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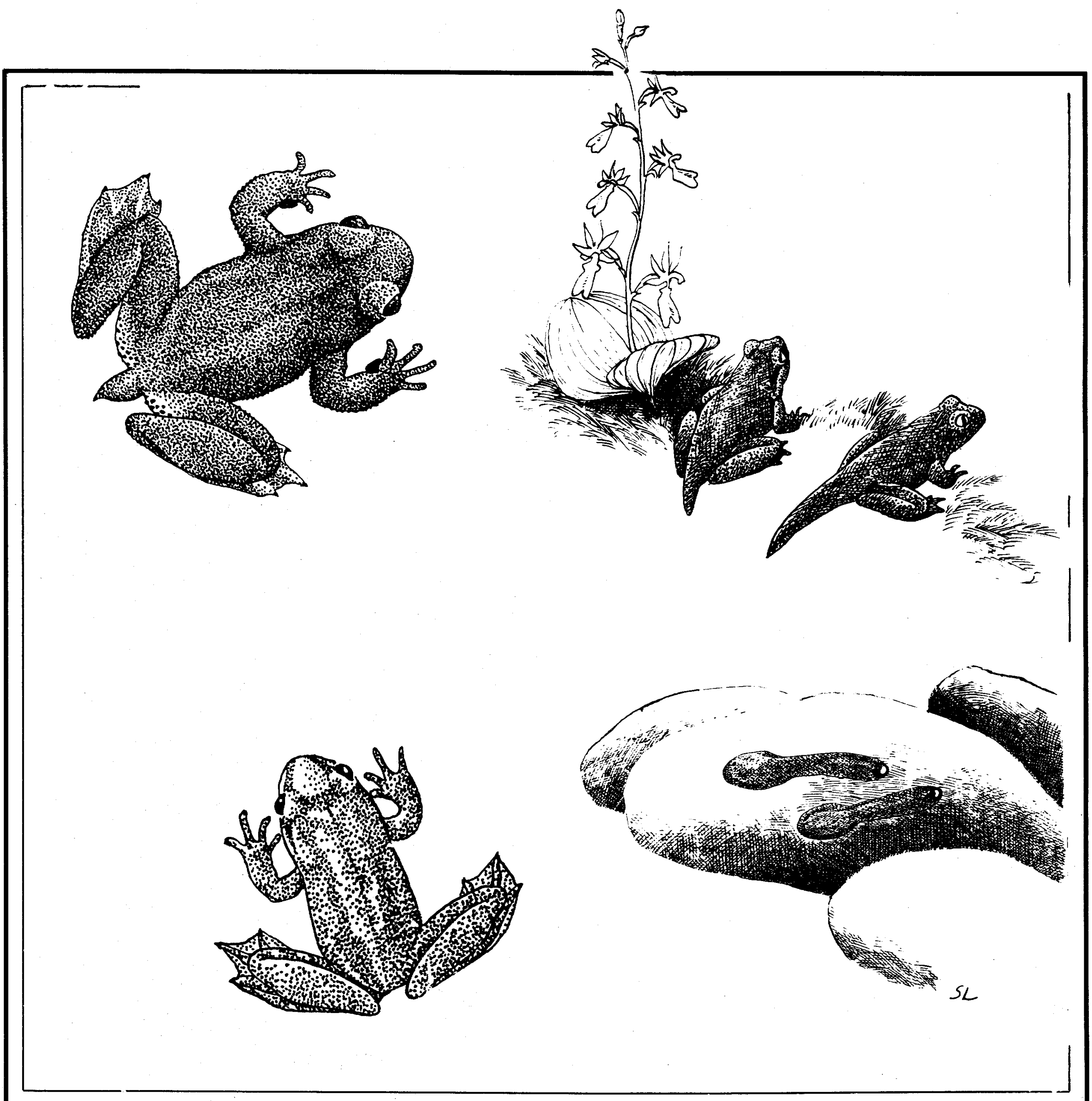
Tailed Frogs: Distribution, Ecology, and Association With Timber Harvest in Northeastern Oregon

Evelyn L. Bull and Bernie E. Carter



Authors

EVELYN L. BULL is a research wildlife biologist, Pacific Northwest Research Station, 1401 Gekeler Lane, La Grande, Oregon 97850; and BERNIE E. CARTER was a wildlife biologist, (deceased), Umatilla National Forest, Pendleton, Oregon 97801.

Abstract

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Tailed frogs (*Ascaphus truei*) were found in 42 of 80 streams surveyed in Union, Umatilla, Wallowa, and Baker Counties in 1992. At least three size classes of larvae were identified in seven of the streams, thereby suggesting that larvae transform after spending 3 or more years in the streams. The amount of cobble and fines in the streambed best predicted abundance of larvae, whereas, cobble, boulders, slope gradient, and stream buffers best predicted abundance of adults.

