DISTRIBUTION AND HABITAT CHARACTERIZATION OF THE TAILED FROG IN THE LILLOOET DISTRICT.

Submitted to:

Ministry of the Environment, Lands, and Parks Southern Interior Region
J.S Jones Timber Ltd.

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Ecoscape **Biological Consultants**

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EXECUTIVE SUMMARY

We conducted an inventory of tailed frogs in headwater creeks in the Lillooet District. We detected tailed frogs in 18% of the creeks sampled using time-constrained searches. Tailed frog locations were clustered along portions of the southern district boundary in streams draining into the Upper Cayoosh, Fraser , and Thompson systems. Two isolated populations were recorded in streams of the central portion of the district draining into the Yalakom and Bridge river systems. Tadpole densities were highest in the southeastern portion of the district. Nevertheless, densities were comparatively lower than those observed in coastal BC, which suggests that tailed frogs in the Lillooet district may be at their easternmost range of their distribution. Tailed frogs were found in cool, clear streams in Englemann spruce –subalpine fir, Interior Douglas Fir, and Interior Cedar-hemlock biogeoclimatic zones. Stream substrates were generally of granitic and basaltic nature and were dominated by boulders and cobbles. Because tailed frog presence appears to be influenced by geological characteristics of the streams, the inventory should be continued so that areas between the clusters of occurrences can be sampled and thus obtain a clearer picture of their distribution.

INTRODUCTION

The extent of the distribution of tailed frogs in British Columbia is not clear (Dupuis and Bunnell 1997). However, the general consensus is that tailed frogs are distributed as two disjunct populations in BC.: A coastal population found along the Coast Mountains, and an isolated population in the Rocky and Purcell mountains (Wahbe 1996).

In the Lillooet District little is known about the extent of their distribution and habitat associations. There have been no previous tailed frog surveys specific to the Lillooet District. However, Dupuis and Bunnell (1997) as part of a larger study designed to determine the status and distribution of tailed frogs in BC, sampled sixteen creeks along the Duffy Lake road and detected tailed frogs in 19% of the creeks sampled. In addition, the Ministry of the Environment, Lands, and Parks has compiled a handful of reports of tailed frog locations, all of which have been made along the southern boundary of the district (John Surgenor, MELP, *pers comm.*).

The tailed frog is considered a species of concern under the Forest practices Code and areas where they occur are eligible for special management considerations.
Given the lack of information, a clearer understanding of Tailed Frog distribution and their habitat associations within the Lillooet District is needed to guide management options in areas where tailed frogs do occur.

The project's main objective was to conduct an inventory of tailed frogs in watershed systems within the Lillooet District. Specifically, to: 1) determine the presence and distribution of tailed frogs within identified watersheds; and, 2) identify and describe stream habitats used by tailed frog tadpoles.

We'd like to thank, John Surgenor and Donna Romain of the Ministry of the Environment, Lands, and Parks, and Gary Aitken, of JS Jones Timber Ltd. for all their support throughout the study period. A special thanks to Stuart Brookes for his assistance in conducting time-constrained searches and his good nature throughout our

stay in Lillooet. Finally, this project would not have been possible without the funds provided by Forest Renewal BC.

STUDY AREA

This inventory was carried throughout the Lillooet Forest District (Fig 1). Specifically, it spanned areas within the Southern Chilcotin Ranges (SCR), Leeward Pacific Ranges (PAR) and Pavilion Ranges (PAR) ecosections. The inventory focused primarily on headwater creeks in the Engelmann Spruce-Subalpine Fir (ESSF) biogeoclimatic unit, although a small proportion encompassed ICH and IDF biogeoclimatic units.

Figure 1. Study Area Location and Ecosection Boundaries (modified from RIC Standards)

METHODS

Watershed selection

Members of J.S. Jones, and Ministry officials were consulted to stratify watershed systems to be sampled. Identification of priority watersheds was based on LRMP information gaps, J.S. Jones harvesting areas, and extent of development of particular watersheds (e.g. extensively harvested or not harvested at all). Other criteria included watersheds where unconfirmed reports had been made or where suitable habitats were likely to occur.

