# NPS Klamath Network: Initial Surveys for Amphibians and Reptiles at Crater Lake National Park 2003

by

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## Introduction

Amphibian declines have been documented throughout western North America and include several species (e.g., Cascades frog and California red-legged frog) in the Klamath region. Status and trends for reptiles are even less well known than for amphibians. For example, the Western pond turtle may also be in decline in parts of the region yet there are no inventories (except for a separate study at Whiskeytown National Recreation Area, California). The bullfrog is a non-native species that is now common throughout the West and this frog may have detrimental effects on native frogs and the Western pond turtle. In many cases, we lack basic information on distribution and abundance of resident species of herpetofauna in units of the National Park Service (NPS). An analysis by the NPS led to an early decision for network parks to conduct aquatic and terrestrial inventories for herpetofuana.

### *Objectives*

(1) To effectively document the herpetofauna in Crater Lake National Park. This will be accomplished by conducting species and habitat-specific surveys for suspected taxa.

(2) To develop distribution and abundance data for species of special concern. We will target species which are suspected to be regionally rare or declining, such as the Cascades frog and the Coastal Tailed frog, or non-native species which may pose a threat to native species, such as the bullfrog.

(3) To document biodiversity in wetland and aquatic habitats of the parks. We will develop standardized methods for sampling these habitats to compare and analyze capture information and biophysical data.

This report covers our brief visits to Crater Lake National Park on August 26-29 and September 24-27 in 2003. This report is a preliminary investigation toward answering the three objectives, when fully funded.

## *Study Area*

Crater Lake National Park is located in Southern Oregon on the crest of the Cascade Range, about 100 miles east of the Pacific Ocean. It encompasses 286 $mi^2$ (741 $km^2$) of relatively high elevation terrain. The lowest point in the park is Red Blanket Canyon at 3,977 ft (1,212 m), located in the southwest corner of the park. The highest point is Mount Scott at 8,929 ft (2,722 m), near the Eastern Boundary. The park contains 90 miles (145 km) of maintained trails and 79 miles (127 km) of road. Besides Crater Lake itself, the park contains numerous streams, springs, and wetlands.

The average precipitation in the park is 69 inches. Snow typically begins to accumulate in October and does not melt in most places until early summer. The average snowfall is 533 inches per year, making it the largest source of water for the park. Although this is a large amount of precipitation, only a fraction of this water is available to plants and animals due to the porous soils and pumice that cover the ground. Average temperatures from January to March are 19° F at night and 36° F during the day. Temperatures from July to September average 40° F at night and 70° F during the day.

Crater Lake National Park contains diverse habitats with elevation, aspect and hydrology playing important roles in determining the suitability of these habitats for herpertofauna. The northeast section of the park is relatively dry because it is located on the east side of the Cascade Divide and is covered with pumice. Not many aquatic habitats exist here because "pumice" desert conditions create a landscape that is open and hot on summer afternoons. The southeast section contains streams that generally originate from springs, including: Wheeler, Sand, Sun, and Annie creeks. These creeks all flow through canyons and some are associated with wet meadows. The southwest section of the park is the wettest part and it contains the most streams, springs, and ponds. Here, the streams are also associated with wet meadows, but are more likely to be located in coniferous forests. Some streams located in this section include: Munson, Trapper, Castle, Dutton, Goodbye, Middle Fork Annie, and Thousand Springs creeks. The northwestern section of the park is drier. This section of the park contains Bybee Creek and the North, Middle and South forks of Copeland Creek. These streams are all associated with wet meadow and coniferous forest habitats.