Keywords: Amphibians, *Ascaphus*, northeastern Oregon, tailed frog, timber harvest.

Summary

This study was designed to investigate the distribution, abundance, life history, and effect of timber harvest on tailed frogs. In 1992, 80 streams in northeastern Oregon were surveyed for tailed frogs. More intensive surveys (diurnal searches for larvae and nocturnal searches for adults) were conducted in 30 streams in 1993.

Tailed frogs were found in streams in four counties (Union, Umatilla, Wallowa, and Baker Counties) in northeastern Oregon. Their presence in three of these counties was previously unknown.

Tailed frog adults and larvae were present in streams all summer. It appeared that three or more age classes of larvae were present in most streams, thereby suggesting that larvae are in the streams at least 3 years before they transform into frogs. Transforming larvae were found in streams in July, August, and September; none was found in October. There were no significant differences in numbers of larvae or adults in streams with a low, moderate, or heavy amount of timber harvest; however, there was a general downward trend in the abundance of tailed frogs as the amount of timber harvest increased.

It appeared that stream characteristics were more important than landscape characteristics in predicting the abundance of tailed frogs in streams. Stepwise regression selected the two-variable model by using the amount of cobble and fines in the streams as best able to predict larval abundance. For adult frogs, the best model was a four-variable model with the stream buffer, amount of boulders and cobble in the stream, and the slope gradient being the variables best able to predict the abundance of adult frogs.

Contents

Introduction

The tailed frog (*Ascaphus truei*) populations have declined in the Pacific Northwest (for example, western Oregon, Marshall and others 1992, and British Columbia, Orchard 1992), primarily because of timber harvesting (Corn and Bury 1989, Marshall and others 1992, Orchard 1992). Tailed frog populations in northeastern Oregon are not well described (Nussbaum and others 1983), and the effect of habitat alterations on these populations is unknown. Our objectives were to determine (1) the distribution of tailed frogs in the Wallowa-Whitman and Umatilla National Forests (in Union, Umatilla, Wallowa, Baker, and Grant Counties), (2) the relative abundance of tailed frogs and the development of larvae in 30 streams, (3) the habitat characteristics that best predict relative abundance of adults and larvae, and (4) the influence of management activities associated with timber harvest on northeastern Oregon populations of tailed frogs.

Methods

Distribution, Abundance, Breeding, and Larval Development

We searched 80 streams for tailed frogs in Union, Wallowa, Baker, Umatilla, and Grant Counties in northeastern Oregon between 22 July and 15 October 1992. We subjectively selected streams that were permanent and flowing, cold, less than 5 m wide, more than 1200 m in elevation, and within 0.5 km of a road. Cold water (less than 20 °C) is necessary for survival of this species (Nussbaum and others 1983). Each stream was searched for 30 minutes by two people, who walked upstream in a 200-m stream stretch and overturned rocks while holding a dip net (16 by 15 cm rectangular frame) downstream to catch frogs.

In 1993, we surveyed 30 streams in watersheds where tailed frogs were known to occur in Wallowa, Union, Baker, and Umatilla Counties based on surveys conducted in 1992. We increased the amount of stream surveyed from the 200 m used in 1992 to 1000 m in 1993 to increase the sample size of individuals found in each stream. A 1000-m stretch of each stream was surveyed for tailed frogs by using both diurnal and nocturnal searches. Diurnal searches of all 30 streams were conducted between 25 May and 6 July 1993. The diurnal search consisted of walking upstream and overturning rocks and holding a dip net downstream from the rocks to capture any frogs. Each stream was searched for 8 staff-hours. Only larvae (tadpoles) were captured and measured during the diurnal search. Four streams (Mud, Gumboot, Clarke, and Catherine Creeks) were surveyed a second time between 21 and 24 August by using the same techniques to document growth in larvae.

The same 1000-m stretch of each stream was surveyed at night for 8 hours between 1 June and 1 July 1993. A person walked along the stream edge looking for adults in the water and on the shore. Adults were captured and measured.

During surveys conducted in 1992 and 1993, larval, recently transformed (metamorphs), juvenile, and adult tailed frogs were captured. Total length and length of the visible hind limbs were recorded for larvae. Total length (measured from snout to rump), sex, presence of eggs, and presence of nuptial pads (fig. 1) were recorded for adult frogs. We defined metamorphs as less than 28 mm total length (four legs present and larval tail often still being absorbed and not measured), juvenile frogs as 28 to 35 mm total length, and adult frogs as more than 35 mm total length. This classification was based on the absence of developed nuptial pads on 76 percent of the males less than 36 mm total length. Eggs could be seen through the body wall on the ventral surface of females (fig. 1) (Metter 1964).

