Red-legged Frog

Rana aurora aurora

Original prepared by Katherine A. Maxcy

Species Information

Taxonomy

The Red-legged Frog belongs to the family Ranidae (true frogs). Two subspecies are recognized: "Northern" Red-legged Frog (*Rana aurora aurora*) and "California" Red-legged Frog (*Rana aurora draytoni*). The "Northern" Red-legged Frog is the only subspecies that occurs in British Columbia.

Description

The Red-legged Frog is a medium-size anuran, ranging from 30 to 100 mm in snout-vent length (SVL). Adult females reach a larger body size (up to ~ 100 mm SVL) than do males (up to ~ 70 mm SVL). Juvenile frogs range from 18 to 40 mm SVL.

Adults have gold-coloured eyes that are oriented outward rather than upward as in Spotted Frog *(Rana pretiosa)*, with which it can be confused (Corkran and Thoms 1996). The colour of the ventral surface ranges from light golden to dark brown, possibly with a reddish tinge. Irregularly shaped black spots may also be present. Red-legged frogs have conspicuous dorso-lateral folds extending down either sides of the back. The undersides of the hind legs and lower belly are translucent red. In contrast to adults, juveniles may have little red on the thighs and belly and chest patterning is absent. In addition, the snout is short and rounded with a light, short lip line that may be quite indistinct.

Hatchlings average 12.4 mm total length and tadpoles reach lengths of 28.7 mm at metamorphosis (Brown 1975). Tadpoles have a stubby appearance and the tail is usually no longer than 1.5 times the body length. The overall body shape is oval with the dorsal fin taller than the thickness of the tail trunk. The ventral surface of the tadpole is tan with gold or brassy blotches. The dorsal fin may have a fine golden tone with light and gold-coloured dots, or it may be colourless (Corkran and Thoms 1996).

Distribution

Global

The Red-legged Frog occurs in the coastal lowlands of southwestern British Columbia, Washington, Oregon, and northern California.

British Columbia

The Red-legged Frog is found in the southwestern part of the province, including Vancouver Island and the Gulf Islands. On the mainland, the species occurs west of the Coast Mountains in the Fraser Valley and adjacent to the Strait of Georgia. Its northern limit in British Columbia has not been verified but may occur at least as far north as Kingcome Inlet (Waye 1999).

Forest region and districts

Coast: Campbell River, Chilliwack, North Island, South Island, Squamish, Sunshine Coast

