

**OCCURRENCE AND HABITAT RELATIONS
OF SENSITIVE AMPHIBIANS AND REPTILES
AT REGIONS WITHIN FOUR STREAM SYSTEMS IN
LOS PADRES NATIONAL FOREST, CALIFORNIA**

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INTRODUCTION

The Los Padres National Forest consists of approximately 1,724,000 acres of mountainous land along the central coast of California (U. S. Department of Agriculture 1984). Within the Forest, there are about 500 miles of streams (U. S. Department of Agriculture 1984) which support relatively rich riparian habitat and fauna. In comparison to other national forests in California, timber harvesting and rangeland usage are low. However, the Los Padres provides approximately 800,000 acre-feet of water per year for agriculture, industry and domestic uses (U. S. Department of Agriculture 1984). In addition, it offers recreational opportunities to more than three million campers, off-road vehicle users, fisherpeople, hikers and bikers each year (U. S. Department of Agriculture 1984). Recently, water usage and recreational activities have been observed to have adverse effects on wildlife species dependent on riparian habitat (Sweet 1991, Sweet 1992, Sweet 1993).

The California red-legged frog (*Rana aurora draytonii*) has been proposed for listing as endangered under the Federal Endangered Species Act (Miller 1994). Because this species requires cool, semi-permanent or permanent water, it is often found associated with deep pools (Hayes and Jennings 1989, Rathbun et al. 1993). These pools are usually bordered by willows and/or emergent vegetation (Jennings 1988, Hayes and Jennings 1989, Jennings and Hayes 1990, Rathbun et al. 1993). In Santa Barbara and Ventura Counties, red-legged frogs are expected to occur in streams, ponds, lakes, and reservoirs throughout the region, with the exception of the Cuyama Valley (Storer 1925, McKeown 1974, Stebbins 1985, Jennings and Hayes in press). However, by the early 1980's red-legged frogs existed only at disjunct locations

within approximately twelve drainage systems in this region (Sweet pers. comm.).

The arroyo toad (*Bufo microscaphus californicus*) has also been proposed for listing as endangered under the Federal Endangered Species Act (U. S. Fish and Wildlife Service 1993). Arroyo toads are found in foothill canyons and intermountain valleys with perennial streams (Sweet 1992). They are often seen associated with open sand or gravel flats near streams, old flood channels, pools with shallow margins, bars connected to shoreline, and near oak woodlands on terraces above the stream or floodplain (Sweet 1992). In the Los Padres National Forest, arroyo toads are known to occur in only four drainages: the Sisquoc River, Sespe Creek, Santa Ynez River, and Piru Creek (Sweet 1991, Sweet 1992).

The southwestern pond turtle (*Clemmys marmorata pallida*) is listed Federally as a Candidate 1 Species (U. S. Department of the Interior 1989). It shares many of the same habitats as the red-legged frog, which are ponds, marshes, rivers, and streams (McKeown 1974, Stebbins 1985). In particular, it favors areas with aquatic vegetation, rocky or muddy substrate, and basking sites (Stebbins 1985). Southwestern pond turtles require a long, wide (0.5 km) corridor of riparian habitat for reproduction (Rathbun et al. 1992) and for overwintering sites (Jennings et al. 1992). In the early 1980's, pond turtles were known to occur in approximately ten drainage systems in Santa Barbara and Ventura Counties (Sweet pers. comm.).

The two-striped garter snake (*Thamnophis hammondi*) is listed Federally as a Candidate 2 Species (U. S. Fish and Wildlife Service 1991). It occurs in coastal drainages throughout southern California and Baja California (Stebbins 1985). *T. hammondi* preys on amphibians and fish, and is usually found in or near permanent water with a border of willows or

other vegetation (Bell and Haglund 1978, Stebbins 1985). In the early 1980's, two-striped garter snakes were known to occur in approximately eleven drainage systems in Santa Barbara and Ventura Counties (Sweet pers. comm.).

OBJECTIVES

The purpose of this study was to determine the presence or absence and relative abundance of sensitive species of amphibians and reptiles at regions within four stream systems in the Los Padres National Forest. At these regions, one or more of the following were previously observed: California red-legged frog, arroyo toad, two-striped garter snake, or southwestern pond turtle. Interest in the conservation of these protected species was enhanced by observations or questions of adverse effects resulting from water use and/or recreational activities in these areas.

In addition to recording the number of individuals of each species observed at each locality, stream habitat data were collected. These data can aid in identifying microhabitats and usage patterns associated with these sensitive species. This information, in turn, may be useful for management of these and similar areas in the Forest.

METHODS

The areas surveyed are shown in Figures 1 through 6. Surveys of a region usually included daylight and night searches. The purpose of the daylight searches was to identify areas which appeared visually to be suitable

for the amphibian and reptile species of concern. In addition, pools were searched for tadpoles visually and with the utilization of a dip net. The type of dip net used varied from an O-ring with a diameter of 33 cm and handle length of 90 cm to small aquarium nets. The net was used to sweep through aquatic vegetation, or was placed in front of a tadpole, and it was flushed into the net using motions of the other hand. Species were identified on site, or if there was any uncertainty a few representative tadpoles were collected alive for species verification by Damien Moloney (Consulting Biologist, University of California, Santa Barbara) or Dr. Samuel Sweet (University of California, Santa Barbara). Daylight searches were also valuable in locating basking southwestern pond turtles and two-striped garter snakes.

During night surveys, observers visually examined the stream and stream banks when searching for the aquatic California red-legged frog, southwestern pond turtle, and two-striped garter snake. The observers walked in the stream and used Koehler Wheat Cap Lights to detect eye shine of frogs and toads. Pond turtles and garter snakes could be seen in or under the water. Since arroyo toads may be found some distance from water on sandy or oak terraces (Sweet 1992), these areas as well as shallow pools and damp areas used for "soaking" were searched. Species identification was confirmed by the author.

Surveys were performed by the author and one or more volunteer observers/data recorders. Data recorded at the beginning of each survey included the date, time, exact locality, air temperature, water temperature, cloud cover and wind speed. Temperature and weather data were updated periodically. Temperature was measured using a PSG hand-held thermometer and the other weather data were estimated. Time and ending point were recorded at the end of the survey.

At the location of each sighting of *R. a. draytonii*, *B. m. californicus*, *C. m. pallida*, or *T. hammondii* additional data were recorded. These data were also taken for sightings of western toads (*Bufo boreas*), bullfrogs (*Rana catesbeiana*), pacific chorus frogs (*Pseudacris regilla*), and California chorus frogs (*P. cadaverina*), unless these were very abundant and then only notes were made in the interest of time management. Location of the sighting was noted on copies of 7.5' topographic maps. The time of the sighting, the species, and the segment number (= elevation) within the stream as described by Sweet (1991) were recorded. The type of survey (day, night or incidental sighting) was noted. For the surveys performed in Mono and Indian Creeks with Damien Moloney, identification numbers given to individuals using passive integrated transponder (PIT) tags (Avid, Norco, California) were recorded. Although capture of the animals was not usually attempted, when they were caught to aid in volunteer training or for PIT tag reading, the sex and the snout-urostyle length in mm was recorded. Otherwise, the size was given as the life stage (adult, juvenile or tadpole). Observations of the animals' activity when sighted were noted. These include the number of individuals of the same species within 30 cm, behavior (resting, moving, or engaged in reproductive or predatory pursuits), whether the animal was directed toward the bank or the water, and where it was in relation to water (on dry land, the bank, the water's edge, or mid-water) . Estimates of habitat parameters in the immediate area and on the banks were recorded. These consisted of dominant vegetation types and height, percent occupied by emergent and submergent vegetation within 0.5 meters of focal animal, average substrate type, flow type (pool, riffle, glide, etc.) and length of section, present stream width, stream width at bank full, maximum water depth within one meter of focal animal, bank angle (with $> 90^{\circ}$ an overhang), and

canopy cover. Special attributes and locational information were recorded in the "notes" section. A copy of a blank data sheet and the key for its use are included in Appendices A and B.

SURVEY RESULTS AND DISCUSSION

Distribution and Abundance

California red-legged frogs were found at Mono and Alder Creeks (Figures 1 and 2, Appendices C and D). Larvae of red-legged frogs were found in Mono and Indian Creeks, but only adults were seen in Alder Creek. Although red-legged frogs occurred in Sespe, Lion, Piru, and Agua Blanca Creeks within the last half of this century (Sanders 1950, Sweet pers. comm.), they were not observed at these localities during the present survey. Arroyo toads were seen at Mono, Indian, Sespe, Piru, and Agua Blanca Creeks (Figures 1, 3, 4, and 5, Appendices C and D). Larvae of arroyo toads were observed at Sespe and Indian Creeks. Newly-metamorphosed toads were seen around the pools that had arroyo toad tadpoles in Indian Creek. In other surveys this summer, arroyo toad tadpoles were seen in Mono Creek by Damien Moloney, and Sespe Creek near Beaver Campground by Clifford Fontenot, Jr. (University of California, Santa Barbara). Southwestern pond turtles were observed in Mono, Agua Blanca, and Piru Creeks (Figures 1, 4, and 5, Appendices C and D). Two-striped garter snakes were seen in all six streams in the four regions (Figures 1 through 5, Appendices C and D).

The introduced bullfrog, *Rana catesbeiana*, was extremely abundant in Piru and Sespe Creeks. Of interest is the fact that this species was not observed in Agua Blanca Creek, a tributary to Piru Creek, nor in Lion and

Piedra Blanca Creeks, tributaries to Sespe Creek. A similar situation occurs in the Santa Ynez River basin. Bullfrogs are known to occur throughout much of the River (pers. observ., Sam Sweet pers. comm.), but are not present in Mono/Indian Creeks and Alder Creek, which are tributaries to the Santa Ynez.

The pacific chorus frog, notoriously abundant and widely-distributed in California (Pickwell 1972), occurred at Mono, Indian, Sespe, Piru, and Alder Creeks. Its relative the California chorus frog was found at Mono, Indian, Sespe, Piru, Agua Blanca, and Alder Creeks. The western toad was observed only at Piru Creek on two separate occasions. A California king snake (*Lampropeltis getulus californiae*) was seen at Lion Campground on Sespe Creek.

Abundance

Because total area surveyed varied between regions surveyed, and because the amount area surveyed per unit time was somewhat dependent on local physical features, the number of sightings of each species may best be expressed as a function of amount of search time.

Table 1. Total number of sightings of sensitive species of amphibians and reptiles by locality at Los Padres National Forest, California. Larvae have been excluded. RLF = California red-legged frog, AT = arroyo toad, PT = southwestern pond turtle, and GS = garter snake.

	RLF	AT	PT	GS
AGUA BLANCA	0	1	5	1
ALDER	9	0	0	1
INDIAN	0	4	0	2
MONO	30	8	1	5
PIRU	0	1	1	1
SESPE	0	6	0	1

Note: three of the arroyo toads seen at Indian Creek were newly metamorphosed individuals which were at the same pool.

The number of hours surveyed is the sum of the actual hours of night searches. Animals seen during the day have been excluded from the following calculations. Surveys performed on September 2 and 19, 1994 at Piru Creek and Agua Blanca Creek respectively were not included in the calculations for arroyo toads because it may have been too late in the year (Sweet, pers. comm.). Values were calculated as follows:

$$X = N/H$$

where X is the number of individual per unit time, N is the number of animals seen, and H is the number of hours.

Table 2. Number of individuals of each species seen per unit effort of night survey time at Los Padres National Forest, California. Larvae have been excluded. RLF = California red-legged frog, AT = arroyo toad, PT = southwestern pond turtle, and GS = garter snake.

	RLF	AT	PT	GS
AGUA BLANCA	0.00	0.00	1.09	0.22
ALDER	2.90	0.00	0.00	0.36
INDIAN	0.00	8.00	0.00	2.00
MONO	3.33	0.89	0.11	0.44
PIRU	0.00	0.43	0.14	0.00
SESPE	0.00	1.77	0.00	0.00

The frequency of California red-legged frog sightings was slightly higher in Mono Creek than in Alder Creek. Moreover, Mono probably has a

greater total number of frogs owing to greater extent of habitat. Indian Creek had the highest frequency of arroyo toads per unit search time, but as mentioned previously this was due to a small group of metamorphs that were easily spotted within ten minutes. Sespe Creek had the next highest frequency of arroyo toad sightings. Southwestern pond turtles were most frequently observed in Aqua Blanca Creek. The highest frequency of garter snake sightings was from Indian Creek, but this was due to the short amount of survey time yielding one individual. Comparisons of the other streams yields the highest frequency of garter snakes in Mono Creek. The only stream to have all four species was Mono Creek.

Habitat Analysis

Selected microhabitat variables are presented graphically (Figures 7 through 27) to show possible animal/environment relationships. The raw data are included (Appendix C), and may be useful to perform further analyses. Some caution is advised in interpreting the habitat data for the following reasons. First, some bias in identifying habitat use patterns may be due to survey technique. For example, because arroyo toads have not often been found in thick brambles and these searches would be potentially labor intensive and destructive, this habitat is not usually searched. Hence the data may falsely show that toads do not occur in brambles. A second caution is that individuals may have been seen utilizing areas which are not optimal, but are those which were the best present at an otherwise not-so-ideal site. This situation would also result from existence of a factor, such as presence of predators, which prevents amphibians from utilizing optimal areas. The small number of localities surveyed would compound this error.

Data were collected on whether California red-legged frogs were facing the bank or the water with the assumption that water orientation may explain a frog's readiness to escape predators on the bank, and search for flying or aquatic prey, while bank orientation may explain search for terrestrial or flying prey. Observations of frogs maintained in the lab and additional field observations have revealed that when potential prey enters a frog's field of vision, it will rotate to face the prey item and wait until it detects additional movement before striking. When alerted to potential danger, red-legged frogs rotate back to face the water prior to jumping in. In the present study, more frogs were seen facing the water than the land (Figure 7), and it is possible some had changed their orientation upon detection of the observers.

Figure 8 shows the position of red-legged frogs within the stream and streambank habitat. Almost all of the frogs were found near shoreline, either at the edge of the water or on the bank. When in these positions, they were often resting within emergent vegetation or in small open areas (Figure 9) which were usually near dense vegetation or large boulders (pers. observ.). These "resting pads" may provide an unobstructed route to water and a view of the immediate surroundings, while the adjacent vegetation helps to conceal them from predators on the bank. Figure 17 also shows a slight correlation with high and moderate canopy cover. Frogs seen in water at the edge may also have the ease of escape and unobstructed vision, or may simply be on their way to bank. I suspect that whether a frog is partially in the water or on the bank may be influenced by water and air temperatures as well. The association of red-legged frogs with mature riparian vegetation is seen in Figure 10, and this is composed mainly of willow (Figure 11). A broad riparian corridor with thick vegetation may provide important refuge during

winter drought and floods. Rathbun et al. (1993) found radio-tagged adult *R. a. draytonii* 26 meters away from water in a dense blackberry/willow thicket in November and December.