Landscape and Stream Characteristics

Thirty streams were surveyed for tailed frogs in summer 1993 in watersheds where tailed frogs were known to occur in Wallowa, Union, Baker, and Umatilla Counties based on

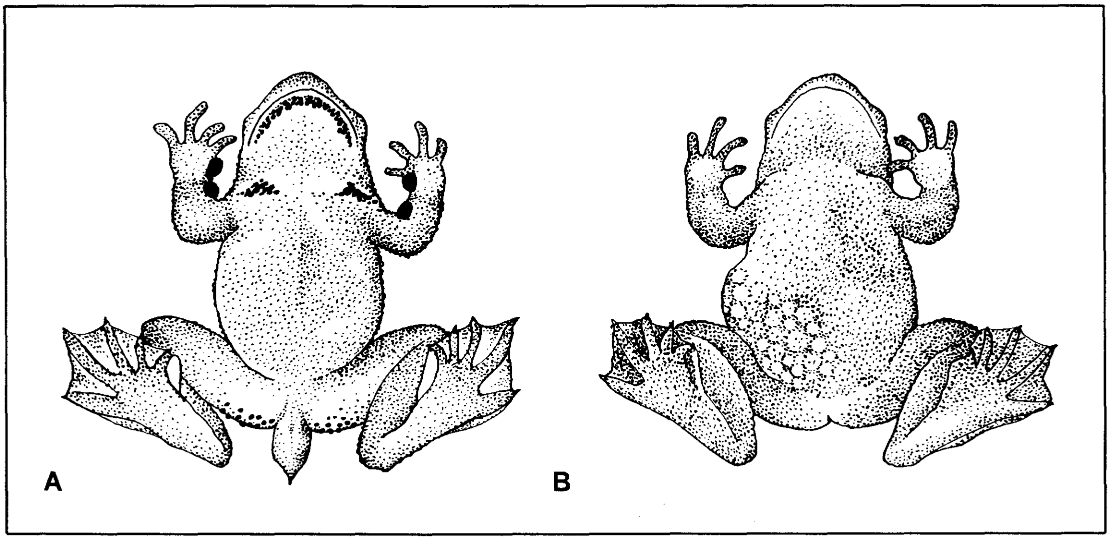

Figure 1—Illustration showing black nuptial pads on a male tailed frog (A) and eggs seen through the ventral surface of a female (B). Eggs can be seen on both sides of the abdomen even though they only are shown on one side here.

surveys conducted in 1992. A third of the streams surveyed had a low degree of timber harvest, a third a moderate degree, and a third a high degree. Degree of timber harvest was determined for the landscape that drained into each stream portion that was sampled. We calculated the percentage of this landscape that had been affected by timber harvest in the last 20 years. A stream with less than 20 percent of the landscape harvested was classified as low, 21 to 50 percent harvested as moderate, and more than 50 percent as high. Timber harvest was defined as clearcuts, shelterwood removals, overstory removals, and partial overstory removals within the last 20 years. Timber harvest determinations were made from aerial photographs, Forest Service logging records, and ground checks.

The 30 streams were subjectively selected based on (1) their timber harvest record, (2) accessibility (within 1 km of a road), (3) prior knowledge that tailed frogs occurred in the watershed, and (4) the presence of suitable habitat for tailed frogs. Suitable habitat was defined as a perennial, cold stream with a cobble and boulder substrate. To reduce variability, only streams flowing through forested land and with stream gradients between 5 and 20 percent were used. Streams were sampled as close to the headwaters as was feasible, so all streams sampled were less than 2 m wide and less than 0.5 m deep.

In addition to classifying each stream by degree of timber harvest, we determined the following variables within the landscape that drained into the stream portion sampled: percentage of unlogged area, percentage of logged area with 33 to 66 percent canopy closure remaining, percentage of logged area with less than 33 percent canopy closure remaining, percentage of stream sampled that had a buffer of uncut trees at least 30 m wide on both sides of the stream, percentage of stream sampled and a 1000 m stretch of stream above the portion sampled that had a buffer, amount of unsurfaced roads (number in km per 100 ha), and amount of surfaced roads (number in km per 100 ha).