Ecoprovinces and ecosections

COM: NIM, NWC, NWL, SPR, WIM (possibly EPR, HEL, OUF)
GED: FRL, GEL, LIM, NAL, SGI

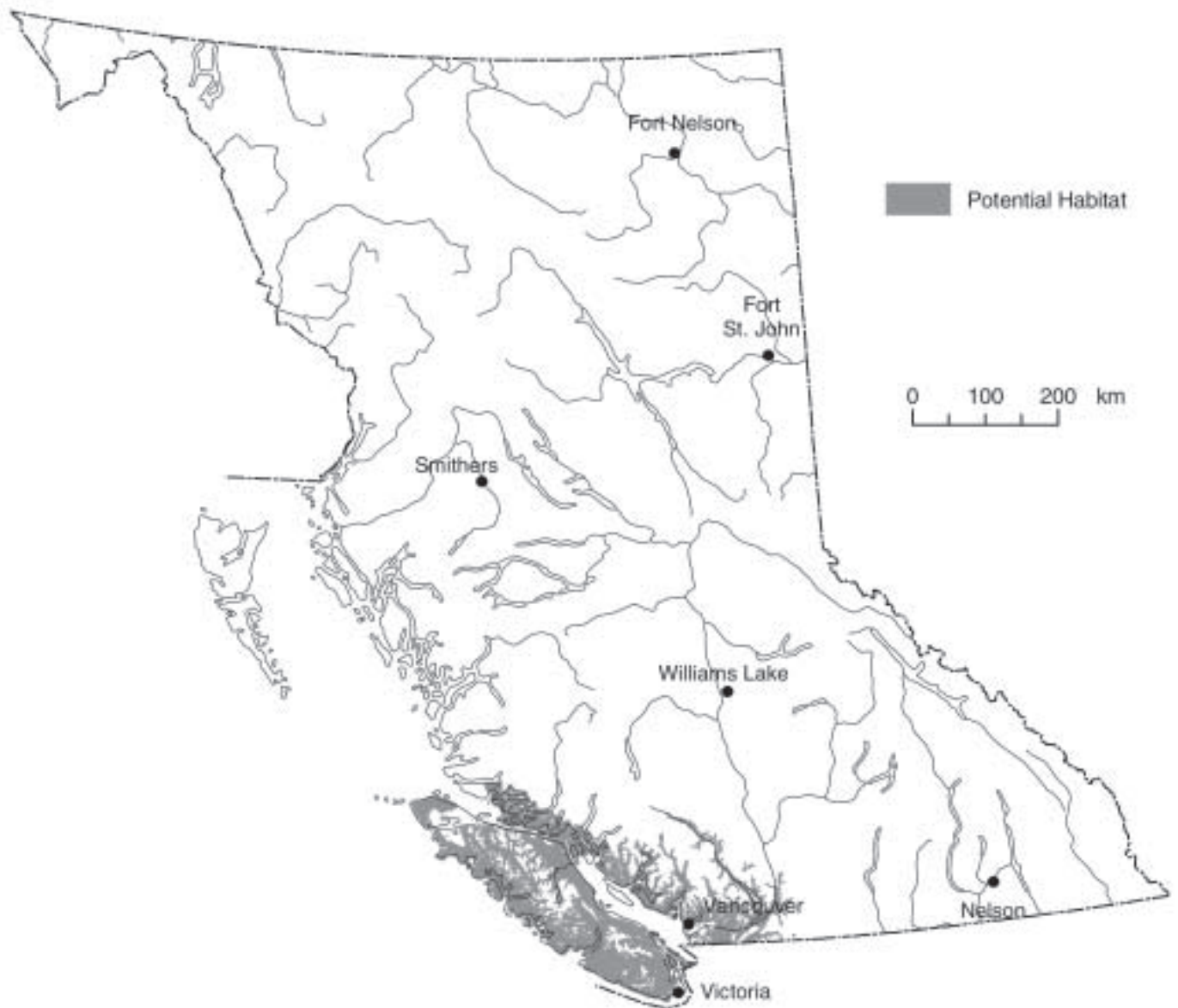*Biogeoclimatic units*

CDF: mm
CWH: dm, ds, mm, vh, vm, wh, xm

Broad ecosystem units

BG, CD, CG, CH, CP, CR, CW, DA, FE, FR, LS, ME, MR, OW, SP, SR, WL

Elevation

Generally at low elevations, mostly below 850 m.

Red-legged Frog
(Rana aurora)

Potential Habitat

0   100   200   km

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.

Life History

Diet and foraging behaviour

Tadpoles are herbivorous and forage on filamentous algae in the water column, scraping algae off substrates, and possibly consuming decaying vegetation at the bottom of pools (Nussbaum et al. 1983).

Adult and juveniles are likely opportunistic foragers limited mainly by their gape in what they can eat (Licht 1986). The frogs feed mostly on land with dominant prey items including slugs, spiders, and many insects. The foraging behaviour of adult and juveniles is not easily observed. Newly metamorphosed individuals tend to remain near the water margins after emergence, stalking small prey in and out of the water (Licht 1986). During rainy periods, they may move several metres inland from the water's edge but return if substrates become dry. Metamorphosed frogs occasionally feed in aquatic habitats but are less efficient at capturing aquatic prey items than are the more aquatic Oregon Spotted Frog (Licht 1986).

Reproduction

Breeding occurs in a wide variety of wetlands including both temporary and permanent ponds, lakes, and slow-moving streams with emergent vegetation (Storm 1960; Brown 1975; Richter and Azous 1995; Beasley et al. 2000). Breeding activity is weather dependent. Frogs become active during rainy periods when daytime temperatures are >4–5°C (Storm 1960; Licht 1969, Calef 1973a) and begin moving to breeding sites. In southwestern British Columbia, breeding usually begins in late February to early March and lasts 2–4 weeks (Licht 1969; Brown 1975).