Red-legged frogs did not appear to discriminate between substrate sizes (Figure 12). They were found to prefer pool habitats, as opposed to riffles or glides (Figure 13). Because pools greater than 8 meters wide were less frequent than those 2 meters wide (pers. observ.), and because the frequency of sightings was similar for these size ranges (Figure 14), it is likely that red-legged frogs prefer wider pools when available. The same situation occurs for maximum water depth associated with red-legged frogs, where very deep water was uncommon (pers. observ.), but had the same frequency of sightings as shallow water (Figure 15). Since wide pools are likely to be deeper than small pools, and wide deep pools are likely to be colder than small shallow pools, it may be difficult to disentangle the most significant attribute.

Low bank angle was characteristic of sites where California red-legged frogs were observed (Figure 16). However, in winter undercut banks stabilized by willows may be a significant refuge. Red-legged frogs have been observed in small pockets or animal burrows within the bank (Jennings et al. 1992).

Arroyo toads were very rarely observed at the edge of the water soaking (Figure 18). They were usually on the bank or some distance from water. They were never found among any vegetation, with the exception of algae which held moisture after the water had receded (Figure 19). The substrate most often associated with arroyo toad sightings was sand, and they were also often found on cobble or bedrock (Figure 22). Sweet (1992) described the requirement of sand substrate for burrowing.

Two-striped garter snakes were usually seen in the water near shoreline (Figure 23), and in many cases foraging behavior was observed. While in the water, they appear to be selecting shallow areas (Figure 24). Chorus frog and arroyo toad tadpoles are common in shallow areas (Sweet 1992, pers. observ.), and small fish may utilize shallows to escape larger predatory fish.

For future surveys, systematic sampling of habitat parameters should also be done for comparisons between the general nature of the habitat and those areas utilized. At present, variation in habitat selection can be seen by comparing data between species at a given site.

The introduction of bullfrogs in the west has been implicated as a factor contributing to the decline of some species of native amphibians (Moyle 1973, Licht 1974, Bury and Luckenbach 1976, Green 1978). Where bullfrogs are present, native ranids are rare or decreasing (Moyle 1973, Hammerson 1982, Hayes and Jennings 1988, Kupferberg 1992). Whether there are direct effects of bullfrogs on native amphibian populations, or whether habitat alterations and introductions of predatory fishes (which may prefer native amphibian larvae and eggs) have given bullfrogs a selective advantage is unknown (Hayes and Jennings 1986, Jennings 1988).

Twedt (1993) found that the northern red-legged frog (*Rana aurora aurora*) is more terrestrial than the bullfrog, and even though he documented predation of bullfrogs on red-legged frogs, he concluded that differences in habitat use were great enough to alleviate predation effects. However, in the present study, bullfrogs and red-legged frogs were found at the edge of water approximately 53% and 54% of the time, respectively (Figures 8 and 25). Even though bullfrogs were more often found in the water than on the land, and red-legged frogs were found on the bank more often than in the water, I doubt

that these data show enough habitat partitioning to conclude predation effects can be discounted. This is supported by the similarity in the types of vegetation (or lack thereof) at resting sites of bullfrogs and red-legged frogs (Figures 9 and 26). Red-legged frogs were found on open mineral substrate 30% of the time, and bullfrogs 21% of the time. Red-legged frogs were found in open water 18% of the time, and bullfrogs 26% of the time. Bullfrogs were never found in emergent vegetation, which may be the result of drainage-specific differences. Bullfrogs did appear to prefer shallower water than did red-legged frogs (Figures 15 and 27).

RECOMMENDATIONS AND CONSIDERATIONS

Beaver (*Castor canadensis*) dams were observed on Mono Creek from pool 1560 upstream beyond pool 1570. Although some beavers have been known to occur in the Santa Ynez River in the past, this is probably the first time that beavers have been observed in this area (Maeton Freil pers. comm., Samuel Sweet pers. comm.). The creation of large, very deep pools appears to have converted some previously suitable arroyo toad breeding pools to seemingly suitable red-legged frog habitat. Monitoring and possibly control of beaver activity may be needed to protect remaining arroyo toad breeding habitat.

Continuing road closure in the Mono/Indian Creek area during arroyo toad activity periods is recommended. The other road from the east (name unknown) to Ogilvy Ranch appeared in much better condition than Ogilvy Ranch Road, and maintenance of this road for access to Ogilvy Ranch may be economically and ecologically preferred.

Arroyo toads and tadpoles were seen in the main swimming hole of Lion Campground on Sespe Creek. Arroyo toads and scat were also seen near the trail crossing, and areas frequented by bathers and fisherpeople. The part of the campground closest to the stream was closed for vehicular traffic, but camping continued on a walk-in basis. Although I recall in winter seeing signs describing the sensitive nature of the area, I did not notice any in the summer. As I remember, the signs were ambiguous and fishermen questioned me as to their meaning. From my short visit to this site, it appeared likely that recreational use may directly or indirectly negatively impact the resident arroyo toad population. If total campground closure is not put into effect, it is recommended that efforts be made to divert recreational activity away from biologically productive sites near the campground. Posting of signs may do little without enforcement, and they may also increase collecting or disturbing of arroyo toads.

There is a diversion flume from Alder Creek to Jameson Lake. At the time of the survey, the diversion pipe had moderately flowing water, approximately 1 1/2 feet wide and 2 inches deep. The stream is perennial near intake. Areas immediately downstream did not appear to experience large effects of this degree of flow reduction. The stream begins to flow underground when the stream leaves the canyon and the gradient becomes lower, and resurfaces in a few pools near the reservoir. If the water level of these pools is directly influenced by groundwater level, and if the reservoir is also at the same level, the diversion may not significantly effect this area. At the time of the survey, there was a locked gate below Jameson Lake. I recommend that recreational use remain restricted throughout much of the year.

Water releases throughout the summer from Pyramid Lake may be contributing to overgrowth of riparian vegetation and a subsequent decrease in arroyo toad habitat along Piru Creek (Sweet 1991). It is unknown to the author if there were large water releases during the 1994 amphibian breeding season as had occurred in previous years (Sweet 1991), but conspicuously absent were bullfrog and chorus frog tadpoles. Blue Point Campground remained closed this summer, and because I observed an arroyo toad in the road crossing to the campground, it is probably wise to continue closure during arroyo toad activity periods. In the area of Piru Creek near Frenchman's Flat, recreational usage has visibly had an effect. Most conspicuous is trash, which is literally everywhere. Of note was the discovery of an apparent chicken sacrifice. In addition, trails and "campsites" along the stream banks are completely devoid of vegetation. In an area that may be experiencing overgrowth of vegetation due to water releases, human trampling may be maintaining some open sites beside the stream.

Agua Blanca Creek had California red-legged frogs within recent years (Sweet pers. comm.). Because none were found during a survey of previously known sites, there may be cause for concern. No bullfrogs were observed, and no large disturbances were evident. I recommend that this area be resurveyed in the spring of 1995 to address the status of this population.

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Figure 1. Map of Mono and Indian Creeks, Los Padres National Forest, California showing areas surveyed for amphibians and reptiles in summer 1994. The area of the streams between [] was surveyed after dark on June 23-24, with emphasis on expected arroyo toad sites. The area between < > was surveyed during the daytime on June 28 for tadpoles. The area between { } was surveyed on June 30-July 1, and both arroyo toad and red-legged frog habitats were searched. The area between () was visited during the day on July 10 to evaluate habitat condition. Arrows in red indicate locations of sightings, where RLF = California red-legged frog (*Rana aurora draytonii*), AT = arroyo toad (*Bufo microscaphus californicus*), PT = southwestern pond turtle (*Clemmys marmorata pallida*), and GS = two-striped garter snake (*Thamnophis hammondi*).

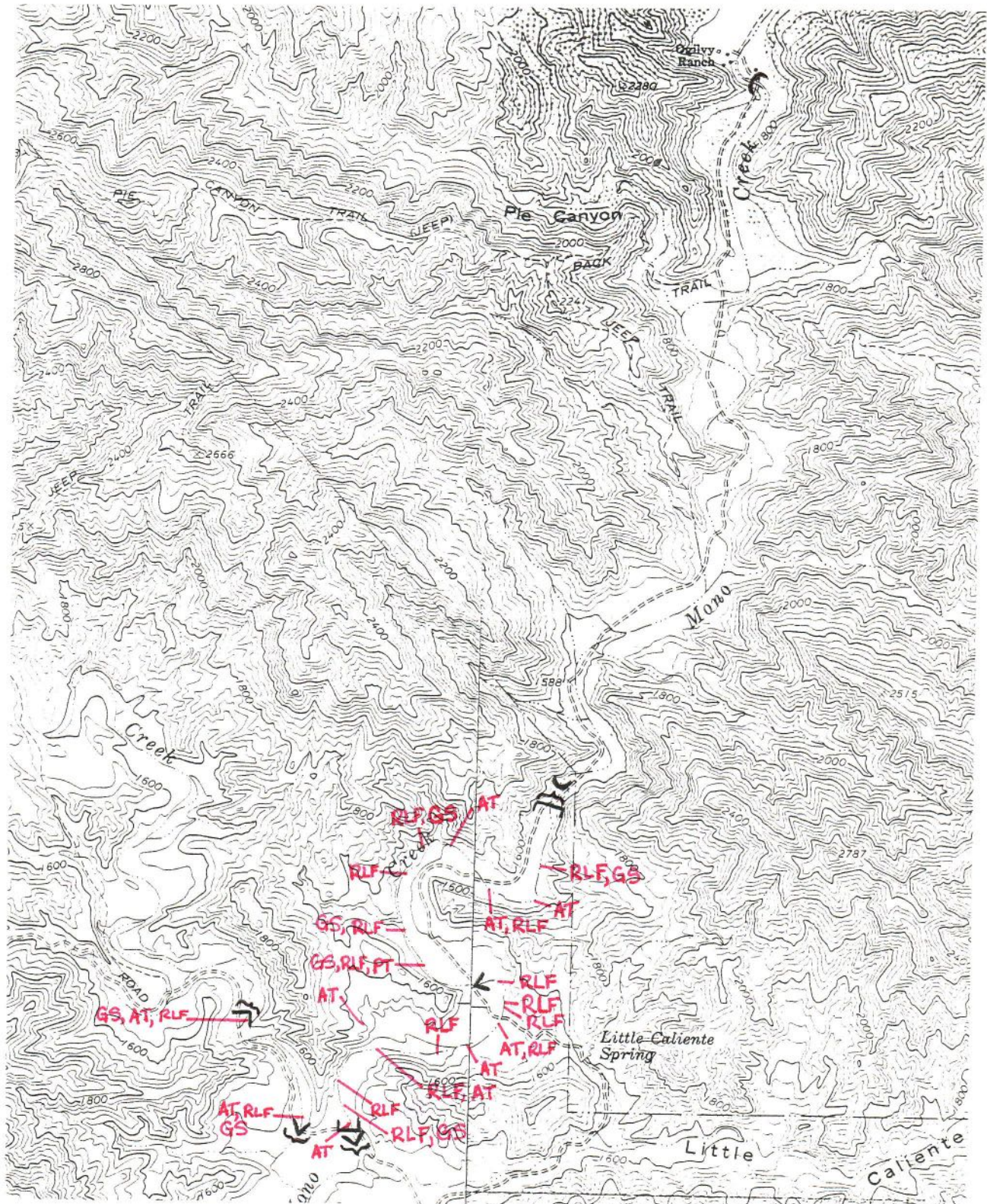


Figure 2. Map of Alder Creek, Los Padres National Forest, California showing areas surveyed for amphibians and reptiles in summer 1994. The area of the stream between [] was surveyed during the daytime and nighttime on August 22-23, with emphasis on expected red-legged frog sites. Arrows in red indicate locations of sightings, where RLF = California red-legged frog (*Rana aurora draytonii*), and GS = two-striped garter snake (*Thamnophis hammondi*).

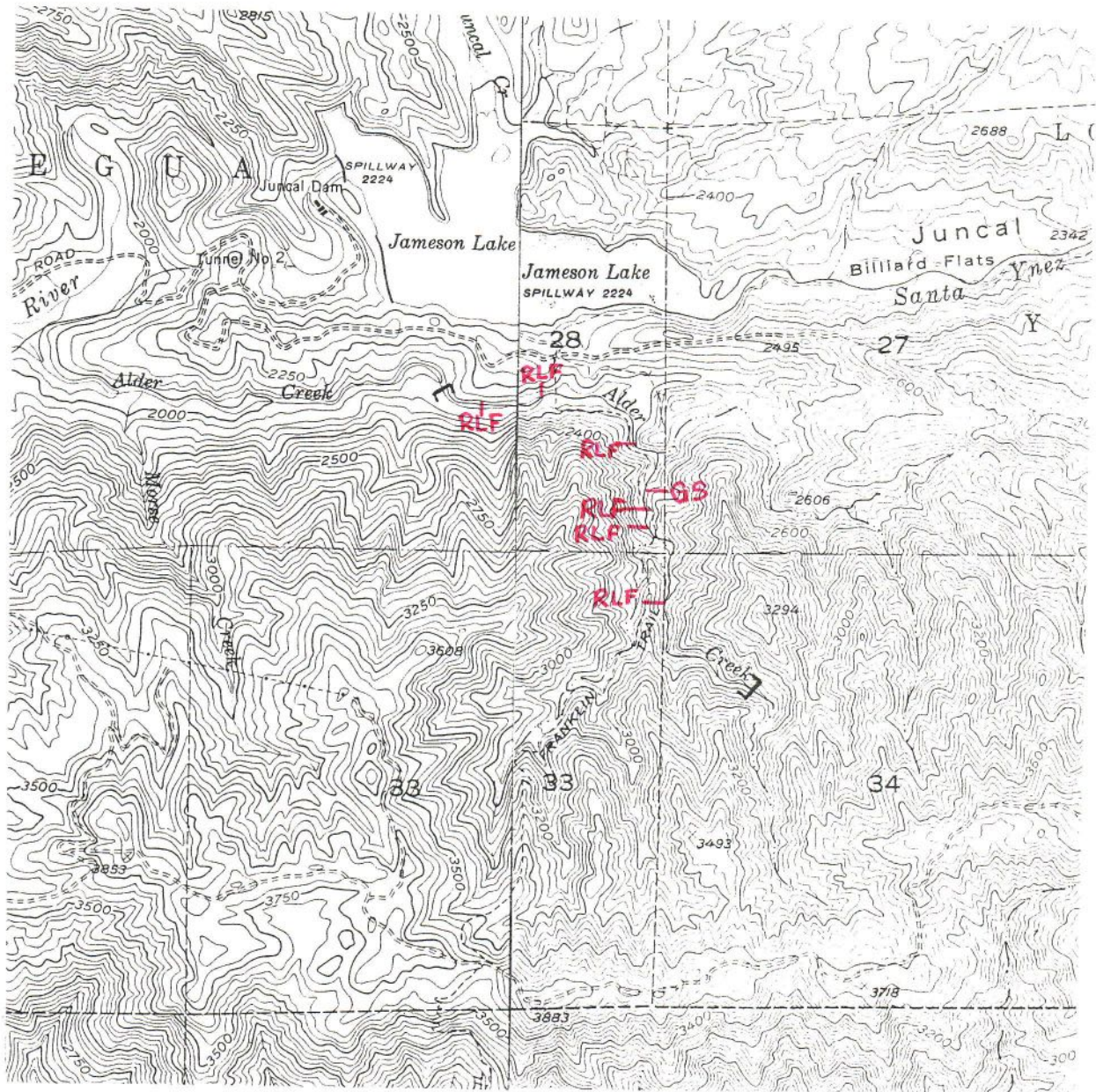


Figure 3. Map of Sespe and Lion Creeks, Los Padres National Forest, California showing areas surveyed for amphibians and reptiles in summer 1994. The area of the stream between [] was surveyed during the daytime and nighttime on June 25-26, and both arroyo toad and red-legged frog habitats were searched. Arrows in red indicate locations of sightings, where AT = arroyo toad (*Bufo microscaphus californicus*), and GS = two-striped garter snake (*Thamnophis hammondi*).

