

Statistical Analysis

The Fisher's Exact Test was used to test 2 x 2 contingency tables ($\alpha = 0.05$) (Zar 1984) for Western Toads, Spotted Frogs, Long-toed Salamanders, and Pacific Treefrogs, comparing their occurrence with four variables that might affect amphibian distributions. These variables included: (1) the presence or absence of fish, (2) occurrence in non-natural versus natural ponds, (3) ponds at high and low elevation levels and (4) species co-occurring together in ponds. This statistical test was used instead of Chi-square because many of the expected frequencies were less than 5 per cell. We also analyzed the species co-occurrence for just the 43 upper elevation ponds because only one amphibian species was found breeding at 90% of the low elevation riverine ponds (See Appendix F).

RESULTS AND DISCUSSION

Visual inspection of Stebbin's (1985) range maps indicate that 21 species of amphibians and reptiles possibly occur on or around the Craig Mountain area. Out of these 21 species, we found 17 species (7 amphibians, and 10 reptiles) (Table 1). This constitutes 47% of the total number of amphibians and reptiles that occur in Idaho. Three species of amphibian and one species of reptile that occur on CM are listed as Species of Special Concern (Conservation Data Center 1994). A diverse assemblage of vegetation types, and amphibian and reptile species are supported on Craig Mountain because of the wide elevational range in topography.

Distribution

Spatial Distribution

Because of the lack of relative habitat along the steep elevational breaks, amphibians were unevenly distributed with the majority occurring at the upper elevations. Specifically the Spotted Frog and Long-toed Salamander, which mostly occurred at these higher and cooler habitats. (Fig. 5). Arc-View dot-distribution

Salamander, which mostly occurred at these higher and cooler habitats. (Fig. 5). Arc-View dot-distribution maps for the seven amphibian species are shown in Figures 6-12. These maps do not represent complete animal distributions because some areas of CM were not surveyed, but they summarize our current knowledge of distribution of amphibians on Craig Mountain and will be useful for modeling potential distributions.

Long-toed Salamanders (*Ambystoma macrodactylum*) were also found breeding above 4100 ft. (1250 m) in the cooler forest-wet meadow habitat ($P < .05$) (Table 6). They also co-occurred at 95% of these sites with Spotted Frogs (Table 4). Besides breeding in ponds, Long-toed Salamander eggs and larvae were distributed in oxbows and slow moving areas of Captain John Creek and Upper Eagle Creek (near the town of Zaza).

Some amphibian species were more limited in their distribution on CM, such as the Great Basin Spadefoot (*Spea intermontana*). In June 1994, a road-kill adult spadefoot was found along the Salmon River Road. Within the same vicinity along the Salmon River, three Bullfrogs (*Rana catesbiana*) were found in the Peninsula Pond (See Appendix A). One juvenile was found in June 1994, and one adult and juvenile in August 1995. In two heavily shaded streams on Craig Mountain, a population of Tailed-Frogs were found in each stream. One of the frog populations was observed for about a half-mile along Eagle Creek (off Eagle Creek Rd.). The other Tailed Frog population was located in a pristine area on the South Fork of Captain John Creek (off Madden Road).

The Western Toad (*Bufo boreas*) was found to be the amphibian species most diverse in its breeding requirements. Eggs and tadpoles were found in ponds along the Snake and Salmon Rivers, upper elevation ponds, and at Soldiers Meadow Reservoir. Three additional sightings of adult toads were made in 1995 along Maloney Creek, Lower Deer Creek, and Webb Creek. Also in 1995, toad tadpoles were located at the South Section 27 Pond in Lewis County. This is a new county record for Lewis County. The South Section 27 Pond is a productive permanent pond with four breeding amphibian species and two species of garter snake present.

From the 1994 calling surveys, we found that Pacific Treefrogs (*Pseudacris regilla*) occur in many of the wet meadows at the upper elevation habitat. We found eggs and tadpoles only above 3600 ft. (1096 m) but

heard calling treefrogs along the Snake River at 900 ft. (274 m). In 1995, we located 10 new treefrog breeding sites at Benton Meadows and Larabee Meadows. We found no significance for treefrogs preferring the upper elevation habitat compared to the grassland breaks and riverine habitat, but may be due to small sample size.

