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THE AMPHIBIANS AND REPTILES OF THE
LOS ALAMOS NATIONAL ENVIRONMENTAL RESEARCH PARK

Introduction

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Refs cited?

Naturalists knew virtually nothing about the fauna of New Mexico until the Southwest became open to American exploration after the Mexican War. Not long after the Treaty of Guadalupe Hidalgo was signed in 1848, the federal government was sponsoring expeditions to explore the terrain ceded to the United States. In 1850 a commission led by John R. Bartlett set out to survey the boundary between the United States and Mexico. The year after this survey was launched, in 1851, Capt. Lorenzo Sitgreaves began a reconnaissance that extended from El Paso to Santa Fe and across northern New Mexico to the Zuñi River before the expedition continued its journey to San Diego, California. Members of these expeditions assembled some of the first collections to reach the United States National Museum.

Members of the medical profession were among the eminent naturalists of the day, and many of them not only collected animals, but provided the reports that dealt with the collections. Dr. Samuel W. Woodhouse, an Assistant Surgeon with the U. S. Army Medical Corps, served as naturalist with the Sitgreaves Expedition. Elliott Coues, who went on to achieve fame as an ornithologist, was officially designated "Assistant Surgeon in the U.S. Army," and "Surgeon and Naturalist to the Northern Boundary Commission." Although a physician, Dr. T. H. Webb, accompanied the Mexican Boundary Commission, Lt. Col. James D. Graham, a member of the Corps of Topographical Engineers, who served as chief astronomer and head of the scientific corps under Commissioner Bartlett, was evidently the one who preserved and documented the amphibians and reptiles that reached collections in Washington, D. C. A patchnosed snake, Salvadora grahamiae, was named in honor of Colonel Graham before the Boundary Commission finished its work in 1853.

In the years following the Mexican war the main objective of the Corps of Topo-

graphical Engineers consisted in finding suitable routes across the Southwest. Emigrants headed for California were seeking ways to avoid rugged mountains and arid deserts. Beyond such immediate needs, however, the Corps was anxious to find a practicable route for a transcontinental railroad that would eventually connect the Mississippi River with the Pacific provinces. Several American explorers had found ways to reach California following routes far to the north of the Mexican Boundary, and such expeditions as those of John C. Frémont and Colonel John J. Abert in 1945, had materially broadened the scope of such undertakings. They continued their studies of the physiography, geology and meteorology, but their interest was no longer restricted to the physical aspects of the environment. They went to great lengths to assemble collections of the plants and animals they found. From then on expeditions were expected to maintain records of the fauna and flora observed in the areas they traversed, documented with specimens and scientific data. Any well organized expedition setting out to explore the newly acquired terrain was expected to have scientists representing a wide range of disciplines on its staff.

Expeditions of the sort were commonly authorized by Congress and financed by the federal government. The explorations and surveys carried by the Corps of Engineers during the years 1871 to 1874 typified the work of the U. S. Army once it had focused its attention on the terrain west of the 100th meridian. Such well known scientists as Edward Drinker Cope, Elliott Coues, and Henry Wetherbee Henshaw participated in the field work during the four years that Lt. George M. Wheeler was in charge. The extensive collections assembled by members of the expeditions, not only in New Mexico, but in portions of five other states, materially broadened our knowledge of the animals in this portion of the United States.

Vast quantities of scientific data and other information obtained by in the Wheeler expeditions are summarized/several impressive volumes. The fourth volume deals with fossils, and the fifth, published in 1875, is restricted to the zoological collections. It contains reports prepared by more than a dozen experts, including naturalists who had participated in the field work. Their summaries of the various groups require more than 1000 pages of text, divided into 16 chapters. The volume is lavishly illustrated. There are 45 lithographed plates/ with several of the more brightly pigmented birds, reptiles and insects portrayed in color. Over 700 pages are devoted to the vertebrates, and the rest of the volume contains chapters dealing with the insects, molluscs, and the fresh-water leeches represented in the collections.