## *Herpetofaunal Elements*

### *Prior Knowledge*

Earlier, there was a herpetofauanal inventory for Crater Lake National Park (Farner and Kezer 1953). The authors noted that with the exception of introducing fish to the park, the herpetofauna appeared to be unaltered by human influence. This inventory spanned 10 years, and yielded 8 amphibian and 4 reptile species. The amphibians captured were: the Rough-Skinned newt (*Taricha granulosa*), the Northwestern

salamander (*Ambystoma gracile*), the Long-toed salamander (*Ambystoma macrodactylum*), the Oregon ensatina (*Ensatina eschscholtzii oregonensis*), the Coastal Tailed frog (*Ascaphus truei*), the Western toad (*Bufo boreas*), the Pacific treefrog (*Pseudacris regilla*), and the Cascades frog (*Rana cascadae*). The reptiles captured were: the Sagebrush lizard (*Sceloporus graciosus*), the Short-horned lizard (*Phrynosoma douglasii*), the Northern Alligator lizard (*Elgaria coerulea*), and the Northwestern Garter snake (*Thamnophis sirtalis*). Besides adding paved roads and other amenities to the park since this survey, habitats have remained fairly intact.

It could be expected that we should find similar species in our brief inventory of the park. We were also interested in determining if the Southern Torrent salamander (*Rhyacotriton variegatus*) might be present in the park. There are records of them in close proximity to the park in the North Fork of the Umpqua River (Nussbaum et al. 1983; Bury and Gangle, in prep.), but at lower elevations of ca. 2500 feet (760 m).

**Cascades Frog** (*Rana cascadae*).—The Cascades frog is endemic to the Pacific Northwest and is usually found near water in relatively high elevations (Nussbaum et al. 1983; Olson 2005). These frogs are primarily pond breeders, but can also inhabit streams and associated marshes, wet sub-alpine meadows, bogs, fens, small lakes and forested swamps (Leonard et al. 1993; Corkran and Thoms 1996; Olson 2005; Pearl and Adams 2005). Historically, Cascades frogs could be found in the Cascade Mountains from Lassen Volcanic National Park in north-central California north through Oregon and Washington, with a disjunct population in the Olympic Mountains in Washington (Bury 1973). The southern range of the Cascades frog appears to have shrunk substantially

from historical records (Fellers and Drost 1993), while many northern populations show no clear signs of decline (Bury and Adams 2000; Tyler et al. 2002). Currently, the Cascades frog is considered a Species of Special Concern in California (California Department of Fish and Game 1999), and Sensitive-Vulnerable in Oregon (Oregon Natural Heritage Program 1995). The reasons for the decline of the Cascades frog in its southern range are not well understood, but they could include predation and competition from introduced species, UV-B radiation, fungal pathogens, and loss of habitat (Fellers and Drost 1993; Olson 2005).

**American Bullfrog** (*Rana catesbieana*). —This is an invasive species from eastern North America. It was first introduced in the Pacific Northwest for food in the early 1930's, and is now widespread throughout the West (Hayes and Jennings 2005). This frog is the largest North American frog and has been documented eating insects, fish, crayfish, other amphibians, reptiles, small mammals, and birds (Bury and Whelan 1984; Hayes and Jennings 2005). Many biologists believe that the introduction of the bullfrog is causing declines in the native amphibians of the Pacific Northwest. Competition and predation from the bullfrog may be behind the decline of the Western pond turtle and the Spotted frog in some areas (Leonard et al. 1993). Other scientists argue that it is interactions with non-native fish species that are causing the declines in native amphibians (Adams et al. 2003; Hayes and Jennings 2005; Pearl et al. 2005).

**Coastal Tailed Frog** (*Ascaphus truei*). —These unique frogs inhabits cold fast-moving headwaters streams and they are endemic to the Pacific Northwest (Leonard et al. 1993). The Coastal Tailed frog is found from sea level to 5,249 ft (1600 m) in elevation throughout the Cascades, Olympics, and the Coast Ranges, north to southwestern British

Columbia and south to northwestern California (Brown 2005). Large scale declines of this frog have not been documented and consensus by biologists on its sensitivity to disturbance has not been reached (Adams and Pearl 2005). Some studies indicate that the increased sedimentation and warmer water temperatures that occur after logging or road building causes reduction of species abundance (Bury and Corn 1989; Ashton et al. 2006).