In 1994, Spotted Frogs (*Rana pretiosa*) were only found breeding in ponds at elevations above 4100 ft (1200 m) (N = 23, P < .05) (Table 6). In late July of 1995, while doing visual encounter surveys, two ponds with Spotted Frog tadpoles were located along the side channel of Limekiln Rapids on the Snake River. One pond had approximately 50 and the other 200 tadpoles, respectively. This sighting was not expected by us, nor predicted by Gap Analysis models. Data, pictures, and voucher specimens of the Snake River tadpoles are located at the Idaho Museum of Natural History at Idaho State University. In creeks, adult Spotted Frogs were found in Lower Deer, Eagle, Captain John, and Maloney Creek. We hypothesize that Spotted Frogs use these creeks for foraging, resting, and dispersing but not breeding because of the lack of appropriate habitat.

Because of the rocky habitat and warm temperatures, the distribution of most reptiles were closely associated with habitat below 2000 ft. (610 m) (Figure 13). Dot-distribution maps for the reptile species are shown on Figures 14-23. Racers (*Coluber constrictor*), and Gopher Snakes (*Pituophis catenifer*) were found up to 4000 ft. (1220 m) on Wapshilla Ridge and down to 800 ft. (610 m) along the rivers. The Western Terrestrial Garter Snake (*Thamnophis elegans*) was found in high elevation ponds and along the Snake and Salmon Rivers. Even though we suspect that Common Garter Snakes (*Thamnophis sirtalis*) occur along both rivers, we only found them at elevations above 3200 ft. (976 m), and closely associated with water. Rubber Boas (*Charina bottae*) were found at elevations ranging from 2440-4200 ft (744-1280 m). We also suspect that they occur along the Snake River on Craig Mountain, because of their presence directly across from Craig Mountain, on the west side of the river (personal communication, Hells Canyon National Recreation Area). In 1994, a Night Snake (*Hypsiglena torquata*) was found along the Salmon River while doing visual encounter surveys. In 1995, we located two more Night Snakes along the Salmon River. These are new records for CM and have expanded the range of this species. These sightings suggest that the Night Snake also occurs in Hells Canyon. A Ringneck Snake (*Diadophis punctatus*) was reported in 1993 by an IDFG biological technician.

The snake was sighted in a grassy talus slope along the Salmon River, but the sighting is unconfirmed. Despite our efforts, we did not locate this species in 1994 or 1995. We speculate that the Ringneck Snake occurs along the Snake River of CM because of the three sightings along on the west side of the Snake River (personal communication, Hells Canyon National Recreation Area). The west side river sightings of both the Rubber Boa and Ringneck Snake occurred at the USFS, Hells Canyon National Recreation Area station along the Oregon and Washington border of the Snake River.

Temporal Distribution

Amphibian species distribution and activity varied with time as wetland habitats changed during the spring and summer. Yearly variation of precipitation also influenced the distribution of amphibians. For example, 1995 was a wetter year than 1994, so water in the ponds remained higher, later into the summer. Usually at the upper elevation, April and May were peak months for locating amphibian egg masses and tadpoles in ponds and wetlands. June and July were peak months to find breeding amphibians at the lower elevation ponds.

Long-toed Salamanders. From what we observed, Long-toed Salamanders were the earliest amphibians to breed, with the majority of eggs being laid between April 1 to May 1 (Figure 24). In the Pullman, Washington area they have been known to breed as early as February (Paul Verrell, pers. comm.). Egg masses were found in Eagle Creek in early June 1994 (water temperature = 16°C). Larvae were found from May through July (Figure 25). Overall, adult Long-toed Salamanders were found from April 3 through May 20.