Two naturalists contributed reports dealing with the amphibians and reptiles. One prepared by Elliott Coues, better known for his ornithological investigations, deals largely with the collections he made in Arizona in 1864 and 1865, although he provides notes on specimens /in northwestern New Mexico, at Fort Wingate and along the Zuñi River. The other report was written by Henry C. Yarrow, who had participated in the field work of the Wheeler Expeditions in 1872 and 1874. Yarrow had collected amphibians and reptiles, as well as other vertebrates, while he was serving as surgeon and zoologist to the Expeditions, first in Utah/and later Colorado and in New Mexico. His report covers collections obtained in all six of the states included in the survey. Yarrow notes in his summary that some of the specimens remained to be identified, but he believed that the collection contained representative 17 species of species of of amphibians and 70 reptiles. His report, nevertheless, contains discussions under specific or subspecific names for/lo only amphibians, 32 lizards, 24 snakes and three turtles. Specimens from the state of New Mexico, as viewed by Yarrow, were referable to 31 species, or subspecies, six of which were amphibians, 14 were lizards, and 11 were snakes. The collections studied by Yarrow contained only five specimens of turtles, all from Arizona and assigned to three species. No turtles

had been obtained in New Mexico, where at least 10 men, most of them naturalists, had collected the specimens covered in Yarrow's report.

Well over a dozen localities are listed as the sources of the specimens, many of which came from well-known places. Few of the collectors had worked in southern New Mexico although one bullsnake had been captured by Henshaw at Fort Bayard, near Silver City. Such place names as the source of a spadefoot toad listed by Cope as "Alto dos Utas," seem to have escaped the attention of cartographers. Detailed maps may have been available for the settled areas along the Rio Grande, but a lieutenant who captured a frog and a garter snake in the northwestern corner of the state indicated only ^{that} they came from the "San Juan River." In some instances tags were lost or separated from specimens that wound up cataloged as having been taken in "New Mexico."

Fortunately collectors often stayed in or near Indian or Spanish settlements, such as San Ildefonso, Santa Fe and Abiquiu, with names that had been in use for at least two centuries before Wheeler's expeditions reached the area. Herpetological specimens from the Southwest had been accumulating in eastern museums for at least 25 years by the time Yarrow prepared his report. At this stage, nevertheless, taxonomists had ^{only fragmentary} notions of distributions of even the commonest, most readily collected species. In some respects it seems curious that Yarrow could assign most of the species he lists to the same families recognized today. Most of the generic names that Yarrow used for the amphibians and lizards are still in use, but systematists were still struggling to work out the relationships of the snakes. Well over ^{and} half a century later systematists still lacked suitably large/ representative samples of the snakes in North America. Extensive investigations remained to be carried out before students could [^] define the species and group them satisfactorily in genera. A large percentage of the specific names employed by Yarrow are in use ^{have been} today, although some/ relegated to subspecific status. No fewer than 16 of the 24 species of snakes that Yarrow listed, however, have since been referred to other genera.

Yarrow credits two of the ablest herpetologists of his day, E. D. Cope and S. F. Baird, with having assisted him in the identification of the species and subspecies included in his report. Moreover, Yarrow adds, Cope supplied the descriptions of the species believed to be new, and he criticised and revised the entire manuscript. With the limited knowledge of the variations and distributions of the species in the Southwest then available, some specimens would inevitably be erroneously identified. In some / instances species remained to be recognized and described long after they had been represented in collections. Others were so inadequately described earlier in the century that naturalists were sometimes misled in their efforts to apply names. Thus we find Yarrow listing eight specimens from Arizona and New Mexico as examples of the Texas horned lizard, Phrynosoma cornutum, whereas two other /obtained in "southeastern Arizona" are referred to P. planiceps. An excellent plate depicting the form leaves no doubt it was a Texas horned lizard, described as P. cornutum 27 years before the name planiceps inadvertently was applied to the same species.