Reach Selection

Prior to sampling a watershed, we selected potential 1st, 2nd, and 3rd order streams that would be sampled on 1:30,000 scale maps. Sampling units (reaches) at identified streams were selected based on accessibility, and habitat attributes associated with Tailed Frogs. These attributes included presence of anchored boulders, cobbles, side pools, and runs.

Sampling Procedure

We used the hand collection procedure outlined in the Resource Inventory Committee (RIC) standards (see Inventory Methods for Tailed Frog and Pacific Giant Salamander: Standards for Components of British Columbia's Biodiversity No. 39).
We conducted Time Constrained Searches (TCS) in selected areas within streams and banks. Each stream section was sampled for 40 minutes by two observers (10 minutes for bank searches, and 30 minutes for in-stream) for a combined total time of 80 minutes per reach.

Terrestrial searches were conducted by briefly scanning the banks for exposed adults. Moveable objects were moved to detect any inconspicuous adults.
In-stream searches involved turning over objects, raking gravels by hand, and hand sweeping large boulders while observing the immediate search area through a plexiglass frame. Dip nets were placed behind the searcher to capture any tadpole that dislodged

during the search effort. Only cobbles and boulders that were not anchored were upturned. Well-anchored cobbles and boulders were left in place because they are a primary source of stability in streams. Upturned boulders and cobbles were returned to their original position.

On instances where searches produced tadpoles or adults, these were set-aside in plexiglass holders until the search was completed. The samples were then returned to the original location(s).

Habitat Data collection

A series of physical parameters, following Resource Inventory Committee standards were measured for a five-metre section of each reach sampled, to characterize each creek's structure. The section was selected at random in creeks where no tailed frogs were detected. In creeks where tadpoles or adults were detected, the location of the tadpoles/adult was used as the center of the section.

Variables measured included elevation (m), stream gradient (%), average wet and bank widths (m), water temperature (°C), canopy closure, and substrate composition (visual estimate). Substrate was classified into four categories: sand (< 2mm), pebbles (2-64 mm), cobbles (64-256 mm), and boulders (> 256 mm). Vegetation parameters included canopy cover (%), categorical species composition (tree, shrub, and herb species), and large organic debris abundance (LOD %) and function (see data sheet, Appendix I).

RESULTS

Distribution

Seventy-three reaches in 26 watersheds were sampled throughout the Lillooet District between August 23 and October 1, 2000. Tailed frogs were located in 18%of the reaches sampled   Tailed frogs were recorded in 3 of the 5 ecosections of the Southern and Central Interior ecosections falling within the Lillooet District (Table 1).

Table 1. Summary of Tailed Frog Surveys and occurrences in relation to Ecosections

Ecoprovince	Ecosection	Reaches sampled	Other Sources[λ]	Total No Records	Tailed Frog Occurrences
Southern Interior	Leeward Pacific Ranges	11	5	15	9
	Southern Chilcotin Ranges	12	0	12	4
	Pavilion Ranges	50	2	53	7
Central Interior	Central Chilcotin Ranges	0	0	0	0
	Fraser River Basin	0	0	0	0
		73	7	80	20

[λ]John Surgenor, MELP

Occurrences of tailed frogs were concentrated in 3 main areas: 1) The Nicoamen watershed draining into the Thompson River, 2) the Kamiak and Pooeyelth watersheds draining into the Fraser River, and 3) Tributaries to the Upper Cayoosh Drainage System. Two additional isolated records were made in Tommy Creek draining into Carpenter Lake, and Shulaps Creek draining into the Yalakom River (Table 2).

The numbers of individuals found ranged between 1 and 5 per 30-minute in-stream search. Larval densities were similar for all locations, although the times at first detection in the south-eastern extreme of the district were shorter than for all other locations (Table 3).