**Southern Torrent Salamander** (*Rhyacotriton variegatus*).—This is another family endemic to the Pacific Northwest that is associated with cold headwater streams, usually in late-seral forests from sea level to 3,937 ft (1200 m) (Leonard et al. 1993; Corkran and Thoms 1996; Welsh 2005). This species is often found in disjunct populations (Leonard et al. 1993). The range of the Southern Torrent salamander is in the Coast Range from the Little Nestucca River in Oregon south to Mendocino County in California, with spotty populations extending east in Oregon to the North Umpqua River drainage of the Cascades Mountains (Welsh 2005). The risks to the Southern Torrent salamander are similar to that of the Coastal Tailed frog. Studies have shown that this salamander is negatively impacted by logging and road building activities, probably due to increased water temperature and sedimentation (Corn and Bury 1989; Ashton et al. 2006). An earlier effort was made to list this species under the federal Endangered Species Act due to population declines and habitat loss, but it was found unwarranted at that time (Welsh 2005).

## Methods

We conducted stream surveys in Crater Lake National Park during trips on 26-29 August and 24-27 September 2003. Our surveys were focused on perennial streams. This was done to supplement our earlier terrestrial surveys of the park in 2002. We conducted two types of stream surveys to detect species of stream amphibians present in Crater Lake National Park. First, we identified 40 perennially flowing streams from topographic maps. These streams were then stratified based on elevation. Streams were placed in one of three categories. We randomly selected sites from these three categories: 3 sites were <1500 m in elevation, 14 sites were from 1500-2000 m, and 3 sites were >2000 m. We were only able to survey 13 sites due to time constraints, accessibility and discovery that some of the selected streams were dry on visits. When a site was first encountered it was classified as either a headwater stream, or a large water stream, and the appropriate survey was then conducted.

The focal species of our large water surveys was the Cascades frog. The focal species of our headwaters surveys was the Coastal Tailed frog and the Southern Torrent salamander.

### *Headwater Surveys*

We completed 11 headwaters surveys. Five of these streams were accessible by car, including two sections of Munson Creek, the spring-fed stream located on the Wildflower trail loop, Wheeler Creek and Sun Creek. The remaining 6 headwaters streams are located along the Pacific Crest Trail, and were accessible only by hiking.

These 6 streams include: Middle Fork Copeland Creek, South Fork Copeland Creek, Bybee Creek, Castle Creek tributary, Trapper Creek, and Dutton Creek.

A headwater stream was defined as 0-2$^{nd}$ order, usually cascading, rocky, and 0.5-1.5 m wide. These streams often had full or mostly complete canopy, and were often located at higher elevations and had steep slopes. We used time constrained surveys in headwaters streams. We surveyed 100-m stretches of each stream, incorporating both intensive hand sampling of belts and visual encounter surveys. Three belt surveys were sampled in each stream for 20 minutes each by two surveyors (40 person-minutes each belt). The first belt started at the zero point of the site, the second was conducted at the 50 m point and the third at the 100 m point. In each belt, substrate was removed and dip nets were used to capture any amphibians present. Visual encounter surveys were conducted in between belts.

Data collected in the headwaters included site name and number, date, time of survey, Universal Transverse Mercator (UTM) readings in the Datum of NAD27, a description of site location, weather, water temperature (°C), observers (people doing the survey), and recorder. We recorded habitat information at the 0, 50, and 100 m belts: distance from start (m), stream width (m), maximum depth (cm), percent canopy cover, aspect, gradient of stream (%) measured upstream 50 m with a clinometer, substrate (see Appendix 1) and UTM's along with associated error.

For any animals captured, we collected data on whether it was captured in a stream belt or a visual encounter survey, distance from the start (m), time of collection, species, age, sex, snout-vent-length (cm), total length (cm), leg measurements for Ranid

species (from knee to ankle in cm), weight (g), habitat (L=land, S=seep, R=riffle, P=pool, Z=splash zone, B=bank/soil, C=cascade) and photo number.