Western Toads. In 1994, all Western Toad eggs at the upper elevation sites were laid by May 6. In comparison, egg masses were found from June 16 to July 12 in the riverine ponds. In 1995, egg masses at the upper elevation were laid around the same time as 1994, but not along the river ponds. We did not observe toad tadpoles or adults along the Salmon and Snake River until the water level receded in mid-July (Figs. 26 and 27). We noticed in 1995 that within a few days of the river ponds being formed, eggs were laid or adults were observed (Fig. 28).

Pacific Treefrogs. The majority of treefrog egg masses and tadpoles were found in April and May at the upper elevation. We observed no egg masses along the riverine habitat. Adult treefrogs were observed only in April for both years surveyed (Fig. 29). No calling surveys were conducted in 1995, so all of the calling data is for 1994. Treefrogs were heard calling in early April at Benton Meadows both in 1994 and 1995, and in 1994 at Deer Creek and Kruze Meadows (Fig. 30). They were also heard calling in early June 1994 along the Snake River between Captain John and Billy Creek.

Spotted Frogs. Spotted Frogs were also early breeders on Craig Mountain (Figure 31). All egg masses were located in palustrine-type ponds from early April to early May. Adult frogs could be located throughout the spring and summer (Figure 32), and their distribution changed as the summer progressed. In June of 1994, the upper elevation temporary ponds dried up and Spotted Frogs began to concentrate at several of the permanent ponds (e.g., Robert's Spring, Large Frye Point, and Benton Meadows Large Pond). During the 1995 season, most of the temporary ponds remained full throughout June because of the increased precipitation. We observed more temporary "roadside" ponds in spring of 1995 than of 1994, so it is possible that Spotted Frogs were distributed wider on the mountain because of the increased habitat.

Reptiles - Along the lower elevation areas, reptiles could be seen more in late spring and early summer than late summer. As summer temperatures increased along the rivers and grassland breaks, reptiles became harder to locate. In contrast, we could find garter snakes and Rubber Boas in August at the upper elevation riparian areas. The air temperature during the summer in the upper elevation habitat hardly ever reaches above 90° F (34° C), compared to the lower elevation riverine habitat which has been known to reach up to 115° F (46° C) (personal observation).

Relative Abundance

Long-toed Salamanders. Long-toed Salamanders (LTS) were the only salamander located, and were fairly abundant on Craig Mountain. Their abundance was tied to temporary ponds and slow moving creeks at the upper elevation habitat. In 1994, we found LTS breeding in 23 ponds and six sites in two creeks. All but

three adult salamander observations were from pitfall traps in wet meadows. Out of these three, two were found under a coverboard put out in 1993 at the Benton Meadows ponds. The other salamander was found under a log in the water at Benton Meadows Large (BML) Pond. In 1995 while doing terrestrial surveys, IDFG's non-game biologists located 19 adult salamanders between April 13, and May 8. Out of the five adult salamanders observed at the BML Pond, four were located underneath the same coverboard.

During the entire 1995 field season, 29 LTS breeding sites were found on Craig Mountain. Long-toed Salamanders bred in large quantities (>500 egg masses) at Benton Meadows Large Pond. The salamanders laid hundreds of egg masses across the barbed wire that was strung across the width of the pond. The wire increased the surface area for egg attachment. In early June of 1995 at Robert's Spring Pond, a large LTS larvae with legs was caught while dipnetting. Because this larvae was too large to have hatched in 1995, we believe that it overwintered as a larvae.

Western Toads. Adult Western Toads were more abundant along the riverine ponds than at the upper elevation ponds. On June 16, 1994, at the Peninsula Beach Pond along the Snake River, we counted 33 adult toads during peak breeding season. In 1995 at the same pond, it was not until July 23 that we located 15 adult toads during peak breeding. At the upper elevation ponds, we never saw more than five adults at one time.

Pacific Treefrogs. Pacific Treefrogs were locally abundant in the wet meadows at the upper elevation. In 1994, six breeding ponds and three adult treefrogs were observed or heard vocally during pond surveys. In 1995, a total of ten breeding ponds and 16 adults were either seen or heard at ponds. Also, at one unknown roadside pond and three known ponds, treefrog tadpoles were present that were not present in 1994. More temporary ponds were formed in 1995 because of the large amount of precipitation. Our pond surveys at Larabee Meadows and Benton Meadows suggest that treefrogs are locally common in most of the wet meadows on CM.