The majority of all tadpole locations (77%) were made in permanent streams in the Engelmann Spruce-Subalpine Fir (ESSF) biogeoclimatic zone. The Remaining detections were made in the Interior Douglas Fir (IDF) (15%) and Interior Douglas Fir/ Interior Cedar Hemlock (ICH) (8%) biogeoclimatic zones. Elevations ranged between 772 m and 1457m.

Table 2. Summary results for Tailed Frog searches by watershed

Drainage Name	Presence	# reaches sampled	Fish Presence	Map #
Kamiak Creek	Yes	2	N	92J.074
Nicoamen Creek	Yes	5	N	92I.024
Pooeyelth Creek	Yes	1	N	92J.074
Shulaps Creek	Yes	2	N	92J.099
Tommy Creek	Yes	3	N	92J.069
Mc Parlon Creek	Unlikely[Ψ]	3	N	92J.074
Murray Creek	Unlikely	2	N	92I.053
Texas/Molybdenite	Probable[Ψ]	6	Y	92I.051
Truax Creek	Unlikely	3	N	92J.087
Upper Cayoosh Creek	Yes	4	N	92J.048
Caspar Creek	Probable	1	N	92J.039
Halbrook Creek	Probable	3	N	92J.089
Larochelle Creek	Probable	3	N	92J.089
Nikaia Creek	Probable	1	N	92I.022
Phair Creek	Probable	5	N	92J.060
Retaskit Creek	Unlikely	2	Y	92J.098
Texas/Skimath	Unlikely	5	Y	92I. 041
Twaal Creek	Unlikely	1	N	92I.054
Ault Creek	Unlikely	3	N	92J.086
Buck Creek	Unlikely	1	N	92J.089
Cerise Creek	Probable	2	N	92I.038
Downton Creek	Unlikely	7	N	92J.059
Ferguson Creek	Unlikely	1	Y	92J.086
Lost Valley Creek	Probable	4	N	92I.069
Skoonka Creek	Unlikely	1	N	92I.033
Spence Creek	Unlikely	1	N	92I.053
Enterprise	Unlikely	1	N	92I.061

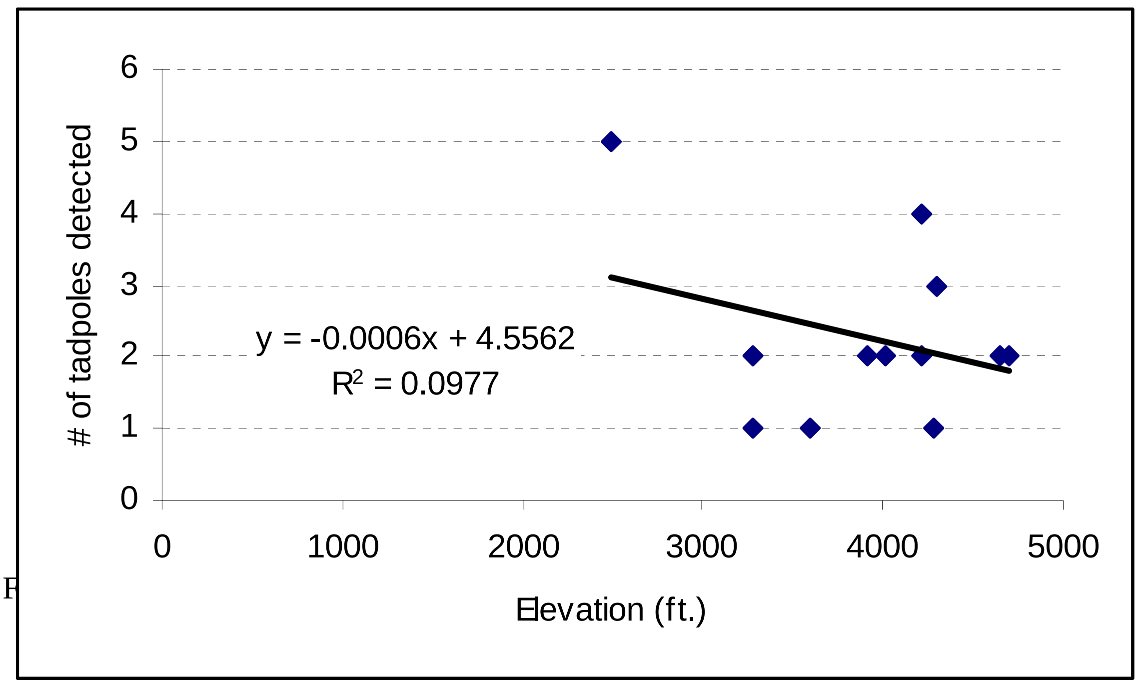
[Ψ]Based on stream substrate and/or immediate adjacency to other watersheds supporting tailed frog populations.

