

## Amphibian and Reptile Abundance in Riparian and Upslope Areas of Five Forest Types in Western Oregon

### Abstract

We compared species composition and relative abundance of herpetofauna between riparian and upslope habitats among 5 forest types (shrub, open sapling-pole, large sawtimber and old-growth conifer forests, and deciduous forests) in Western Oregon. Riparian- and upslope- associated species were identified based on capture frequencies from pitfall trapping. Species richness was similar among forest types but slightly greater in the shrub stands. The abundances of 3 species differed among forest types. Total captures was highest in deciduous forests, intermediate in the mature conifer forests, and lowest in the 2 young coniferous forests. Species richness was similar between stream and upslope habitats; however, captures were higher in riparian than upslope habitat. Tailed frogs (*Ascaphus truei*), Dunn's salamanders (*Plethodon dunni*), roughskin newts (*Taricha granulosa*), Pacific giant salamanders (*Dicamptodon tenebrosus*) and red-legged frogs (*Rana aurora*) were captured more frequently in riparian than upslope habitats. Of these species the red-legged frog and Pacific giant salamander may depend on riparian habitat for at least part of their life requirements, while tailed frogs, Dunn's salamanders and roughskin newts appear to be riparian associated species. In addition, we found Oregon salamanders (*Ensatina eschscholtzii*) were associated with upslope habitats. We suggest riparian management zones should be at least 75-100 m on each side of the stream and that management for upslope/and or old forest associates may be equally as important as for riparian species.

### Introduction

Much riparian management in the Pacific Northwest has been focused on protection of fish habitat along larger streams (Mcchan et al. 1977, Sedell et al. 1981). Bilby (1988) suggested that the alterations along the smaller streams have a more dramatic effect than on larger streams, because they shift the primary source of organic matter from land to the stream. Leopold et al. (1964) estimated that 85 % of the total length of running waters are first- to third- order streams. Changes in these streams may alter the structure and productivity at higher levels of the riparian food chain (Murphy and Hall 1981, Hawkins et al. 1983), and eventually may drastically effect riparian-associated plants and animals, some which are already listed by the Department of Interior as threatened or endangered (Hirsch and Segelquist 1978).

Intergradation of riparian vegetation with the adjacent upland habitat provides increased structural diversity of vegetation for wildlife (Thomas et al. 1979), and amphibians and other vertebrates have an important role in the food chain of these ecosystems (Bury et al. 1980, Brode and Bury 1981). The cool-moist microclimate found in riparian habitats may be essential for some herpetofauna, and it undoubtedly offers limited resources to others during at least part of the year

(Brode and Bury 1981). Riparian habitat is used by many amphibians for cover and/or breeding habitat (Bury 1988). Alterations in these components by changes in the forest can be detrimental to many amphibian species, including salamanders (Bury et al. 1980). Increased temperatures of exposed stream-beds as a result of timber removal were hypothesized to lead to the disappearance of the tailed frog (Bury 1968; Noble and Putnam 1931). Bury and Corn (1988) suggested that canopy removal may negatively effect the tadpole population of tailed frogs by increasing water temperatures and altering the food base. Brode and Bury (1981) found that populations of Torrent salamanders (*Rhyacotriton variegatus*), which are often associated with cool ravines and rivulets, were eliminated by logging in Northwestern California. Although the numbers of herpetofauna species in the Pacific Northwest is lower than birds and mammals, their ecological significance as measured by density and biomass is high (Bury 1988). Thomas et al. (1979) suggested that vertebrates which feed and/or reproduce in water are usually dependent on riparian habitat, but some amphibians including the plethodontid salamanders, have a less direct association with water and are more general in their habitat requirements.

Life history information is available for some herpetofauna in the Oregon Coast Ranges

(Nussbaum et al. 1983). Ten of 24 native species of herpetofauna in the Oregon Coast Ranges often are found in riparian habitat (Marshall 1986). Bury (1988) indicated that the northwestern salamander (*Ambystoma gracile*) and the roughskin newt require water (preferably slow moving) for breeding. He also stated that the northern alligator lizard (*Elgaria coerulea principis*) may be more abundant along the streams, but it does not require riparian habitat for survival. Bury (1988) concluded that none of the herpetofauna of the Oregon Coast or Northern California appear to be riparian obligates, because none of them are dependent on riparian habitat alone for both breeding and cover. His statement left some doubt about the occurrence of riparian obligate herpetofauna in the Oregon Coast Ranges.