Spotted Frogs. The the most commonly observed amphibian species on Craig Mountain was the Spotted Frog (Figure 33). This is not to say that Spotted Frogs were the most abundant amphibian, just that we were able to observe more Spotted Frogs. In 1994, over 280 Spotted Frog adults and 23 pond breeding sites

were found at the upper elevation sites. Only adult Spotted Frogs were seen at Captain John, Deer, and Eagle Creek. In 1995, 166 Spotted Frog adults and 25 breeding sites were located. At the Channel Pond at Benton Meadows, the number of Spotted Frog egg masses was significantly less in 1995 than in 1994 (50 and 18 respectively). We cannot conclude whether this decrease was caused from a reduced number of breeding adults or environmental factors.

Reptiles. Racers were the most abundant reptile observed along the lower elevation river habitats, with Western Rattlesnakes being the second most encountered snake (Fig. 34). Western Terrestrial Garter Snakes were the most abundant snake at the higher elevation sites. Most sightings of Western Terrestrial and Common Garter snakes were in or around ponds that had *Carex* surrounding the waters edge. We also saw seven Western Terrestrial Garter Snakes while doing stream surveys along Upper Eagle Creek and South Fork Captain John Creek and along the edges of both the Snake and Salmon River. Three Night Snakes were found along the Salmon River.

Survey Technique Evaluation

The most effective survey technique for finding amphibians and reptiles was terrestrial surveys in appropriate habitat and time (Table 2). Pitfall traps in wet meadows were successful in trapping adult and juvenile Long-toed Salamanders and adult Western Toads and a couple of Spotted Frogs. The 1994 metal flashing drift fences with funnel traps only caught one Racer. This could possibly be due to trapping design. The trap placement in the five habitat types was chosen primarily for small mammals, so suitability for reptiles was questionable. We also had initial problems with trap construction. In June of 1994, two portable drift fences (Night Snake and China Ck arrays) were placed where we thought reptiles would occur, and we succeeded in catching three species of snakes and two juvenile fence lizards. The Night Snake trap array along the Salmon River beach was near a Western Toad breeding pond and caught 10 adult toads as they traveled along the beach. Calling surveys at night were most effective for hearing treefrogs in wet meadows, and night road driving turned up many Western Toads in early spring. It was possible to see adult

Western Toads while doing visual searches around ponds, but timing was critical. Within a year, it was easier to locate adult toads along the rivers than at the upper elevation ponds because of their breeding synchronization with the receding water levels and pond formation. Once the river ponds formed, toads would almost immediately begin to gather. Upper elevation ponds were more variable because there was no environmental cue by which toads would use to begin breeding. The timing from pond to pond was variable, so the chance of observing adults was not as favorable.

Coverboards were a successful technique for finding salamanders and fence lizards, if they are put in appropriate places and allowed to “season” for a year. The extra year may allow a microenvironment to be created underneath the board that new boards do not have. For example, in 1994 we placed two new coverboards at Benton Meadows, but only found salamanders under the 1993 coverboard. In 1995, salamanders were found under the coverboards put out in 1993 and 1994 at Benton Meadows.

Amphibian Habitat Relationships

Wetland Associations

During the 1994-1995 surveys, we located a total of 54 ponds on Craig Mountain (Figure 35). Topographic maps for all of the ponds showing their location and the species breeding are located in Figures 37-51. All of the ponds are above 4100 ft. (1,414 m) except for 13 that are along the Snake and Salmon Rivers. At the South Section 27 Pond and Benton Meadows Large Pond, a pair of ducks were present both summers. The S. Section 27 Pond also had several red-winged blackbirds nesting in the cattails both summers.