See Appendix IV for rationale of presence likeliness of specific reaches sampled.

Table 3. Relative abundance of tailed frog in watersheds where tadpoles/adults occurred.

Location	% Occurence	Avg. # (range) of tadpoles/adults per 30 minute search	Avg. time (min) at first detection
Nicoamen Creek	80	2 (1-3)/1 (n/a)	6
Kamiak Creek	100	2 (n/a)	5
Pooeyelth	100	5 (n/a)	5
Upper Cayoosh Creek	50	3 (4-2)	7
Tommy Creek	33	1 (n/a)	10
Shulaps Creek	50	2 (n/a)	14

In previous studies, density of tadpoles has been positively correlated with increasing elevations (Wahbe 1996, Dupuis and Bunnell 1997). However, a regression analysis to test the relationship between elevation and tadpole density for this survey was not significant. The number of tadpoles detected was similar for all locations and was not related to elevation (Fig 2.).



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<u>Habitat Characteristics</u>

1. *Physical Characteristics of Tailed Frog bearing streams*

1. 1. Microhabitat

Tadpoles and the single adult were all located within 1.5 m. of the stream edge (Table 4). Specifically, all tadpoles were found under cobbles. Mean water depth for all tadpole locations was 19 cm (range 10-28). The specific within stream location was in all cases under cobbles in shallow side pools and slow moving runs (Plate 1).

Tadpoles were found in small groups ranging from 2-5 individuals except two streams where lone individuals were detected. A single adult male was located in a slow moving run wedged between two cobble-sized rocks.

Table 4. Microhabitat characteristics in streams where tadpoles occurred.

Creek Name	# of Tadpoles/adults	Reach Morphology	Water Depth (cm)	Turbidity	Cover Type	Distance from Stream bank (m)
U. Cayoosh	2/0	Run-Pool	10	Clear	Cobble	1.3
U. Cayoosh	4/0	Step-Pool	15	Clear	Cobble	0.9
U. Cayoosh	2/0	Run-Pool	22	Clear	Cobble	0.3
Nicoamen	2/0	Step-Pool	25	Clear	Cobble	1.5
Nicoamen	2/0	Run-Pool	17	Clear	Cobble	1.0
Nicoamen	3/0	Run-Pool	19	Clear	Cobble	1.4
Nicoamen	0/1	Run-Pool	19	Clear	Cobble	1.4
Kamiak	2/0	Step-Pool	12	Clear	Cobble	0.6
Pooeyelth	5/0	Step-Pool	19	Clear	Cobble	0.7
Tommy	1/0	Step-Pool	28	Clear	Cobble	1.3
Shulaps	2/0	Step-Pool	25	Clear	Cobble	0.2

1. 2. Stream Characteristics

Streams where tailed frogs (tadpoles and adults) were detected shared similar physical characteristics. Streams were either straight or sinuous in morphology. All records of tadpoles and the single adult were made in clear streams with little or no debris (Plate 2). Stream widths ranged between 0.5m and 7m (mean=3m) with stream gradients of 4% to 25% and water temperatures ranging between 9 ^{o}C and 4 ^{o}C (mean= 6.5 ^{o}C) (See Appendix II for complete details of individual stream morphologies).