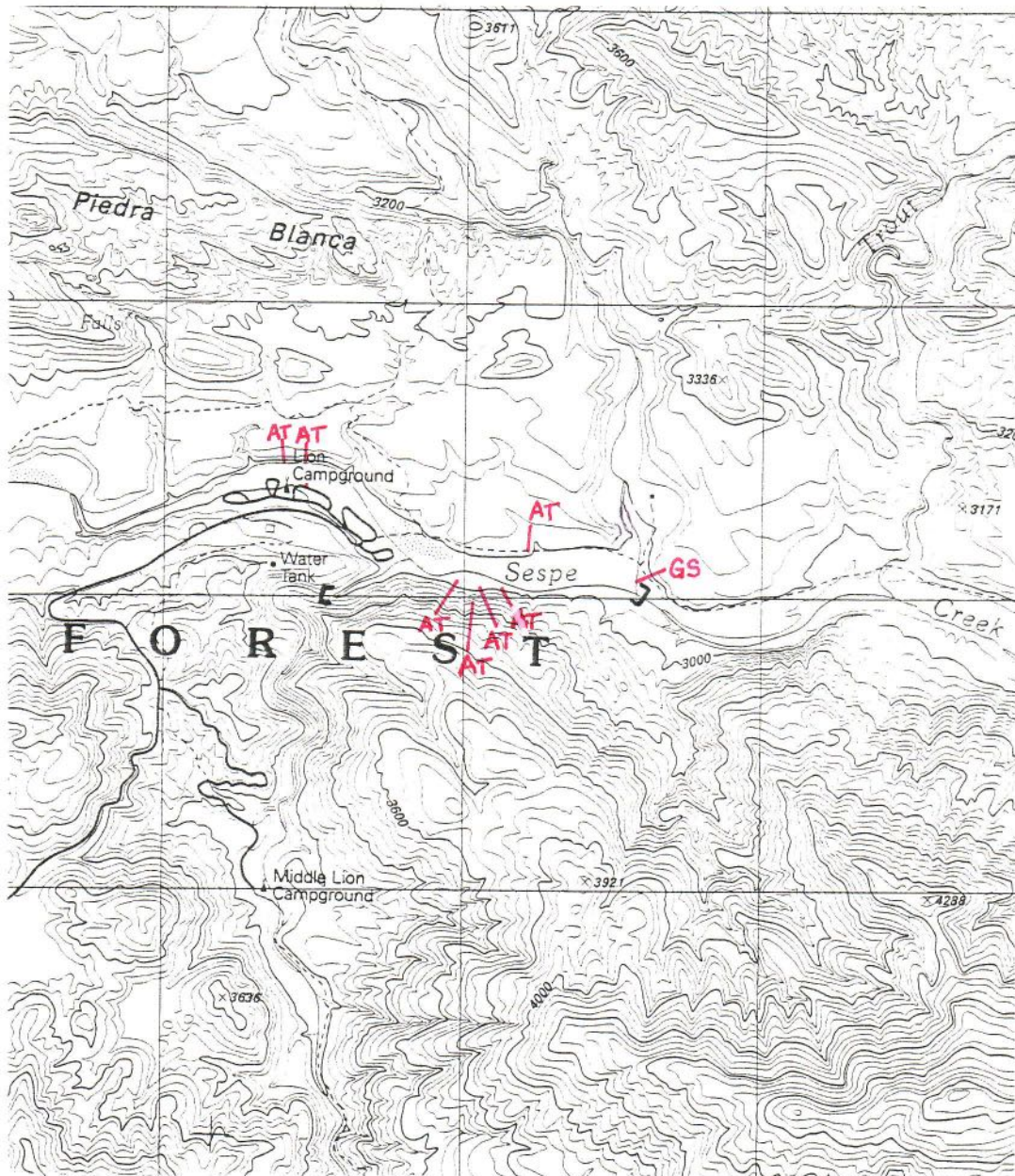


Figure 4. Map of Piru Creek, Los Padres National Forest, California showing areas surveyed for amphibians and reptiles in summer 1994. The area of the stream between [] was surveyed during the daytime and nighttime on August 3-4, with emphasis on expected red-legged frog sites. The area between < > was surveyed on September 2-3 after dark, with emphasis on expected arroyo toad sites. Arrows in red indicate locations of sightings, where AT = arroyo toad (*Bufo microscaphus californicus*), PT = southwestern pond turtle (*Clemmys marmorata pallida*), and GS = two-striped garter snake (*Thamnophis hammondi*).

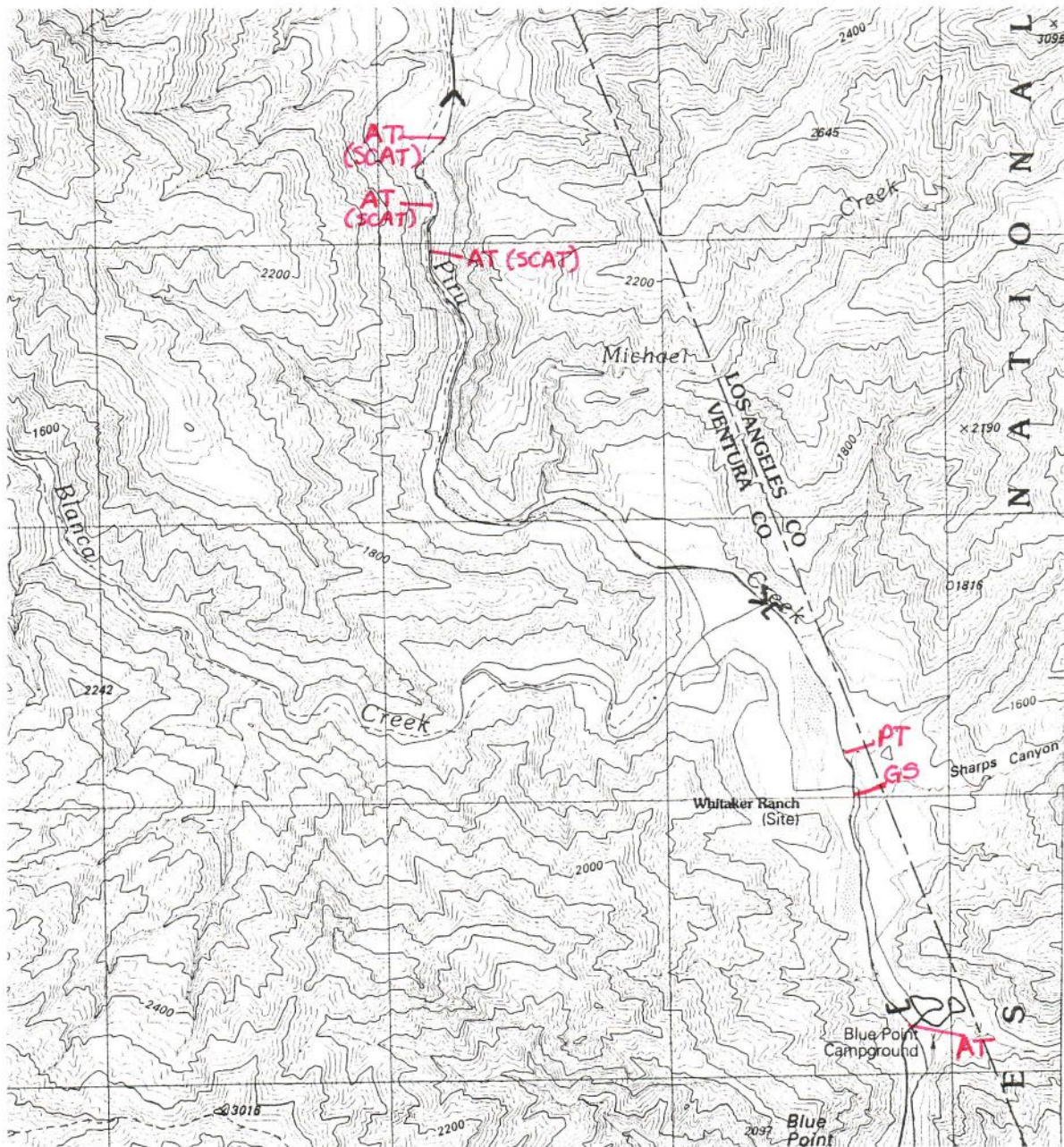
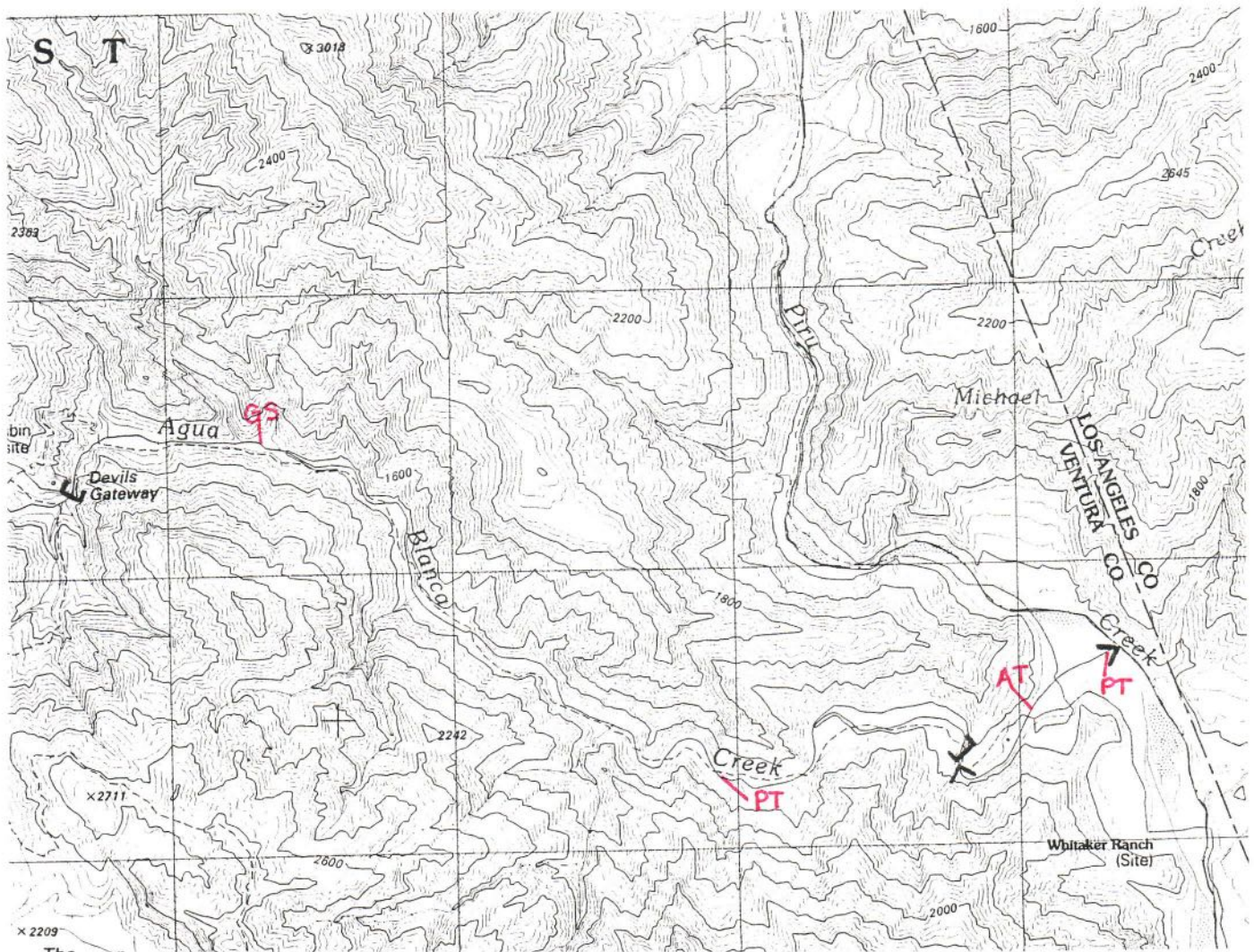


Figure 5. Map of Agua Blanca Creek, Los Padres National Forest, California showing areas surveyed for amphibians and reptiles in summer 1994. The area of the stream between [] was surveyed after dark on September 19-20, with emphasis on expected red-legged frog sites. The area between < > was surveyed on August 3-4 during the daytime and nighttime, with emphasis on expected red-legged frog sites. Arrows in red indicate locations of sightings, where AT = arroyo toad (*Bufo microscaphus californicus*), PT = southwestern pond turtle (*Clemmys marmorata pallida*), and GS = two-striped garter snake (*Thamnophis hammondi*).



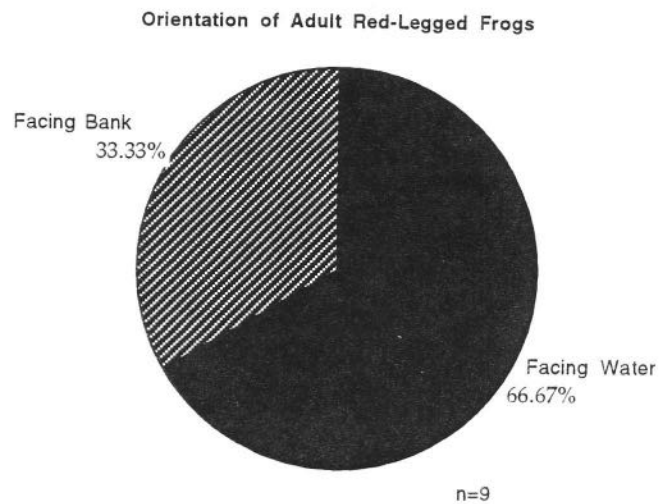


Figure 7. Orientation to water or bank of adult California red-legged frogs seen in summer 1994 surveys in Los Padres National Forest, California.

