Rocky Mountain Tailed Frog

Ascaphus montanus

Original prepared by Linda A. Dupuis

Species Information

Taxonomy

Phylogenetic studies have determined that tailed frogs belong in their own monotypic family, Ascaphidae (Green et al. 1989; Jamieson et al. 1993). Recent phylogeographic analysis has determined that coastal and inland assemblages of the tailed frog are sufficiently divergent to warrant designation as two distinct species: *Ascaphus truei* and *Ascaphus montanus* (Nielson et al. 2001). The divergence of coastal and inland populations is likely attributable to isolation in refugia in response to the rise of the Cascade Mountains during the late Miocene to early Pliocene (Nielson et al. 2001).

The Coastal Tailed Frog and Rocky Mountain Tailed Frog are the only members of the family Ascaphidae and are considered the most primitive frogs in the world, representing the basal lineage of the anurans (Ritland et al. 2000; Nielson et al. 2001).

Description

Tailed frogs have unique morphological adaptations to life in fast-flowing mountain streams. They are the only frog species in North America that breed in cold mountain streams. Adults are small (2.2–5.1 cm) with a large head, a vertical pupil, and broad and flattened outer hind toes. They lack tympana (ear membranes) and the ability to vocalize, presumably adaptations to the constant sound of rushing water. The species is commonly known as the Tailed Frog because males have a short, conical "tail" with which to inseminate females. Adults have a grainy skin that can vary in colour from tan, to chocolate brown, to olive green (Metter 1964a; Dupuis, pers. obs.); fine black speckling generally occurs on paler individuals. There is often a distinct copper bar or triangle between the eyes and snout, with green undertones (Metter 1964a).