Ontogenetic changes in proportions and more especially in the patterns of some of the lizards led to their misidentifications. There is no reason to question the identity of the 18 specimens, including five from Santa Fe, that Yarrow lists as collared lizards, Crotaphytus collaris. One additional specimen from Santa Fe, however, is identified as the reticulate collared lizard, C. reticulatus. Decades later it finally became apparent that this species is restricted to the Lower Rio Grande Valley of southern Texas and the adjacent states in Mexico. As late as 1900, however, Cope could cite only two specimens of C. reticulatus, both from near Laredo, Texas. He must have become aware of / identification, which had escaped Cope's attention / 25 years earlier. For Cope (1900:255) observed that "Any approach to the reticulation described is never seen in collaris, except in very young specimens---" It seems virtually certain that Yarrow was misled / astray when he compared five adult or subadult collared lizards with a juvenile, and concluded that the juvenile belonged to another species.

Some of the specimens listed by Yarrow in 1875 were assigned to other example, species by Cope in 1900. For / Yarrow listed "2 Y" (presumably meaning two young or juveniles) from San Ildefonso under the name Phrynosoma cornutum. Cope (p. 436) listed them under the same name, whereas two others/obtained at the same place that Yarrow had by Cope to another species, P. modestum. at approximately the same time were referred/ The roundtail horned lizard, P. modestum, which Yarrow failed to recognize, has recently proved to be represented as far north as Bandelier National Monument. Hence it could have occurred near San Ildefonso a century ago, and it may be gratuitous to assume that the population there was exterminated. Reeve (1952:870) evidently found one of Yarrow's specimens still extant, but two other localities plotted on his map (fig. 4) are not substantiated in his text.

It is appreciably more difficult to explain Cope's records of the Texas horned lizard, P. cornutum, in the upper Rio Grande Valley, where Yarrow and others collected. For in addition to San Ildefonso, Cope included Santa Fe, Abiquiu, and Taos in his tabulation of sources. Within recent decades, however, the species seems not to have been taken north of Albuquerque on the Rio Grande drainage. In the plains east of the Sangre de Cristo Mountains the Texas horned lizard is relatively abundant as far north as most of Kansas, and records for southeastern Colorado have been verified. Nevertheless, Cope's record of P. cornutum from "Pagosa Archuleta County, Colorado, has been rejected for valid reasons, and Conant (1975) of New Mexico omits this record, as well as those for the upper Rio Grande Valley from his map. Reeve (1952), who plotted the four localities mentioned ~~noted~~ above, credits their source to Van Denburgh (1924). No specimens were cited by either author to substantiate the records. Cope, however, noted that he, Yarrow and another naturalist, W. G. Shed, who participated in the Wheeler expeditions, were the collectors/ of the Taos specimen. It is impossible to say whether it was misidentified or carelessly labelled, although it seems most improbable that P. cornutum would have been taken north of Albuquerque at four localities where it has not been taken or reported since.

Yarrow's identifications of the garter snakes that had been obtained in New Mexico were equally confused. He indicates that three species were obtained at San Ildefonso, namely the species now recognized as Thamnophis elegans, T. sirtalis, and T. marcianus. The first two are readily found in the area today, but the third species, marcianus, which ranges northward to Kansas east of the Sangre de Cristo Mountains, has not been found north of Albuquerque on the Rio Grande drainage. A third species, the blackneck garter snake, T. cyrtopsis, though mentioned by Yarrow as "not seen," is among the snakes most commonly seen around San Ildefonso today. Without additional information one might suspect that T. cyrtopsis had replaced T. marcianus in the upper Rio Grande. Ruthven (1908:62) left little doubt, however, that Yarrow had failed to recognize cyrtopsis. Two specimens in the United States National Museum, Nos. 8416-8417, from San Ildefonso, although labeled marcianus and so listed by Cope (1890:1046), are actually T. cyrtopsis.

