SPECIES PROFILE

Northern Leopard Frog

Rana pipiens

Federal Listing: Not listed
State Listing: Special Concern
Global Rank: G5
State Rank: S3
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Element 1: Distribution and Habitat

1.1 Habitat Description

Northern leopard frogs require 3 distinct habitats for breeding, foraging, and overwintering. Breeding (May to late June), egg deposition, and tadpole development occur in shallow standing water and emergent vegetation, such as lake inlets, slow streams, ponds, temporary wetlands holding water until at least July or August (e.g., long-hydroperiod vernal pools), overflows, or the backwater of rivers (Merrell 1977, Hine et al. 1981, Hunter et al. 1999, Alberta Sustainable Resource Development 2003). The best spawning habitat is marked by ample vegetation and a lack of fish (Merrill 1977).

During the summer, adult, juvenile, and young-of-the-year frogs are typically found near water (Alberta Sustainable Resource Development 2003). However, leopard frogs will travel 1 to 2 km from major waterbodies to wet meadows, pastures, hay fields, scrub vegetation, sedge meadows, drainage and irrigation ditches, or damp wooded areas (Hunter et al. 1999, Kendell 2002). Leopard frogs cannot withstand prolonged freezing and therefore overwinter in permanent waterbodies that do not freeze to the bottom (Schmid 1982, Costanzo et al. 1992, Layne 1992, 1993, Hunter et al. 1999, Russell and Bauer 2000, Alberta Sustainable Resource Development 2003). Hibernacula are most often located in springs, streams, spillways below dams, or in deeper lakes and ponds (Emery et al. 1972, Merrell 1977, Cunjak 1986). Within waterbodies, leopard frogs have been found hibernating under rocks, logs, leaf litter, vegetation, or in depressions in sand or mud (Emery et al. 1972).

1.2 Justification

Leopard frogs have apparently declined throughout much of New England. The decline is likely related to farm abandonment, forest regeneration, and decreases in grassland. The current distribution and abundance of northern leopard frogs, and the status of remaining populations in New Hampshire, are poorly known.

1.3 Protection and Regulatory Status

Leopard frogs are not specifically protected. Breeding wetlands are regulated through NHDES Wetlands Bureau (RSA 482-A and Administrative Rules). Uplands are generally not regulated.

1.4 Population and Habitat Distribution

The northern leopard frog (or, more specifically, the northern leopard frog complex) has a broad distribution in the United States and Canada. Northern leopard frogs range from New England to the mid-Atlantic to west of the Rockies, and in Canada, populations exist from southeastern British Columbia east to the Maritimes. The northern leopard frog is absent from most of the southeast. Throughout its range, the species often has a spotty distribution and is considered critically imperiled (S1) or imperiled (S2) in several states in the west and south and in British Columbia. In New England, the species is considered imperiled (S2) in Connecticut and Rhode Island, Vulnerable (S3) in New Hampshire and Maine, and apparently secure (S4) in Vermont and Massachusetts (Nature Serve 2001). Throughout New England, the species

has a very spotty distribution and is strongly associated with grassy riparian floodplains. For example, in Connecticut, Klemens (1993) found that the species is restricted mainly to the Housatonic and Connecticut drainage basins and their tributaries.

In New Hampshire, records submitted to RAARP database were verified for the following areas between 1992 and 2004: Coos County (Errol, Pittsburg), Merrimack County (Concord), Rockingham County (Portsmouth), and Sullivan County (Charlestown). Reports from a number of other towns have not been verified with a photograph or specimen. Most observations were from the Merrimack River, Connecticut River, Androscoggin River, and associated floodplains.

1.5 Town Distribution Map
Not completed for this species.

1.6 Habitat Map
N/A

1.7 Sources of Information

Information relating to the distribution and status of this species was gathered through a literature review and from NatureServe, as well as from the RAARP database.

1.8 Extent and Quality of Data

No comprehensive survey has been conducted for this species in New Hampshire, thus detailed distribution data are lacking. Because leopard frogs are commonly confused with pickerel frogs (*Rana palustrus*), a photograph is required to verify records submitted to the RAARP. Many new populations are likely to be identified in the future (M. Marchand, NHFG, personal communication).

1.9 Distribution Research

Current distribution data are poor for northern leopard frogs. Surveys should focus on grassy riparian floodplains.

Element 2: Species Condition

2.1 Scale

There are insufficient demographic data from which to determine species condition.

2.2 Relative Health of Populations

Data are insufficient to determine population health.