We classified the aquatic sites into four wetland types (riverine ponds, meadow ponds, forest ponds and streams) and graphed the number of amphibian breeding sites found for each wetland type (Figure 36). Wet meadows and forest ponds had the most diverse amphibian assemblage, with the four species of pond-dwelling amphibians breeding in them. According to the wetland classification scheme designed by Cowardin et. al., (1979), which recognizes three distinct wetland systems (i.e., palustrine, lacustrine, and riverine), the majority of the ponds were palustrine (Appendix A).

Conductivity, pH and water temperature readings were taken throughout the spring and summer in all ponds. No relationship was found to exist between amphibians choosing breeding sites and the chemical readings or the water temperature, but we noted that these readings increased as the summer progressed and water levels decreased.

Long-toed Salamanders. These salamanders typically chose ponds to breed in that had emergent vegetation or structures to attached their eggs (n=31). Only once in both years of sampling did we observe LTS eggs laid like a string of pearls in the Benton Meadows Channel Pond. We are positive of their identification because we took back several eggs and hatched them. In 1994, Long-toed Salamanders eggs were also found in four oxbows and slow moving areas of Captain John Creek and five areas in Upper Eagle Creek near the ghost town of Zaza. When we found the Eagle Creek eggs in June they were still developing. The water temperature was only 16° C and habitat was shady, with 80-95% canopy coverage. The cool environmental conditions must have slowed down larval development.

Long-toed salamanders were more likely to be found breeding in human-influenced ponds compared to natural ponds ($P < .05$) (Table 7). Natural ponds at the upper elevation habitats, were either associated with wet meadows or are attached to a creek system. These habitats did not have shallow areas and/or emergent vegetation for egg mass attachment.

Tailed Frogs Tailed frogs were found in two mountain streams (Eagle Creek and S. Fork Captain John Creek). These streams were the only streams that had a cobble substrate, high canopy coverage of Grand Fir, and cold running water. We found over 50 adults and over 100 tadpoles in Eagle Creek. We noticed that Tailed frog numbers dwindled when the substrate changed from a predominantly rocky to a substrate to a heavy gray-colored clay with few small cobbles. The South Fork of Captain John Creek also had over 100 tadpoles and over 10 adult frogs. The frog population on this creek ended at a 15 m high waterfall.

Western Toads Western Toads were the most diverse amphibian in their breeding habitat. They were the most abundant amphibian that bred in the lower elevation riverine ponds. Toads were found breeding in a natural pond that is part of a tributary of Deer Creek. Egg masses were also found in the slow

moving oxbows and shallow areas of this same creek (< 15 cm deep). The habitat is a wet, open meadow system with the vegetation mainly consisting of sedges and grasses.

In 1994, egg-masses and tadpoles were found in China Creek Mudhole Pond, a small temporary pond (1 m²), approximately 1/4 mi. from the Salmon River. It was formed when a rut in the road filled with water when a small area of China Creek overflowed. China Creek is a tributary of the Salmon River, so it may provide a corridor for traveling toads. Egg masses were laid on the shallow mud bottom with grass and small sedges bordering the pond. In 1995, we observed no water in this pond (rut).

From our observations, toads were more likely to be found in natural ponds compared to human-influenced and man-made ponds ($P < .05$) (Table 7). This could be attributed the high number of toads breeding at the riverine ponds.

Because of water fluctuations along the Snake and Salmon Rivers, Western Toad eggs were not observed until early June and mid-July. On three occasions between June 16 and July 22, 1994 while surveying the Snake and Salmon River, we found over 20 male toads in four ponds. The males either rested quietly at the water's surface or swam vigorously toward other males. They were giving frequent bird-like twittering calls, which seemed to be in response to nearness or actual touching by another male during the breeding time (Nussbaum, Brodie and Storm 1983). Only once did we observe a pair of toads amplexing at the upper elevation ponds even though we visited these ponds more than the lower ponds.

Pacific Treefrogs We located six treefrog breeding sites in human-influenced ponds and one site in a shallow mudhole near Zaza (Culvert Pond). Adult frogs were difficult to find, but tadpoles were easily found, especially in small ponds. For 1994 and 1995, the Redbird Road Pond had a large population (>1000) of treefrog tadpoles co-occurring with Long-toed Salamanders, and Common and Western Terrestrial Garter Snakes. We found no statistical significance for treefrogs using one type of pond over the other to breed. We did hear over 10 treefrogs calling in wet meadows, but it is unknown whether they were actively breeding or not.