As might be expected, most of the reptiles that Yarrow reported for San Ildefonso are the relatively abundant, widely distributed species currently inhabiting the area. In addition to the three species of garter snakes, Yarrow reported one bullsnae, Pituophis melanoleucus, and a western hognosed snake, Heterodon nasicus. In view of the occurrence of two species of rattlesnake, Crotalus atrox and C. viridis in the vicinity of San Ildefonso, it seems odd that the only rattlesnakes from New Mexico mentioned by Yarrow were taken in the northwestern portion of the state. Lizards commonly abroad and foraging during the day, were more readily found than snakes, and not surprisingly Yarrow obtained specimens of the lesser earless lizard, Holbrookia maculata, the collared lizard, Crotaphytus collaris, and two species of horned lizard, the relatively ubiquitous short-horned lizard, Phrynosoma douglassi and the roundtail horned lizard, P. modestum. As noted earlier, P. modestum may not occur in the immediate vicinity of San Ildefonso today, although it is known to inhabit an area ^{that extends into} ~~near~~ the southern boundary of Bandelier National Monument, less than 15 km to the southwest of San Ildefonso.

It proves to be impossible to verify the occurrence at San Ildefonso of other species reported by Yarrow, who must have misidentified some of the relatively nondescript lizards now abundant and easily obtained in the area. Yarrow lists fence lizards, Sceloporus undulatus, from other areas, including one from Taos now regarded as a valid subspecies, S. u tristichus, which occupies most of central New Mexico. This race of the fence lizard is perhaps more commonly seen around San Ildefonso than other lizards, Although Yarrow failed to list it, it is improbable that he failed to see it. Similarly, Yarrow listed no tree lizard from San Ildefonso, ^{the nominate subspecies,} Urosaurus o. ornata, although/ inhabits rocky areas and cliffs in the immediate vicinity. One can only guess whether Yarrow confused one or both of these species with the side-blotched lizard, Uta stansburiana, specimens of which are listed for both San Ildefonso and Tierra Amarilla, although the species is not found even as far north as Bandelier National Monument. Yarrow could scarcely have been expected to apply the correct name to the whiptail lizard he listed as "Cnemidophorus octolineatus" for whiptails continued to be erroneously identified by most herpetologists until recent decades. The lizard Yarrow obtained may have been either C. neomexicanus or C. velox.

What Yarrow had to report concerning the Gila monster, Heloderma suspectum, however, reveals how little was known about the distributions of reptiles at this stage in the herpetological exploration of the Southwest. Yarrow expected to find Gila monsters at San Ildefonso, for he states that while he was camped on the Río Grande near the village "a large lizard, presumably of this species, visited camp, but was not secured, owing to the fact that its sudden appearance frightened the packer, who supposed it to be an alligator." The nearest place where alligator could have been found was in the humid portions of eastern Texas, and to this day the nearest authenticated records for the Gila monster in New Mexico are from on the headwaters of the Gila River,/ the vicinity of Red Rock in Grant County. If Yarrow knew little about the distribution of the lizard, however, he was more seriously misinformed concerning its bite, which he described as "neither painful nor dangerous."

ANNOTATED LIST OF THE SPECIES RECORDED

Class Amphibia

Order Caudata: Salamanders

Family Ambystomatidae: Mole Salamanders

Tiger Salamander, Ambystoma tigrinum Green

Field investigations in the spring and summer of 1978, a year characterized by meager precipitation during the warmer months, failed to reveal any salamanders in the Los Alamos National Environmental Research Park. The spring of 1979, however, was characterized by unusually heavy precipitation in the area, even though ^{air} temperatures were abnormally low until the last week in May. While I was inspecting the ponds in Pajarito Canyon on June 1 air temperatures in the area during the middle of the day ranged from 11.8°C to approximately 16° C. The previous days had been warmer, with enough solar radiation reaching the ponds to raise water temperatures to levels approximating 20°C.

Tiger salamanders, as well as Rocky Mountain Toads, Bufo w. woodhousei, had evidently deposited their eggs in the pools sometime in May, and Chorus Frogs, Pseudacris triseriata, were still issuing their mating calls. The larvae of tiger salamanders were readily found in pools on both sides of the stream not far below the junction of Threemile Canyon at an elevation of 2050 m. Larvae were present in channels ~~wherever~~ wherever the current moved slowly enough to permit them to rest on the bottom without effort. There was a tendency for larvae in the deeper ponds to form aggregations near the margins where the water was presumably warmer. The greatest concentrations, insofar as I could determine, were in the shallow ponds, roughly 10 to 15 cm in depth. Large numbers of larvae inhabited the ponds farther down stream, roughly two km northwest of the outskirts of White Rock.