The purpose of this study was to describe differences in species composition and relative abundance of herpetofauna between riparian and upslope habitats among five forest types. Our primary objective was to identify any species with riparian or upslope associations in order to develop management strategies for these species.

## Methods

### Study Sites

Fifteen study sites were located in the Central Coast Ranges, Lincoln County, Oregon along second-,

third-, and fourth-order streams (Horton 1945; Strahler 1957) (Figure 1). "Stream Order" is a system of stream classification; each small unbranched tributary is a first-order stream; two first order streams join to make a second-order stream; a third order stream has only first- and second-order tributaries, etc. (Brown 1985:201). The Coast Ranges is influenced by the maritime climate of Western Oregon, with mild-wet winters and cool-dry summers (Brown and Curtis 1985). The annual precipitation ranges from 64 cm in the interior valleys to 305 cm on the western slopes of the coastal mountains (Brown and Curtis 1985). Franklin and Dyrness (1973:31-32) described the Coast Ranges as a narrower zone which receives 170-300 cm of precipitation a year, with average temperatures that seldom drop below 0°C in the winter and never exceed 27°C in the summer. The upland soils of these areas consist largely of silt loams and clays (of sedimentary origin) and finer textured clay loams which are igneous (Maser et al. 1981). Organic matter content is high and acidity is medium (Franklin and Dyrness 1973:9-10). There may be substantial differences in soil types which occur locally as topography changes from poorly developed soils on steep slopes to deep soils on gradual slopes (Maser et al. 1981).

We selected study sites in five forest types (Hall et al. 1985) including: (1) shrub conifer forests; 5-10 years old, trees <3 m tall, dbh <2.5 cm, <40%

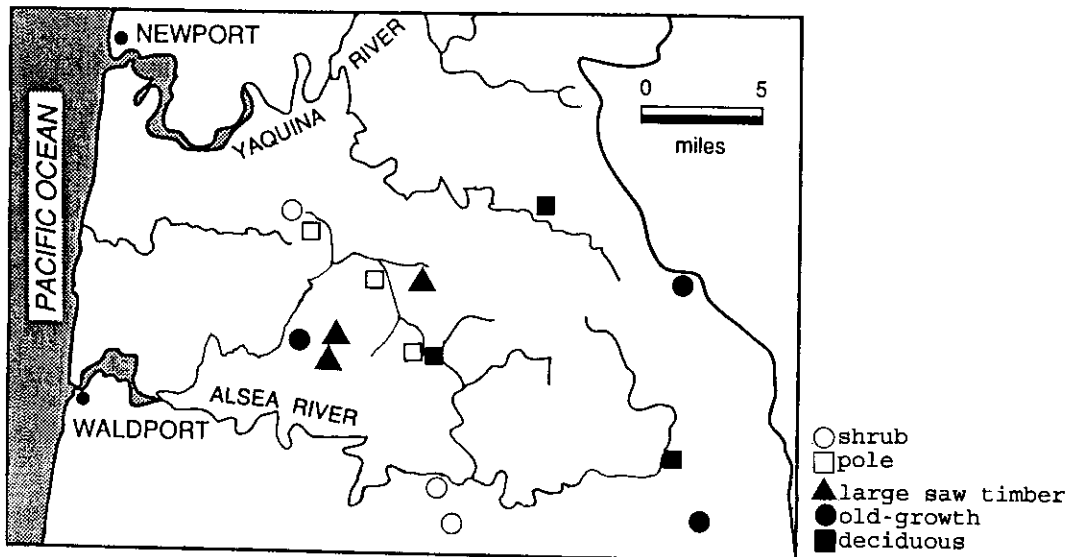


Figure 1. Map of study site locations, Lincoln County, Oregon.