Spotted Frogs Spotted Frogs were found breeding in only palustrine-type ponds. These ponds ranged in diameter from 1-m² to approximately 100-m². Most of the ponds were created by human activities that include development of springs to create ponds, and damming or alteration of streams by roads and culverts (Cassirer 1995). Spotted frogs were not found breeding in ponds that either had no emergent vegetation, were populated with fish, or did not have a shallow shoreline for eggs to develop. Only adults were present in these types of habitats. A *Carex* wet-meadow system did have one egg mass but it was located closest to the road near the culvert where clean water flowed in, and cows did not have access. This meadow is heavily grazed. There is a pond in this meadow but no amphibians were found to be breeding in it. It is abundant with algae and the substrate is dark and muddy, but has the potential of being a productive pond.

In 1994, Spotted frogs were more likely to be found in human-influenced ponds than natural ponds ($P < .05$) (Table 8). In July of 1995, we located two natural ponds in the Limekiln Rapids side channel of the Snake River. Each pond had 100-300 Spotted Frog tadpoles. These two ponds are part of a series of ponds that form when the Snake River recedes, thereby creating a large side channel. As the channel recedes, it leaves ponds dispersed throughout the length. This was a surprising observation because it was not predicted by us or the Gap Analysis models. We considered the elevation too low for Spotted Frogs.

Reptile Habitat Relationships

Craig Mountain is diverse in elevation and habitat, and consequently provides habitat for many species of reptiles. The warmer low elevation habitat (i.e., grassland, columnar basalt cliffs, riparian draws, and hackberry trees) attract certain animals, whereas the upper elevation habitat (coniferous forest complex, wet meadows) attract others. Still, some species occur over the entire range of elevations. For example, with the CM reptiles, fence lizards, rattlesnakes, Night Snakes and a Ringneck Snake were observed only in the lower habitat, in comparison to Common Garter Snakes and Rubber Boas which were observed only at the upper elevation habitat. Interestingly, Racers and Gopher Snakes and Western Terrestrial Garter Snakes

were seen along Wapshilla Ridge at 5000 ft. (1524 m) down to the Snake and Salmon Rivers. Western Skinks could be found along the rivers and on talus slopes in the riparian draws of the grassland breaks around 3200 ft. (976 m). Racers were mostly observed moving in grassland-type habitats.

The individual habitats that the 10 reptile species inhabit also varied. For example, the two lizard species found on Craig Mountain were observed in different habitats. Western Fence Lizards were usually found basking on rocks or pieces of driftwood along the Salmon River beaches. In comparison, Western Skinks were more secretive and frequently found under rocks on talus slopes. A skink was also caught in a 1994 pitfall trap along Madden Creek Road, in a yellow-star thistle and balsamroot habitat.

While visually searching the Salmon River beaches we found three snake species (Night Snake, Gopher Snake and Western Rattlesnake) hiding under driftwood. On a cool, cloudy morning in June 1994 on a Salmon River beach, a Night Snake was found underneath a small piece of driftwood.

In 1995 along the Salmon River, two more Night Snakes were located. One was underneath a piece of driftwood on the beach. The habitat characteristics are the same as the previous sighting in 1994 and approximately 0.5 mile (800 m) from the 1994 sighting. The other Night Snake was caught in the funnel trap along the Salmon River. The drift fence array was located in an annual grassland and basalt talus-slope hills area, approximately 200 ft. (60 m) from the river.

In 1993, a Ringneck Snake was sighted in a rocky, brushy slope along the Salmon River Road, approximately 200 feet from the beach.

For both years of drift fence and funnel trap data in riparian areas along the lower elevation, we caught Racers, Gopher Snake Western Rattlesnakes, and fence lizards. In the drier more open habitat along the rivers we caught Racers, a Night Snake, Western Rattlesnakes, fence lizards, Gopher Snakes, and Western Toads.