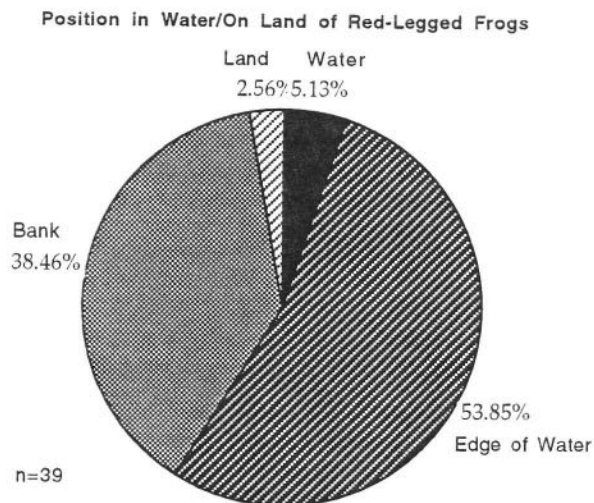


Figure 8. Position of adult and juvenile California red-legged frogs within stream and streambank habitat from summer 1994 surveys in Los Padres National Forest, California. A "land" or "water" observation indicates > 30 cm from the edge of water. "Bank" indicates out of water within 30 cm of the shoreline, and "Edge of Water" indicates in water within 30 of shoreline.

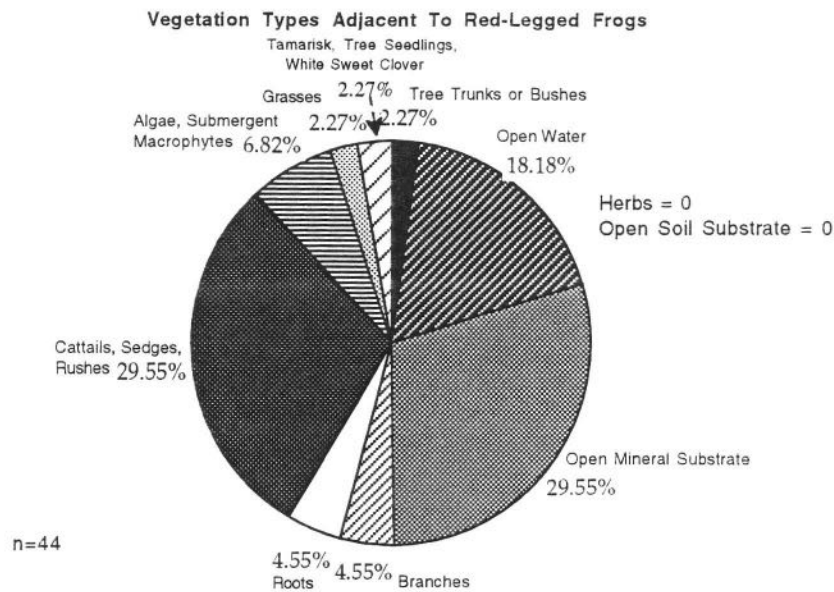


Figure 9. Dominant type of vegetation or lack thereof in the immediate vicinity of adult and juvenile California red-legged frogs seen in summer 1994 surveys in Los Padres National Forest, California.

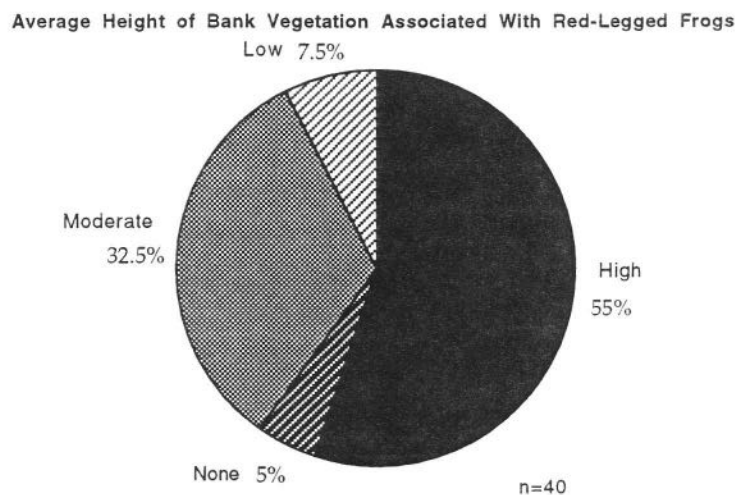


Figure 10. Average height of bank vegetation estimated along a visual transect perpendicular to the stream channel and 10 meters long originating at sighting point of adult and juvenile California red-legged frogs, from summer 1994 surveys in Los Padres National Forest, California.

Dominant Bank Vegetation Associated With Red-Legged Frogs

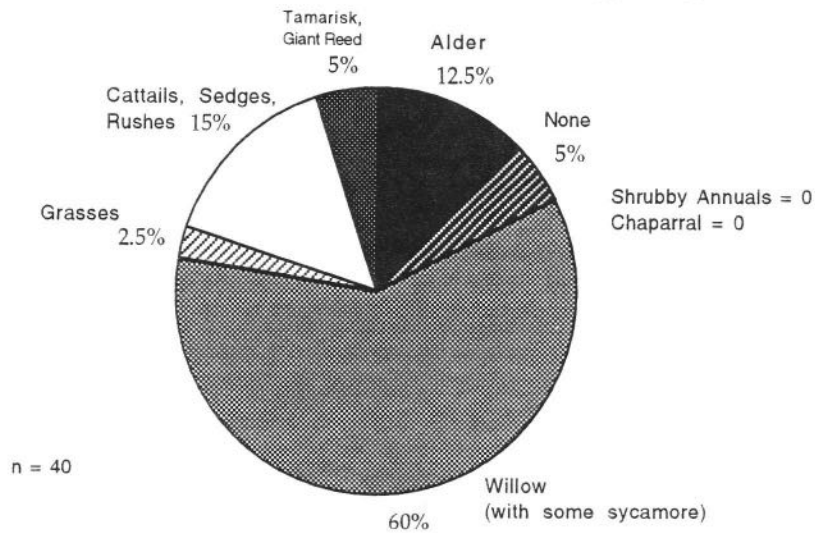


Figure 11. Dominant types of vegetation along a visual transect perpendicular to the stream channel and 10 meters long originating at sighting point of adult and juvenile California red-legged frogs, from summer 1994 surveys in Los Padres National Forest, California.

Substrate Types Associated With Adult Red-Legged Frogs

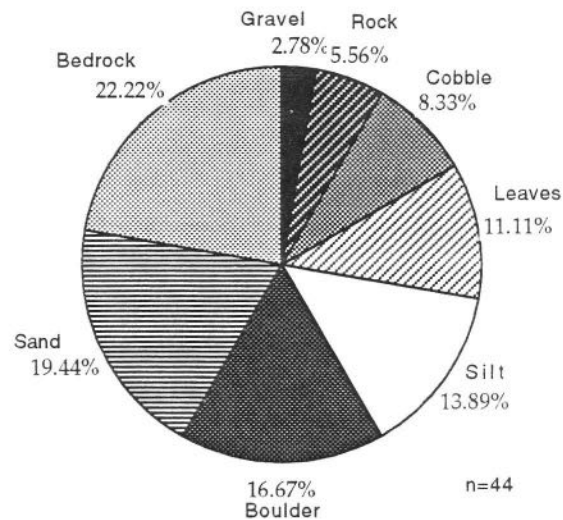


Figure 12. Dominant category of substrate in the immediate vicinity of adult California red-legged frogs sightings from summer 1994 surveys in Los Padres National Forest, California. Categories are as follows: Silt < 1mm, sand 1 - 5 mm, gravel 5 - 70 mm, cobble 7 - 30 cm, rock 30 - 60 cm, boulders > 60 cm.

Characteristics of Stream Flow at Red-Legged Frog Sightings

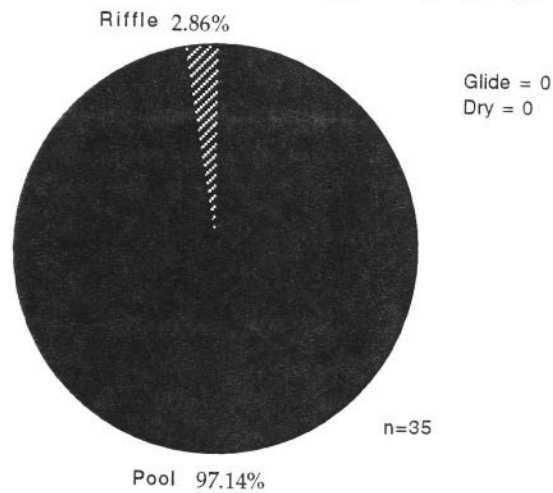


Figure 13. Type of stream flow at adult and juvenile California red-legged frog sightings from summer 1994 surveys in Los Padres National Forest, California.

Stream Width at Sightings of Adult Red-Legged Frogs

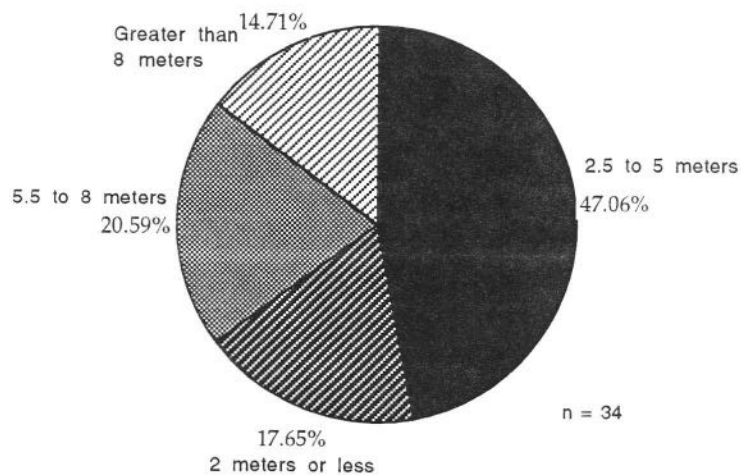


Figure 14. Estimated stream width at adult and juvenile California red-legged frog sightings from summer 1994 surveys in Los Padres National Forest, California.

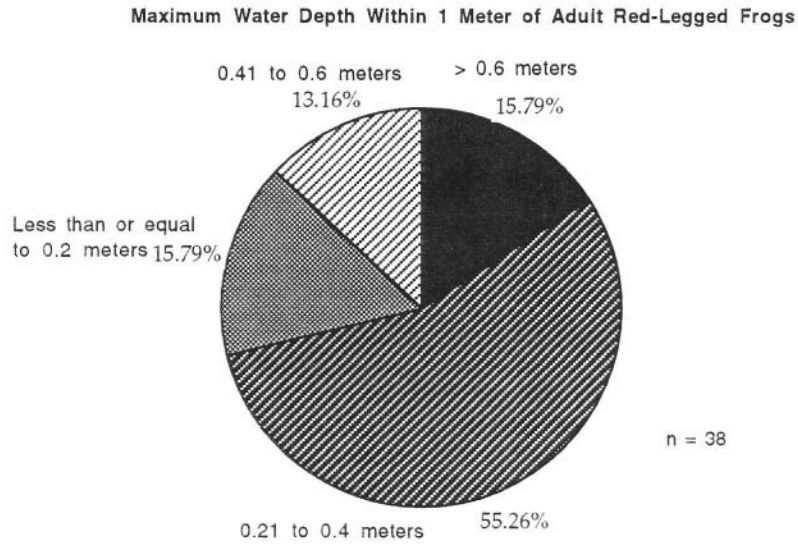


Figure 15. Maximum water depth within one meter of sightings of adult California red-legged frogs from summer 1994 surveys in Los Padres National Forest, California.

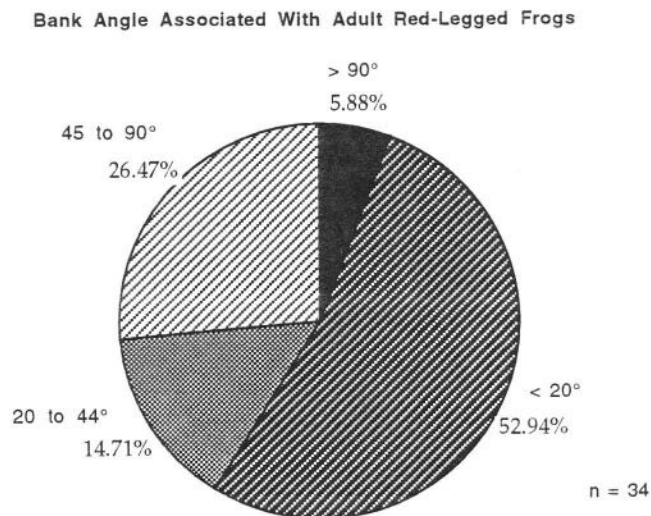


Figure 16. Estimates of bank angle at adult and juvenile California red-legged frog sightings from summer 1994 surveys in Los Padres National Forest, California. Greater than 90° is an overhang.

Canopy Cover At Sightings of Adult Red-Legged Frogs

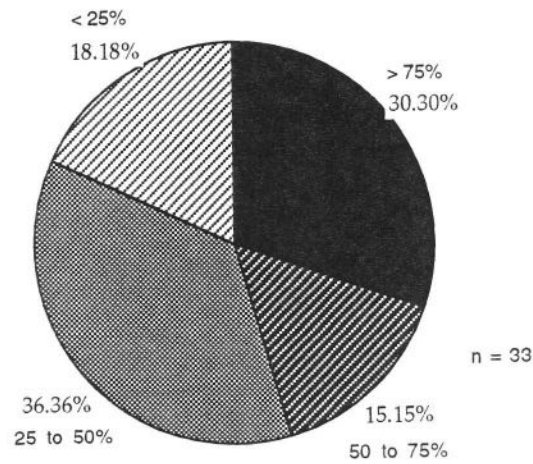


Figure 17. Estimated canopy cover at adult and juvenile California red-legged frog sightings from summer 1994 surveys in Los Padres National Forest, California.