crown cover, with grass-forb condition intermittent, dominant tree species Douglas-fir (*Pseudotsuga menziesii*) (2) open sapling-pole conifer forests: 20-35 years old, trees usually >3 m tall, 2.5-10 cm dbh, <60% crown cover, dominant tree species Douglas-fir (3) large sawtimber conifer forests: 110-200 years old, trees usually >30 m tall, dbh >53 cm, 60-80% crown cover, dominant tree species Douglas-fir (4) old-growth conifer forests: 200+ years old, multilayered vertical structure, 60-80% crown cover, dominant tree species Douglas-fir and western hemlock (*Tsuga heterophylla*) and (5) deciduous forests: >70% cover, dominant tree species, red alder (*Alnus rubra*) and bigleaf maple (*Acer macrophyllum*). Forest type selection was based on a combination of age, species and structural characteristics, and was limited to what was available in the Oregon Coast Range. We sampled three replicates of each forest type (= 15 total stands). Each stand had the appropriate forest type on both sides of the stream and was large enough to include the transects plus a buffer of at least 100m to reduce edge effects. Aerial photos and field reconnaissance were used to locate sites. The elevation of the study sites ranged from 110-378 m and slope was from 28 to 68%. Aspect, slope, litter depth

and other habitat variables were measured at each station at each site (Gomez 1992).

### Trapping Design and Method

Transect lengths and spacing between trap stations were modified from McComb et al. (1991), these reductions allowed us to maximize the efficiency of the study design and the search for study sites, but still obtain a representative sample of the population. The trapping design on each study site consisted of one 350-m riparian transect, one 350-m upslope transect (200 m upslope and parallel to the riparian transect), and two 200-m trans-riparian transects that connected the ends of the riparian and upslope transects (Figure 2). Eight trap stations with two pitfall traps/station were located at 50-m intervals along the riparian and upslope transects and nine trap stations at 25-m intervals along the trans-riparian transects. There were 60 pitfall traps per stand and a total of 900 traps for all stands combined. Multiple traps were used per station to increase capture rates. The traps were constructed by taping two #10 sized cans together and placing them in holes so that the top of the can was flush with the ground. Traps were located within a 10 m radius of the station center

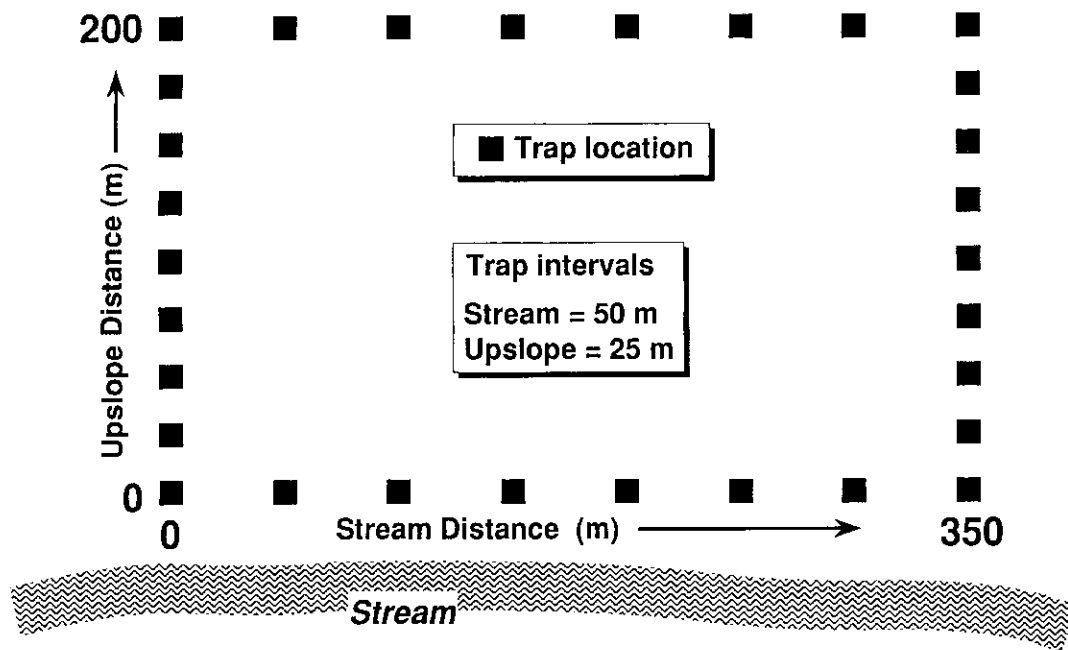


Figure 2. Study site design for placement of pitfall traps.

to allow trap placement along fallen logs, stumps, live trees, rocks, or slope breaks, which acted as natural drift fences. Kill trapping methods were used in this study because of poor accessibility to the sites and time constraints.

The study included four 28-day trapping periods during May (cool, wet season) and August (hot, dry season) of 1989 and 1990. Each trap was checked weekly which resulted in 100,800 trap nights. Dead animals were taken from the field to freezers where they were stored for positive identification. Live animals were identified and released in similar habitats at an adequate distance (miles) outside the study sites to prevent recapture.