2.3 Population Management Status

There are no management efforts for any particular northern leopard frog population in New Hampshire at this time.

2.4 Relative Quality of Habitat Patches

Data are insufficient to determine relative quality of habitat patches.

2.5 Habitat Patch Protection Status

There are insufficient data to assess protection status for this species.

2.6 Habitat Management Status:

Northern leopard frog habitat is not specifically managed in New Hampshire.

2.7 Sources of Information:

No information was found pertaining to leopard frog status in New Hampshire.

2.8 Extent and Quality of Data:

No information was found pertaining to leopard frog status in New Hampshire.

2.9 Condition Assessment Research

- Acquire and map basic distribution data for this species, using remote sensing and GIS to delineate potential habitat and surveys to determine actual distribution
- Conduct population and metapopulation stud-

ies to determine growth rates, stability, dispersal, habitat use (and landscape distribution of critical habitats)
- Determine threats to local populations and develop population and habitat management plans if feasible

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Fragmentation, Habitat Loss and Conversion)

(A) Exposure Pathway
The loss of leopard frog habitat will result in a population reduction. Habitat loss and fragmentation restrict gene flow, impede recolonization, and compound environmental stochasticity, often leading to local extirpation (Alberta Sustainable Resource Development 2003, Blaustein et al. 1994, Corn 1994). In New Hampshire, the most significant threat comes from development in riparian floodplains and farmland.

(B) Evidence
Habitat loss is believed to be one of the causes of northern leopard frog declines in Washington, Oregon, Idaho and Montana (Alberta Sustainable Resource Development 2003). The extent to which wetland loss and alteration have affected northern leopard frog populations in New Hampshire is unknown; however, significant loss of early successional grassland habitat and farmland has been well documented (see Grasslands habitat profile). Degradation or loss of critical habitat may be deleterious to leopard frog populations (Pope et al. 2000), and because metapopulations depend on the regional flow of genes and individuals, local extirpations can lead to widespread population collapse (Seburn and Seburn 2000, Alberta Sustainable Resource Development 2003, Blaustein et al. 1994, Marsh and Trenham 2001).

3.1.2 Transportation Infrastructure

(A) Exposure Pathway
Road traffic can kill leopard frogs and may be particularly problematic for small populations. Roads fragment habitat and act as partial barriers to migration, leading to the aforementioned restrictions on gene flow and re-colonization. When (meta) population dynamics are thus disrupted, the species may not remain viable.

(B) Evidence
Amphibians are especially vulnerable to traffic mortality because they migrate between wetland and upland habitats, and because individuals are inconspicuous and sometimes move slowly (Trombulak and Frissell 2000). Ehmann and Cogger (1985) estimated that more than 5 million amphibians and reptiles are killed each year on roads in Australia. Research conducted in the Ottawa area indicates that anuran populations decrease in size with increasing traffic volume (Fahrig et al. 1995). Additionally, Carr and Fahrig (2001) found that traffic can influence leopard frog abundance at least 1.5 km from the population and that more vagile species, such as northern leopard frogs, are more strongly affected by road traffic.

3.1.3 Non-Point Source Pollution (Chemical Contaminants)

(A) Exposure Pathway
Pesticide wetting agents can interfere with cutaneous respiration in metamorphosed and adult frogs and with gill respiration in tadpoles, leading to indirect or direct mortality. Chemicals can suppress the immune system, cause endocrine disruption and developmental malformations, and alter behavior which may lead to decreased vigor, ability to fight off disease, reproduce, or escape predation, thereby increasing the chance of mortality.

(B) Evidence
The northern leopard frog is a frequent subject of toxicity experiments (e.g., see Hoffman et al. 2003). Leopard frogs are commonly found near agricultural areas where they are exposed to pesticides, herbicides, and nutrient (fertilizer) runoff. Low levels of nitrates can cause reduced activity, feeding, reproductive ability, and increases in deformities in tadpoles (Hecnar 1995). Allran and Karasov (2000) report that nitrate slowed the growth of leopard frog larvae. Such a decrease in growth as a larva can have a significant detrimental impact later in the life of a frog by decreasing survival, size as an adult, rate of sexual maturation, mate selection, and locomotion ability for preda-

tor evasion (Allran and Karasov 2000). Ouellet et al. (1997) found higher rates of limb deformities in northern leopard frogs in Ontario, Canada at sites in agricultural area and suggested that contaminants were the likely cause. In addition, *Rana pipiens* tadpoles are also sensitive (e.g., have lower survival, experience paralysis, delayed growth, or abnormal behavior) to low concentrations of insecticides and herbicides commonly used in forest management (Berrill et al. 1994, Berrill et al. 1995). It has also been demonstrated that, for leopard frogs, pesticides can act as immunosuppressive agents at sub-lethal doses that are present in wild frogs. The immunosuppressive effects of pesticides may be contributing to amphibian declines by rendering exposed populations susceptible to common pathogens (Gilbertson et al. 2003). Hayes et al. (2002) reported that very small doses (0.1 ppb) of the commonly used herbicide Atrazine can cause hermaphroditism in northern leopard frogs.