Stream characteristics were recorded at 100-m intervals along each stream. The following variables were measured: stream depth, stream width at the high-water mark, and stream gradient (percentage measured with a clinometer). In a 15-m stretch of stream both upstream and downstream from the sampling point, we estimated the percentage of stream bed made up of fines (less than 0.3 cm in diameter), gravel (0.3 to 5 cm), cobble

(5 to 30 cm), and boulders (greater than 30 cm). In the same stretch of stream, we estimated (1) the percentage of rocks that were embedded more than 25 percent, (2) the percentage of stream in riffles (versus pools), (3) the percentage of stream with a deep channel (more than 0.7 m), and (4) the percentage of stream exhibiting no siltation or a light dusting of silt on the rocks.

Analysis

Larval development was evaluated by using a cluster analysis for each stream where more than 100 tadpoles were captured (N = 7 streams). The analysis identified three size classes based on larval length and length of hind limbs. The number of larvae and adults observed in streams were compared among the three timber harvest categories by using a Kruskal-Wallis test (Conover 1971).

We ran all possible regressions by using the number of larvae found in each stream as the dependent variable and the drainage and stream characteristics as independent variables. The best model was selected based on the R^2, adjusted R^2, Mallow's Cp statistic, and mean square error, as well as the significance level of the variables in the model. The same analysis was conducted by using the number of adults found at night. This analysis determined which variables best predicted the number of larvae and adults found in streams. All statistical hypotheses were tested at $P \leq 0.05$.

Results

Distribution, Abundance, Breeding, and Larval Development

In 1992, tailed frogs were found in 42 of 80 streams (appendix A): in 26 of 37 streams in Wallowa County, in 10 of 19 streams in Union County, in 5 of 10 streams in Baker County, in 1 of 6 streams in Umatilla County, and in 0 of 8 streams in Grant County (fig. 2). These findings expand the range of this species to three additional counties not reported in Nussbaum and others (1983).

In 1992, we captured 292 frogs: 60 percent were adults, 27 percent metamorphs, and 13 percent juveniles. Of the adults, 68 percent were males and 32 percent were females. Males ranged from 36 to 45 mm total length. Fifty-eight percent had well-developed nuptial pads, and 32 percent had nuptial pads that were less developed but still obvious. Total length of adult females ranged from 36 to 48 mm, and 19 percent had eggs visible through the ventral wall. Of the juveniles, 57 percent were males and 43 percent were females.

In 1993, we captured 782 frogs during nocturnal surveys. Of these frogs, 52 percent were males, 42 percent females, and 6 percent metamorphs, for which we could not determine sex.

In 1992, when we surveyed streams over a longer period than in 1993, we found transforming frogs in the streams from July to September; transformation was completed by October. The percentage of transforming frogs captured in July that were still absorbing their tails was 100 percent (N = 3); 68 percent in August (N = 38); 22 percent in September (N = 6); and 0 percent in October (N = 2).

During 1992, we observed six pairs of frogs in amplexus. Two males were clasping each other and floating upside down in a pool on 17 August. Three pairs (male and female) were clasping and floating upside down in pools on 17, 18, and 20 August in three different streams; the male's cloacal extension was not in the female's cloaca. Two pairs were clasping in an upright position under rocks on 17 September and 15 October, and the male's cloacal extension was in the female's cloaca. On 15 October, the stream temperature was 0 °C, and there was ice on the edge of the stream.