### Data Analysis

All data analysis was conducted using the SAS software system (SAS Institute 1987). Relative abundance of each species was compared among forest types using one-way Analysis of Variance (ANOVA) and Student-Newman-Kuels (SNK) mean comparison test. Relative abundance of each species was compared between stream and upslope habitats among forest types, and stations along the trans-riparian gradient among forest types using two-way ANOVA and Student-Newman-Kuels (SNK) mean comparison test. SNK was chosen for its power in declaring significant differences and because it works well with equal sample sizes. The transect by forest type interaction and station by forest type interaction were used to test the transect effect and station effect along the trans-riparian gradient, respectively. Site within forest type was used as an error term when the interaction between transect and forest type (or station and forest type) was insignificant. When the mean square for site within forest type was less than the mean square for transect by site within forest type, the site within forest type error term was dropped and it became a completely randomized design. This procedure allowed us to separate the effects due to differences among forest types and sites from differences between and within transects. When necessary, variables were transformed [ $\log_{10}(x+1)$  and arc sine square-root for percent cover] to correct for non-normality or to obtain homogeneous variances. In some cases transformations were unsuccessful in producing normally distributed variables or homogeneous variables. Comparisons were made among habitats and between transects for each species individually. Results

for some species were not included, because small sample sizes ( $N < 20$ ) made statistical analysis and interpretations tenuous.

## Results

### Abundance and Species Richness

A total of 917 amphibians and reptiles were captured including nine species of amphibians and three species of reptiles (Table 1). Amphibian species richness was greatest in the pole forest type (9 species) and slightly lower in the old-growth forests with six different species. Reptile species richness was greatest in the shrub forest type (3 species) and only one species was found in the other forests types. Species richness was similar in stream (8 amphibian and 3 reptile species) and upslope (9 amphibian and 2 reptile species) habitats with 11 species each (Table 2). Amphibian abundance was highest in the deciduous forest type, intermediate in large sawtimber and old-growth forest types, and lowest in the shrub and pole timber forest types. In contrast, reptile abundance was highest in the shrub forest type. Amphibian abundance was greater in the riparian than upslope habitats, and reptile abundance was greater in upslope habitats (Table 2). The species capture rate was similar between seasons along riparian and upslope transects; there were no significant differences in capture rates between wet and dry seasons for any species.

There was a total of 858 amphibians captured, which included seven salamander and two frog species. The roughskin newt, tailed frog and western red-backed salamander (*Plethodon vehiculum*) together made up 82% of the amphibians and 76% of the total herpetofauna (Table 1).

The roughskin newt was the most abundant salamander in this study representing about 86% of the 350 salamanders captured. It was captured more often ( $P < 0.01$ ) along stream than upslope habitats (Table 2). Along the trans-riparian transects there was more captures at stations close to the stream than further away ( $P < 0.05$ ) (Figure 3). There was progressively fewer captures of roughskin newts from old to younger coniferous forests; however roughskin newts were more abundant in the deciduous forest type than in any of the other forest types (Table 1).

The Pacific giant salamander was captured more often ( $P < 0.05$ ) in the large sawtimber and old-growth

TABLE 1. Frequency of herpetofaunal captures among the five different forest types in the Oregon Coast Ranges, 1989-1990.

Herpetofauna	Forest Type <sup>a</sup>										Total Captures	P <sup>b</sup>
	S (n=3)		P (n=3)		L (n=3)		O (n=3)		D (n=3)			
	X	SE	X	SE	X	SE	X	SE	X	SE		
Amphibians:												
Northwestern salamander	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	1.0	1.0	5	—
Pacific giant salamander	0.3	0.3b	1.3	1.3ab	6.0	1.5a	4.7	2.7ab	1.0	0.0ab	40	0.0424*
Oregon salamander	2.3	0.7	4.3	1.7	4.7	0.9	5.0	2.6	5.7	1.5	66	0.6709*
Dunn's salamander	0.3	0.3	2.0	0.6	2.0	0.6	2.3	1.2	2.0	1.5	26	0.4833*
Red-backed salamander	10.7	4.8ab	6.0	1.5b	12.3	4.5ab	9.7	2.4ab	27.7	6.1a	199	0.0355
Torrent salamander	0.7	0.7	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	4	—
Roughskin newt	1.0	0.6b	7.0	3.6ab	10.7	5.8ab	17.7	11.8ab	64.0	22.5a	301	0.0620*
Tailed frog	1.0	0.6	2.0	1.0	29.7	3.5	25.0	21.6	9.3	5.2	201	0.0573*
Red-legged frog	1.3	1.3	0.3	0.3	0.0	0.0	0.0	0.0	3.7	3.2	16	0.4026*
Subtotals	53		72		197		193		343		858	
Reptiles:												
Northern alligator lizard	14.3	3.8a	1.7	0.9b	0.3	0.3b	0.3	0.3b	0.0	0.0b	50	0.0002*
Northwestern garter snake	1.7	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	—
Common garter snake	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	—
Subtotals	52		5		1		1		0		59	
TOTAL CAPTURES <sup>c</sup>	105		77		198		194		343		917	