Position In Water/On Land of Arroyo Toads

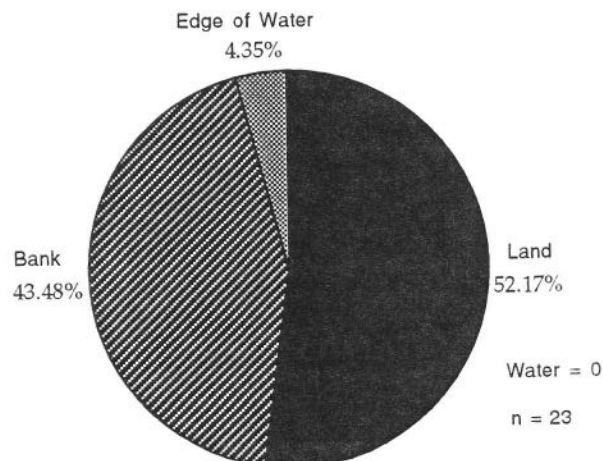


Figure 18. Position of adult and juvenile arroyo toads within stream and streambank habitat from summer 1994 surveys in Los Padres National Forest, California. A "land" or "water" observation indicates > 30 cm from the edge of water. "Bank" indicates out of water within 30 cm of the shoreline, and "Edge of Water" indicates in water within 30 of shoreline.

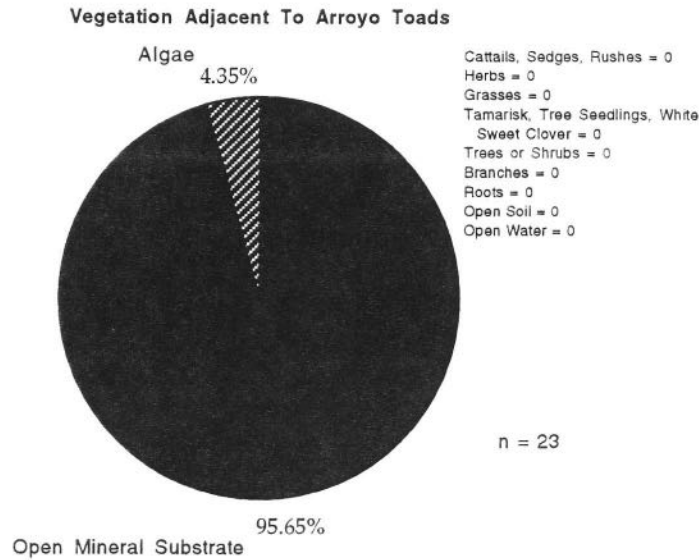


Figure 19. Dominant type of vegetation or lack thereof in the immediate vicinity of adult and juvenile arroyo toads seen in summer 1994 surveys in Los Padres National Forest, California.

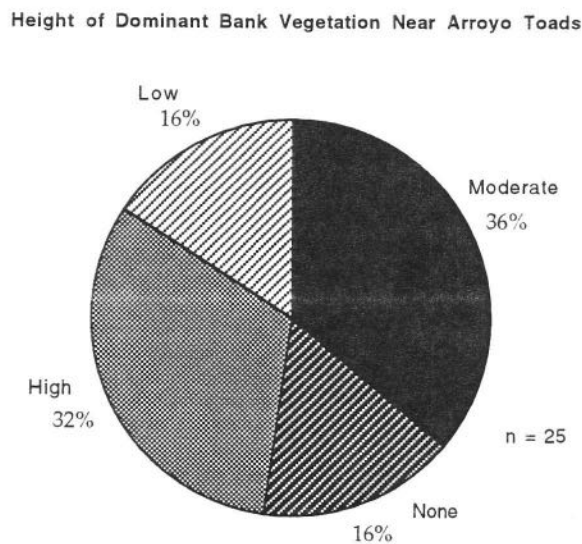


Figure 20. Average height of bank vegetation estimated along a visual transect perpendicular to the stream channel and 10 meters long originating at sighting point of adult and juvenile arroyo toads, from summer 1994 surveys in Los Padres National Forest, California.

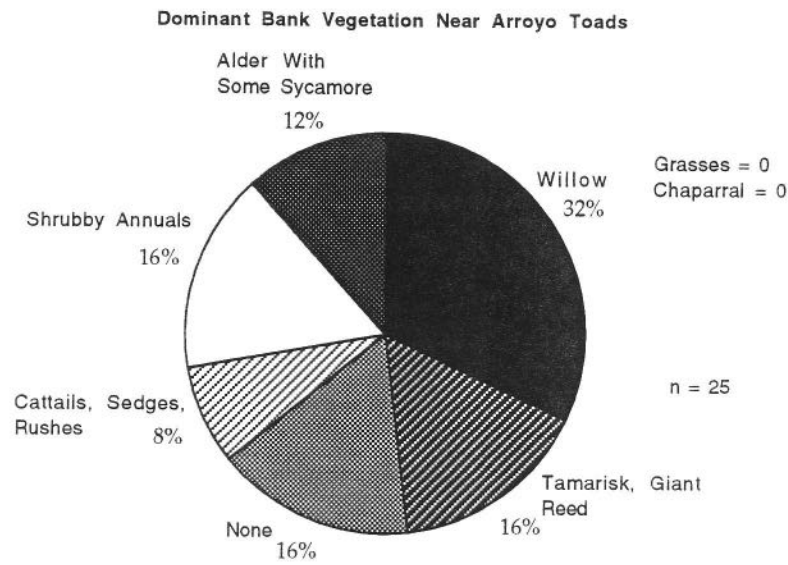


Figure 21. Dominant types of vegetation along a visual transect perpendicular to the stream channel and 10 meters long originating at sighting point of adult and juvenile arroyo toads, from summer 1994 surveys in Los Padres National Forest, California.

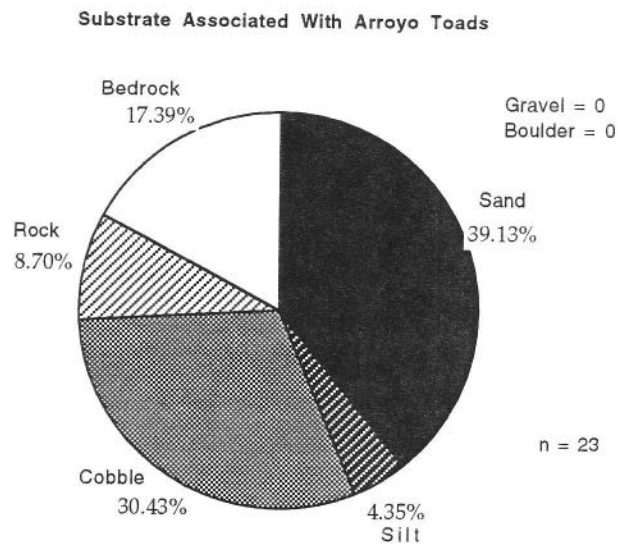


Figure 22. Dominant category of substrate in the immediate vicinity of arroyo toad sightings from summer 1994 surveys in Los Padres National Forest, California. Categories are as follows: Silt < 1mm, sand 1 - 5 mm, gravel 5 - 70 mm, cobble 7 - 30 cm, rock 30 - 60 cm, boulders > 60 cm.

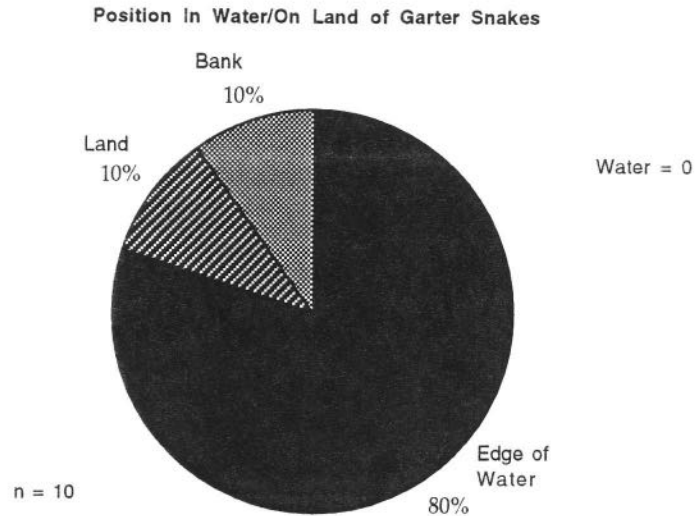


Figure 23. Position of two-striped garter snakes within stream and streambank habitat from summer 1994 surveys in Los Padres National Forest, California. A "land" or "water" observation indicates > 30 cm from the edge of water. "Bank" indicates out of water within 30 cm of the shoreline, and "Edge of Water" indicates in water within 30 of shoreline.

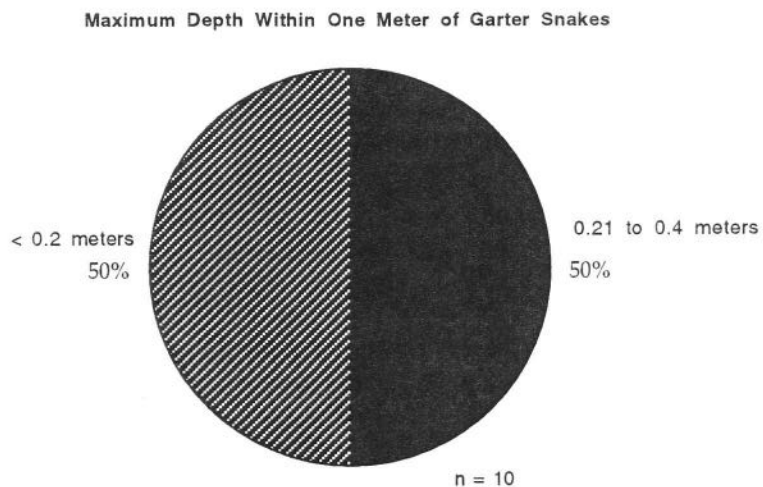


Figure 24. Maximum water depth within one meter of sightings of two-striped garter snakes from summer 1994 surveys in Los Padres National Forest, California.

Position In Water/On Land of Adult Bullfrogs

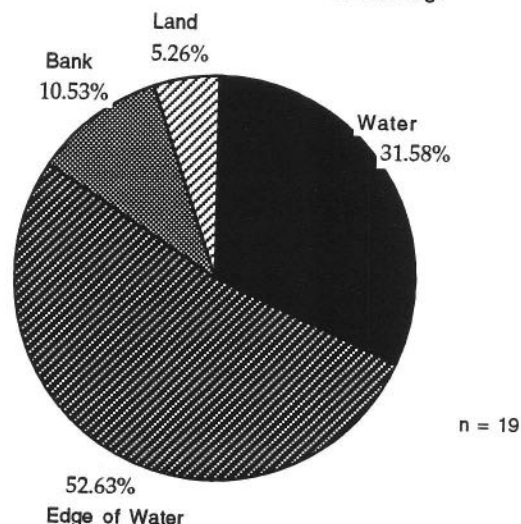


Figure 25. Position of adult bullfrogs within stream and streambank habitat from summer 1994 surveys in Los Padres National Forest, California. A "land" or "water" observation indicates > 30 cm from the edge of water. "Bank" indicates out of water within 30 cm of the shoreline, and "Edge of Water" indicates in water within 30 of shoreline.

Vegetation Types Adjacent to Adult Bullfrogs

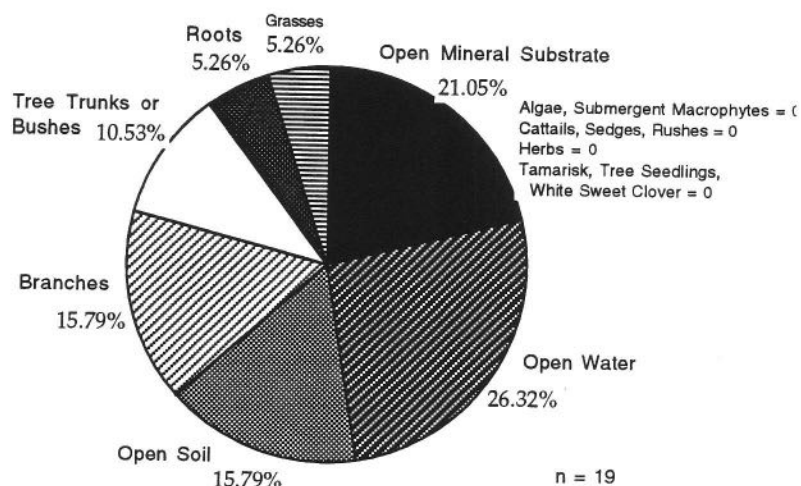


Figure 26. Dominant type of vegetation or lack thereof in the immediate vicinity of adult bullfrogs seen in summer 1994 surveys in Los Padres National Forest, California.

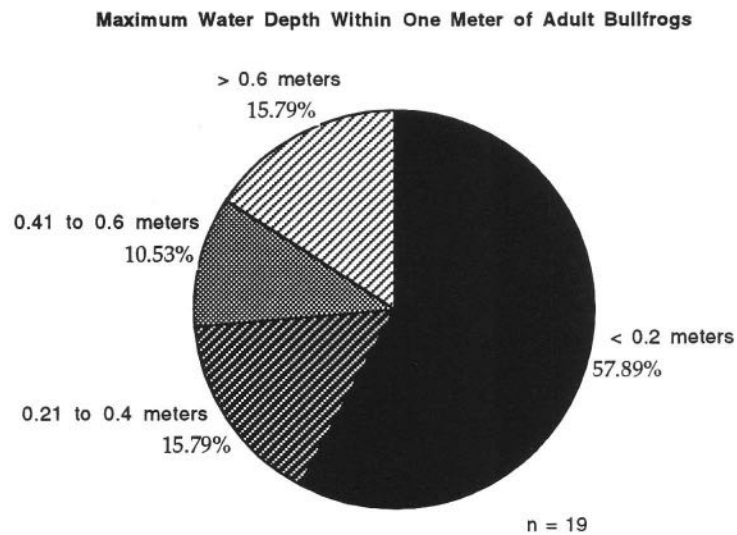


Figure 27. Maximum water depth within one meter of sightings of adult bullfrogs from summer 1994 surveys in Los Padres National Forest, California.

Appendix A. Data sheet used in collection of data for most field surveys performed in 1994.

LOC, 111, Y:

PAGE OF

START TIME:

OBSERVERS:

END TIME:

[illegible]

NOTES:

Appendix B. Key for data sheet used in collection of data for most field surveys performed in 1994.

**KEY TO SIGHTING RECORDS AND MICROHABITAT USE
OF AMPHIBIANS AND REPTILES
STREAMS OF CENTRAL AND SOUTHERN CALIFORNIA**

TIME: 24-hour clock.

SEGMENT: use elevation to nearest 5 feet from 7.5' topographic maps. Indicate position within segment by compass points (i. e. 1590SE).

