivity between the aquatic-breeding habitat, terrestrial foraging habitat, and overwintering sites (if different than breeding site). The establishment of a metapopulation structure over more than one locale may be assisted if streams are present to facilitate movement and colonization (Seburn et al. 1997).

General wildlife measure

Goals

1. Maintain structural integrity and abundance of submergent and emergent vegetation (i.e., spikerush) to provide egg-laying sites and rearing habitat for developing tadpoles.
2. Maintain riparian vegetation to provide cover, but manage sites to reduce abundance of overly thick reed canary grass stands that would impede movement. Good cover to lower predation during seasonal migration is beneficial.
3. Maintain water quality and water levels.
4. Maintain WHA in a properly functioning condition.
5. Prevent or reduce road mortality.

Measures

Access

- Do not construct roads, deactivate temporary road structures, and close roads during critical times as recommended by MWLAP. Barrier fences may be recommended by the statutory decision maker for locations where road mortality is extensive.

Pesticides

- Do not use pesticides.

Range

- Plan livestock use in the core area to meet objectives described above (GWM goals). Exclusion fencing may be required by the statutory decision maker to meet objectives.
- Do not place livestock attractants within WHA.

Additional Management Considerations

Minimize road mortality by avoiding road developments that intersect known dispersal routes or incorporating barrier fences and "toad tunnels" to enable the safe passage of frogs.

Prevent introduction of fish species into suitable habitats for Northern Leopard Frogs.

Prevent or minimize wetland drainage, dyking, or flooding.

Information Needs

1. Suitability of proposed release sites must be assessed and compared with known areas of occupation.
2. Knowledge of the genetic structure of populations in British Columbia, Washington, Idaho, and Montana would be useful in deciding source populations for release sites.
3. Further study of the cause(s) of the Northern Leopard Frog decline in the west may provide information on the suitability of potential release sites.

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