\*Variable was Log10 + 1 transformed.

Letters (a and b) are used to distinguish between means with significant differences. Significantly different means will not share the same letter.

<sup>a</sup>S=shrub, P=pole, L=large saw timber, O=oldgrowth, D=deciduous.

<sup>b</sup>2-way ANOVA with site as block and error term to test for stand-type effect. Letters represent specific differences identified by the multiple comparisons test.

<sup>c</sup>Not including non-target species and the specimens which were in too poor condition to identify.

TABLE 2. Frequency of herpetofaunal captures among the stream and upslope transects in five forest types in the Oregon Coast Ranges, 1989-1990.

Herpetofauna	Transect				Total	P <sup>a</sup>
	Stream (n=15)		Upslope (n=15)			
	X	SE	X	SE		
Amphibians:						
Northwestern salamander	0.1	0.1	0.1	0.1	2	—
Tailed frog	6.6	2.3	1.6	0.7	123	0.0033*
Pacific giant salamander	1.0	0.4	0.3	0.2	22	0.1211*
Oregon salamander	0.0	0.0	2.0	0.4	30	0.0003*
Dunn's salamander	1.1	0.3	0.3	0.1	20	0.0355*
Western red-backed salamander	3.2	0.6	3.4	0.9	99	0.6007*
Red-legged frog	0.8	0.6	0.1	0.1	14	0.0828*
Torrent salamander	0.2	0.1	0.1	0.1	4	—
Roughskin newt	7.3	2.6	2.9	1.2	153	0.0041*
Subtotals	305		162		467	
Reptiles:						
Northern alligator lizard	0.3	0.3	1.1	0.6	21	0.0619*
Northwestern garter snake	0.1	0.1	0.0	0.0	1	—
Common garter snake	0.1	0.1	0.1	0.1	3	—
Subtotals	8		17		25	
TOTAL CAPTURES <sup>b</sup>	313		179		492	

\*Variable was Log10 + 1 transformed.

<sup>a</sup>2-way ANOVA with transect by stand condition interaction used to test for transect effect and site by condition used as error term.

<sup>b</sup>Not including non-target species and the specimens which were in too poor condition to identify.

