

# WILDLIFE DATA CENTRE

## FEATURED SPECIES - WOOD FROG

R. Wayne Campbell

Throughout the central and northern interior of British Columbia the wood frog (*Rana sylvatica*) (Figure 1) is the true harbinger of spring. As temperatures rise above freezing and ice begins to melt, masses of wood frogs move at night from the forest where they passed the winter to nearby breeding sites. Almost immediately the males begin their loud mating calls which for a short period can be deafening. Herpetologists call the mating system an “explosive aggregation”.



**Figure 1.** The black facial mask and white jaw stripe are two identifying features of the wood frog (*Rana sylvatica*). Sukunka River, BC. 23 June 2002 (R. Wayne Campbell).

The wood frog, mainly a diurnal species, occurs farther north than any other amphibian or reptile in Canada, extending above the Arctic Circle at 68° North latitude to the northern edge of the boreal forest. It is marvelously adapted to harsh northern environments. It has a low embryonic temperature tolerance, develops rapidly, and its egg masses have a higher temperature than the surrounding water due to the retention of solar radiation.

Long term monitoring of wood frog populations in northern regions may become important in determining and assessing the effects of global warming on wetland habitats in British Columbia.

### Wildlife Data Centre Provincial Status Designation

The wood frog is **Not in Jeopardy** in British Columbia because of its broad distribution and the diverse variety of permanent and temporary wetlands and forested habitats it occupies at different elevations. Locally, however, small populations may be threatened.

### **At a Glance**

#### *Adults and Juveniles*

- Body colour varies but usually brown or grey
- Males and females are similar in appearance
- Underparts white; webbing does not extend to tip of toes identified by its black mask and
- Black mask extends from end of snout to shoulder white stripe along the jaw.
- Prominent white lip (jaw) line
- Light stripe may be present on back
- Irregular black markings may be scattered on back
- Adult size from 35 to 50 mm. (1.4 to 1.97 in.) long

#### *Tadpoles*

- Black or dark brown with bright gold flecks
- Dark belly with silver sheen
- Very short, round body
- Tail 1 ½ times body length
- Eyes located on top of head
- Mouth has 2-4 tooth rows on top and 3-4 on bottom

#### *Eggs*

- In soft egg masses about the size of a large plum
- Individual eggs black above and white below
- Eggs appear very close together

### **Where and When**

#### World Range

The wood frog is endemic to North America where it is closely associated with the distribution of spruce forests. It ranges just north of the Arctic Circle in Alaska, Yukon, and Northwest Territories, south through northern and eastern British Columbia and most of the prairie provinces, east to Labrador and the Maritime provinces, and south through the eastern United States to the Appalachian Mountains. Isolated populations exist in the Ozark Mountains, northern Colorado, and northern and southern Wyoming. It occurs from sea level to 3,050 m (10,000 ft.).

#### British Columbia

The wood frog is a common and widely distributed



**Figure 2.** Distribution of the wood frog (*Rana sylvatica*) in British Columbia.

species found throughout most of the interior of British Columbia (Figure 2). Populations vary considerably with latitude but are highest in more northern areas. The centre of abundance appears to be in the southern Peace River region. It ranges from the vicinity of the Alsek River in the extreme northwest and across the northern half of the province south to Terrace, Francois Lake and Prince George in the west. The range continues southeast through the eastern Fraser Plateau and Cariboo-Chilcotin regions to Clinton and Chase and east to Yoho National Park (Figure 3). It has been found at subalpine elevations.

#### Habitat - Nonbreeding

Adult wood frogs are primarily terrestrial except for the brief period spent at breeding sites. Juveniles spend more time associated with water and can be found in low numbers into the late summer. Both age classes range widely in search of food in a variety of forests including pure deciduous (e.g., trembling aspen and balsam poplar) and coniferous (e.g., spruce), mixed deciduous and coniferous, and shaded shrublands (e.g., willows and red-osier dogwood). Leaf litter and some dampness are important constituents of the frog's home range. They are rarely found in degraded areas. During the coldest months the wood frog hibernates on land under a substantial blanket of leaf litter, in rotting logs and stumps, under boulders, and embedded deep within mosses and lichens. It is suspected that some animals may hibernate in permanent aquatic habitats.