Because of the low buffering capacity of most water bodies in New Hampshire, northern leopard frogs may be at risk from decreased environmental pH resulting from sulfur dioxide and nitrogen oxides emitted by burning of fossil fuels. Simon et al. (2002), found that frogs experimentally exposed to pH 5.5 had spleens colonized with both Gram-positive and Gram-negative bacteria whereas spleens of frogs exposed to pH 7.0 either were sterile or exhibited little bacterial colonization. Resulting systemic infections combined with decreased natural defenses may in part cause increased mortality in leopard frogs (Simon et al. 2002). Leopard frogs collected early in the spring, immediately following hibernation, but prior to the breeding season, exhibited 100% mortality within the first 4 days of exposure to pH 5.5 (Vatnick et al. 1999). Frogs collected later in the season, post-breeding and prior to hibernation, exhibited 58% mortality over the 10 days of exposure. Prolonged exposure to pH less than 4.0 is lethal for leopard frogs, and bacterial infection, inhibition of yolk plug retraction, thoracic swelling, and caudal curling occur at a pH less than 6.3 (Watkins-Colwell and Watkins-Colwell 1998).

3.1.4 Non-Point Source Pollution (Runoff)

(A) Exposure Pathway
Eutrophication from fertilizer and farm runoff can cause an increase in snail populations that serve as the host for the trematode *Ribeiroia ondatrae* whose larvae (cercariae) infect larval leopard frogs, forming metacercarial cysts that cause malformations. Individuals with malformations are at increased risk of predation and have lower survival rates. Other diseases, both emerging and existing, can cause morbidity and mortality. Immune systems suppressed by, for example, exposure to contaminant (see 3.1.3), can render frogs susceptible to diseases with which they can normally cope. Populations that experience high disease rates may become locally extirpated.

(B) Evidence
Widespread reports of malformed amphibians in North America have prompted investigations into the causes of the deformities. Some amphibian deformities may be the result of a trematode known as *Ribeiroia ondatrae* (Sessions and Ruth 1990, Johnson et al. 2002). Larvae (cercariae) of this parasite infect amphibians around the base of the hind limbs where they form subcutaneous cysts (metacercariae), often causing improper formation of the developing limb bud. If the malformations are severe enough to impair movement, the individual may die due to a reduced ability to acquire food, avoid predators, and reproduce. In addition to eutrophication, loss or replacement or natural wetlands with artificial impoundments (e.g., dams, farm ponds), and introduction of non-indigenous species have all been associated with increases in trematode populations (Johnson et al. 2002). However, not all malformations are cause by the trematode (see previous section), and research on northern leopard frogs in adjacent states suggests multiple causes for malformations (Meteyer et al. 2000).

Amphibians are known to be susceptible to a variety of diseases, including many diseases of fish (Crawshaw 1992). Mortality in northern leopard frogs has often been associated with the condition called red leg, which is not a disease but a condition of kidney failure (Gibbs et al. 1971, Hine et al. 1981). It is often associated with infection by *Aeromona hydrophila*, a naturally occurring and widespread bacterium. Ordinarily, this pathogen only affects individuals whose immune systems have been weakened by stress and does not affect entire populations.

The fungal disease chytridiomycosis has been found repeatedly at the sites of mass deaths of amphibians

in Australia and North and Central America and was implicated in northern leopard frog declines in Colorado in the 1970s. Chytridiomycosis has now been reported from 38 species of amphibians, representing 12 different families (Daszak et al. 1999).

3.2 Sources of Information

Information about threats was compiled from a literature review.

3.3 Extent and Quality of Data

The northern leopard frog is one of the most studied amphibian species; therefore the quality of the data for the species is reasonably good. There is a significant amount of experimental toxicity research on this species; however, relating laboratory experiments to on-the-ground threats is difficult. We lack data for populations of northern leopard frogs in New Hampshire, so the threats to this species are drawn largely from the general literature and knowledge rather than from specific evidence for this species in New Hampshire. Clearly, the loss of farmland and grassland has resulted in loss of habitat for this species, and this threat remains today.