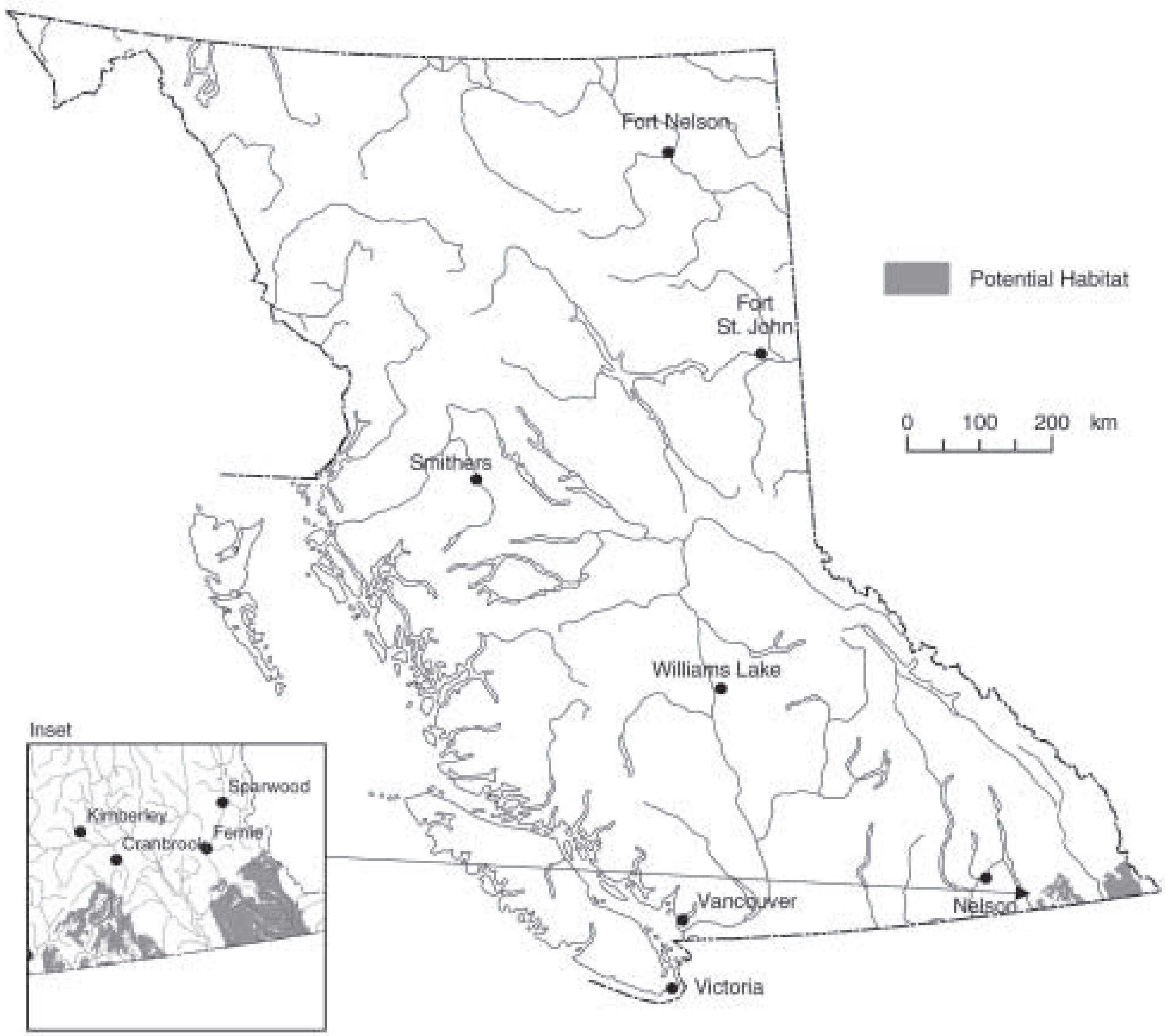
Tadpoles are roughly 11 mm in length upon hatching, and can reach up to 65 mm long prior to metamorphosis (Brown 1990). They possess a wide flattened oral disc modified into a suction mouth for clinging to rocks in swift currents and grazing periphyton (Metter 1964a, 1967; Nussbaum et al. 1983), a ventrally flattened body, and a laterally compressed tail bordered by a low dorsal fin. They are black or light brownish-grey, often with fine black speckling; lighter flecks may or may not be present (Dupuis, pers. obs.). The tadpoles usually possess a white dot (ocellus) on the tip of the tail and often have a distinct copper-coloured bar or triangle between the eyes and snout. Hatchlings lack pigmentation, and are most easily characterized by the large, conspicuous yolk sac in the abdomen.

Distribution

Global

The Rocky Mountain Tailed Frog is endemic to the Pacific Northwest and occurs in the Blue Mountains of southeast Washington (Metter 1964a; Pauken and Metter 1971; Bull 1994), the Wallowa Mountains of northeast Oregon (Ferguson 1952; Bull and Carter 1996), central Idaho and the panhandle (Linsdale 1933; Corbit 1960; Maughan et al. 1980), the Columbia Ranges and Rocky Mountain Foothills of southeastern British Columbia (Dupuis and Wilson 1999), and the mountains east of western Montana's Bitterroot Ranges (Smith 1932; Franz and Lee 1970). Historically, at least one population was found on the eastern slopes of the Rocky Mountains (Donaldson 1934).

Rocky Mountain Tailed Frog
(Ascaphus montanus)



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.

British Columbia

The Rocky Mountain Tailed Frog was first identified in the Southern Interior Mountains Ecoprovince in 1958 (Grant 1961). This occurrence was confirmed in the 1980s, but no official surveys were conducted until 1996 (Dupuis and Bunnell 1997; Dupuis and Wilson 1999). Based on these studies, there appears to be two separate populations: one in the Columbia Ranges and one in the Rocky Mountain Foothills. All known occurrences were within 20 km of the U.S. border (*n* = 190 creeks; Dupuis and Wilson 1999). The Columbia Ranges population is clustered within the Yahk River watershed, west of Yahk Mountain. In the Flathead, tailed frogs occur throughout the Couldrey, Cabin, Burnham, Storm, North Fork of the Bighorn and South Fork of Leslie drainages (Dupuis, pers. obs.).