#### Habitat - Breeding

Unlike most other frogs, the wood frog prefers semi-permanent and temporary flooded wetlands for breeding. These may include shallow seasonal ponds, roadside ditches, active and abandoned beaver ponds, grassy agricultural ponds, flooded fields, willow swamps, back waters of slow-moving rivers, streams, and creeks, wet meadows, cattle and horse dugouts, shallow seasonal ponds in forests, small, undisturbed wetlands in recently harvested cut-blocks, and small cattail marshes. Overhead cover in these vernal sites can be open or closed but the water must be clear. The species also breeds in larger permanent water bodies including lakes, slow-moving rivers, and large sloughs. The important common denominator in all larger waterbodies is that they do not contain fishes in the immediate breeding location, that some sort of emergent vegetation or aquatic plants are prevalent for attachment of egg masses, and a forested environment is close by.

#### Occurrence

The wood frog has a short explosive breeding season and a somewhat longer terrestrial period. In British Columbia it has been recorded active for 170 days of the year from 6 April (Prince George) to 10 September (Barton Lake) (Figure 4).

### **Family Life**

#### Emergence from Hibernation

The wood frog spends about 53 % of the year hibernating in forested environments (Figure 5). It prefers semi-permanent and flooded ponds and pools for breeding and its active season is short compared to other species of frogs. The wood frog emerges from hibernation when air temperatures rise and melting snow and spring rains provide a wet substrate for the annual migration to breeding sites. At this time snow may still cover the ground and ice may still be in the ponds.

Breeding times vary each year but are controlled by environmental temperatures remaining above freezing until the upper few inches of ground are thawed and breeding sites have some open water. In British Columbia, wood frogs have been first heard on 6 April (Prince George) and 11 April (Dawson Creek) but most emerge from hibernation during the last two weeks of April. In Alaska, the emergence period ranged from 24 April to 22 May.

As males enter the water they become very vocal with a variety of croaks and quacks sounding to some observers like ducks. In the Prince George region this activity only lasts about two weeks. Males may call day or night but highest activity early in the season appears to peak during the middle of the afternoon when air temperatures are highest. In the



**Figure 3.** Locations (dots) of confirmed occurrence of the wood frog (*Rana sylvatica*) in British Columbia.

Peace River region, wood frogs call well into the night if temperatures are warm enough. They will even call as the air temperature drops below freezing. The peak-calling occur just after dark for mid- and late season. In Nova Scotia, it

has been reported that the vocal sacs of some males become so inflated that they often have difficulty diving underwater. Frogs are sensitive to shadows, quick movement, and vibrations and may suddenly stop calling. As soon as one



**Figure 4.** Annual chronology of the wood frog (*Rana sylvatica*) in British Columbia.



**Figure 5.** Soon after mating in the early spring adult wood frogs move to terrestrial habitats including trembling aspen forests with a shrubby understory and lots of leaf litter and downed woody debris. Beaton Park, BC. 23 June 1996. R. Wayne Campbell).



**Figure 6.** Breeding sites must provide protection in shallow water for unattached as well as attached egg masses. Sunset Prairie, BC. 31 May 2004. (R. Wayne Campbell).

animal starts again the full chorus soon follows.

#### Mating and egg-laying

As females enter the breeding waters males compete vigorously by attempting to mount them. Successful males may remain in amplexus (clasped onto the female's back) for over 24 hours. While she lays her eggs the male fertilizes them by depositing sperm onto the globular mass of eggs and into the water. Egg-laying commences from 4 to 6 days after first frogs appear at the breeding grounds. In Alaska, 50 % of the eggs are laid within 2-4 days after the first mass appears, with most being laid in the late afternoon when temperatures peak. The actual egg-laying process may last from 6 to 10 days and adults may vacate the area between 12 and 22 days after arrival. Each year, the chronology of egg-laying varies with region and seasonal extremes of weather.

During weather extremes egg-laying may be hastened.