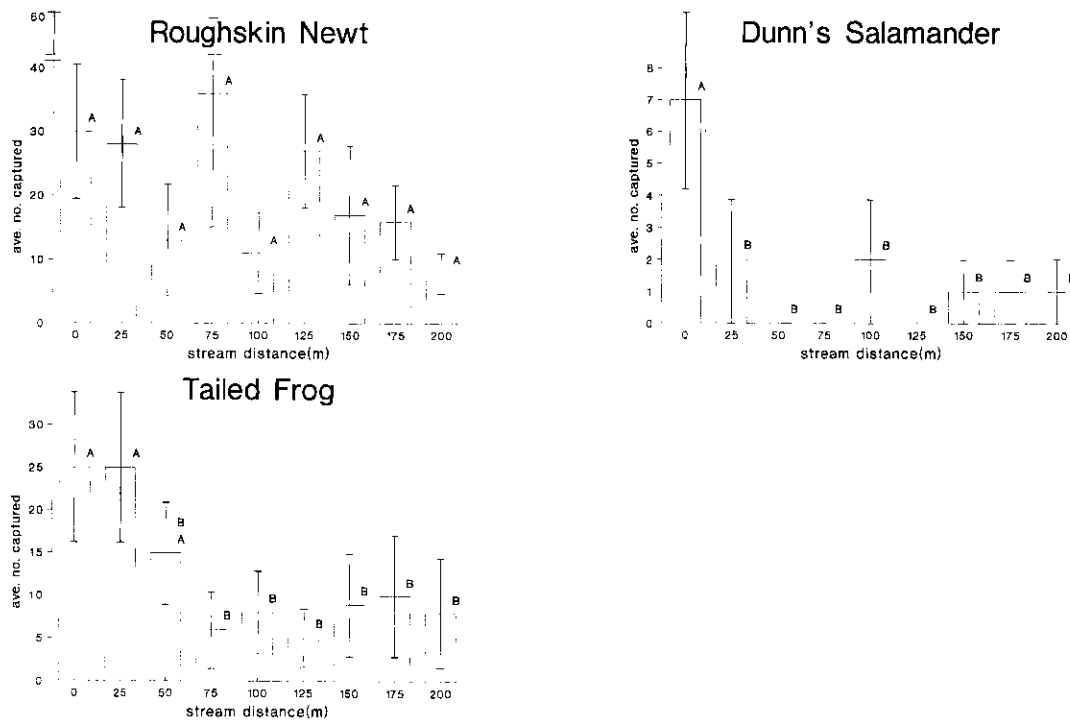


Figure 3. Average number of roughskin newts, Dunn's salamanders, and tailed frogs captured ( $\pm$ standard error) along trans-riparian transects (n=15) in the Oregon Coast Ranges, 1989-90. Letters (A and B) are used to distinguish between means with significant differences. Significantly different means will not share the same letter.

stands than in the other three forest types (Table 1) and was more abundant along the riparian than upslope transects (Table 2).

The Dunn's salamander was more abundant ( $P < 0.05$ ) in riparian than upslope habitats and was more abundant ( $P < 0.05$ ) at stream stations than stations away from the stream along the trans-riparian transects (Figure 3). Dunn's salamanders had a similar capture rate in all the forest types with the exception of the shrub stands where there was only one capture (Table 1).

The western red-backed salamander was more abundant in the deciduous than in the other forest types and least abundant in the pole forest type ( $P < 0.04$ ) (Table 1). It was the most abundant of the Plethodontids and comprised 68% of the total captures for the family.

The Oregon salamander was more abundant ( $P < 0.001$ ) in the upslope than riparian habitats (Table 2). In fact, there were no captures of this species in the riparian habitat in our study.

The tailed frog was more abundant ( $P < 0.01$ ) in the riparian than upslope habitats (Table 2) and was captured more frequently ( $P < 0.001$ ) next to streams compared to upslope habitats (Figure 3). Tailed frogs were found in all forest types in this study; however, it was more abundant in the large sawtimber and old-growth forest types than the other forest types (Table 1).

The red-legged frog was represented only by 16 individuals. It was more abundant in the deciduous stands than the other forest types and had higher captures in the riparian than upslope transects in this study.

There were 59 captures of reptiles, comprised of two snakes and one lizard species. Northern alligator lizards accounted for 85% of the reptiles but only 5% of all the herpetofauna. The northern alligator lizard was more abundant ( $P < 0.001$ ) in the shrub forest type than the other forest types. There were no captures of alligator lizards in the deciduous forests and only one capture in the large sawtimber and old-growth forests (Table 1). The

northern alligator lizard was more abundant in the upslope than stream habitat (Table 2).

## Discussion

### Salamanders

*Dicamptodon* is a genus endemic to moist coniferous forests of the Pacific Northwest, but the degree to which these species depends on aquatic environments is variable among the family (Nussbaum et al. 1983). The Pacific giant salamander depends on streams for breeding, and paedogenic forms require stream habitat for survival. However, transformed adults may be found on the forest floor under woody debris or fully exposed, especially during the rainy season (Nussbaum et al. 1983). In this study, the Pacific giant salamander was significantly more abundant in large sawtimber and old-growth forests than in the other three forest types and was more abundant along the riparian than upslope transects. Only 10 % of the Pacific giant salamanders captured in this study, were in young (< 35 yr.) coniferous forests. Similarly, McComb et al. (1993) captured more Pacific giant salamanders on streamside compared to upslope transects but the differences were not statistically significant. Raphael (1984) and Bury and Corn (1991) also found the Pacific giant salamander to be more abundant in mature coniferous forests than in young coniferous forests. Bury (1983) compared logged and unlogged redwood forests and found Pacific giant salamanders absent from the former. Our results support those of previous studies, and we suggest that changes in microclimate and vegetation for 35 or more years following a clear-cut may make areas unsuitable for Pacific giant salamander populations.