The larvae captured on June 1 included one with a head-body length of 22 mm, with limbs in rudimentary stages of development. The majority of the larvae obtained

were appreciably larger, with well developed limbs and head-body lengths of at least 38 mm; overall lengths ranged from 70 to 80 mm. I was unable to obtain additional ^{specimens} of the smaller larvae, but the disparity ^{in length} between the one obtained and the minimum dimensions of the others leaves little doubt that tiger salamanders had initiated their breeding activities weeks earlier, with at least two migrations to breeding sites in Pajarito Canyon.

Only one adult salamander was discovered in the area on June 1. It had found shelter beneath a large, thick wooden disk that had been rolled into the channel near the upper end of a pool where the water was shallow. The disk was resting on coarse ^{outer} grass, and the salamander was at least 60 cm from the ^{small} edge of the disk, not far from the stream of water that flowed into the pool. The salamander seemed to be healthy although it was abnormally thin. It may well have participated in the mating activities at an earlier date, but its emaciated condition can probably be attributed to the abnormally dry terrain resulting from the subnormal precipitation ~~precipitation~~ the previous summer. Adult tiger salamanders are seldom encountered on the surface except at the time of the year when they are en route to breeding sites or engaged in the brief courtship that precedes the deposition of their eggs. Little is known about their foraging activities, but ^{ordinarily} salamanders would not be expected to be abroad and active, even at night, unless the surface was wet or with showers continuing. Unlike many species of lungless salamanders (or the family Plethodontidae) that find shelter in moist situations, either in rotting logs or under rocks, boards or logs, tiger salamanders must normally avoid the loss of moisture by seeking cover in the burrows of animals, where the relative humidity commonly approaches levels of 95%, even in arid regions.

Perhaps the adult found under the wooden disk was too emaciated to find shelter in normal fashion. It had an overall length of 186 mm and head-body dimensions of 98 mm, proportions similar to ^{those of} adult salamanders in the general area.

Eleven larvae obtained in the same ponds on June 26 were roughly the same size as the larger larvae found on June 1. They varied in head-body lengths from 30 to 43 mm, with overall dimensions that ranged from 65 to 83 mm. The pond that had contained the greatest concentration of larvae on June 1 was now almost dry. Many larvae had presumably moved to the stream, remaining in the areas where the current was sluggish, and there were larger concentrations of larvae in the ponds farther down the stream. The water in the lower ponds was much deeper, and cooler (little above 16°C) than it had been in the shallower ponds more than three weeks earlier.

By the end of the first week in July many larvae in the upper ponds and the adjacent stream had metamorphosed. On July 7 Mr. William Atkins, ~~who lives in White Rock~~ ^{from his home in White Rock}, telephoned me in the evening to report that a relatively heavy rain had fallen in the area that afternoon. I asked Mr. Atkins to inspect the road driving his car slowly up the pavement, by / at least as far as the upper ponds. Later in the evening Mr. Atkins reported that he had discovered transformed tiger salamanders crossing the road, along with hordes of recently metamorphosed Rocky Mountain toads, Bufo woodhousei, another species of toad, Bufo punctatus not previously encountered in the area, and a spadefoot toad, Spea multiplicata. Two recently transformed salamanders found leaving the ponds had head-body measurements of 56 and 62 mm, respectively, roughly two thirds the size of the adult individual obtained on June 1. When environmental conditions force tiger salamanders to dispense with their gills and shift to terrestrial habitats it is plainly advantageous for them ^{be able to} to complete their growth on land.