SEARCH: H = daytime habitat/tadpole survey R = daytime reptile survey
F = frog night survey I = incidental

SPECIES: A = *Rana aurora draytonii* C = *Rana catesbeiana*
B = *Bufo microscaphus californicus* P = *Pseudacris regilla*
H = *Thamnophis hammondi* V = *Pseudacris cadaverina*
M = *Clemmys marmorata pallida* O = *Bufo boreas hallophilus*

IDENTIFICATION: PIT tag number, preceded by "R" if recapture. 9999 = no ID.

SEX: F = female M = male U = undetermined

SIZE: S = small, if A < 60mm B < 30mm H < 300mm M < 100mm

L = large

E = eggs

M = metamorph

T = tadpole

U = undetermined

GROUP SIZE: number of individuals of the same species within 30 cm of focal animal. If single animal, then 0.

BEHAVIOR: S = stationary P = pursuing prey
C = calling D = disturbed by investigator
A = in amplexus M = other unclassified movement
D = dead U = undetermined

ORIENTATION: B = facing bank W = facing mid-creek/pond

POSITION: combine codes from each column to describe immediate area of focal animal.

Adults, Juveniles and Metamorphs

W = water, > 30 cm
of shore

E = edge of water,
within 30 cm of shore

B = bank or out of water
on vegetation, within
30 cm of shore

L = land, > 30 cm of shore
(indicate distance in notes)

U = undetermined

Tadpoles and Eggs

S = shallow edge of pool

D = deep area of pool, on bottom

M = mid-water, at surface

A = algae, submergent vegetation

C = cattails, sedges, rushes

H = herbs

G = grasses

K = tamarisk and tree seedlings, *Melilotus*

T = trees or shrubs

B = branches

R = roots

O = open mineral substrate

S = open soil substrate

W = open water

F = flotsam

U = undetermined

BANK VEGETATION: combine codes from each column to describe dominant bank vegetation along 10 meters perpendicular to channel.

H = high > 4 m tall

M = moderate 2 - 4 m tall

L = low < 2 m tall

N = none

U = undetermined

C = cattails, sedges, rushes

G = grasses

B = shrubby annuals (*Melilotus*, *Urtica*,
Brassica, + *Rubus*)

H = chaparral

K = tamarisk, *Arundo*

W = willow

A = alder

S = sycamore

SUBSTRATE: may use up to two.

D = bedrock	S = sand 1-5 mm
B = boulders > 60 cm	F = fine sediments < 1mm
R = rock 30-60 cm	L = leaves
C = cobble 7-30 cm	U = undetermined
G = gravel 5-70 mm	

FLOW: P = pool -- if isolated pool, distance to nearest water in meters (i. e. "P7"). If pool is flowing, "PF"
R = riffle
G = glide D = dry
L = lagoon U = undetermined

STREAM WIDTH: measure or estimate to nearest 0.5 meter.

BED WIDTH: measure or estimate to nearest 0.5 meter.

POOL/RIFFLE LENGTH: distance in meters along channel that flow category occurs.

DEPTH: measure or estimate to nearest 0.1 meter.

BANK ANGLE: measure or estimate bank nearest to focal animal in degrees. > 90° is an overhang. 999 = undetermined.

CANOPY COVER: L = low < 25% H = high 50-75%
M = moderate 25-50% C = closed > 75%
U = undetermined

PERCENT EMERGENT VEGETATION: estimate within 1 meter around focal animal.

PERCENT SUBMERGENT VEGETATION: estimate within 1 meter around focal animal.

WATER TEMPERATURE: measure at site of focal animal to nearest °F. 99 = undetermined.

AIR TEMPERATURE: measure at site of focal animal to nearest °F. 99 = undetermined.

CLOUD COVER: estimate to nearest 10%. Include fog.

WIND: C = calm G = gale
B = breeze approx. 10 mph U = undetermined
W = wind 10-20 mph

NOTES: indicate number to be cross-referenced at bottom of data sheet.

[Susan V. Christopher, Department of Biological Sciences, University of California, Santa Barbara, 7 July 1994. Adapted from National Biological Survey, Piedras Blancas Research Station, San Simeon, CA, 8 May 1992]

Appendix C. Raw data from field surveys performed in 1994. Each row has two pages; refer to numbers in bold for cross-referencing. Data codes are given in Appendix B. Refer to maps in Appendix D for segment codes.

	STREAM	DATE	TIME	SEGMENT	SEARCH	SPECIES	IDENTIFICATION	SEX	SIZE	GROUP SIZE	BEHAVIOR	ORIENTATION	POSITION	BANK VEGETATION	SUBSTRATE	FLOW	STREAM WIDTH	BED WIDTH	POOL/RIFLE LENGTH	DEPTH	BANK ANGLE
1	INDIAN	230694	1850	1490SE	H	A	999999999	U	T	30	U	U	SW	HW	C	P	0.5	10	99	0.3	10
2	INDIAN	230694	1850	1490SE	H	B	999999999	U	T	20	U	U	SW	HW	C	P	0.5	10	99	0.3	10
3	INDIAN	230694	1850	1490SE	H	V	999999999	U	T	70	U	U	SW	HW	C	P	0.5	10	99	0.3	10
4	INDIAN	230694	1855	1470SE	H	A	999999999	U	T	99	U	U	SW	HW	C	P	99	10	99	99	99
5	INDIAN	230694	1855	1470SE	H	B	999999999	U	T	99	U	U	SW	HW	C	P	99	10	99	99	99
6	INDIAN	230694	1855	1470SE	H	V	999999999	U	T	99	U	U	SW	HW	C	P	99	10	99	99	99
7	MONO	240694	0015	1495	F	B	000110263	M	46	0	S	U	LO	MW	F	P	1	10	99	0.1	5
8	MONO	240694	0037	1470-85	F	A	999999999	U	L	0	S	U	ER	UU	R	P	2	6	99	0.4	45
9	MONO	240694	0040	1470-85	F	A	999999999	U	L	0	S	U	ER	UU	R	P	2	6	99	0.4	45
10	MONO	240694	0045	1470-85	F	A	999999999	U	U	0	S	U	BC	MC	S	P	2	6	99	0.4	20
11	MONO	240694	0046	1487	F	A	999999999	U	U	0	S	U	BC	MC	G	P	3	7	99	0.3	20
12	MONO	240694	0053	1470	F	A	999999999	U	S	0	S	U	EO	LC	C	P	3.5	10	99	0.3	20
13	MONO	240694	0055	1470	F	A	999999999	U	L	0	S	U	EO	UU	F	P	3.5	10	99	0.3	90
14	MONO	240694	0105	1460	F	B	000893876	M	49	0	S	U	LO	NN	C	D	0	15	99	0	0
15	SESPE	250694	1600	9999	H	H	999999999	U	L	0	S	U	EO	HW	R	R	4	10	99	0.1	30
16	SESPE	250694	1640	2930	H	B	999999999	U	T	5	S	U	SO	LB	S	P	6	13	99	0.5	5
17	SESPE	250694	1745	2932	H	B	999999999	U	T	30	S	U	SO	LB	G	P	2	20	99	0.5	5
18	SESPE	250694	2150	2990	I	B	999999999	F	L	0	M	U	BO	NN	S	P	12	14	99	0.2	5
19	SESPE	250694	2205	2990	I	B	999999999	U	L	0	M	U	BO	NN	S	P	12	14	99	0.2	5
20	SESPE	250694	2245	2932	F	B	999999999	F	L	0	M	U	LO	HW	C	D	0	10	99	0	5
21	SESPE	250694	2320	2933	F	B	999999999	U	S	0	S	U	BO	MC	S	G	3	10	99	0.5	5
22	SESPE	250694	2322	2933	F	B	999999999	U	S	0	S	U	BO	LB	S	G	3	10	99	0.5	5
23	SESPE	250694	2350	9999	I	B	999999999	U	S	0	S	U	LO	HW	R	R	3	10	99	99	5
24	SESPE	260694	0915	2990	I	B	999999999	U	T	0	M	U	EW	MB	R	R	10	14	99	0.1	5

25	MONO	280694	1800	1490	H	P	999999999	U	T	50	M	U	SW	UU	D	P	0.2	10	99	0.4	40
26	MONO	280694	1530	1490S	H	V	999999999	U	T	100	M	U	SW	UU	D	P	0.5	7	99	0.4	50
27	MONO	280694	1530	1490S	H	P	999999999	U	T	100	M	U	SW	UU	S	P	0.5	7	99	0.4	50
28	MONO	280694	1630	1485	H	P	999999999	U	T	20	M	U	SW	HW	C	P	0.5	10	99	0.6	35
29	MONO	280694	1800	1490	H	H	999999999	U	L	0	M	U	SW	UU	D	P	0.2	10	99	0.4	40
30	INDIAN	300694	1925	1470SE	H	H	999999999	U	S	0	P	U	EA	UU	D	P	0.5	10	99	0.1	50
31	INDIAN	300694	1925	1470SE	H	A	999999999	U	T	15	S	U	SA	UU	D	P	0.5	10	99	0.1	50
32	INDIAN	300694	1927	1470SE	H	B	999999999	U	T	25	M	U	SO	UU	D	P	0.5	10	99	0.1	50
33	INDIAN	300694	1955	1470SE	H	B	999999999	U	M	3	S	U	BO	UU	D	P	0.5	10	99	0.1	50
34	INDIAN	300694	1955	1470SE	H	B	999999999	U	M	3	S	U	BO	UU	D	P	0.5	10	99	0.1	50
35	INDIAN	300694	1955	1470SE	H	B	999999999	U	M	3	S	U	BO	UU	D	P	0.5	10	99	0.1	50
36	MONO	300694	2130	1525SW	F	B	001289524	M	50	0	S	U	LO	MK	C	D	0	10	99	0	0
37	MONO	300694	2142	1525E	F	B	999999999	M	50	0	S	U	LO	MW	C	D	0	10	99	0	0
38	MONO	300694	2230	1530N	F	A	999999999	M	L	0	S	U	EC	HW	C	P	7	10	99	0.5	20
39	MONO	300694	2220	1525	F	A	999999999	U	T	0	S	U	SO	HW	C	P	6	10	99	0.7	20
40	MONO	300694	2230	1530E	F	H	999999999	U	L	0	P	U	EC	UU	C	P	4	10	99	0.3	45
41	MONO	300694	2315	1519S	F	B	005616041	M	49	0	S	U	LO	MC	C	D	0	3	99	0	10
42	MONO	300694	2330	1518N	F	A	999999999	U	L	0	S	U	EC	LW	F	P	3	10	99	0.4	20
43	MONO	300694	2331	1518E	F	H	999999999	U	S	0	M	U	EC	MW	F	P	3	10	99	0.4	10
44	MONO	300694	2337	1518E	F	A	999999999	U	L	0	S	U	BA	MW	F	P	3	10	99	0.3	0
45	MONO	300694	2338	1518N	F	A	999999999	U	L	0	S	U	BA	MW	F	P	3	10	99	0.2	0
46	MONO	300694	2350	1518	F	A	999999999	U	L	0	S	U	EC	HW	C	P	9	11	99	0.5	20
47	MONO	300694	2350	1518	F	A	999999999	U	L	0	S	U	BC	HW	C	P	9	11	99	0.4	45
48	MONO	300694	2350	1518	F	A	999999999	U	L	0	S	U	BC	HW	C	P	9	11	99	0.5	10
49	MONO	10794	0012	1518	F	A	999999999	U	L	0	S	U	EC	HW	C	P	9	11	99	0.3	10
50	MONO	10794	0012	1518	F	H	999999999	U	S	0	S	U	EC	HW	C	P	9	11	99	0.3	10
51	MONO	10794	0012	1518	F	A	999999999	U	L	0	S	U	BK	HW	C	P	9	11	99	0.3	10
52	MONO	10794	0012	1518	F	A	999999999	F	U	0	S	U	BO	HW	C	P	9	11	99	0.3	10
53	MONO	10794	0030	1512	F	A	999999999	U	U	0	S	U	BC	HW	C	P	8	10	99	0.1	0
54	MONO	10794	0030	1512	F	H	999999999	U	S	0	S	U	EC	HW	C	P	8	10	99	0.3	0
55	MONO	10794	0040	1512	F	A	999999999	U	L	0	S	U	EC	HW	C	P	8	10	99	0.3	10
56	MONO	10794	0040	1512	F	M	999999999	U	L	0	E	U	LO	HW	C	D	0	10	99	0	10
57	MONO	10794	0050	1500SE	F	A	999999999	U	L	0	S	U	BC	HW	R	P	3	6	99	0.2	0

58	MONO	10794	0055	1500SE	F	A	999999999	U	L	0	S	U	EW	HW	R	P	3	6	99	0.3	0
59	MONO	10794	0055	1500SE	F	A	999999999	U	L	0	S	U	BO	HW	R	P	3	6	99	0.3	0
60	MONO	10794	0055	1497N	F	A	999999999	U	L	0	S	U	EW	HW	R	P	3	6	99	0.7	0
61	MONO	10794	0055	1497N	F	A	999999999	U	L	0	S	U	EC	HW	R	P	6	7	99	1.5	50
62	MONO	10794	0100	1497N	F	A	999999999	U	L	0	S	U	BO	LG	R	P	6	7	99	0.2	0
63	MONO	10794	0110	1497S	F	A	999999999	U	L	0	S	U	EO	MC	B	P	6	7	99	0.3	45
64	MONO	10794	0110	1497S	F	A	999999999	U	L	0	S	U	EO	MC	B	P	6	7	99	0.4	0
65	MONO	10794	0110	1497S	F	A	999999999	U	L	0	S	U	EO	MC	B	P	6	7	99	0.3	10
66	MONO	10794	0117	1495NE	F	A	999999999	U	L	0	S	U	EO	MW	R	R	1	6	99	0.5	10
67	MONO	10794	0139	1485E	F	B	00186638	U	50	0	S	U	EA	MK	R	P	3	8	99	0.5	0
68	MONO	10794	0151	1470-85	F	B	00202589	U	46	0	S	U	BO	MK	C	P	3	10	99	0.1	5
69	MONO	10794	0155	1470-85	F	A	999999999	U	L	0	S	U	BC	MK	C	P	3	10	99	0.3	10
70	MONO	10794	0214	1475N/SV	F	B	006062099	U	54	0	S	U	LO	MK	S	D	0	5	99	0	0
71	MONO	10794	0220	1470	F	A	999999999	U	L	0	D	U	LG	MK	S	P	2	10	99	0.2	20
72	INDIAN	10794	0235	1470SE	F	B	999999999	U	S	0	S	U	LO	HW	S	D	0	10	99	0	0
73	INDIAN	10794	0235	1470SE	F	A	999999999	U	T	50	M	U	EW	N	D	P	0.5	10	99	0.1	50
74	MONO	71094	9999	1560	H	V	999999999	U	T	50	U	U	U	U	UU	U	P	99	99	99	99
75	MONO	71094	9999	1570N	H	V	999999999	U	L	0	U	U	U	U	UU	U	P	99	99	99	99
76	MONO	71094	9999	1655	H	V	999999999	U	T	99	U	U	U	U	UU	U	P	99	99	99	99
77	MONO	71094	9999	1655	H	H	999999999	U	L	0	U	U	U	U	UU	U	P	99	99	99	99
78	PIRU	30894	1340	1090W	H	C	999999999	U	L	0	D	W	BO	HA	C	P	8	16	6	0.4	90
79	PIRU	30894	1411	1115	H	C	999999999	U	L	0	D	U	WW	HA	F	P	11	15	20	0.5	5
80	PIRU	30894	1449	1130	H	H	999999999	U	S	0	P	W	BS	HW	F	G	6	15	15	0.2	10
81	AGUA BLANCA	30894	1542	1141	H	V	999999999	U	S	0	S	B	LO	N	C	P	2.5	8	2	0.1	5
82	AGUA BLANCA	30894	1557	1147	H	V	999999999	U	T	0	S	U	EW	LW	C	P	1	12	2	0.5	5
83	AGUA BLANCA	30894	1607	1150	H	B	999999999	U	25	0	D	B	BO	LW	C	R	5	8	C	0.5	5
84	PIRU	30894	1714	1143	H	U	999999999	U	L	0	S	B	BG	MW	G	G	4	11	25	0.3	20
85	PIRU	30897	2045	1090S	F	V	999999999	U	S	0	S	W	BO	N	U	P	2	15	3	0.1	5
86	PIRU	30897	2055	1090N	F	B	999999999	F	57	0	S	W	BO	N	D	P	2	15	2	0.1	5
87	PIRU	30897	2100	1090N	F	C	999999999	U	59	0	S	W	WO	MW	C	G	7	15	10	0.1	5
88	PIRU	30897	2110	1090S	F	C	999999999	U	S	0	S	B	WO	N	C	R	7	15	10	0.1	5
89	PIRU	30897	2112	1091S	F	C	999999999	M	170	0	S	U	EO	MW	C	R	7	15	10	0.1	5
90	PIRU	30897	2115	1091N	F	C	999999999	M	188	0	S	U	WW	HA	C	R	5	15	10	0.2	5