Forest region and district

Southern Interior: Rocky Mountain

Ecoprovinces and ecosections

SIM: FLV, MCR, SPM

Biogeoclimatic unit

ESSF: wm

ICH: mk1, mw2

MS: dk

Broad ecosystem unit

EF (on steep south-facing slopes), AV, WR

Elevation

1190–1905 m

Life History

Diet and foraging behaviour

Adults and post-metamorphs emerge at dusk and during the night, to feed terrestrially on small arthropods within the riparian borders of streams (Metter 1964a, 1967). The diet consists primarily of spiders but other food items include Diptera (flies) and adult Trichoptera (caddisflies), Coleoptera (beetles), Lepidoptera (butterflies and moths), Hymenoptera (sawflies, ichneumons, chalcids, ants, wasps, bees), snails, ticks, mites, and crickets (Metter 1964a; Held 1985). The kinematics of prey capture in *Ascaphus* species have been described by several authors (Nishikawa and Cannatella 1991; Nishikawa and Roth 1991; Deban and Nishikawa 1992).

Tadpoles graze as they cling to gravel surfaces with their suctorial mouthparts. They consume primarily diatoms (non-filamentous algae), as well as some desmids and filamentous algae (Metter 1964a; Franz 1970b). Large amounts of pollen can be found in the intestines of larvae in the spring (Metter 1964a). It is expected that foraging opportunities for larvae are high during the summer months when productivity of algae is at its peak, and that larvae use this time to store fat for the coming winter.

Reproduction

The Rocky Mountain Tailed Frog does not reach reproductive maturity until 7 or 8 years of age (Daugherty and Sheldon 1982a) and females appear to breed every other year (Metter 1964a). In early fall, adults aggregate in the breeding creeks. Relatively high concentrations of adults have been noted in the upper reaches of breeding streams, and not in the lower reaches (T. Antifeau, pers. comm; P. Davidson, pers. comm.) during this time (August and September). Unlike most frog species, the males fertilize the eggs internally and females retain sperm until the following summer, ovipositing after spring runoff (Gaige 1920; Metter 1964b; Franz 1970a; Daugherty and Sheldon 1982a). Eggs are deposited in double strands of colourless, pea-sized ova attached to the downstream undersides of rocks (Metter 1964b; Franz 1970a; Daugherty and Sheldon 1982a; Nussbaum et al. 1983; Leonard et al. 1993), in deep pools. Tailed frogs have the largest eggs of all North American frogs (Wright and Wright 1949), and the longest embryonic period, varying from 3 to 6 weeks depending on the climate (Noble and Putnam 1931; Metter 1964a, 1967; Franz 1970a; Brown 1990).

Free-swimming larvae emerge in late August to early September (Metter 1964a; Franz 1970a). Hatchlings overwinter at the egg-laying site (Metter 1964a), feeding on the yolk sac until the following spring, when their suctorial mouth is fully developed (Brown 1990). Stream residency lasts from 1 to

5 years for *Ascaphus* species (Metter 1964a, 1967; Daugherty and Sheldon 1982a; Brown 1990; Bury and Corn 1991; Gray 1992; Bull and Carter 1996; Wahbe 1996; Wallace and Diller 1998; Bury and Adams 1999). Larval size-frequency patterns suggest a 3- to 4-year larval period for *A. montanus* (Daugherty and Sheldon 1982a). The rate of development may be related to the length of the growing season (Bury and Adams 1999), which is influenced by aspect, gradient, elevation, snowpack, and frost-free days (see Dupuis 1999). Metamorphosis occurs in late summer.