Individual eggs, about 1.6 mm in diameter, are black above and white below and are surrounded by a thin dense layer of jelly. The colour of the egg aids in absorbing radiation and the tough layer of jelly acts as an insulator to retain a constant temperature for development. Each gelatinous mass, from 5-8 cm in diameter, may contain from 42 to 1,570 individual eggs. Egg masses of the wood frog, unlike most other species, are deposited in communal aggregations that may be free-floating or attached to stalks of plants or submerged twigs generally in shallower water (Figure 6). Egg masses may also be attached to fallen logs and branches and some may be free-floating. In British Columbia, the maximum numbers of egg masses that have been observed together is 38. In Alaska, egg-laying lasted 6 to 10 days and adult frogs spent only 12 to 22 days in the breeding ponds

before returning to the cover of the nearby forest.

### Hatching

Depending on the temperature of the water eggs take 10 to 30 days to hatch. In most years, however, hatching probably occurs closer to 20 days after egg deposition.

### Metamorphosis

The newly hatched tadpoles are very dark brown to black and have gills that may be as long as the head. The actual tail, without the fins, is usually shorter than the body. Growth is rapid, with tadpoles soon displaying their short and rounded bodies and tails that may be 1 ½ times as long as the body. The transition, from an aquatic larval form to a frog that can move to land to feed and hibernate (i.e., metamorphosis), takes between 53 and 78 days and probably averages at least 60 days. In southern parts of its range metamorphosis may be complete as early as 42 days but could last as long as 105 days. The development of each larva depends on the temperature of the water, the density of other tadpoles, the amount of food available, and the hydroperiod in the breeding wetland.

Male wood frogs mature in 1-2 years while females take 2 years to reach sexual maturity. In British Columbia most wood frogs seen after the third week of May associated with wetlands are likely immatures. By then most adults have moved to more terrestrial habitats where they live a more solitary existence. Most adults, up to 80 %, return to their natal wetlands to breed.

### Lifespan

The oldest known wood frog, an individual breeding in Alaska, returned to the same pond for 3 consecutive years.

## **How are we doing?**

### Conservation and Management

The wood frog has a complex life history that requires suitable breeding, rearing, foraging, and overwintering habitats in order to survive. The full complement of life requisites, and the transition between an aquatic and terrestrial environment, is not well known in British Columbia and requires study. The species' home range is unknown. At present the species is not threatened or endangered in the province nor is there any solid evidence that populations have suffered declines or been extirpated locally.

Over the past few decades it has become apparent that throughout the world amphibians may be declining as a faster rate than any other animal group. Many biologists now suggest amphibians may also be the best animals to use as bioindicators of the health of some aquatic environments.

There has been no research completed on the direct

and indirect impacts of human activities on populations of the wood frog in British Columbia. We do know, however, from fieldwork done elsewhere in the frog's range, which disturbances may cause declines in populations and cause local extirpations. Risk factors relevant to the future of wood frog populations in British Columbia include the following topics.

### Timber Harvest

The adult wood frog is primarily terrestrial and spends most of its life in pure and mixed forested environments where it feeds and hibernates among ground litter, woody debris, and undergrowth. There can be both positive and negative impacts of timber harvesting activities. Direct habitat loss, alteration, degradation, and fragmentation are the primary factors that affect the species negatively. The use of various habitats through forest succession is unknown, as are the size of forested buffer strips required adjacent to breeding sites. The building and maintenance of access and haul roads and increased road traffic impacts habitats through increased sedimentation runoff and settling dust from dry gravel and dirt roads (Figure 7).

Depending on the scale of logging, some impacts may be positive. Limited removal of trees may create small forest openings that may support vernal pools for breeding and additional forest litter for foraging sites. Adjacent to breeding sites it has been shown that limited tree removal may benefit the breeding process. The longevity of semi-permanent breeding sites may be increased by reducing evapotranspiration, while at the same time allowing for slight increases in water temperature that hasten larval development and allows full metamorphosis before the waterbody dries.

### Livestock Grazing and Dairy Farming

The full impact of grazing of free-ranging and fenced cows and horses on wood frogs is unknown, but anecdotal information does exist. The most direct impact is from trampling of adults in forests and egg masses in early spring (May) while livestock walk, forage and drink in shallow breeding sites. At one small breeding pond near Chetwynd in 2004, 75 % of frog spawn was destroyed by cattle walking along the edge of a drying pond.