Males arrive at the breeding sites up to 1 week before females (Licht 1969). Males typically call underwater (Calef 1973b). Females are thought to reproduce every year (Licht 1969), laying an average of about 600 eggs per clutch with larger females producing more eggs. For egg-laying to occur, water temperatures must be at least 4°C (Licht 1969, 1971; Calef

1973b). The egg masses are attached to stalks of emergent vegetation (e.g., rushes and sedges) in quiet water of little or no flow (Storm 1960; Licht 1969; Briggs 1987; Richter and Azous 1995). Water depths range from 30 to 500 cm deep and are at least 60 cm from the shoreline (Briggs 1987). The placement of eggs below the surface of the water prevents the eggs from being stranded above the high watermark as water recedes. The egg masses are also protected from thermal extremes, as water temperature fluctuations are less than near the surface (Licht 1971).

The eggs hatch in approximately 5 weeks (Brown 1975) with some variation in development time depending on water temperature: the warmer the water, the faster development occurs. Normal egg development occurs at temperatures from 4 to 20°C (Licht 1971). The hatchlings take at least 3–4 months to metamorphose (Licht 1974; Brown 1975); young of the year begin to emerge in late July/early August and continue emerging through early October (Calef 1973a). Larval developmental and growth rate may be altered by both biotic (e.g., presence of predators) and abiotic (e.g., water temperature) factors.

Survival of embryos can be high; Licht (1974) observed a 90% survival rate to hatching. However, like other anurans, larval survival to metamorphosis appears to be much lower, estimated at 5% (Licht 1974). The main source of mortality of developing larvae is likely predation (Licht 1974; Adams 2000).

Site fidelity

Limited information exists on movement patterns and site fidelity of Red-legged Frogs. One study showed that males had a tendency to return to the same breeding site (a particular part of a lake; Calef 1973b), and individuals may well show fidelity to particular breeding sites from year to year. It is not known whether adult frogs return to the same terrestrial foraging area following breeding.

Home range

Unknown.

Movements and dispersal

One study on northern Vancouver Island examined movements of radio-tagged Red-legged Frogs within logged landscapes. While most (up to ~ 80%) tagged frogs moved <10 m within a 24-hour period, some made long movements, demonstrating potential to move relatively long distances over short periods (Chan-McCleod et al. 2000). Chan-McCleod et al. (2000) observed movements >300 m within 24 hours. However, these movements were recorded for frogs that were displaced from their original point of capture, so it is unlikely that these observations represent typical daily movements within the home range. Nothing is known about dispersal ability of the frogs and movements to and from aquatic breeding sites.

Habitat

Structural stage

2c: aquatic herbaceous 5: young forest
3b: tall shrub 6: mature forest
4: pole/sapling forest 7: old forest

Important habitat and habitat features

Aquatic

Although Red-legged Frogs require standing water to breed, they can use a diversity of waterbodies and wetlands. Breeding sites exhibit a wide variation in size, water depth, degree of permanency, and community structure (Richter and Azous 1995; Adams 1999; Beasley et al. 2000). Low water flow and complexity of microhabitat within the wetlands appear to be important. For example, although Red-legged Frogs were present in all types of wetlands sampled on western Vancouver Island (including shallow open water, marsh, swamp, fen, and bog), the highest proportion of occurrence was in bogs and fens (Beasley et al. 2000). Bogs and fens are characterized by humus substrate (as opposed to rock), greater herbaceous and emergent vegetation, and submerged down wood, all of which provide structural habitat for tadpoles. Adams (1999) also found that wetlands with emergent vegetation were more likely to be occupied by Red-legged Frogs than those with more open water (i.e., <50% of wetland

surface had emergent vegetation). The Red-legged Frog selects sites with thin-stemmed, emergent plants (e.g., rushes and sedges) for breeding (Storm 1960; Licht 1969; Richter and Azous 1995); therefore, microhabitat of increasing complexity appears to be important for the frogs. Red-legged Frogs are also associated with wetlands having low water flow (Storm 1960; Licht 1969; Bury 1988; Richter and Azous 1995). Briggs (1987) recorded eggs in water depths from 30 to 500 cm deep and at least 60 cm from the shoreline.