Site fidelity and home range

In Montana, breeding adults are highly sedentary, remaining in a 20 m stream segment for several years (Daugherty and Sheldon 1982b). Daugherty (1979) reported very little within- or between-stream movement of adults, and suggested that the species' recolonization potential is low. Metter (1964a) found *A. montanus* at a maximum distance of 12 m from the water's edge. Remaining near streams and maintaining small territories are likely selective advantages for securing food, mates, and shelter in the otherwise dry, inhospitable environment (Daugherty and Sheldon 1982b).

Movement and dispersal

Movements directly after metamorphosis have not been well documented. *Ascaphus* populations are remarkably discrete. They show strong genetic differences among streams (Ritland et al. 2000; Nielson et al. 2001), implying low movement potential. Daugherty and Sheldon (1982b) recorded a maximum dispersal distance of 360 m/yr for a juvenile female. Adults, especially males, disperse upstream. In the Yahk River, males were encountered 2.5:1 more than females in 1st order streams, but sex ratio was equal in 2nd and 3rd order streams (Dupuis and Friele 2002).

Habitat

Structural stage

7: old forest (>140 years)
6: mature forest (100–140 years)

Important habitats and habitat features

The presence of sedimentary or metamorphic sedimentary bedrock formations, moderate annual rainfall with a relatively high proportion of it occurring during the summer, and watersheds with low or moderate previous levels of harvest appear to be large-scale regional features in predicting the presence of tailed frogs (Wilkins and Peterson 2000). The main limitation, especially in the Flathead, is cold summer stream temperatures.

Terrestrial

Little work has been done on post-metamorphic and adult habitat associations. Tadpole-bearing creeks flow through young, mature, and old forests with structurally complex riparian zones (Franz and Lee 1970; Dupuis and Wilson 1999). A well-developed overstorey and understorey can help maintain high humidity and low temperatures (Franz and Lee 1970).

Forested riparian buffers benefit tailed frog larvae not only by moderating stream temperatures, but also by maintaining bank stability and channel characteristics (Kelsey 1995; Dupuis and Friele 1996; Dupuis and Steventon 1999). A rapid decline in the number of fine roots after trees are felled, and a sharp decrease in the tensile strength of the remaining roots, can reduce the strength of the soil mantle to the point of failure (Beschta 1978). The resulting sediment inputs to streams degrade habitat carrying capacity by increasing bedload movement and reducing interstitial refugia and foraging areas. Riparian buffers are particularly important for the Rocky Mountain Tailed Frog because the creeks in extreme southeast British Columbia have fractured and brittle bedrock, resulting in high bedload transport (see Dupuis and Wilson 1999). In addition, there appears to be strong fidelity to riparian habitats (Daugherty and Sheldon 1982b; Dupuis and Friele 2002).

Aquatic

Primary breeding habitats are step-pools of permanent mountain streams and headwaters (Dupuis 1999). Pool-riffle habitats characteristic of more gentle, fish-bearing streams, and cascade-pool habitats, where permanent boulder/log constrictions are created within a channel may also be used (see Chin 1989; Grant et al. 1990).

In the Flathead, streams between 10–16°C in the summer were most productive. In the northern interior, cold summer temperatures limit growth and development. Eggs require temperatures between 5 to 18.5°C for survival (Brown 1975). Incipient lethal water temperatures for adults range from 22°C (Metter 1966) to 24.1°C (Claussen 1973).

Larvae reach highest densities in warmer streams with stable, coarse gravel substrates (Dupuis and Friele 1996; Diller and Wallace 1999; Wilkins and Peterson 2000). Stable mountain streams are characterized by regularly spaced pools and interlocked cobble/boulder (or wood) steps that withstand moderate floods and sediment pulses (Chin 1998). An open-framework of boulders and cobbles between steps provides interstitial refugia to the tadpoles as well as stable egg-laying and overwintering sites. Conversely, sand and pebble substrates offer little shelter and foraging opportunities, and are generally avoided by tailed frog tadpoles (Franz and Lee 1970; Altig and Brodie 1972; Welsh 1993; Dupuis and Friele 1996; Welsh and Ollivier 1998).