Some researchers have suggested that livestock defecation in small water bodies increases fecal coliform counts leading to mass mortality in some amphibians and hastening eutrophication of waters. In some instances, fecal contamination may cause snail numbers to increase that serve as an intermediate host for nematode parasites, which lead to deformities in amphibians.

In the East Kootenay region of British Columbia

conservation measures taken to restrict grazing livestock from watering ponds that are ecologically sensitive include fencing and/or providing only one or to access points for drinking (Figure 8). Access paths are hardened to prevent erosion in spring, summer, and autumn.

Dugouts, and other human-created small waterbodies used to water livestock, may have a positive impact on wood frogs by providing additional breeding sites. These must be close to woodlands and contain emergent and aquatic vegetation for egg mass attachment. Laird Law suggested that adding a few branches or handfuls of cattail stems and leaves or other vegetation such as seed heads may help enhance an otherwise sterile habitat for wood frogs.

Ducks Unlimited Canada, in cooperation with the Intermountain Wetland Conservation Program, realizes the immense value of wetlands, riparian or otherwise, for all wildlife. Together, they have initiated a “Livestock Watering Incentive Program” that can provide clean water to livestock while at the same time control access of cattle to adjacent wetland areas through natural features, management, and fencing. They will pay for 50 % of new livestock watering installations, up to a maximum of \$4,000. Application forms and additional information can be obtained from Ducks Unlimited Canada, 954 A Laval Crescent, Kamloops, BC. V2C 5P5 (Tel: 250-374-8307).

#### Fire Activities

The impacts of agricultural and forest burning on the wood frog is unknown. Most prescribed burning takes place in spring and autumn when grounds are moist and

the movement of wood frogs is greatest. In spring, for a short period, the temporary movement from terrestrial to aquatic habitats occurs en masse in late April and early May, and migrating frogs may be impacted locally. Emergent vegetation burned at breeding sites, especially cattails, may impact breeding and remove some shade required for water retention.

Only recently have biologists considered the impact of fire retardants dropped from airplanes on adult and larval amphibians. In 2000, two researchers in the northeastern United States showed that the interactive effects of UV radiation on six fire retardants containing sodium ferrocyanide significantly increased mortality in tadpoles of the northern leopard frog (*Rana pipiens*).

#### Introduced Exotic Species and Their Management

It is well known that nonindigenous fishes, as well as other native vertebrates, prey on the eggs, larvae, and adults of many amphibians. This activity is unlikely to impact the wood frog populations because of the semi-permanent and ephemeral nature of its breeding sites. Of concern, however, are chemicals that may be used to remove unwanted fish stocks from a variety of wetlands. Chemical herbicides and pesticides used to manage waterweeds and insect pests to increase recreational fishing opportunities can also greatly impact wood frog populations. Fortunately, many of the newer chemicals have been developed to decompose quickly after application.



**Figure 7.** This pond, used by wood frogs for breeding in mid-May, was completely silted by dust from road traffic and was abandoned by frogs in mid-June (near Boucher Lake, BC. 19 June 2004. (R. Wayne Campbell).



**Figure 8.** To minimize erosion and protect amphibian habitat at ecologically sensitive ponds, access paths for livestock are used to concentrate drink locations. Rocky Mountain Trench near Cranbrook, BC. 8 May 2004 (Larry Halverson).

### Environmental Pollutants

Within the past decade amphibian deformities, such as extra hind limbs, twisted limbs, missing toes, and other aberrant growths have been found in the United States and Canada. This trend may be the first indication the health of our environment is being jeopardized. A major source of pollution is acid rain that accumulates in the atmosphere and falls wherever the weather system flows. The acid lowers the pH in wetlands to levels toxic to developing frogs. Adult frogs may further serve as sensitive biological indicators as their highly permeable skin rapidly absorbs toxic chemical substances.

### Other Threats

Other causative agents for wood frog declines in the future may include increased ambient UV-B radiation, climate change, human commerce, draining wetlands, forest habitat fragmentation, contaminant residues (e.g., polychlorinated biphenyls), all-terrain vehicles, collecting, and pathogens that lead to deformities and death.