Stream substrate was dominated by boulders (mean= 50%; range 5%-85%) followed by cobble (mean=30%, range 10%-60%), gravel (mean=15%, range 4%-35%) and sand (mean=4.5%, range 0%-10%) (Table 5). Stream substrate was composed almost exclusively of igneous rocks, namely those of granitic and basaltic nature (Plates 3, 4, and 5). One stream section sampled on Shulaps creek that supported tadpoles was composed primarily of large sandstone boulders.

Table 5. Summary (mean; (range)) of physical characteristics of streams sampled

	Streams Sampled	
Variable	Tadpole Bearing n=13	Non-tadpole bearing n=60
Stream width (m)	2.93 (0.5-7)	2.4 (1-12)
Boulder (%)	50.76; (5-85)	37.6; (5-80)
Cobble (%)	31.15; (10-60)	25; (5-50)
Gravel (%)	14.15; (4-35)	13.5; (2.5-70)
Fines (%)	4.42; (0-10)	11; (2-50)
LOD (%)	2.00; (0-10)	3.25; (0-50)
Temperature	6.57; (4-9)	5.4; (3-9)
Gradient (%)	13.46; (4-25)	10.3 (4-32)

1. 3. Stream Banks and Riparian Zones

Streambanks for all streams where tadpoles were detected were dominated by robust anchored boulders that appeared to provide bank stability. Riparian understories were well developed and provided adequate over stream cover. Alder (Alnus spp), rhododendron, oval-leaved blueberry, devil's club, were the primary shrub species. Horsetail, coltsfoot, lady fern, and arrow-leaved arnica dominated the herb community. Stepmoss and red-stemmed feathermoss dominated the ground cover.

DISCUSSION

We determined tailed frog presence in 18% of the streams we surveyed. Their distribution included watershed systems that drain into the Cayoosh, Thompson, Fraser, and Yalacom drainage systems. Tailed frogs were found in developed watersheds (e.g. harvested areas), fish bearing streams, and undeveloped watersheds in Engelmann spruce-subalpine fir, Interior cedar-hemlock, and Interior Douglas Fir biogeoclimatic zones. Our findings are commensurate with those obtained by Dupuis and Bunnell (1997). In their study, they detected tailed frog tadpoles in 19% (n=16) of the creeks sampled in the Lillooet District.

Tailed frogs were recorded with higher frequency along the southern boundary of the district. Thus, the tailed frog population in the Lillooet District appears to be contiguous with coastal populations of the Chilliwack, Squamish, and Merritt Districts.

Based on the search effort, and the number of streams that supported tailed frogs, the southeastern extreme of the District appears to support higher densities of tailed frog tadpoles than any other area. However, the densities observed are much lower than those observed in coastal populations and more typical to those observed in the tailed frog's northernmost range and Kootenay populations (Dupuis and Wilson 1999). Therefore, it is possible that tailed frog populations in the Lillooet district are likely approaching the eastern extreme of their distribution (excluding the Kootenay population, which is believed to be genetically distinct).

Studies in coastal BC have suggested that tadpole density is positively correlated with increasing elevation (see Wahbe 1996). We found no evidence to corroborate this in the Lillooet District. Numbers of tadpoles per unit time was not different between high and low elevations. However, the sample number for the regression was low (n=13), therefore, our results may not accurately detect differences in density with changes in elevation.

Several authors have provided detailed habitat requirements for tailed frogs (see Dupuis 1998, Wahbe 1996, and others). The biophysical characteristics of streams where tailed frogs were detected were similar to those outlined in the literature. Tailed frogs appeared to be associated with specific stream features. Clear streams with moderate gradients dominated by robust boulders and cobbles, particularly of granitic and basaltic origin, resulted in a large proportion of detections whereas streams where streambed textures were dominated by flattened rocks (i.e. shale) or highly fractured rock did not produce any tailed frog detections.

Although there were no clear structural differences between tadpole bearing and non-tadpole bearing streams, there were other factors that likely made some streams inhospitable for tadpoles.

In some cases, stream substrates were composed of mixtures of igneous, metamorphic, and sedimentary rock types such as basalt, granite, slate, shale, pumice, and sandstone. These streambeds were dominated by unconsolidated flattened cobbles, gravels, and fine particulates that likely provided little or no interstitial spaces (Plate 6).