Dupuis and Friele (2002) found that primary breeding streams were characterized by 1–10 m^3/s discharge, good summer base flow, gradients between 3 and 20%, stable, step-pool channel morphology, and summer temperatures between 10 and 16°C.

Conservation and Management

Status

The Rocky Mountain Tailed Frog is on the provincial *Red List* in British Columbia. It is designated as *Endangered* in Canada (COSEWIC 2002).

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

BC	ID	MT	OR	WA	Canada	Global
S1	S3	S4	S2S3	S?	N1	G4

Trends

Population trends

Currently, the total population size of *Ascaphus* is unknown (Dupuis et al. 2000; Dupuis and Friele 2002). Most data on densities and abundances are based on in-stream (larval) surveys. Three key uncertainties prevent good estimates of *Ascaphus* population sizes: (1) fundamental demographic characteristics–especially survival rates; (2) area and carrying capacity of aquatic and adjacent riparian habitats; and (3) among-year and among-site variability (Sutherland et al. 2001). There is high, natural variability in tailed frog abundance within and among streams, governed in part by habitat characteristics and natural disturbance regimes (floods, sediment pulses, drought).

The Rocky Mountain Tailed Frog occurs in 10 tributaries in the Rocky Mountain Foothills (12 records) and 6 tributaries of the Columbia Ranges (7 records). Subpopulations are isolated from one another by the dry climatic conditions of the surrounding habitat matrix, particularly in the Columbia Ranges. The Rocky Mountain Tailed Frog may be threatened with imminent extirpation not only because of this isolation and the lengthy larval stage, low reproductive rate, and specialized habitat needs characteristic of *Ascaphus* species, but because of the low level of legal protection, threat of drought (global climate change), and the suboptimal nature of breeding habitats in the East Kootenays (Dupuis et al. 2000). Poor habitat quality is reflected in larval densities: area-constrained searches conducted in the late 1990s averaged 0.8 individuals/m^2 in the interior compared with 1.5 individuals/m^2 on the Coast (Dupuis and Wilson 1999; Dupuis et al. 2000).

Habitat trends

Suitable habitat is likely declining in British Columbia. Rocky Mountain Tailed Frog adults are largely dependent on riparian habitats adjacent to breeding sites because of the harsh thermal contrast between stream and upslope habitats in the interior. Whether non fish bearing streams are buffered depends on forestry operational constraints and professional discretion.

The Yahk watershed, where tailed frogs occur, has been altered by fire and forest harvesting (80–85% cover <100 years of age), and road densities are high (Dupuis and Friele 2002). Changes to the natural hydrological regime could have occurred and altered the habitats of tailed frogs. However, the extent of change is not known.

Threats

Population threats

Rocky Mountain Tailed Frog populations are at risk due to a restricted range (3 km radius in Columbian Ranges, 5 km radius in Border Ranges), geographic isolation, low number of occurrences (19), and low densities (0.78 ± 0.23 tadpoles/m^2). The Rocky Mountain Tailed Frog also exhibits a high level of genetic drift and possible declines in fitness (Ritland et al. 2000; Nielson et al. 2001). Reduced genetic diversity indicates that the species may have a limited capacity to migrate in response to changing conditions.

Habitat threats

Streams in the Flathead and Columbia mountains of Canada are generally underlain with brittle, meta-sedimentary rocks; as a result, they contain a large proportion of fractured bedrock as mobile bedload (Dupuis and Wilson 1999; Dupuis and Friele 2002). Unstable streams such as these are vulnerable to degradation following road building and timber harvesting activities. Road building and timber harvesting can increase the frequency and magnitude of sediment input to channel beds (Beschta 1978; Reid and Dunne 1984). The addition of woody debris to the channel can increase the risk of logjams, which trap fine sediments and alter a gully's substrate composition. Clearcut logging can also alter the hydrological regime of a watershed and accentuate peak discharges and low summer flows (Jones and Grant 1996). Several studies have reported declines in tailed frog tadpole populations following clearcut logging (Noble and Putnam 1931; Bury and Corn 1988; Corn and Bury 1989; Bury et al. 1991; Welsh and Lind 1991). In British Columbia, Dupuis and Steventon (1999) found that Coastal Tailed Frog tadpole densities were significantly lower in clearcut streams than in buffered or undisturbed streams of the north coast. Unstable streams like those within the range of the Rocky Mountain Tailed Frog in Canada are particularly vulnerable to degradation following timber-harvesting activities (Dupuis and Friele 1996).