We completed a "Site Information Form" for each site. This form was from the NPS Klamath Network and was created to standardize habitat information collected between the different parks. Data recorded on this form included: the four letter code for the park, date, time, SampleRecordID, crew, air temperature (°C), UTM northing and easting and associated error, elevation (m), percent slope, aspect, % SurfaceWater, topography of the site, slope shape, hydrology, ground cover information, a general description of the site, leaf phenology of cover, physiognomic class, and a description of the canopy, subcanopy, shrub and herb strata. Definitions of these fields are provided in Appendix 2. Also, a field map was drawn of each headwater stream survey.

***Large Water Surveys***

We conducted large water surveys at Annie Creek and Thousand Springs, and both are accessible by car. A large water stream was defined as 3rd order or greater, ≥2 m in width, and usually had slower moving water. Large water streams generally had gentle to moderate gradients, were lower in elevation, and had incomplete or no tree canopy. A time constrained method was used to survey large water streams. Two people conducted a visual encounter survey (VES) by walking up the sides of the stream for 1 hour (1 hour x 2 people = 2 person hours), concentrating on shallows and 0.5 m onto the shore. Also, more intensive sampling of specific habitats occurred. Seeps (S), side pools (P), shallows with vegetation (D), and riffles (R) were sampled a maximum of 5 times per type as they were encountered. Seeps were sampled by turning over surface substrate

and searching for animals for a maximum of 10 minutes or until 50% of the area was searched. Side pools were sampled using a dip net and by turning substrate and scanning the shore for a maximum of 10 minutes, or until 50% of the area was searched. Shallows with vegetation were sampled for 2-3 minutes using a dip net sweep. Riffles were sampled 2-3 minutes by turning substrate upstream of a dip net. Time to survey these specific habitats was not included in the 1 hour VES of the site.

Data collected in the large water surveys included the same features as in headwaters (above): site name and number, date, time of survey, UTM readings, site description, weather, water temperature, observers, and recorder. Other habitat information we recorded at the start of the survey (0 min), at the middle of the survey (30 min), and at the end of the survey (1 hr). Data included: distance from start (m), stream width (m), maximum depth (cm), percent canopy cover, aspect, gradient of stream (%) measured upstream 50 m with clinometer, substrate (see Appendix 1) and UTM's along with associated error. Besides recording the time for the first and second half of the visual encounter survey, the time taken to survey any specific habitats encountered along the way were also recorded. The distance from the start of the survey to specific habitat was also recorded and placed on a map drawn for each site.

For any animals captured, we collected data on what type of survey it was captured with (VES, S, P, D, or R), distance from the start (m), time of collection, species, age, sex, snout-vent-length (cm), total length (cm), leg measurements for Ranid species (from knee to ankle in cm), weight (g), habitat (L=land, S=seep, R=riffle, P=pool, Z=splash zone, B=bank/soil, C=cascade) and photo number. Again, a "Site Information Form" from the NPS Klamath Network was completed for each site.

***Opportunistic Records***

The focus for our 2003 surveys in Crater Lake National Park were perennial streams but, on occasion, other aquatic and terrestrial habitats were surveyed opportunistically, including: a sewage pond near park headquarters, Wheeler Creek above the Information Center, and a terrestrial survey at the Pinnacles. These surveys were usually done because someone at the park mentioned they had seen interesting herpetofauna there. Incidentals from regular surveys were also recorded on the opportunistic records data form, which included: site name, date, and surveyors. As animals were encountered, were recorded data on: species, sex, SVL (mm), TL (mm), position, age, and cover object dimensions if possible.

## Results

We sampled a total of 16 sites in Crater Lake National Park in 2003. These surveys yielded 189 captures of herpetofauna. We found 5 species of amphibians, as well as observing an unknown ranid species and unknown salamander larvae (*Ambystoma* or *Taricha*). One species of reptile was also found (Table 1). The most commonly captured animal was the Coastal Tailed frog (Fig. 1).

The catch per unit effort (CPUE) for large water surveys was 0.72 animals per person hour. We captured only 4 individuals using this survey: 3 Pacific treefrogs, and 1 Cascades frog. Captures for large water surveys were only 2.1% of the total captures for the park.