The genus *Taricha* is the only newt genus in western North America, and the roughskin newt is the only species found in the Pacific Northwest. The roughskin newt is the most common salamander in the Pacific Northwest and may be found in numerous habitats including coniferous and hardwood forests, open valleys and farmlands (Nussbaum et al. 1983). In this study, the roughskin newt was captured more often along streams than upslope habitats and there were differences in number of captures at stations along the trans-riparian gradient. McComb et al. (1993) found little difference in capture rate between stream

and upslope habitats of mature coniferous forest for the roughskin newt. These results do not differ from this study: captures of the rough-skinned newt were low in the large saw timber stands with 6 individuals found in both the upslope and riparian transects. Eighty-three percent of roughskin newt captures in upslope and riparian transects were in the deciduous and old-growth stands in this study, although these differences among forest types were not statistically significant. This species may be restricted to low gradient sections of creeks and streams during breeding (Bury and Corn 1991). However, Nussbaum et al. (1983) suggested they may also be found in lakes, ponds, and on land. Similar to this study, Corn and Bury (1990) found roughskin newts more frequently in old-growth than in younger conifer stands, and Raphael (1984) found greater abundance of roughskin newts in mature conifer stands than in younger (<150) and older (>250) conifer forests. The roughskin newt was most abundant in the deciduous forest type in this study and we suggest from our results that it might benefit from management which includes maintenance of some deciduous forests on the Oregon Coast Range.

The Dunn's salamander is a lungless salamander, and it does not require moving water to breed (Nussbaum et al. 1983). It was significantly more abundant in riparian than upslope habitats in this study. The riparian influence was also evident with more captures at stream stations than stations further away from the stream. McComb et al. (1993) also captured more Dunn's salamanders along streamside than upslope transects. The species has been found more associated with aquatic habitats than other members of the *Plethodon* genus (Nussbaum et al. 1983, Bury 1988), and Blaustein et al. (1995) suggested that habitat disturbances that increase substrate temperatures and decrease moisture will be detrimental to Dunn's salamander populations. Our results support their conclusions and we suggest the maintenance of some mature coniferous forests in riparian areas would benefit the Dunn's salamander in managed areas on the Oregon Coast.

Nussbaum et al. (1983) suggested that the preferred habitat of the red-backed salamander is the dryer sections of dense coniferous forests. It was the only other member of the genus *Plethodon* captured in our study. Although it was found equally abundant between stream and upslope

habitats, it was captured in greater numbers in deciduous stands than other forest types. This is another species which might benefit from management that would include retention of some deciduous forests.

The Oregon salamander is a lungless salamander restricted to the coast of the Pacific Northwest and Coastal Northern California (Nussbaum et al. 1983). In this study, it was the only amphibian which was more abundant in the upslope than riparian habitats. Similarly, McComb et al. (1993) captured more Oregon salamanders in the upslope transects than streamside, and Welsh and Lind (1991) found abundances decreased as moisture increased in older forests. Nussbaum et al. (1983) suggested that Oregon salamanders usually preferred forested areas but have been found in clearings in the Pacific Northwest. Raphael (1984) found greater numbers of the Oregon salamanders in older Douglas-fir forests than in younger forest types in Northern California, and Bury (1983) found it more abundant in old-growth forests than in logged stands. The results from our study were similar to their findings; the Oregon salamander was less abundant in the shrub forest type especially in the upland areas.

#### Anurans

There are 6 families, 6 genera and 14 species of anurans which occur in the Pacific Northwest (Nussbaum et al. 1983). In contrast to the higher abundance of tailed frogs that we found in riparian versus upslope habitats, McComb et al. (1993) captured similar numbers of tailed frogs between stream and upslope transects in mature forests. It was found mostly in cooler sections of streams by Nussbaum et al. (1983) and Bury and Corn (1991). It requires permanent drainages often with a dense canopy cover for optimal temperatures (Noble and Putnam 1931, Nussbaum et al. 1983, Bury and Corn 1991). However, tailed frogs (especially the juveniles) have been found at long distances from permanent streams in forested areas (Corn and Bury 1990). Noble and Putnam (1931) found adult tailed frogs at greater distances away from the stream during the wet season and with higher abundances along the stream during dryer times. Noble and Putnam (1931) and Metter (1964) have suggested that habitat loss caused by logging and/or fire has resulted in the disappearance of tailed frogs. Our results support these.