91	PIRU	30897	2120	1092S	F	C	99999999	U	L	0	S	B	BW	LW	C	R	5	15	10	0.1	5
92	PIRU	30897	2130	1092N	F	C	99999999	U	S	0	S	B	EG	LW	C	G	5	15	10	0.1	5
93	PIRU	30897	2145	1120S	F	C	99999999	U	L	0	S	B	EW	LW	C	R	5	10	15	0.1	5
94	PIRU	30897	2150	1120S	F	C	99999999	U	S	0	S	W	EW	N	C	P	2.5	20	15	0.1	5
95	PIRU	30897	2150	1120S	F	C	99999999	U	S	0	S	W	EW	N	C	P	1	20	15	0.1	5
96	PIRU	30897	2155	1120S	F	C	99999999	U	T	0	S	W	D	N	C	P	9	11	17	0.3	10
97	PIRU	30897	2200	1121N	F	C	99999999	U	L	0	S	W	WB	MA	S	P	8	15	17	0.4	0
98	PIRU	30897	2205	1122S	F	C	99999999	U	L	0	S	W	EO	N	C	R	4	12	10	0.1	5
99	PIRU	30897	2220	1130S	F	C	99999999	U	L	0	S	B	WB	HA	C	R	6	10	25	0.2	0
100	PIRU	30897	2220	1130	F	C	99999999	U	L	0	S	B	WB	HA	C	R	6	10	25	0.2	0
101	PIRU	30897	2245	1132	F	M	99999999	U	L	0	D	B	WO	MW	C	P	6	8	20	0.7	99
102	PIRU	30897	2245	1135	F	C	99999999	U	L	1	S	W	ET	HA	C	P	6	8	20	0.7	5
103	PIRU	30897	2245	1135	F	C	99999999	U	L	1	S	W	ET	HA	C	P	6	8	20	0.7	5
104	PIRU	30897	2255	1135	F	U	99999999	U	L	0	S	W	EG	HA	C	P	6	8	20	0.7	5
105	PIRU	30897	2255	1135	F	C	99999999	U	L	0	S	W	EW	MW	C	P	6	8	20	0.6	5
106	PIRU	30897	2300	1135	F	U	99999999	U	L	0	S	U	EC	MW	C	G	7	10	15	0.2	20
107	PIRU	30897	2305	1136	F	C	99999999	U	L	0	S	B	ER	HW	C	G	7	10	15	0.2	20
108	PIRU	30897	2305	1136	F	C	99999999	U	L	0	S	W	LG	MW	F	P	5	8	20	0.9	35
109	PIRU	30897	2330	1140	F	C	99999999	U	S	0	S	B	EO	LW	R	R	4	8	11	0.1	20
110	PIRU	30897	2335	1140S	F	V	99999999	MF	L	1	A	W	WW	N	C	G	6	10	20	0.1	0
111	PIRU	30897	2335	1140S	F	V	99999999	MF	L	1	A	W	WW	N	C	G	6	10	20	0.1	0
112	PIRU	30897	2340	1140N	F	C	99999999	U	L	0	S	W	ES	HW	C	G	6	10	20	0.3	0
113	PIRU	30897	2345	1140S	F	C	99999999	U	S	0	S	W	WO	MW	R	G	6	10	20	0.2	0
114	AGUA BLANCA	30894	2355	1142	F	M	99999999	U	M	3	D	W	WW	HA	S	P	2.5	5	8	0.2	0
115	AGUA BLANCA	30894	2355	1142	F	M	99999999	U	M	3	D	W	WW	HA	S	P	2.5	5	8	0.2	0
116	AGUA BLANCA	30894	2355	1142	F	M	99999999	U	M	3	D	W	WW	HA	S	P	2.5	5	8	0.2	0
117	AGUA BLANCA	40894	0005	1145SE	F	V	99999999	U	TS	10+	D	W	S	N	R	D	1.5	10	6	0.1	5
118	AGUA BLANCA	40894	0015	1146	F	V	99999999	U	S	1	D	W	LO	N	C	G	1.5	10	11	0.1	0
119	AGUA BLANCA	40894	0015	1146	F	V	99999999	U	S	1	D	W	LO	N	C	G	1.5	10	11	0.1	0
120	AGUA BLANCA	40894	0045	1th XING	F	C	99999999	U	L	1	S	W	ES	HA	C	P	3	6	15	0.1	5
121	AGUA BLANCA	40894	0045	1ST XING	F	C	99999999	U	L	1	S	W	ES	HA	C	P	3	6	15	0.1	5
122	AGUA BLANCA	40894	0045	2nd XING	F	O	99999999	F	63	0	D	B	WW	HA	C	P	3	6	15	0.1	5
123	PIRU	40894	1206	FRENCH	H	P	99999999	U	TM	20	S	-	S	MW	C	P	1.5	9	3.5	0.1	5

124	PIRU	40894	1217	FRENCH	H	P	99999999	U	T	15	S	-	S	LC	C	P	2	12	3	0.2	5
125	PIRU	40894	1239	FRENCH	H	V	99999999	U	T	30+	S	U	S	LC	C	P	2	12	3	0.2	5
126	PIRU	40894	1250	FRENCH	H	U	99999999	U	L	0	D	W	BC	MC	C	P	6	10	15	0.1	0
127	PIRU	40894	1330	FRENCH	H	P	99999999	U	S	0	S	B	BH	MW	C	P	2	20	15	0.1	0
128	ALDER	220894	1505	UUUUUUU	H	H	99999999	U	L	0	S	B	LO	HA	FB	R	0.3	4	3	0.1	20
129	ALDER	220894	1520	UUUUUUU	H	P	99999999	F	L	0	D	W	EO	HA	C	P	1.5	6	4	0.1	10
130	ALDER	220894	1525	UUUUUUU	H	V	99999999	F	L	0	D	W	LO	HA	C	P	1.5	6	4	0.1	10
131	ALDER	220894	1550	UUUUUUU	H	A	99999999	F	L	0	S	B	WT	HA	GB	P	2.5	7	3.5	1	120
132	ALDER	220894	1625	UUUUUUU	H	V	99999999	U	L	0	D	W	LO	HA	R	P	2	5	3	0.1	10
133	ALDER	220894	1627	UUUUUUU	H	V	99999999	U	L	0	S	B	LO	HA	B	P	2	5	3	1	10
134	ALDER	220894	2100	UUUUUUU	F	A	99999999	U	L	0	S	B	EW	HA	R	P	1.5	5	4	0.3	10
135	ALDER	220894	2115	UUUUUUU	F	A	99999999	U	L	0	S	W	EO	HA	RC	P	4	7	2	1	0
136	ALDER	220894	2125	UUUUUUU	F	A	99999999	U	L	0	S	B	EO	N	RC	P	1.5	5	1.5	0.4	5
137	ALDER	220894	2145	UUUUUUU	F	A	99999999	U	L	0	S	B	BO	HA	R	P	2.5	7	3.5	1	30
138	ALDER	220894	2148	UUUUUUU	F	A	99999999	U	L	0	S	B	EB	HA	L	P	2.5	7	3.5	1	80
139	ALDER	220894	2155	UUUUUUU	F	V	99999999	U	L	0	S	W	EB	HA	R	P	2.5	7	4	0.2	0
140	ALDER	220894	2158	UUUUUUU	F	P	99999999	U	L	0	S	B	EW	HA	R	P	2.5	7	4	0.2	0
141	ALDER	220894	2220	UUUUUUU	F	V	99999999	U	L	0	S	B	LO	N	B	R	1.5	5.5	3	0.1	10
142	ALDER	220894	2308	UUUUUUU	F	A	99999999	U	L	0	S	W	BB	MWS	BR	P	2.5	4	6	0.2	80
143	ALDER	220894	2312	UUUUUUU	F	A	99999999	U	L	0	S	W	WW	MWS	G	P	2.5	4	6	0.4	80
144	ALDER	220894	2325	UUUUUUU	F	A	99999999	U	L	0	S	B	EW	MW	R	P	2.5	10	3.5	0.6	80
145	ALDER	220894	2335	UUUUUUU	F	V	99999999	U	L	0	S	W	LO	LW	B	R	0.5	7	2	0.1	20
146	PIRU	20994	2015	1130E	I	O	99999999	F	71	0	S	B	EO	N	C	P	7	10	15	0.1	5
147	PIRU	20994	2025	1130W	I	P	99999999	U	L	0	S	U	LT	HA	U	U	99	99	99	99	99
148	PIRU	20994	2230	1185W	F	B	SCAT	U	U	99	U	U	LO	HAS	SB	U	99	99	99	99	99
149	PIRU	20994	2245	1190E	F	B	SCAT	U	U	99	U	U	LO	HAS	SB	U	99	99	99	99	99
150	PIRU	20994	2300	1195-120	F	B	SCAT	U	U	99	U	U	LO	HAS	SB	U	99	99	99	99	99
151	AGUA BLANCA	190994	1950	UUUUUUU	F	V	999999999	U	L	0	S	B	EO	LG	S	P	4	7	12	0.3	5
152	AGUA BLANCA	190994	2050	UUUUUUU	F	H	999999999	U	L	0	S	W	EW	N	B	P	3	5	7	0.2	25
153	AGUA BLANCA	190994	2325	UUUUUUU	F	M	999999999	U	L	1	M	W	WW	MW	CR	P	3	6	6	0.4	0
154	AGUA BLANCA	190994	2325	UUUUUUU	F	M	999999999	U	L	1	M	W	WW	MW	CR	P	3	6	6	0.4	0

	CANOPY COVER	% EMERGENT VEG	% SUBMERGENT VEG	WATER TEMPERATURE	AIR TEMPERATURE	CLOUD COVER	WIND	NOTES	
1	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., second xing from downstream	
2	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., second xing from downstream	
3	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., second xing from downstream	
4	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., first xing from downstream	
5	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., first xing from downstream	
6	99	99	99	99	99	0	C	In drying pool near Camuesa Rd., first xing from downstream	
7	99	99	99	68	58	0	N	In damp soil, muck from dying Chara. Not PIT tagged previously	
8	99	99	99	68	58	0	N	On left bank	
9	99	99	99	68	57	0	N	On left bank	
10	99	99	99	68	56	0	N	On right bank	
11	99	99	99	68	56	0	N	On right bank	
12	99	99	99	68	53	0	N		
13	99	99	99	68	53	0	N		
14	99	99	99	0	53	0	N	in dry creek bed at least 100 m from water. Not PIT tagged previously	
15	99	99	99	99	86	0	B	between trail and Sespe Cr. on Piedras Blancas Cr., just upstream of confluence	
16	99	99	99	99	90	0	B	collected 3, in glide in backwater of sandbar. Blend into background well.	
17	99	99	99	99	87	0	B	same species as above, similar habitat but larger substrate size	
18	99	99	99	99	70	0	C	California King Snake chasing bullfrogs, went into wall by arroyo toad; at swimming hole	
19	99	99	99	99	70	0	C	at swimming hole; BuMi, PsRe and RaCa calling in vicinity	
20	99	99	99	99	68	0	C	in dry channel beside S channel of the Sespe, 1/2 way to either confluence	
21	99	99	99	71	64	0	C	soaking	
22	99	99	99	71	64	0	C	RaCa in all areas, tads, metamorphs; adults in larger pools, PsRe & PsCA abundant	
23	99	99	99	99	63	0	C	on trail	
24	99	99	99	99	75	0	C	upper end of swimming hole at campground	

25	99	99	99	90	98	0	B	Trout 3-4 cm long	
26	99	99	99	93	117	0	B	south of Camuesa Rd., collect approx. 100 for Cliff to use as snake food	
27	99	99	99	93	117	0	B	Damien had seen RaAu and Ps tads in 1500 and 1470 the night before, but	
28	99	99	99	92	99	0	B	these pools were dried up. He also found BuMi and RaAu tads in 1490 at both	
29	99	99	99	90	98	0	B	road xings, and RaAu in 1522. No RaAu tads seen today. Dead trout and Ps tads.	
30	L	99	99	79	78	0	B		
31	L	99	99	79	78	0	B		
32	L	99	99	79	78	0	B		
33	L	99	99	79	78	0	B		
34	L	99	99	79	78	0	B		
35	L	99	99	79	78	0	B		
36	L	99	99	99	70	0	B	Few hundred meters from water. Recapture.	
37	L	99	99	99	70	0	B	Escaped before PIT tagged, not a recapture.	
38	M	99	99	99	70	0	B		
39	L	99	99	99	70	0	B		
40	L	99	99	99	70	0	B	under water, striking at trout.	
41	L	99	99	99	67	0	B		
42	H	99	99	67	67	0	B		
43	H	99	99	67	67	0	B		
44	M	99	99	67	67	0	B		
45	H	99	99	67	67	0	B		
46	M	99	99	67	67	0	B		
47	M	99	99	67	63	0	B		
48	M	99	99	67	63	0	B		
49	M	99	99	67	63	0	B		
50	M	99	99	67	63	0	B		
51	M	99	99	67	63	0	B		
52	M	99	99	67	63	0	B		
53	M	99	99	67	63	0	B		
54	M	99	99	67	63	0	B		
55	M	99	99	67	63	0	B		
56	M	99	99	67	63	0	B	Probably eaten by a bear	
57	H	99	99	67	63	0	B		