The CPUE for headwaters surveys was 6.7 animals per person hour. We captured 156 animals (Table 2). Coastal Tailed frogs (52.6%) were the greatest proportion of

headwaters captures. Cascades frogs (42.9%) were second. Pacific treefrogs, Long-toed salamanders, and the unknown salamander larvae each were 1.3% of the captures. The unidentified larval Ranid species comprised 0.6% of the captures. Captures for headwaters surveys made up 82.5% of the total captures for the park.

We conducted 3 opportunistic surveys and found 24 animals. These surveys were both aquatic and terrestrial (Table 3). These opportunistic captures made up 12.7% of our total captures in the park. The remaining 2.6% of captures for the park consisted of incidentals.

Microhabitat information was recorded for 146 of the captures of amphibians in large water and headwaters surveys. Species differed on their relative use of various microhabitats (Fig. 2). Different life stages of the same species appeared to prefer distinct microhabitats.

## Discussion

We found many of the species of amphibians in the park that were recorded earlier (Farner and Kezer 1953). We did not capture any Rough-Skinned newts, but we did not survey the lake itself where this species is most common. We also did not capture an Oregon ensatina, which is a terrestrial salamander. Our surveys were almost exclusively aquatic and were conducted in the summer months, so it is not surprising we did not locate an ensatina. The other species on the 1953 list we did not encounter was the Northwestern salamander. This salamander is usually found in pond habitats, which we did not survey.

Our large-water stream surveys did not yield many captures of herpetofauna. We were only able to sample 2 large water streams in 2003, and our lack of captures may have been due to our small number of sites. Another possible reason for the lack of amphibians may have to due to increased competition and predation in larger streams from non-native fishes which inhabit these water bodies. Studies have shown that Cascades frogs may be negatively associated with introduced salmonids (Fellers and Drost 1993; Jennings and Hayes 1994; Bury and Adams 2000). The eastern brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), and german brown trout (*Salvelinus confluentus*) have all been introduced into the streams of Crater Lake National Park.

The Coastal Tailed frog was found to be locally abundant in headwaters accessible by trail. These streams tended to have steep gradients and were often located in forested areas. These frogs can be the dominant herbivore in headwaters streams, and may comprise 90% of the herbivore biomass (Brown 2005).

The sewage pond appears to be an important breeding site for the Western toad and the Pacific treefrog in the park. Long-toed salamanders may also be using this site to breed. Crater Lake National Park does not have many ponds, so this man-made pool may be valuable habitat for some species in the park.

## Recommendations

In the future, we recommend that all types of aquatic habitats are sampled including more ponds and seeps. It is important that seep habitats are sampled more thoroughly to determine whether Southern Torrent salamanders exist in the park. There

are records near the park but at lower elevations on the flanks of the Cascade Mountains (Bury and Gangle in prep). We also recommend that in the spring or fall, surveys for terrestrial salamanders should be done. More stream sites should be sampled as well. All habitats and areas of the park need to be surveyed to detect rare species. In particular, there are few records of reptiles in the park but this may only reflect lack of intensive surveys in drier habitats (e.g., pumice "deserts" around the crater).

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**Figure 1: Percent captures by species for herpetofauna at Crater Lake National Park.**