When the few upper ponds that remained were visited again on July 26, tiger salamanders were still present in moderate numbers. Some of them retained conspicuous gills, others only vestiges, but at least half of them had completely transformed. The water was so shallow, seldom more than 20 cm in depth in the deepest portions, that its exposure to solar radiation had resulted in its reaching levels of 34.0° to 37° C. At such temperatures larvae with or without gills were making frequent

forays to the surface to gulp air. The dimensions of three salamanders obtained on July 26 differed little from those of the two transformed individuals Mr. Atkins had found on the road on July 7. One that retained vestiges of gills had head-body measurements of 62 mm and overall dimensions of 117 mm. The other two, which lacked gills as well as the tail fins lost at metamorphosis, had ^{nearly identical} head-body measurements of 57 mm; the tip of the tail was missing on one, but the other had a head-body length of 85 mm.

Whereas the adaptability of tiger salamanders may permit the larvae of the population breeding in Pajarito Canyon to transform at head-body lengths of 50 to 60 mm, an abundance of summer rain may often permit them to delay their metamorphosis and continue foraging in their aquatic habitat until September or October on favorable years. I have seen transformed tiger salamanders with head-body lengths barely exceeding 50 mm that were taken on the east side of the Rio Grande, at Rio en Medio and Nambe. Limited data for other populations in the general area, however, suggests that tiger salamanders under favorable conditions transform at dimensions comparable to those of the adult found in Pajarito Canyon. On ~~June~~ ^{June} 19th 1979, Dr. Philip L. Shultz provided me with a large larva taken the day before in the fish pond maintained near the Shultz residence in Tesuque. This large larva was maintained in a small aquarium, into which I introduced the two transformed salamanders Mr. Atkins found on the road in Pajarito Canyon on July 7. Two days later it became evident that the larva from Tesuque was losing its gills, which disappeared in three or four days. The tail fin was ^{noticeably} ~~markedly~~ reduced a few days later, but the changes in pigmentation that began to reveal a pattern approximating those of adults in the area required at least 15 days. The much larger size of this larva may be attributable to its having remained in the fish pond throughout the winter. Dr. Shultz informs me that the pond was not drained, and this larva may have emerged from an egg deposited in late winter or early ^{in the} ~~in the~~ spring of 1978.

Transformation of tiger salamander larvae under natural conditions probably is most often initiated by the shrinkage of ponds, or more directly by the depletion

of the oxygen supply as the temperature rises in increasingly shallow water. It is improbable that depletion of oxygen in the aquarium induced the transformation of the Tesuque larvae. Under the conditions observed in Pajarito Canyon, however, it is plain that transformations triggered by deficiencies of oxygen in breeding ponds would greatly enhance the chances of survival of tiger salamanders whenever rainfall became deficient during the summer. It may be added that when the Tesuque salamander was preserved following its metamorphosis it had an overall length of 180 mm, and a head-body length of 99 mm, thereby approximating closely the dimensions of the adult from Pajarito Canyon.

Few salamanders tolerate the extremes of environmental temperature now reported (1943) for tiger salamanders. McClure found literally thousands of salamanders (presumably of the same subspecies, Ambystoma t. mavortium, inhabiting the eastern half of New Mexico) participating in what seemed to be a breeding migration in western Nebraska. The migration began on March 11, and reached its peak on March 12, when the mean air temperature was 3.9°C, and continued during a snow storm the following day when the air temperature was "below or just above freezing," with a mean of 1.7°C. Aside from coming to the surface to gulp air, the salamanders observed in the shallow pools in Pajarito Canyon on July 26, showed no sign of discomfort while foraging in water that reached 37.0°C.

Tolerance of such a wide range of environmental temperatures has permitted tiger salamanders to occupy habitats from near sea-level to/at least 3000 m. Dunn (1940) regarded Ambystoma tigrinum as an extraordinarily adaptable species, with a disjunct distribution that extends from coast to coast in the United States. The very adaptability of tiger salamanders, ontogenetic changes, and meager samples of adult specimens from many parts of their range, have made it difficult to diagnose and define subspecies. Several have been recognized although insufficient data have been available to plot their distributions with much precision west of the Great Plains.