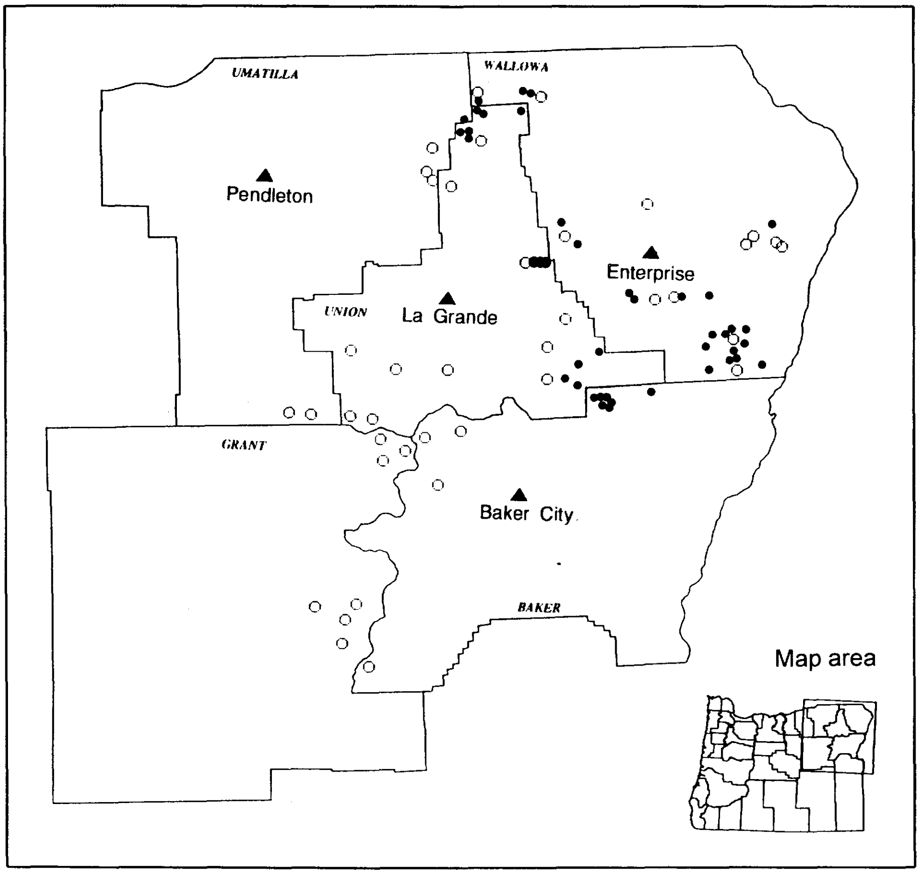

Figure 2—Locations of streams surveyed for tailed frogs in summer 1992. Solid dots designate streams where tailed frogs were found; open circles designate streams where tailed frogs were not found.

After evaluating the distribution of the total lengths of larvae in streams where more than 100 larvae were found, we believe most streams contained larvae in three size classes (fig. 3). The cluster analysis identified three size classes of larvae for each stream based on total length and length of hind limbs (table 1, appendix B). There may have been four size classes in some of the streams based on the variation in the range of some of the clusters (appendix B). Clusters also are shown for the second sampling period in the four streams that were surveyed twice in summer (table 1). The second sampling period was 58 to 89 days after the first one in each stream.

Mud Creek was sampled twice with 65 days between the sampling periods. The mean larvae length differed by 6 mm between the two sampling periods in clusters 1 and 2, thereby suggesting 6 mm of growth in 65 days (table 1). Cluster 3 had a mean length that was shorter during the second sampling period than during the first. At least some of the largest larvae likely transformed between the two sampling periods, thereby resulting in somewhat smaller larvae remaining in the stream for another year or transforming in September.

In Gumboot Creek, the growth of larvae in clusters 1 and 2 was 9 and 4 mm in 60 days, respectively. Again, larvae in cluster 3 probably metamorphosed, leaving shorter larvae with shorter legs that probably overwintered in the stream.