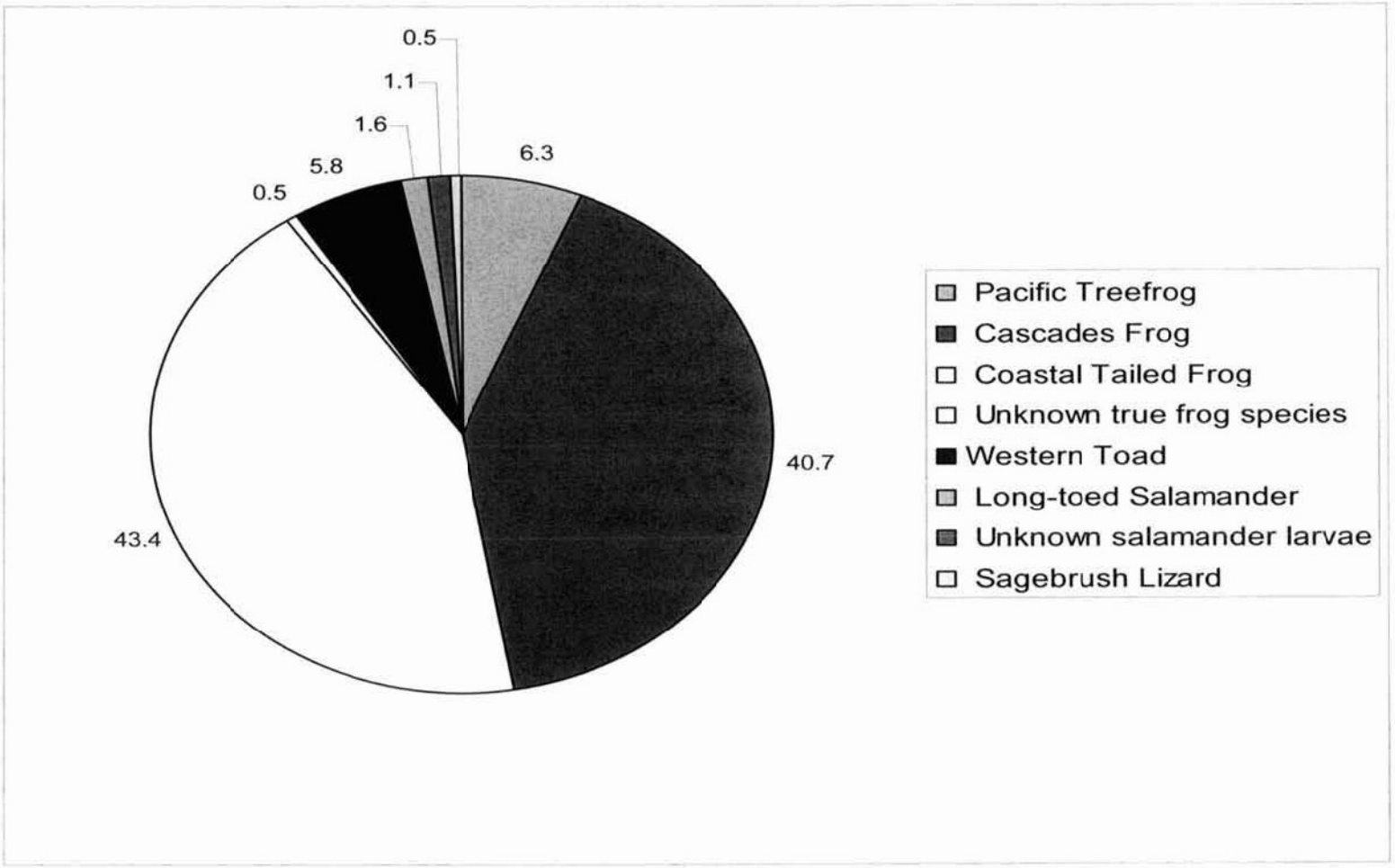