In addition, other stream gullies were composed of fine glaciofluvial till. The banks were unstable, and were likely to contribute high loads of sediment during peak water flows and contribute large amounts of highly fractured rocks to streambeds (Plate 7).

Finally, some drainage systems exhibited high turbidity as a result of high loads of volcanic ash, and glacial abrasion (Plate 8), and others, although clear, contained high loads of silt on the stream bed (Plate 9).

Our observations are supported by numerous studies in British Columbia and Washington that found strong associations between tadpole density and the geological character of individual areas (Dupuis and Bunnell 1997, Wahbe 1996, Corn and Bury 1989). This specificity suggests that presence of tailed frogs is largely dependent on the physical attributes of a given watershed (Steventon *et al* 1996).

RECOMMENDATIONS.

The Lillooet District Tailed Frog Inventory covered a significant portion of the Lillooet District. The inventory was primarily guided by a need to determine the extent of their distribution throughout the district and active J.S Jones harvesting areas, and secondarily by Land Resource Management Plan information gaps.
There were however important areas that were not sampled as a result of time and budget constraints. Areas not sampled included undeveloped (and therefore not accessible by land) watersheds, and others that have been extensively developed, which are considered of management concern.

From a general perspective the following Timber Supply areas (in 1: 50,000 forest cover maps) should be sampled wholly or partially: Stein Lake, Lytton (western portion), Stein River, Duffy Lake, Birkenhead Lake, North Creek, Dixon Range, Noaxe Creek, and Spences Bridge (see Appendix III for general locations). Specifically, areas that should be sampled include watersheds draining into the Yalakom, Bridge, Lower Duffy, Stein, Kwoiek, and Hurley river systems.

Finally, based on our experience with sampling we recommend the following modifications/changes to future sampling techniques in the Lillooet district:

- Conduct searches only in the streams. Bank searches for adults yield low results per unit effort when compared to results obtained for in-stream tadpole searches.
- Confine searches to 1.5 metres of the stream's edge. All records of tadpoles made in this project were made within that distance.
- Avoid sampling streams that are unlikely to support tadpoles, such as glacial, turbid, sandy, and intermittent streams. However the locations of such streams should be noted, and rationales for likelihood of occurrence should be outlined in detail.

ANNOTADED PHOTOGRAPHS

Plate 1. All tadpoles detected were located under cobbles near the stream edge.

Plate 2. Tadpoles were located in clear streams with little or no debris.

Plate 3. Typical Tailed Frog habitat in the southeastern portion of the district. Note the presence of large boulders and the well developed riparian understorey.

Plates 4 and 5. Tailed frog presence was confirmed in streams dominated by boulders and cobble of granitic and basaltic nature.

Plate 6. Tributary to Phair Creek. Streams with unstable banks like this one contribute to high sediment loads during peak water flows and are unsuitable for tadpoles and adult tailed frogs.

Plate 7. Truax Creek. Streambeds composed of highly fractured rock lack interstitial spaces for cover, experience frequent bedload movements, and have high sediment loads

Plate 8. Mc Parlon Creek. High sediment loads stemming from volcanic ash make water conditions unsuitable for tadpoles, regardless of stream and riparian structure.

Plate 9. Mc Parlon Tributary. High sediment loads clog interstitial spaces and provide little security cover for tadpoles.

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(Includes citations in Appendix II)

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APPENDICES

Appendix I. Variables collected to characterize physical attributes of streams sampled

LILLOOET DISTRICT TAILED FROG INVENTORY **Page ___/___**

Date: ____/____/____ Surveyors: ____

Forest Cover Map ID: _____________ Watershed Name: _________________________ Reach #: ______

UTM Coordinates: ________________ ________________ Elevation: _________ BEC Zone: _______