3.4 Threat Assessment Research

Additional research is needed to establish and thoroughly detail the threat that pesticides and contaminants pose to northern leopard frogs in New Hampshire. However, the most needed research is a systematic survey and mapping of the distribution of this species in the state. Determination of the location and sizes of extant populations is necessary to inform potential land management or protection aimed at this species. Documentation of the effects of development on northern leopard frog population dynamics and dispersal behavior is also vitally needed, as habitat loss and fragmentation and roads are the highest-ranking threats affecting this species.

Element 4: Conservation Actions

A lack of knowledge about northern leopard frogs in New Hampshire precludes specific conservation. Thus, 4.1.3 of the grassland habitat profile (Permanently Protect Grasslands), broadened to include grassy riparian floodplains and associated aquatic breeding sites, constitutes the most important conservation action.

4.2 Conservation Action Research

Mapping potential northern leopard frog habitat and conducting a systematic survey for the species is the most critical research needed to inform conservation activities.

Element 5: References

5.1 Literature

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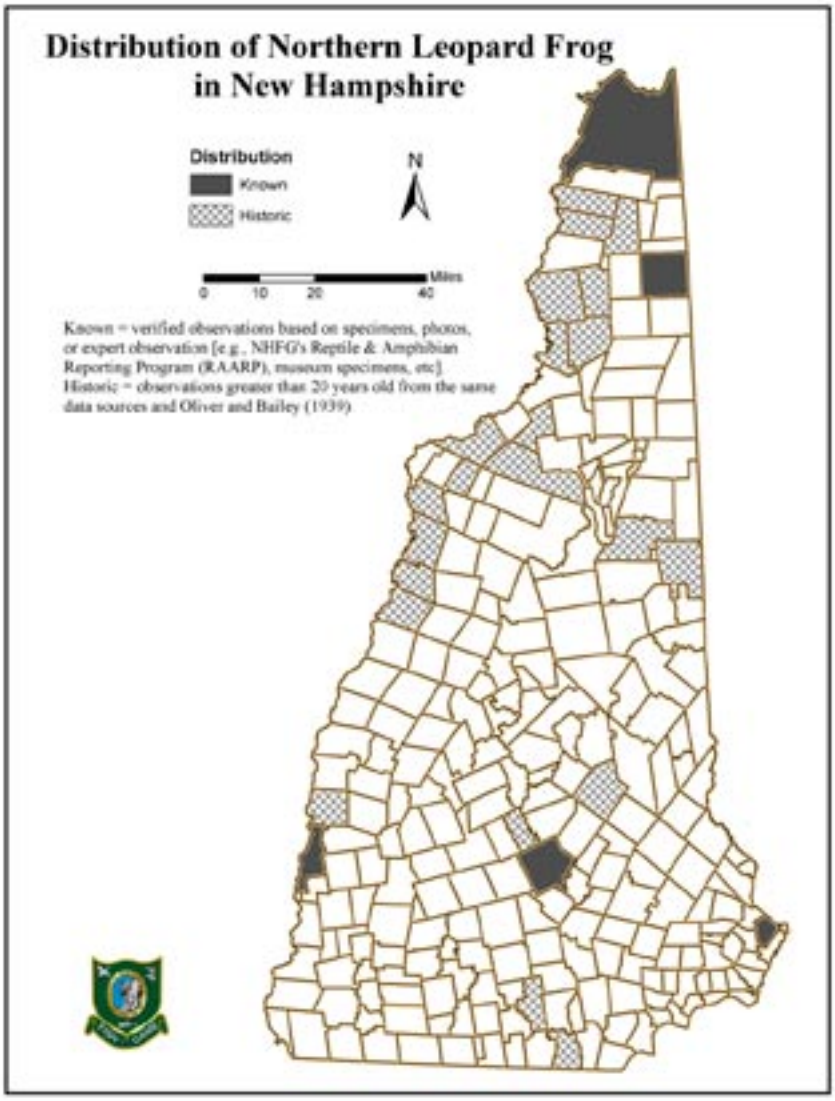
Distribution of Northern Leopard Frog
in New Hampshire
Distribution
Known
Historic
N
0
10
20
40
Miles
Known = verified observations based on specimens, photos, or expert observation [e.g., NHFG's Reptile & Amphibian Reporting Program (RAARP), museum specimens, etc].
Historic = observations greater than 20 years old from the same data sources and Oliver and Bailey (1939)