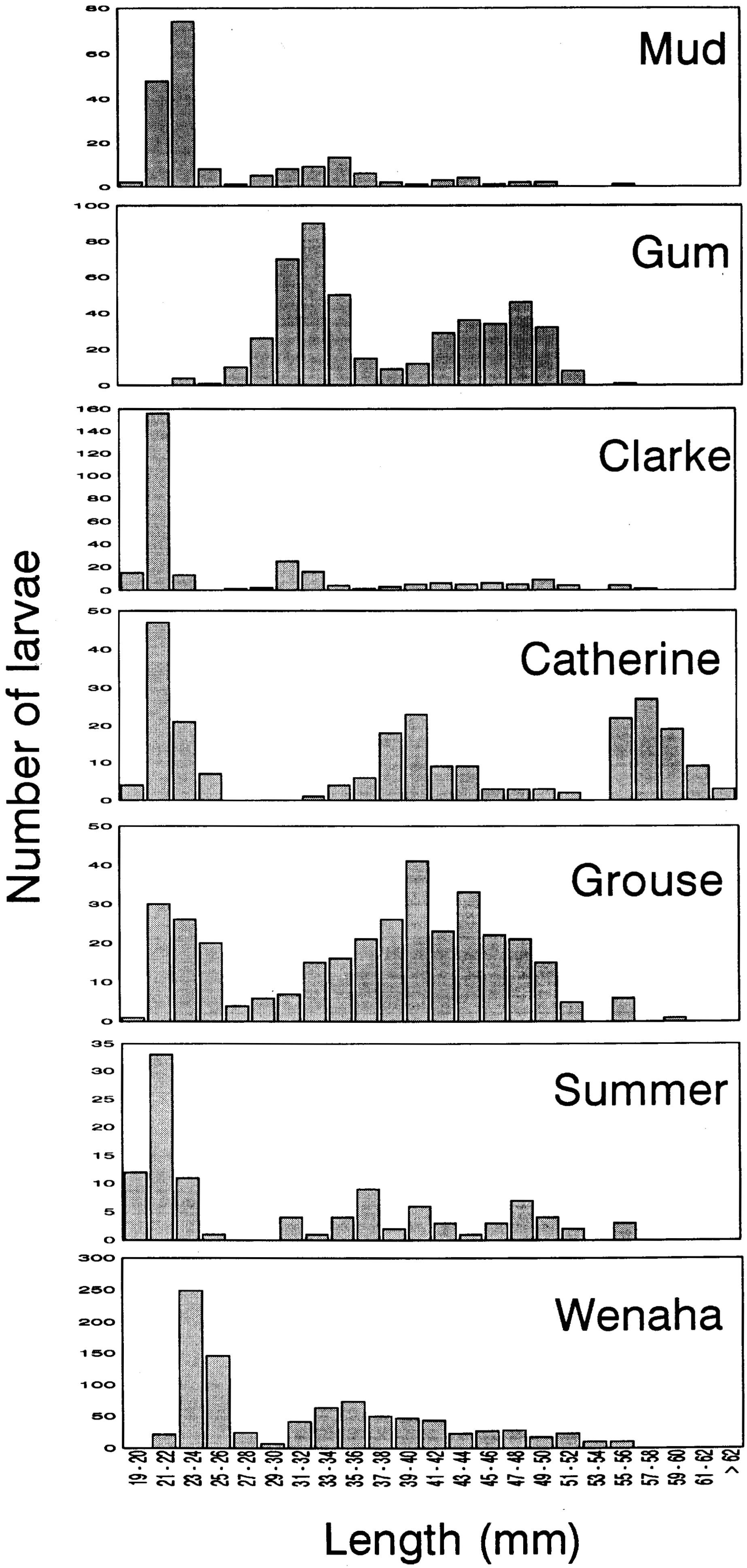
Mud
Gum
Clarke
Catherine
Grouse
Summer
Wenaha
Number of larvae
Length (mm)
19-20
21-22
23-24
25-26
27-28
29-30
31-32
33-34
35-36
37-38
39-40
41-42
43-44
45-46
47-48
49-50
51-52
53-54
55-56
57-58
59-60
61-62
> 62

Table 1—Mean total length (mean length of visible hind limbs) in millimeters of larval tailed frogs in 7 streams clustered into 3 size classes from northeastern Oregon, 1993

Stream and dates sampled	No. of larvae	Cluster (1)	Cluster (2)	Cluster (3)
Mud:				
21 June	190	21.8 (0)	33.0 (0.1)	45.6 (5.7)
25 August	138	27.7 (0)	39.0 (0.3)	45.2 (5.3)
Gumboot:				
23 June	806	22.9 (0)	39.9 (0.7)	50.4 (10.1)
22 August	473	32.0 (0)	43.6 (1.7)	48.9 (5.8)
Clarke:				
26 May	281	20.2 (0)	31.2 (0)	46.9 (2.8)
23 August	380	27.9 (0)	39.3 (0)	50.5 (2.4)
Catherine:				
28 June	242	22.4 (0)	42.0 (0.1)	58.1 (12.0)
25 August	229	15.0 (0)	34.6 (0)	52.4 (2.8)
Grouse:				
22 June	340	23.4 (0)	39.8 (0.8)	49.7 (8.7)
Summer:				
14 June	109	21.7 (0)	37.5 (0.1)	50.2 (7.6)
Wenaha:				
7 July	902	23.2 (0)	35.4 (0)	47.7 (6.6)

In Clark Creek, the growth of larvae in clusters 1 and 2 was 8 mm in 89 days. Cluster 3 changed little in size.

Hatchlings (15 mm long and whitish in color) were found in Catherine Creek during the second sampling period on 24 August, so clusters differed greatly from the first sampling period. If August is the typical time for eggs to hatch, cluster 1 found in the four streams during the first sampling period (table 1) probably represents larvae that hatched the previous year.

The repeated sampling in the same stream suggests that the larvae grew about 8 to 9 mm in length in 60 to 80 days in summer. We believe cluster 1 in most of the streams represents 1-year-old larvae that had hatched the previous summer. We believe cluster 2 probably represents 2-year-old larvae. Cluster 3 probably represents 3-year-old larvae, some of which metamorphosed that summer. The cluster 3 identified during the second sampling period suggests that at least some of the larvae 40 to 50 mm in length do not metamorphose until the following year because metamorphosis was completed in September 1992. This observation suggests that some of the larvae could be in the streams for 4 years.