Observ #	Spp	min. of detection	Micro Habitat	Water Depth	Cover Type	Age	Location

CHANNEL AND WATER CHARACTERISTICS

Channel Width:	**Wetted Width**:		**Gradient %:**	**Temp (°C):**
Turbidity: T M L C	**Stage**: L M H	**Other:** Dry Intermittent	**Pattern**: TM ME IM IR SI ST	
Boulder: %	**Cobble:** %	**Gravel:** %	**Fines:** %	**CWD:** %
Rock Type and description (e.g. granite, shale, etc):				
Morphology: RP CP SP LC			**Subcode**: rock boulder cobble	

COVER

Total Cover: N T M A	**Crown Closure:** 0% 1-20% 21-40% 41-70% 71-90% 91-100%
LWD Function: N F A	**Instream Vegetation:** N A M V
Left Bank	**Right Bank**
Shape: U V S O	**Shape**: U V S O
Riparian Stage: INIT SHR PS YF MF NA	**Riparian Stage**: INIT SHR PS YF MF NA
Texture: F G C B R A	**Texture**: F G C B R A
Riparian Vegetation: N G S C D M W	**Riparian Vegetation**: N G S C D M W

Roll#: _____________ Photo #'s and description:____

Comments: ____

____

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Appendix II

HARVESTING IMPACTS ON TAILED FROG POPULATIONS

All but one of the watersheds sampled were located in areas that had been developed or were currently under development. This provided us with the opportunity to comment on some of the harvesting practices and related activities and their impacts on tailed frog habitat. Throughout the study area there were certain practices that were detrimental to both life stages of tailed frogs. Two salient impacts were directly related to harvesting and road presence.

Harvesting between watersheds and up to the stream's bank can have several detrimental effects on both life stages of tailed frogs. Adult frogs are relatively sedentary and also highly susceptible to desiccation (Wahbe 2000). A lack of adequate riparian cover can result in mortality to adult tailed frogs and restrict juvenile dispersal (Dupuis 1998). Similarly, a lack of suitable habitat between drainage systems can affect colonization rates (Merriam and Saunders 1993). Isolated populations can thus become highly susceptible to extinctions as a result of stochastic events (Caughley 1994).
Tadpoles are also affected by harvesting up to stream banks. Debris from harvesting activities can alter natural drainage patterns, contribute to higher sedimentation inputs into the stream, and clog interstitial spaces, which makes affected stream sections unsuitable to pre-metamorphic life stages (Plates 10, 11).

Roads can also affect tadpole habitat. Roads can alter the natural runoff regime of an area by increasing flooding events and/or decreasing summer flows (Dupuis 1998). Similarly, road construction and inadequate deactivation activities can alter the water quality and security cover in tadpole bearing streams by increasing silt loads into the stream during flooding and high precipitation events. Sand and silt clogs interstitial spaces between cobbles and boulders that tadpoles rely on for escaping predators and flooding events. Similarly, silt deposition on slow moving streams can reduce the ability of tadpoles to attach to rocks properly (Plate 12).

Plates 10 & 11. Mc Pharlon and Phair creek tributaries. Non-fish bearing streams are not afforded much protection under the Forest Practices Code. Harvesting up to the edge of a stream can have serious impacts on tadpole and adult tailed frogs.

Plate 12. Nikoamen Creek. Inadequate road deactivation practices can contribute to unusually high loads of sediment falling into the stream. Note the undercut bank, and high proportion of rubble and gravel downstream.

Appendix III. Map of all streams sampled for tailed frogs and areas where additional sampling is required.