The presence of Red-legged Frogs in aquatic-breeding habitat does not appear to be associated with forest age. Beasley et al. (2000) surveyed a variety of wetlands on the west coast of Vancouver Island for the presence of aquatic-breeding amphibians. Red-legged Frogs were present in 32% ($n = 11$) of wetlands that were in logged and/or roaded areas and 24% ($n = 27$) of wetlands that were undisturbed in old-growth forest (Beasley et al. 2000). Although Red-legged Frogs used wetlands disturbed by harvesting and intersected by roads, it is unknown whether these sites produced sufficient offspring to ensure population viability or whether they acted as reproductive sinks.

Terrestrial

Terrestrial habitat is where a significant portion of feeding and growth occurs (up to 90% of the time). Despite this, what constitutes high versus low quality terrestrial habitat remains unknown. Red-legged Frog abundance has been found to be positively and negatively associated with a variety of terrestrial habitat components. These relationships are difficult to interpret in a biologically meaningful way; however, some patterns are beginning to emerge. Red-legged Frogs are negatively associated with elevation (Aubry and Hall 1991; Bury et al. 1991; Aubry 2000; Beasley et al. 2000) and slope (Bury et al. 1991; Aubry and Hall 1991). Flatter sites at lower elevation (i.e., below 500 m) are areas associated with standing water (Aubry and Hall 1991). They also tend to be more abundant in riparian areas compared with upslope (McComb et al. 1993; Gomez and Anthony 1996; Cole et al. 1997). Chan-McCleod et al. (2000) found that frogs radio-tracked

in clearcuts on northern Vancouver Island were usually associated with streams. Therefore, proximity to water appears to be an important determinant of their distribution, especially in disturbed landscapes. Two other habitat components that may be important to Red-legged Frogs include deciduous forest (in the United States) and abundance of coarse woody debris. Gomez and Anthony (1996) found the highest abundance of Red-legged Frogs in deciduous forest compared with a variety of conifer stand ages including old growth. Red-legged Frog presence was also correlated with high amounts of coarse woody debris indicating this habitat element may be important for cover (Aubry and Hall 1991).

At the stand level, as long as there is forest cover, the age of the forest does not appear to be important in determining the distribution of Red-legged Frogs. The Red-legged Frog has been found in a range of forest stand ages and although it can be associated with old growth (Walls et al. 1992; Blaustein et al. 1995), it is not considered an old growth dependent species in the United States (SAT 1993). The abundance of the frogs varies greatly among sites (Bury and Corn 1988; Bury et al. 1991; Cole et al. 1997; Maxcy 2000), making it difficult to establish clear relationships with specific variables such as forest age, structure, and composition. In Washington State, Red-legged Frogs were 1.25 more abundant in successional forests (30–76 yr) compared with clearcuts (Bury and Corn 1988). In Oregon, they were 5–10 times more abundant in rotation age stands (50–70 yr) compared with younger age classes including clearcut sites (Aubry 2000). In southwestern British Columbia, Maxcy (2000) captured 11 frogs in a 70-year-old second-growth stand before harvesting and only one frog one year post-harvesting.

The spatial distribution of Red-legged Frogs is likely related more to proximity of suitable breeding habitat rather than forest age *per se* (Welsh and Lind 1988; Bury et al. 1991; Corn and Bury 1991). Although Red-legged Frogs have no apparent association with stand age, they do appear to be negatively affected by clearcutting and very young successional forest.

Conservation and Management

Status

The Red-legged Frog is on the provincial *Blue List* in British Columbia. It is designated as a species of *Special Concern* in Canada (COSEWIC 2002).

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

BC	WA	OR	CA	Canada	Global
S3S4	S5?	S3	S2?	N?	G4

Note: Washington has an incorrect and conflicting rank with the global rank. State ranks can not be more secure (i.e., S5) than the global rank (G4).

Trends

Population trends

There is currently no information on population trends for Red-legged Frog populations in British Columbia (Waye 1999). Most historical localities from the province have not been visited recently. Since the 1970s, populations in the Willamette Valley in Oregon have declined severely (Blaustein and Wake 1990). Populations of the California subspecies (*R. aurora draytoni*) have declined drastically through their range (Hayes and Jennings 1986; Fisher and Shaffer 1996).