Gehlbach (1965) has discussed some of the problems arising from the variations encountered in dealing with tiger salamander populations in northwestern New Mexico. Neoteny, or the retention of larval characters for prolonged periods, as well as paedogenesis, or breeding while retaining larval peculiarities, have further complicated efforts to define the subspecies in that part of the state. The situation may not be quite so complex in the populations inhabiting the area around the head waters of the Río Grande. It is evident, nevertheless, that recent handbooks have greatly oversimplified the distributional picture in this portion of the state.

All populations of Ambystoma tigrinum in the eastern half of New Mexico are commonly assigned to the subspecies mavortium, known as the "Barred/Salamander." This name seems appropriate enough for the salamanders inhabiting the lowlands east of the Río Grande, at least from Río en Medio, Nambe, Tesuque, and Santa Fe. The tiger salamanders obtained in the Jemez Mountains, however, would more aptly be described as being spotted. Tiger salamanders taken at higher elevations in the Brazos Mountains, which are separated from the Jemez Mountains to the south by the lowlands along the Rio Chama, are even more distinctive. On successive years samples of the tiger salamanders breeding in a pond eight kilometers south of Hopewell Lake in Río Arriba County proved to be uniformly slate gray on the dorsum, paler on the underside, but devoid of any markings remotely resembling the bars or spots of populations in the Jemez Mountains. The breeding pond in the Brazos Mountains lies at an elevation somewhat above 2,800 m. Conceivably populations in the lowlands or foothills with characters that might be construed as intermediate may be discovered. Equally possible, however, the alpine populations may prove to be genetically isolated from those south of the Río Chama, and warrant recognition as a distinct species. Reliable conclusions can scarcely be reached, however, until detailed studies have been made of their breeding habits, behavior, and ontogenetic changes in representative populations both north and south of the Rio Chama. Pending such studies nothing is to be gained by applying subspecific names to tiger salamanders on the Río Grande drainage.

Family Plethodontidae: Lungless Salamanders

Jemez Mountains Salamander, Plethodon neomexicanus Stebbins and Riemer

Two of the three species of salamanders known from New Mexico are lungless inhabitants of montane forests. One of the two species is known only from a few isolated populations in the Sacramento Mountains. The other is not only endemic to the Jemez Mountains, but restricted to a relatively small area centering around the Jemez Caldera. Other amphibians and reptiles inhabiting these mountains are widely distributed elsewhere, but the distribution of the Jemez Mountains Salamander is so restricted that the New Mexico Department of Game and Fish has valid reasons for regarding this amphibian as a 'threatened species.'

Reagan (1972), who studied the ecology of P. neomexicanus, managed to find the species in only seven of 41 sites where he had hoped to find it. He obtained specimens no farther west than the Seven Springs Fish Hatchery near the edge of the Caldera. Williams (1978), whose extensive studies of reproduction in this salamander revealed that females remain gravid for two years prior to oviposition, reports that ~~the~~ ^{now known} species is / from 25 sites, 18 in Sandoval County and five in Los Alamos County. I have seen specimens / ^{obtained in} Medio Dia Canyon at an elevation of approximately 2400 ^{the} m on southern flank of the Caldera, but little effort seems to have been made to ascertain how far north ~~the~~ range of the species extends. Much of the area is not readily accessible, but it seems probable that the distribution may prove to extend northward into Río Arriba County. It would not be surprising if a disjunct population proved to be represented on Tschicoma ('Chicoma' on Forest Service maps) Mountain, where habitats closely resembling those in the Sierra de los Valles are readily found. Williams indicates that the records in Sandoval and Los Alamos counties range from 2194 to 2743 m.