In addition, the climate in the interior is harsh (Dupuis et al. 2000). Debris torrents, sediment floods, summer aridity, and cool summer stream temperatures probably play a significant role in local extinction and recolonization processes (Lamberti et al. 1991).

Legal Protection and Habitat Conservation

The Rocky Mountain Tailed Frog is protected, in that it cannot be killed, collected or held in captivity without special permits, under the provincial *Wildlife Act.* If salmonid habitat exists downstream, some level of protection may be provided through the *Fisheries Act*.

No populations occur within a protected area.

The results based code may provide protection through the establishment of old growth management areas (OGMAs) provided these overlap with known sites or suitable habitat. In addition, riparian management guidelines provide a measure of protection for riparian habitats, particularly for streams with game fish. However, since most populations of the Rocky Mountain Tailed Frog are found in small streams without fish, they are not protected by FRPA riparian management recommendations. These recommendations do not recommend retention of a riparian reserve zone on small streams where "game" fish are not present. However, they do recommend that forest practices in management zones adjacent to streams classified as S4–S6 (small fish or non fish bearing) be planned and implemented to meet riparian objectives. These objectives can include retaining sufficient vegetation to provide shade, reduce microclimatic changes, maintain bank stability and, where specified, may include objectives for wildlife, fish habitat, channel stability, and downstream water quality.

Identified Wildlife Provisions

Sustainable resource management and planning recommendations

In landscapes or those portions of landscapes (i.e., catchment areas for streams with tailed frogs) documented to contain tailed frog populations consider the following recommendations:

- ❖ Wherever appropriate use OGMAs to protect known tailed frog occurrences and suitable riparian habitats.
- ❖ Maximize connectivity of riparian habitats, particularly between WHAs and adjacent stream reaches.
- ❖ Increase retention on streams classified as S5 or S6 to maintain thermal conditions.
- ❖ Minimize use of chemical applications (e.g., dust-palliative polymer stabilizers and soil binders that can be sprayed within ditch lines).
- ❖ Minimize site disturbance during harvesting, especially in areas with high sediment transfer potential to natal streams.
- ❖ Fall and yard away from, or bridge, stream channels (ephemeral or perennial) to reduce channel disturbance and slash loading.
- ❖ Consider both the risk of desiccation and risk of sedimentation when determining size of cutblocks. Larger blocks can be accessed and yarded with a less dense road system, thus decreasing the potential sedimentation impacts but may have a greater impact on summer flows by having a more significant effect on the clearcut equivalent ratio and by increasing the wind fetch on streamside buffers. However, where desiccation is of greater concern, smaller block sizes may be more appropriate. Sedimentation risk may be offset by incorporating careful road planning and maintenance as described below.
- ❖ Construct narrow roads to minimize site disturbance and reduce groundwater interception in the cutslope and deactivate roads but minimize digging and disturbance to adjacent roadside habitat.
- ❖ Maintain naturally dispersed water flows (seepages, non-classified drainages and streams should be supplied with cross-drainage structures where crossed by roads).
- ❖ Use sediment-control measures in cut-and-fill slopes (e.g., grass-seeding, armouring ditch lines, and culvert outfalls).
- ❖ Develop a plan to consider issues of hydrological green-up and runoff response.

Wildlife habitat area

Goal

Maintain and link tailed frog streams and breeding areas.