The tailed frog was more abundant in the large sawtimber and old-growth forests than the younger forest types. There were only three individuals captured in the shrub forest type and these were all within 25 m of the stream in this study. Bury (1968) suggested that the effect of timber removal on stream microclimate and tailed frog populations is dependent on the geography of the area. He found tailed frogs in recently logged locations of coastal Humboldt County, CA, where the maritime climate reduces the temperatures of the exposed stream bed. In contrast, we suggest that the maintenance of mature or old-growth coniferous forests will benefit the tailed frog in managed areas on the Oregon Coast.

The red-legged frog is restricted to the Pacific Northwest Coast and the coast of Northern California. Nussbaum et al. (1983) suggested that red-legged frogs may be found in riparian areas of moist forests in the Pacific Northwest. They are dependent on water for breeding; however, adults are semi-aquatic to terrestrial (Nussbaum et al. 1983), and individuals can be found up to 300 m away from standing water. Seventy-five percent of the red-legged frog captures in this study were along streams; however, two individuals were captured 200 m away in the upslope transect. Aubry and Hall (1991) found red-legged frogs more abundant in mature than young forests in the southern Washington Cascades. In contrast, the red-legged frog was most abundant in the deciduous forest type and was not found in the mature coniferous forests in this study. Bury and Corn (1991) suggested that red-legged frogs may prefer creeks and streams with low gradients for breeding and Nussbaum et al. (1983) suggested that breeding sites must have little or no flow. Results from our study suggest that red-legged frogs might be associated with some component of deciduous forests, although the relationship was weak possibly because of a small sample size. Alternatively, we suggest that populations of red-legged frogs might be more dependent on site-specific characteristics such as low stream flow and low abundance of predators, rather than vegetative type. Nussbaum et al. (1983) suggested that declining red-legged frog populations might be attributed, in part, to Bullfrog introductions and they suggested that roughskin newts may be important predators on eggs and larvae of red-legged frogs. Predators such as the Pacific giant salamanders and roughskin newts may have limited red-legged frog

populations in some areas in this study. Further investigation is necessary before conclusions may be made about this species.

### Reptiles

The northern alligator lizard is an endemic species to the Pacific Northwest and Northern California and is the only lizard which occupies the coast of Northern Oregon and Washington (Nussbaum et al. 1983). In this study, the alligator lizard was more abundant in the shrub stands than in all other forest types and in the upslope versus stream transects. Similarly, Raphael (1984) found abundance of alligator lizards decreased with stand age in Douglas-fir forests in Northwestern California. Corn and Bury (1990) found few or no reptiles in young (>40 years), mature and old-growth forest sites in the Pacific Northwest and suggested that the closed canopy and lack of suitable open areas in these forests probably did not provide the necessary habitat requirements for this group. The lack of abundance of reptiles in forest types of our study, with the exception of the shrub forest type, supports their results. However, low snake captures in this study are probably a result of poor catch success for snakes using pitfall traps and the ability of snakes to escape from pitfall traps.

### Riparian Associates

The tailed frog, Dunn's salamander and roughskin newt were significantly more abundant in riparian than upslope habitats and at distances closer to the stream than further away along the trans-riparian transects. These species may be considered riparian associates. In addition, the Pacific giant salamander and red-legged frog were captured more often along the stream transect than upslope and may depend on riparian habitat for at least part of their life requirements. In contrast, the Oregon salamander was significantly more

abundant in the upslope than in the stream habitat.

These results suggest that small riparian systems provide important habitat for tailed frogs, Dunn's salamanders, roughskin newts, and Pacific giant salamanders in the Oregon Coast Ranges. There was a significant decline in captures of the first three species at 50-100 meters away from streams. Consequently, we suggest riparian management zones should be at least 75-100 m on each side of the stream to include features of riparian habitat and the areas of highest abundance of all of these species. Management for upslope/and or old forest associates (e.g., Oregon salamander and the Pacific giant salamander respectively) may be equally as important as for riparian species. It is vital that these systems be considered in management plans which include the protection of at least some of the areas from timber harvest. Many of these herpetofauna species have limited geographic ranges which includes only portions of the Pacific Northwest. Protection of these areas and species is critical. The tailed frog and red-legged frog are considered sensitive species in Oregon by Oregon Department of Fish and Wildlife. The importance of monitoring and maintaining populations of sensitive species is obvious.

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