Habitat trends

There has been a significant loss of Red-legged Frog habitat in parts of its range in British Columbia. The Lower Mainland is the most populated area of the province. Since 1827, wetland area has decreased from 10 to 1% in the lower Fraser Basin ecosystem (Boyle et al. 1997). Over this same period, the area of coniferous forest declined from 71 to 54%, while urban and agriculture use increased by 26% (Boyle et al. 1997). Southern and eastern Vancouver Island have also become extensively urbanized and developed. Much of the forest in the interior of the island and north of Vancouver has been fragmented

by logging, but the effects of this fragmentation on the Red-legged Frog are unknown.

Threats

Population threats

The introduction of exotic species has been suggested as one reason for the decline of ranid frogs in western North America, including Red-legged Frogs. Bullfrogs (*Rana catesbieana*) in particular have been implicated in these declines (Nussbaum et al. 1983; Hayes and Jennings 1986; Kiesecker and Blaustein 1997). However, results from recent studies indicate Red-legged Frog responses to introduced predators including bullfrogs and fish are not predictable (Keisecker and Blaustein 1997; Adams 2000).

Under experimental conditions (e.g., pond enclosures or aquaria), the larvae of the Red-legged Frog are adversely affected by the presence of both bullfrog larvae and adults. Larval microhabitat use can change (Kiesecker and Blaustein 1998), growth rates are lower, and time to metamorphosis may be shorter (Adams 2000) or longer (Kiesecker and Blaustein 1998); all these factors have potentially negative consequences to survival. Due to the lower growth rates, metamorphosis occurs at a smaller size, which has implications for subsequent survival. Survival may also be directly reduced in the presence of bullfrog larvae (Lawlor et al. 1999); however, this is not a predictable response and depends on other factors as well. For example, Keisecker and Blaustein (1997) found the survival of Red-legged Frog tadpoles was unaffected by bullfrog presence if the tadpoles originated from a population that was sympatric with bullfrogs in its natural setting but not if the tadpoles were from a native population. Survival of Red-legged Frog tadpoles alone with bullfrog tadpoles was unaffected but was reduced when bullfrog larvae were present with adult bullfrogs and/or predatory fish (Kiesecker and Blaustein 1998). Adams (2000) observed low survival rates of Red-legged Frog tadpoles across a number of treatments, which included the presence and absence of predators in temporary and permanent wetlands. He suggests tadpole survival within enclosures was related to the abundance of tadpoles outside enclosures, indicating that some other factor other than the presence of exotic species was influencing survival rate of Red-legged Frog tadpoles such as predation by invertebrate predators and/or food limitation. Although Red-legged Frog tadpoles have variable survival in the presence of bullfrog larvae, metamorphosing frog survival was <5% in the presence of adult bullfrogs (Kiesecker and Blaustein 1998), indicating terrestrial mortality may have a considerable effect on the number of successful metamorphs leaving the wetland.

While the presence of bullfrogs and exotic fish has been shown to negatively affect Red-legged Frogs in a number of ways, other factors have been found more important in determining the distribution of Red-legged Frogs at the landscape scale. For example, Adams (1999) found the distribution of Red-legged Frogs was more closely associated with habitat structure and the presence of fish than to the presence of bullfrogs. Richter and Azous (1995) sampled 19 wetlands and found Red-legged Frogs in 70% of the wetlands. Lower species richness in these wetlands was not correlated with the presence of exotic fish or bullfrogs, but rather increasing water-level fluctuation and percentage of watershed urbanization. While bullfrogs and fish can significantly impact Red-legged Frog populations, other factors may be more important in determining their abundance and distribution.

Another factor implicated in the decline of amphibians in the Pacific Northwest is increased ultraviolet (UV) radiation. However, for Red-legged Frogs, UV does not appear to be an issue. There were no significant differences in survival of Red-legged Frog eggs (Blaustein et al. 1996; Ovaska et al. 1997) or larvae (Ovaska et al. 1997) between treatments shielded from UV-B compared with those exposed to ambient levels. Furthermore, the activity of photolyase (an enzyme important in repairing UV-damaged DNA) was higher in Red-legged Frogs compared with many amphibians (Blaustein et al. 1996), indicating UV-B radiation is an unlikely mechanism in the decline for this species at present. However, under experimentally enhanced UV-B levels, eggs and larvae of the Red-legged Frogs were

more sensitive than those of the sympatric Pacific Treefrog (*Pseudacris regilla*) and experienced high mortality.