Landscape and Stream Characteristics

There were no significant differences ($P > 0.05$) in numbers of larvae or frogs observed in streams with a low, moderate, or heavy amount of timber harvest, although there was a general downward trend in the average number of larvae and adults in streams by timber harvest category (table 2). The variability of the number of larvae or frogs among

Table 2—The mean (standard deviation) number of larvae and adult tailed frogs found in a 1000-m stretch in 10 streams with a low, moderate, and heavy amount of timber harvest in the surrounding drainage[a]

Amount of harvest	Tadpoles	Adults
Low	162 (287.43)	35 (41.72)
Moderate	88 (124.00)	29 (32.13)
Heavy	101 (251.42)	23 (35.64)
Adjusted mean:		
Low	75 (87.03)	26 (32.56)
Moderate	58 (85.13)	24 (32.07)
Heavy	22 (23.64	13 (15.01)

[a]An adjusted mean is shown where the stream with the highest number of tadpoles and adults was deleted from each category.

streams in each of the three timber harvest categories was high. If the stream with the highest number of frogs and larvae in each category is deleted and the averages are recalculated, the trend is more obvious (table 2). In addition, no frogs were found in 30 percent of the 10 streams where drainages had received a heavy amount of timber harvest, whereas all streams whose drainages had received a low or moderate amount of timber harvest contained frogs.

Stepwise regression selected the two-variable model using percentage of cobble and percentage of fines as best able to predict larval abundance ($F = 9.09$; adjusted $R^2 = 0.36$; tadpole abundance = -353.23 + cobble (8.69) + fines (6.43)). For adult frogs, the best model was a four-variable model with the percentage of a 2000-m stretch of stream containing a buffer, the percentage of boulders and cobble in the stream, and the slope gradient (slope) being the variables best able to predict the abundance of adult frogs ($F = 5.067$; adjusted $R^2 = 0.36$; adult abundance = -29.78 + buffer (0.49) + boulder (2.12) + cobble (0.01) + slope (-5.68)).

Discussion

This study documents tailed frog occurrence in three counties in northeastern Oregon in which their presence was previously unknown.

The age distribution of adults was surprising because few juvenile frogs were captured in 1992 (13 percent). With a species that requires 7 to 8 years to reach sexual maturity (Daugherty and Sheldon 1982), we expected a greater proportion of juveniles in the population. Of the adult males, 90 percent had obvious nuptial pads, two-thirds of which were well developed, thereby suggesting that most males were sexually mature. If there are no differences in detectability rates of adults and juveniles, the data suggest that there is limited recruitment in these streams. In this situation, the survival of adults is critical, and collecting them may seriously jeopardize some populations.

More males than females were captured in 1992; however, we suspect there may be a difference in detectability rates. We observed amplexus from August to October, so males may have been more obvious in their search for mates. The sex ratio of juveniles was nearly equal.

The three size classes of larvae identified by the cluster analysis (table 1) are similar to those reported by Metter (1967), who stated that inland populations exhibit a 3-year larval period. Gray (1992) also identified a 3-year larval period in eastern Washington. Brown (1990) reports that 4 years were required for larvae to transform in subalpine streams of the North Cascade Mountains.

The regression analyses suggest that stream characteristics are more important in predicting tailed frog abundance than are landscape characteristics in the drainage—within the range of characteristics we used in our study. This conclusion is supported by the fact that there were no significant differences in tailed frog abundance among timber harvest categories, even though the mean number found in streams decreased as timber harvest increased.

Regression analysis selected the percentage of cobble and fines in the streams to best predict larval abundance. Larvae were typically found attached to and feeding on cobble in the streams, so this association is logical. Without cobble, they would have no place to feed or hide from predators.

The percentage of cobble and boulders in the stream, the amount of a 2000-m stretch of stream with a buffer, and the stream gradient were the variables best able to predict abundance of adults. We found adults under cobble and boulders in the stream during the day, but at night we found them on the surface of boulders, presumably foraging. This stream structure provides foraging and hiding habitat. The percentage of a 2000-m stretch of stream with a buffer probably reflects the frogs' need for cool water.

Findings of this study suggest that this species is more widespread in northeastern Oregon than previously thought. In addition, the larvae are probably in the streams at least 3 years before they transform. Recruitment into the adult population seems poor and warrants further study. Timber harvest may not significantly influence populations as long as a no-cut buffer is retained, the integrity of the stream structure is retained, and the harvest activity is no more severe than what we considered in our study.

Acknowledgments

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Equivalents

When you know:	Multiply by:	To find:
Millimeters (mm)	3.940	Inches
Centimeters (cm)	2.54	Inches
Meters (m)	3.281	Feet
Kilometers (km)	1.610	Miles
Hectares (ha)	2.471	Acres
Celsius (°C)	1.8 and add 32	Fahrenheit

Literature Cited

Brown, Herbert. A. 1990. Morphological variation and age-class determination in overwintering tadpoles of the tailed frog, *Ascaphus truei.* Journal of Zoology London. 220: 171-184.