### Lack of Information and Research Needs

There is good recent evidence that amphibian populations are declining world-wide. Like all living organisms, however, populations of amphibians fluctuate from year to year due to environmental and climatic conditions. In some years certain species may be difficult to find. To better understand and evaluate the significance of these oscillations in numbers we need long-term monitoring and field research.

In British Columbia, we do not have standard long-term population information to determine such trends. In fact, we have poor information on all aspects of the wood frog's life. We still need to bring together all historic and recent records for the province. We also require specific information on the status, distribution, elevational range, life history, habitat requirements, foods, and predators for this adaptable frog. Some basic inventory has been initiated in the province and only recently have the results been integrated into our databases. For example, in 1996, 202 amphibians were recorded for 49 occupied ponds in the Prince George Forest District. In 2004, 18 of 33 large and ephemeral wetlands in the Hudson's Hope, Chetwynd, and Tumbler Ridge areas contained evidence of breeding wood frogs.

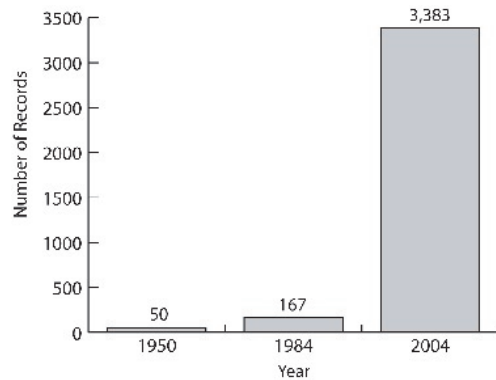
If you want to contribute observations on amphibians and reptiles in British Columbia or help establish a regional monitoring program, please contact us at:

**Biodiversity Centre for Wildlife Studies**  
P. O. Box 6218, Station C  
Victoria, BC., V8P 5L5

### **Databases**

The Wildlife Data Centre, in Victoria, is operated by the Biodiversity Centre for Wildlife Studies and serves as the province's only comprehensive central repository for historical and current information on wildlife. Over the past five years or so a large digital database has been amassed for amphibians and reptiles that is now over 60,000 records. Active field naturalists and biologists are adding thousands of new records to the databases each year.

The histogram (Figure 9) shows the dramatic increase in records over 55 years that were used to write the wood frog account in *The Amphibians of British Columbia* handbooks in 1950 and 1984 compared with databases currently housed at the Wildlife Data Centre (2004).



**Figure 9.** Comparison of total number of occurrence records used to compile wood frog species' accounts for the handbooks on *The Amphibians of British Columbia* by Carl (1950) and Green and Campbell (1984) with records presently in the Wildlife Data Centre databases (2004). The latter information was used to prepare this account and exemplifies the importance of contributing information to a centralized provincial repository.

### **Did You Know?**

#### What's in a Name

The name *Rana sylvatica* literally means "a frog that is found growing among trees" which is very appropriate, for most of this animal's life is spent in wooded environments.

#### Half Frozen

About a dozen species of amphibians are able to tolerate repeated freezing and thawing. During hibernation between 35 and 45 % of the wood frog's body may freeze and actually turn to ice. Freezing toes are the stimulus for the animal's

protective response. Within 10-15 minutes, glycogen in the frog's liver is turned into glucose and distributed throughout its body. This process helps lower the freezing point of water in body cells thus preventing the formation of small ice crystals. The whole process takes about a day.

#### A True North American

It has been estimated that the range of the wood frog in North America occupies 4 million square miles. Only the northern leopard frog occupies more.

### Your Data at Work

I am grateful to the dozens of naturalists and biologists who have contributed their observations of amphibians and reptiles to our databases. In particular, Sandra Kinsey and Laird Law (Alpine Environmental Services, Prince George), Douglas J. Wilson (British Columbia Ministry of Water, Land and Air Protection, Prince George), Mark Phinney (Louisiana-Pacific Canada Ltd., Dawson Creek), and Larry Halverson (Parks Canada, Kootenay National Park) provided recent information for poorly known areas of the province from literature, reports, and personal databases. They also peer-reviewed this account.

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\* indicates copy is filed in the Wildlife Data Centre library

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