Roads can have both direct population impacts, particularly when they cross important dispersal or migration routes and are heavily used (Fahrig et al. 1995), as well as indirect impacts through habitat alteration. Road mortality has been documented for this species and may be common in urban environments (Waye 1999). The impact to populations is not known.

Although the effect of toxic pollutants on the Red-legged Frog is not specifically known, agricultural pollutants have been shown to have mutagenic effects on amphibians (Bonin et al. 1997). There have been no known instances where disease was determined to negatively impact populations of *R. a. draytoni* (USFWS 1996).

Habitat threats

Habitat loss and degradation have been suggested as the primary causes of ranid declines (Corn 1994; Blaustein 1994).

The loss of wetlands in the lower Fraser Valley and on southern Vancouver Island to urbanization and agriculture has significantly reduced available breeding habitat, fragmented habitats, and reduced the quality of breeding habitats.

On Crown land, forest harvesting and road construction are likely one of the primary threats to Red-legged Frog habitat. Forest harvesting has been shown to affect many functions of wetlands including productivity, hydrology, species assemblage, and habitat (Richardson 1994). However, the degree to which functions are altered depends on a number of other factors such as type of harvesting used (e.g., partial cutting, clearcut), use of a buffer around the wetland, and size of the wetland. In British Columbia, harvesting practices have likely altered wetlands but the importance of this to Red-legged Frog populations is unknown.

At the local scale (i.e., individual wetlands), removing forest canopy increases the rate of evaporative water loss. A shoreline that recedes too early in the spring potentially strands eggs that are laid in the shallow margins, directly increasing mortality of eggs. Developing larvae may also be stranded if the wetland dries up before the tadpoles have had a chance to metamorphose. Protection around wetlands is also critical to metamorphosing frogs that have a high risk of desiccation due to their timing of metamorphosis during the hottest, driest times of the year, and high surface area to volume ratio (they lose water more quickly than do adults). Without suitable microclimates, the risk of mortality due to desiccation is greatly increased (Semlitsch 1998; DeMaynadier and Hunter 1999).

At larger scales (e.g., watershed scale), the loss of small wetlands can affect metapopulation dynamics of pond-breeding amphibians and increase the probability of extinction of populations in the remaining wetlands (Gibbs 1993, 2000; Semlitsch 1998). Although small wetlands do not comprise a large area in the land base, they are often numerically dominant to large wetlands. For example, Semlitsch and Bodie (1998) observed 46% of wetlands in the southeastern Atlantic coastal plain were <1.2 ha. Over 97% of all wetlands surveyed on the west side of Vancouver Island were <0.1 ha (Beasley et al. 2000); Red-legged Frogs were present in 26% of these wetlands. The loss of unclassified wetlands not only decreases the number of aquatic-breeding sites, reducing the abundance or density of organisms, it also increases the nearest neighbour distance between sites, impeding source-sink processes (Gibbs 1993, 2000; Semlitsch 1998). For a number of species of ranid frogs, the occupancy of wetlands is related to the proximity of other breeding ponds (Laan and Verboon 1990; Gulve 1994; Pope et al. 2000). These results suggest nearby population sources are important in maintaining metapopulations of pond-breeding amphibians. Little is known about the metapopulation dynamics of Red-legged Frogs but studies on other ranids suggest they may be important.

Legal Protection and Habitat Conservation

Under the provincial *Wildlife Act*, the Red-legged Frog is protected in that it cannot be killed, collected, or held in captivity without special permits.

Several sites occur in protected areas including: Little Campbell River Regional Park, Miracle Beach Provincial Park, Morrell Nature Sanctuary, Garibaldi Provincial Park, Strathcona Provincial Park, Stanley Park, Rithet's Bog Nature Sanctuary, Spectacle Lake Provincial Park, and Trevlac Municipal Park (Waye 1999).

Habitat conservation needs may be partially addressed under the results based code, particularly the riparian management recommendations. Although retention of buffers on streams and wetlands is likely beneficial to Red-legged Frogs, the regulations associated with the riparian manage-ment for wetlands are not at an appropriate scale to manage for Red-legged Frog breeding habitat. Additional protection is required for wetlands <0.5 ha that currently receive no protection.