Appendix IV. Rationale for the various designations of presence likeliness

Watershed Name	Status	Rationale
Kamiak Creek	Present	2 tadpoles located, good habitat structure
Nicoamen Creek	Likely	Present in 4 areas. Assumed to be throughout
Nicoamen Creek	Present	Present in 4 areas. Assumed to be throughout
Nicoamen Creek	Present	Present in 4 areas. Assumed to be throughout
Nicoamen Creek	Present	Present in 4 areas. Assumed to be throughout
Nicoamen Creek	Present	Present in 4 areas. Assumed to be throughout
Pooeyelth Creek	Present	5 tadpoles located, good habitat structure
Shulaps Creek	Present	Located 2 tadpoles, good instream structure
Tommy Creek	Present	1 Tadpole located, Good instream structure
Upper Cayoosh Creek	Absent	Present in 2 areas, assumed to be throughout
Upper Cayoosh Creek	Likely	Present in 2 areas, assumed to be throughout
Upper Cayoosh Creek	Present	Present in 2 areas, assumed to be throughout
Upper Cayoosh Creek	Present	Present in 2 areas, assumed to be throughout
Ault Creek	Likely	Good habitat, but long search yielded no individuals
Ault Creek	Likely	Good habitat, but long search yielded no individuals
Caspar Creek	Likely	Proximate of known locations, good habitat structure
Halbrook Creek	Likely	Good instream structure, proximate to other known location (Shulaps)
Halbrook Creek	Likely	Good instream structure, proximate to other known location (Shulaps)
Halbrook Creek	Likely	Good instream structure, proximate to other known location (Shulaps)
Larochelle Creek	Likely	Proximatly of known locations, good habitat structure
Larochelle Creek	Likely	Proximatly of known locations, good habitat structure
Larochelle Creek	Likely	Proximaty of known locations, good habitat structure
Lost Valley Creek	Likely	good habitat structure, poor riparian cover
Nikaia Creek	Likely	Proximaty of known locations, good habitat structure
Shulaps Creek	Present	Good habitat, and riparian cover
Tommy Creek	Likely	Good instream structure, good riparian cover
Ault Creek	Unlikely	Structurally sound, stream intermittent
Buck Creek	Unlikely	Poor Habitat, Very sandy
Buck Creek	Unlikely	Poor Habitat, Very sandy
Cerise Creek	Unlikely	SLOW MOVING/ SANDY BOTTOM
Cerise Creek	Unlikely	Stream very silty. Poor Habitat structure.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Downton Creek	Unlikely	Poor habitat structure, stream very silty.

Downton Creek	Unlikely	Poor habitat structure, stream very silty.
Enterprise	Unlikely	Poor habitat structure ie. no round boulder
Ferguson Creek	Unlikely	Mod. Habitat, Fish Bearing
Lost Valley Creek	Likely	Poor habitat, silty, poor instream structure
Lost Valley Creek	Likely	Good structure, little riparian understorey
Lost Valley Creek	Unlikely	Sandy, poor riparian cover
Mc Pharlon Creek	Unlikely	River very silty, with high turbity, poor habitat quality
Mc Pharlon Creek	Unlikely	River very silty, with high turbity, poor habitat quality
Mc Pharlon Creek	Unlikely	River very silty, with high turbity, poor habitat quality
Murray Creek	Unlikely	Intermittent stream
Murray Creek	Unlikely	Poor habitat, creek intermitent
Phair Creek	Unlikely	V shaped, unstable banks
Phair Creek	Likely	Moderate Habitat
Phair Creek	Unlikely	poor habitat structure/sediment
Phair Creek	Unlikely	poor habitat structure
Phair Creek	Unlikely	poor habitat structure
Retaskit Creek	Unlikely	Poor Habitat, Fish Bearing
Retaskit Creek	Unlikely	Poor Habitat, Fish Bearing
Skoonka Creek	Unlikely	Poor habitat, silty, sandy
Spence Creek	Unlikely	Poor habitat, silty, sandy
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Molybdenite	Likely	# of samples (11), good habitat structure
Texas/Skimath	Unlikely	# of samples (11), poor habitat structure
Texas/Skimath	Unlikely	# of samples (11), poor habitat structure
Texas/Skimath	Unlikely	# of samples (11), poor habitat structure
Texas/Skimath	Unlikely	# of samples (11), poor habitat structure
Texas/Skimath	Unlikely	# of samples (11), poor habitat structure
Truax Creek	Unlikely	River very silty, high turbity but habitat structurally good
Truax Creek	Unlikely	River very silty, high turbity but habitat structurally good
Truax Creek	Unlikely	River very silty, high turbity but habitat structurally good
Twaal Creek	Unlikely	Poor habitat, no boulder, mud bottom