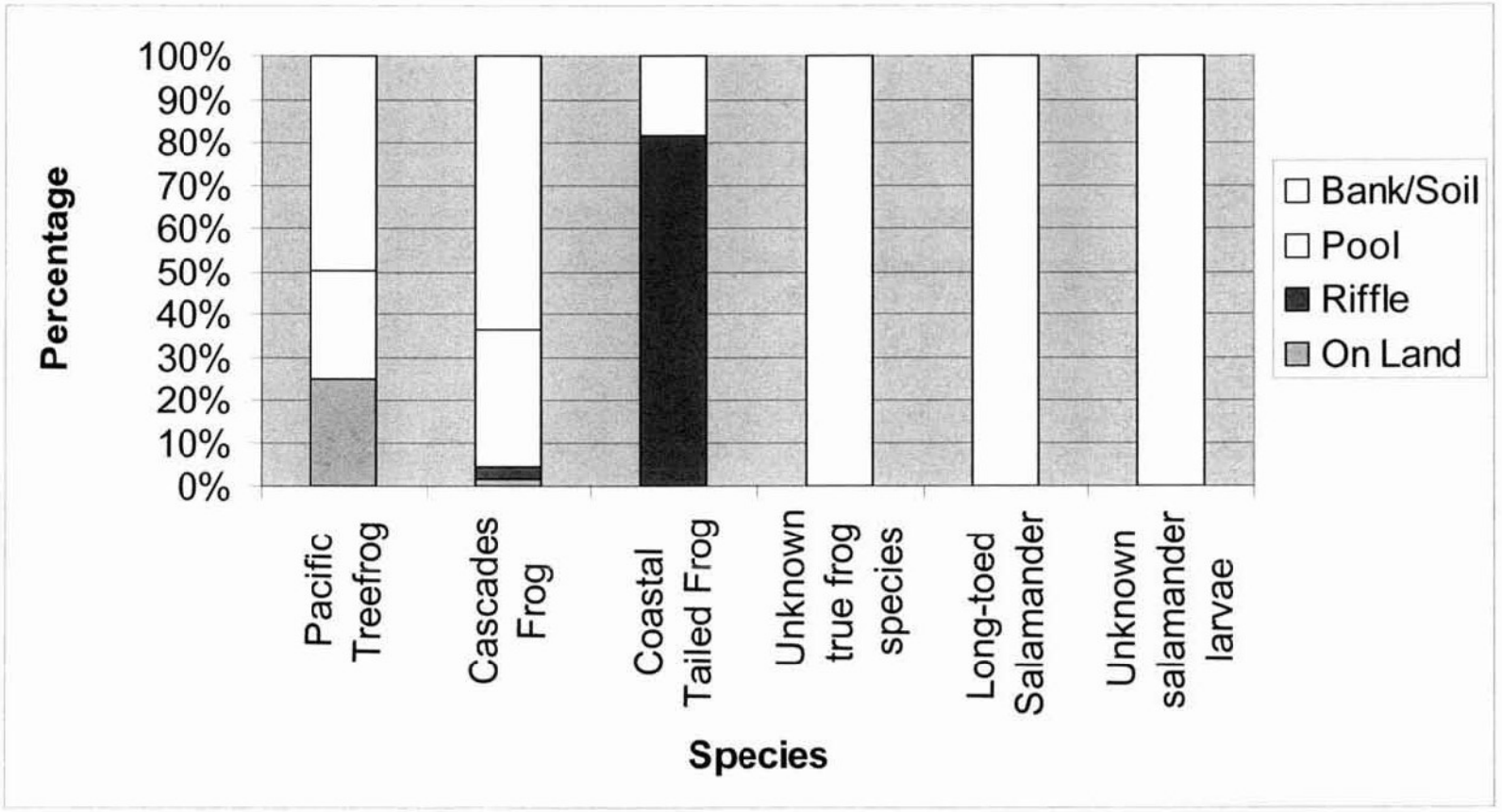