Feature

Establish WHAs at streams that are characterized by (1) presence of tadpoles or adults; (2) year-round stream flow (i.e., perennial streams); (3) low to moderate gradients (<50%); (4) coarse gravel substrates (cobbles and boulders); (5) stable channel beds; and (6) forest cover. WHAs should be established in the headwaters of Cabin Creek, Couldrey Creek, and Yahk River (west of Yahk Mountain).

Size

Typically 100 ha (range 50–150 ha) but will ultimately depend on site-specific factors including the number and length of streams included and terrain stability.

Design

Ideally, the WHA should include several interconnected stream reaches (S4–S6) with evidence of presence of tailed frogs. The boundaries of a WHA should be designed to maintain stream conditions (substrate, temperature, macro-invertebrate, and algae communities) and connectivity between streams. The WHA should include a core area that extends 30 m from the water's edge on both sides and a 20 m management zone surrounding the core area.

General wildlife measures

Goals

1. Maintain clean and stable cobble/boulder gravel substrates, natural step-pool channel morphology, and stream temperatures within tolerance limits.
2. Maintain microclimatic, hydrological, and sedimentation regimes to (1) limit the frequency of occurrence of extreme discharge events, (2) limit the mortality rate of tailed frogs during floods, and (3) meet foraging and dispersal requirements of the adults and metamorphs.
3. Maintain riparian forest.
4. Maintain important structural elements (e.g., coarse woody debris).
5. Maintain water quality and naturally dispersed water flows.

Measures

Access

- Minimize roads or stream crossings within the core area. When stream crossings are determined to be necessary, use cross-drainage structures particularly bridges or open-bottomed culverts and ensure type of crossing structure and any associated roads are designed and installed in a manner that minimizes impacts to tailed frog instream and riparian habitats. When roads are determined to be necessary, minimize length and construct narrow roads to minimize site disturbance and reduce groundwater interception in the cutslope; use sediment-control measures in cut-and-fill slopes (e.g., grass-seeding, armouring ditch lines, and culvert outfalls); deactivate roads but minimize digging and disturbance to adjacent roadside habitat; minimize site disturbance during harvesting, especially in terrain polygons with high sediment transfer potential to natal streams; and fall and yard away from, or bridging, all other stream channels (ephemeral or perennial) within the WHA, to reduce channel disturbance and slash loading.

Harvesting and silviculture

- Do not harvest within the core area.
- No salvage should be carried out.
- In the management zone, use partial harvesting systems that maintain at least 70% basal area with the appropriate structure necessary to achieve the goals of the GWM.
- Wherever possible and practicable, augment management zone using wildlife tree retention areas.
- Do not use chemical applications (e.g., dust-palliative polymer stabilizers and soil binders that can be sprayed within ditch lines).

Pesticides

- Do not use pesticides.

Range

- Control livestock use. Fencing may be required by the statutory decision maker to achieve goals.

Additional Management Considerations

Manage stream reaches adjacent to WHA according to the recommended riparian management "best management practices." Where livestock grazing occurs follow the "target conditions for range use in stream riparian areas" from riparian management recommendations.

In extensively developed areas, management of the WHA should focus on channel restoration including channel and gully assessments, in-stream work to restore step-pool morphology and reduce sediment transport, stream-side planting to stabilize banks, and road deactivation to reduce sediment inputs.

Prevent fish introductions and rechannelization of areas supporting tailed frog populations.

Maintain slash-free headwater creeks and forested riparian buffers, especially within fragmented areas.

On S5 and S6 streams containing tailed frogs, retain structure especially on south side of east–west or west–east flowing streams to shade streams.

Information Needs

1. Detailed description of larval distribution and abundance within documented streams of occurrence; resurvey Gilnockie Creek drainage.

2. Channel assessment and habitat suitability ranking for tadpole-bearing creeks.
3. Age-specific movement/dispersal patterns and requirements of adults and post-metamorphs.

Cross References

Grizzly Bear, Williamson's Sapsucker (*nataliae* subspecies), Wolverine

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