58	C	99	99	67	63	0	B		
59	C	99	99	67	63	0	B		
60	C	99	99	67	63	0	B		
61	M	99	99	67	63	0	B		
62	L	99	99	66	62	0	B		
63	L	99	99	66	62	0	B		
64	L	99	99	66	62	0	B		
65	L	99	99	66	62	0	B		
66	M	99	99	66	62	0	B		
67	L	99	99	66	62	0	B	Recapture.	
68	L	99	99	66	62	0	B		
69	L	99	99	66	62	0	B		
70	L	99	99	66	62	0	B	Beside ant trail, small black ants - not the usual with red mid-section	
71	L	99	99	66	62	0	B	jumped from within grass on gravel bar > 1 meter from water.	
72	L	99	99	66	62	0	B		
73	L	99	99	66	62	0	B		
74	99	U	99	99	99	99	C	from 4th xing Ogilvy Ranch Rd. to pool 1560. some beginning to metamorphose	
75	99	U	99	99	99	99	C	beaver dams from 1560 to 1570 and beyond. most with rainbow trout.	
76	99	U	99	99	99	99	C		
77	99	U	99	99	99	99	C		
78	H	0	20	74	89	0	B	Crayfish and sculpins abundant	
79	L	0	100	74	89	0	B	in submergent vegetation ("angle hair"), and flushed into fallen alder	
80	H	0	40	74	89	0	B	eating a sculpin with head 4X size of snake's head	
81	L	0	5	74	89	0	B	began going up Agua Blanca	
82	L	0	5	74	89	0	B	upstream there were many more	
83	L	0	0	74	89	0	B	1 meter away from road crossing.	
84	L	25	20	74	89	0	B		
85	N	0	0	69	78	0	C	In road crossing.	
86	N	0	0	69	78	0	C	In road crossing.	
87	N	5	0	69	78	0	C		
88	N	0	0	69	78	0	C		
89	N	0	10	70	78	0	C		
90	H	0	0	70	78	0	C		

91	N	0	0	70	78	0	C		
92	N	50	25	70	78	0	C		
93	L	0	10	70	63	0	C		
94	L	10	0	70	63	0	C		
95	L	10	0	70	63	0	C		
96	N	0	0	70	63	0	C		
97	L	0	0	70	63	0	C		
98	L	0	75	70	63	0	C		
99	H	0	0	70	63	0	C	Sitting on overhanging willow.	
100	H	0	0	70	63	0	C	PsCa and PsRe calling	
101	L	0	0	70	63	0	C	Near fallen tree, on bottom, whitish shell	
102	H	0	0	70	63	0	C		
103	H	0	0	70	63	0	C		
104	H	0	0	70	63	0	C		
105	H	0	0	70	63	0	C		
106	M	20	70	70	63	0	C		
107	M	40	0	70	63	0	C		
108	H	0	0	70	63	0	C		
109	L	10	0	70	63	0	C		
110	N	0	10	70	60	0	C		
111	N	0	10	70	60	0	C		
112	N	0	10	70	60	0	C		
113	N	5	80	70	60	0	C		
114	U	0	0	67	60	0	C	Very small (12 cm). White shell, but not as white as previous one	
115	U	0	0	67	60	0	C	< 12 cm	
116	U	0	0	67	60	0	C	< 12 cm	
117	L	0	10	67	60	0	C		
118	N	0	0	67	60	0	C		
119	N	0	0	67	60	0	C		
120	U	0	90	63	60	0	C		
121	U	0	90	63	60	0	C		
122	U	0	90	63	60	0	C	Swimming under water.	
123	M	15	15	66	85	0	C	In pool on side of main flow	

124	L	20	20	66	86	0	C	Extensive emergent veg and willows. Abundant crayfish. Litter, trampled banks	
125	L	20	20	66	92	0	C	In another side pool off main flow, 15 mm long, black w/ gold flecks. Collected.	
126	H	75	0	66	93	0	C	Not a treefrog, probably a bullfrog	
127	L	100	30	66	97	0	C	Just downstream from start, in side pool	
128	C	0	0	63	75	0	C	15-20 meters downstream of dam diversion	
129	C	0	0	63	75	0	C	Immediately above the diversion	
130	C	0	0	63	75	0	C	Immediately above the diversion. Curled digits and lazy extended left leg.	
131	C	0	0	63	75	0	C	Seen on bottom of pool under and undercut bank. 122' above diversion.	
132	C	0	0	63	75	0	C	after creek turned east	
133	C	0	0	63	75	0	C	after creek turned east	
134	C	0	0	62	67	0	C	just below 1st xing of the diversion	
135	C	0	0	62	67	0	C	immediately below diversion dam	
136	C	0	0	62	67	0	C	30 meters above diversion dam with a quicker current	
137	C	0	0	62	67	0	C	Probably same frog seen earlier	
138	C	0	0	62	67	0	C	Same pool as above. Sitting on flood debris	
139	C	0	0	62	67	0	C	Next to below	
140	C	0	0	62	67	0	C	Next to above	
141	C	0	0	62	67	0	C	Saw on return back	
142	H	0	0	64	67	0	C	First huge pool after dry section below end of road	
143	H	0	0	64	67	0	C	First huge pool after dry section below end of road	
144	C	0	0	64	67	0	C		
145	L	0	0	64	67	0	C	juvenile RaCa very common, one tadpole with legs seen in canyon, deep pool	
146	L	0	0	99	64	0	C		
147	C	99	99	99	64	0	C	near side pond along road	
148	U	99	99	99	64	0	C		
149	U	99	99	99	64	0	C		
150	U	99	99	99	64	0	C		
151	N	0	0	63	67	0	B	Full moon	
152	L	0	0	63	67	0	C	approaching 2nd canyon to the north. directed toward pool of fish	
153	H	0	40	66	69	0	C		
154	H	0	40	66	69	0	C		

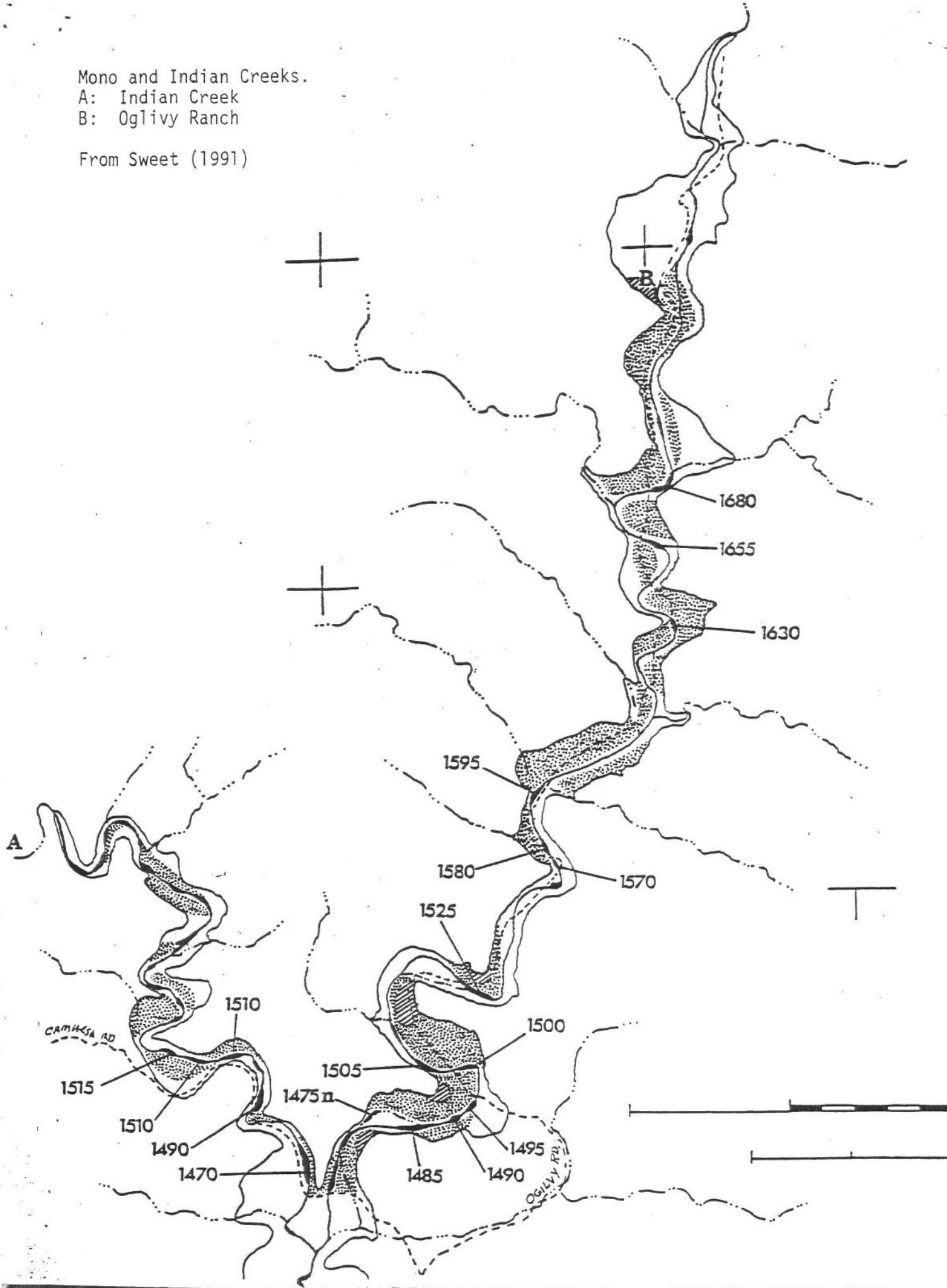
Appendix D. Maps used to code stream segments for Mono/Indian Creeks, Sespe Creek, and Piru/Agua Blanca Creeks from Sweet (1991).

Mono and Indian Creeks.

A: Indian Creek

B: Oglivy Ranch

From Sweet (1991)



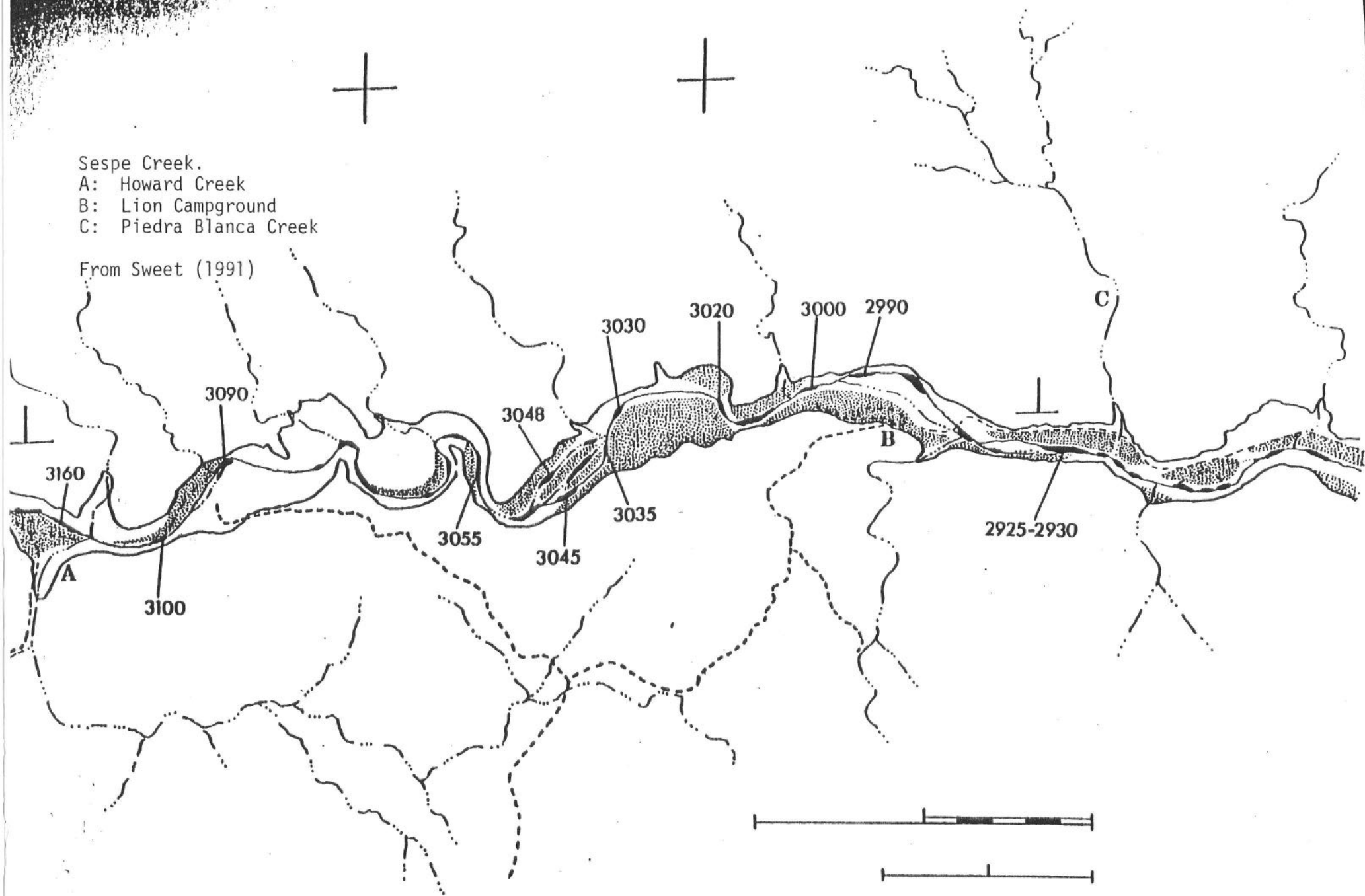
Sespe Creek.

A: Howard Creek

B: Lion Campground

C: Piedra Blanca Creek

From Sweet (1991)



Piru and Aqua Blanca Creeks
A: Ruby Canyon
B: Ellis Apiary Campground
C: Agua Blanca Creek
D: Blue Point Campground

From Sweet (1991)