**Figure 2: Microhabitat use by species for herpetofauna at Crater Lake National Park.**



**Appendix 1: Substrate Classification.**

Substrate was visually classified as dominant based on substrate sizes (modified from Platts et al. 1983) [from Lane 1947]). Size classes:

1 = silt
2 = <1 mm
3 = 1-2 mm
4 = 3-4 mm
5 = 5-8 mm
6 = 9-16 mm
7 = 17-32 mm
8 = 33-64 mm
9 = 65-160 mm
10 = 161-256 mm
11 = >256 mm
17 = bedrock bottom.

Nonrock materials are given the following classes:

12 = wood
13 = bark
14 = soil
15 = vegetation
16 = leaf litter

**Appendix 2: Definitions of Fields and Values for Site Information Form (NPS Klamath Network).**

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**Sample Record ID:** Sequential number for each sample site, input format is 9999 (4 numeric characters).

**Crew:** List of Crew involved in sampling this site, first name and last name.

**Percent Slope:** Record percent slope, facing down slope using a clinometer.

**Aspect:** Record aspect in compass degrees facing out from site.

**%Surface Water:** Record the amount of surface water found within sample site.

| | |
|---|---|
| <1% | Site has extremely little or no surface water. |
| 1-5% | Site has very little surface water. |
| 5-25% | Site has surface water but less than ¼ of the site. |
| 25-50% | More than ¼ of site with water but less than half. |
| 50-100% | More than 50% of site has water. |

**Topography of Site:** Topography is the general landform of the survey site, choose one of the values.

| | |
|---|---|
| Level: | The site is level in all directions. |
| Toe Slope: | The site is at the bottom of a hillslope adjoining a valley bottom, usually with a shallower slope than the adjacent hillslope. |
| Lower-Slope: | Site on lower 1/3 of hillslope. |
| Mid-Slope: | Site on middle 1/3 of hillslope. |
| Upper-Slope: | Site on upper 1/3 of hillslope. |
| Escarpment/Face: | Site on vertical area of exposed rock or soil. |
| Ledge: | Flat area adjacent to a dropoff. |
| Crest: | Site at apex of a hill or ridge. |
| Depression: | Site at base of a depressed area which is concave in both directions. |
| Draw: | Site in area which is concave across the slope but straight down the slope. |

**Slope Shape:** General shape of the slope in a x/y axis.

| | |
|---|---|
| ConcaveConcave: | Site is on slope, which is concave, both in across slope and in downslope directions. |
| ConcaveStraight: | Site is on slope, which is concave in across slope and straight in downslope directions. |
| ConcaveConvex: | Site is on slope, which is concave in across slope and convex in downslope directions. |
| StraightStraight: | Site is on slope, which is straight, both in across slope and in downslope directions. |
| ConvexConcave: | Site is on slope, which is convex in across slope and concave in downslope directions. |
| CovexStraight: | Site is on slope, which is convex in across slope and straight in downslope directions. |
| ConvexConvex: | Site is on slope, which is convex, both in across slope and in downslope directions. |

**Hydrology:** Type of surface water found within survey site.

| | |
|---|---|
| Flooded Permanently: | Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. |
| Semi-Permanently: | Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface. |
| Seasonally/Temporary: | Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. |
| Intermittently: | The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. |
| Seep: | Site of low volume groundwater discharge, ponded water may or may not be present. |
| Upland: | Surface water present only during heavy precipitation. |

**Ground Cover:** Assigned to cover classes: **1** (<1%); **2** (1-5%); **3** (5-25%); **4**: (25-50%); and **5** (50-100%). Ground cover summed to 100%. Cover was assigned to one of the following:

BedrockBoulder
HerbsForbs
LeafLitter
GravelCobble
GrassLitter
WoodyDebris
SandSoil
Mosses
BryophyteLichen
Talus
Ferns

**Leaf Phenology for trees and shrubs:** Tree and shrub types based upon the leaves found in overstory.

| | |
|---|---|
| Evergreen: | Trees and shrubs are predominantly plants that maintain their leaves the whole year. |
| Deciduous: | Trees and shrubs that lose their leaves for at least part of the annual cycle. |
| Mixed: | A mixture of both evergreen and deciduous trees and shrubs. |
| None: | No trees or shrubs found within the sample site. |

**Leaf Phenology for herbs:** Herbaceous plant's life cycle length.

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|---|---|
| Annual: | A plant that germinates, grows, reproduces and dies all in one season. |
| Perennial: | A plant that lives for more than one season. |
| Unknown: | Unsure as to whether herbaceous plants are annual or perennial. |

**Physiognomic Class:** Physiognomy of dominant vegetation at site.

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|---|---|
| Forest: | Vegetation predominantly large trees, sub-stories may be present also. |
| Woodland: | Vegetation is a mixture of large trees interspersed with open areas. |
| Sparse Woodland: | Open areas interspersed with a few large trees. |
| Shrubland: | Vegetation predominantly shrubs, large trees absent. |
| Sparse Shrubland: | Open areas interspersed with a few shrubs. |
| Herbaceous: | No trees or shrubs present, herbaceous plants only. |
| Sparse Vegetation: | No trees or shrubs present, few herbaceous plants, mostly bare soil or rock. |
| None: | No plants present, bare soil or rock only. |