The most critical component for terrestrial habitat is likely sufficient cover and, on a larger scale, connect-ivity and distance between wetlands to maintain metapopulation dynamics in the landscape. Connectivity of habitats is not explicitly addressed under the results based code but may occur through landscape level planning.

Since the range of the species overlaps with urban areas, urban planning and municipal provisions may also provide some protection.

Identified Wildlife Provisions

Sustainable resource management and planning recommendations

❖ Maximize connectivity of wetlands and riparian habitats considered to be of importance to this species (i.e., wetlands <850 m). Connectivity should be considered in terms of 1 km or less. A network of interconnected wetlands will increase connectivity and dispersal of juvenile frogs, possibly maintain metapopulation dynamics, and buffer against temporal variation in productivity

of individual wetlands or stochastic events that may change a source population to a sink and vice versa.

Wildlife habitat area

Goal

Maintain aquatic and riparian breeding habitats not addressed by the *Riparian Management Area Guidebook* (e.g., non-classified wetlands <0.5 ha, ephemeral wetlands) or through landscape level planning. Over time, WHAs may need to be relocated to account for succession.

Feature

Establish WHAs at networks of small ephemeral or perennial wetlands (each <0.5 ha). A wetland network defined here is different from a wetland complex as defined in the riparian management recommendations. A wetland network is a general term that can include a wetland complex but also wetlands that are too small to be considered a complex (i.e., <5 ha total area) but are likely still important breeding habitat for Red-legged Frogs. A network should include at least three wetlands that are within 300 m of each other.

The priority for establishing WHAs should be those wetlands where Red-legged Frogs are known to occur regularly. Suitable sites are characterized by the following attributes: (1) high structural com-plexity within the wetland (i.e., high percent coverage of thin-stemmed emergent vegetation, coarse woody debris); (2) a humus substrate; (3) forest/vegetation cover surrounding wetland; (4) absence of vertebrate predators (fish and bullfrogs); (5) <850 m in elevation; (6) small size (<0.5 ha; and (7) capacity to hold water until the end of the summer (31 August).

Size

Generally, <10 ha but will depend on site-specific factors including the spatial arrangement of wet-lands and size of wetlands.

Design

The WHA should include a core area that encompasses the wetland network plus a 30 m reserve of adjacent riparian habitat beyond the high watermark. The WHA should also include a 20 m management zone beyond the core area.

General wildlife measures

Goals

1. Prevent road mortality and mortality due to industrial activities during the breeding season (March–August).
2. Maintain as closely as possible the natural hydrological regime of wetlands.
3. Maintain the structural integrity of emergent vegetation to provide egg-laying sites and rearing habitat for developing tadpoles.
4. Maintain forest or vegetation cover adjacent to breeding sites to provide suitable microclimatic conditions for emerging juveniles and foraging adults.
5. Maintain important habitat features including natural levels of coarse woody debris, a deciduous component to stands where appropriate, and understorey vegetation surrounding wetlands.

Measures

Access

- Do not construct roads.

Harvesting and silviculture

- Do not harvest in the core area.
- In the management zone, use partial harvesting systems that maintain 70% basal area. Maintain forest structure and cover by retention of large diameter trees, multi-layered canopies, snags, and coarse woody debris. Retain as much understorey trees, shrubs, and herbaceous vegetation as is practicable.
- No salvage should be carried out.

Pesticides

- Do not use pesticides.

Additional Management Considerations

Consider installing culverts under roads with drift fences directed toward the culverts at selected locations on roads that have high traffic volume at night and where road mortality of Red-legged Frogs is high.

Prevent fish introductions and the spread of bullfrogs.

Information Needs

1. Determine population/distribution trends and the northern extent of the Red-legged Frog. Trends should be determined separately for the Vancouver Island and mainland populations.
2. Information on movement patterns of newly metamorphosed Red-legged Frogs, home ranges of terrestrial adults, and metapopulation dynamics is needed to determine the appropriate scale of Red-legged Frog WHAs (i.e., network of wetlands).
3. More information is needed on the effects of forest management on Red-legged Frogs, particularly with respect to aquatic-breeding habitats. Experimental designs should focus on the breeding site in conjunction with the surrounding upland habitat as experimental units.

Cross References

Keen's Long-eared Myotis, Pacific Water Shrew

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