Corn, Paul Stephen; Bury, R. Bruce. 1989. Logging in western Oregon: responses of headwater habitats and stream amphibians. Forest Ecology and Management. 29: 39-57.

Conover, W. J. 1971. Practical nonparametric statistics. 2d ed. New York: John Wiley and Sons. 493 p.

Daugherty, Charles H.; Sheldon, Andrew L. 1982. Age-determination, growth, and life history of a Montana population of the tailed frog *(Ascaphus truei).* Herpetologica. 38: 461-468.

Gray, Lucie Ann. 1992. Larval growth and age at completion of metamorphosis of the tailed frog, *Ascaphus truei.* Ellensburg, WA: Central Washington University. 62 p. M.S. thesis.

Marshall, David B.; Chilcote, Martin; Weeks, Hal. 1992. Sensitive vertebrates of Oregon. Portland, OR: Oregon Department of Fish and Wildlife.

Metter, Dean E. 1964. A morphological and ecological comparison of two populations of the tailed frog, *Ascaphus truei* Stejneger. Copeia. 1964: 181-195.

Metter, Dean E. 1967. Variation in the Ribbed Frog *Ascaphus truei* Stejneger. Copeia. 1967: 634-649.

Nussbaum, Ronald A.; Brodie, Edmund D., Jr.; Storm, Robert M. 1983. Amphibians and reptiles of the Pacific Northwest. Moscow, ID: University of Idaho Press. 332 p.

Orchard, Stan A. 1992. Amphibian population declines in British Columbia (occasional pap.). In: Declines in Canadian amphibian populations: designing a national monitoring strategy. Canadian Wildlife Service. 76: 10-13.

Appendix A

Streams containing tailed frogs in northeastern Oregon, 1992

Baker County:
- Big Creek
- Jim Creek
- Trout Creek
- Groves Creek
- Glendenning Creek
- Little Bear Creek
- Mud Spring Creek
- Salt Creek
- South Fork Big Sheep Creek
- Gumboot Creek
- Tributary of Gumboot

Umatilla County:
- Summer Creek
- Mahogany Creek
- Fergusen Creek

Union County:
- Little Lookinglass Creek
- East Fork Swamp Creek
- West Fork Swamp Creek
- Sheep Creek
- North Fork Indian Creek
- West Fork Clarke Creek
- East Fork Clarke Creek
- Camp Creek
- Buck Creek
- Catherine Creek
- Summit Creek
- Deer Creek
- Carol Creek
- Skookum Creek
- Dry Creek
- South Fork Wenaha
- Mottet Creek
- Bear Creek
- Velvet Creek
- Boulder Creek
- Jarbo Creek

Wallowa County:
- Washout Creek
- Lake Creek
- South Fork Grouse Creek
- Elk Flat Creek
- Squaw Creek
- North Fork Gumboot Creek
- Lick Creek

Appendix B

Table 3—Range in total length of tailed frog larvae (range in length of hind limbs) measured in millimeters in 3 size clusters for 7 streams surveyed in northeastern Oregon, 1993

Stream and dates surveyed	Cluster (1)	Cluster (2)	Cluster (3)
Mud:			
21 June	19-25 (0)	28-39 (0-2)	39-55 (0-10)
25 August	22-32 (0)	34-43 (0-2)	42-49 (3-11)
Gumboot:			
23 June	18-28 (0)	30-48 (0-8)	45-58 (6-15)
22 August	22-40 (0-6)	39-47 (0-5)	44-55 (2-13)
Clarke:			
24 May	18-22 (0)	26-35 (0)	37-56 (0-10)
23 August	23-34 (0)	35-43 (0)	44-57 (0-12)
Catherine:			
28 June	20-25 (0)	33-52 (0-3)	53-65 (5-18)
25 August	15 (0)	27-42 (0)	44-61 (0-12)
Grouse:			
22 June	20-27 (0)	30-48 (0-7)	44-15 (1-22)
Summer:			
14 June	20-25 (0)	31-44 (0-4)	44-56 (4-12)
Wenaha:			
7 July	20-27 (0)	28-44 (0)	40-56 (0-12)

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Keywords: Amphibians, *Ascaphus*, northeastern Oregon, tailed frog, timber harvest.

Pacific Northwest Research Station
333 S.W. First Avenue
P.O. Box 3890
Portland, Oregon 97208-3890

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333 S.W. First Avenue
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