I managed to find the Jemez Mountains Salamander at only two sites, both of them in Los Alamos Canyon. On 24 June 1976 I found two specimens no more

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than 30 m above the Los Alamos Reservoir at elevations only slightly above 2300 m. One was discovered inside a wet, well decomposed log within five minutes after I began the search. The second one was not encountered until somewhat more than an hour later. Both salamanders were in logs resting on moist terrain, one within three meters of the stream and the other on a hillside roughly 25 m from ~~a pool where the stream, was partially dammed~~. The canyon above the reservoir is steep-sided, and densely covered ^{mainly} with quaking aspen, Douglas fir and Engelmann spruce, as well as shrubs and forbs. The air temperature at mid-day in the canyon hovered around 18°C but the moist, rotting wood in the log where the second salamander was found had reached a level little above 12°C.

Two days later, on 26 June, I attempted to find the species on the same drainage, but on slopes ^{at elevations} 2700 to 2850 m above the Los Alamos Reservoir. The area selected was on the northeastern flank of ^{sea-level, over 400 m, higher than} Pajarito Mountain, near the divide along the Sierra de los Valles that separates the Caldera drainage from the head waters of Los Alamos Canyon. I spent more than an hour in a well forested area, overturning logs and occasionally rocks. Many of the logs seemed to be sufficiently wet and decomposed to provide shelter for lungless salamanders, but none could be found. ^{on 10 July,} Two weeks later, after rain had fallen the previous day, I returned to the same area with Edward Collins, Keith Diezantanner, and Leon Fisher, all of whom are ^{employees of} the United States Forest Service. Mr. Collins found a salamander shortly after we began overturning logs at an elevation of approximately 2700 m, when the air temperature had reached 22.8°C at 9:50 a.m. At least seven salamanders were encountered within the next half hour as we worked our way up a relatively steep slope to a level approaching 2850 m. ^{taken time to} We might well have found more specimens had we not recorded [^] the temperature of the rotting wood adjacent to each salamander as soon as it was uncovered. Seven temperatures recorded all fell between 13 and 14°C, closely approximating the range Reagan (supra cit.) reported for a much larger sample.

When I returned to the area on 26 July, I had the assistance of Russell Holbrook,

but a prolonged search failed to reveal any salamanders. The immediate area received little moisture during the ensuing weeks when precipitation was below normal. Nevertheless I had relatively little difficulty in finding moist logs on the slope when ^I again returned on 24 August, even though no salamanders could be found. It seems probable that ^{their} surface activity is largely restricted to nights during or following the receipt of enough rain to saturate the surface. Neither Reagan nor Williams mentions having seen P. neomexicanus on the surface at night. Reagan's examination of the stomach contents of 39 salamanders, however, revealed a diet consisting of an assortment of in-vertebrates, including some that would have ^{been expected from} / nocturnal foraging, whereas others would probably have been found and consumed while the salamander was underground.

Our failure to find salamanders on three of the four occasions when we tried to find them on the slopes of Pajarito Mountain points to the probability that these ~~amphibians~~ are induced to approach the surface only when it is saturated. The unusually slender habitus of P. neomexicanus presumably facilitates movement in crevices, not ⁱⁿ only ⁱⁿ piles of fragmented rock below the surface, but in rotting logs as well. The body diameter of the six salamanders obtained on 10 July varied from 10 to 12 percent of the length from snout to vent, which ranged from 62 to 67 mm. If a slender body is advantageous to salamanders that habitually forage in subterrestrial crevices, it could be disadvantageous in dry climates. The increase in the ratio of the surface to mass accompanying the elongation of the trunk implies that more skin is exposed to evaporation. Inasmuch as the skin is the principal organ of respiration in lungless salamanders, their very survival depends upon the maintenance of a moist integument. Unless the atmosphere on the soil surface is saturated, therefore, the Jemez Mountains Salamander can most readily avoid desiccation by retreating to ~~habitats~~ beneath the surface where any air encountered is likely to be saturated with moisture.

The very specializations that enhance the movements of P. neomexicanus in subsurface habitats, therefore, impose limits on surface activity. These limitations are reflected in other specializations. The eggs have not been found in the salamander's natural environment, but Reagan offers the valid suggestion that they are probably deposited in cavities in the talus beneath the litter on the forest floor. Williams notes that seasonal activity is largely restricted to June, July and August. The adaptive specializations of the female that permit her to deposit eggs every other year presumably compensate for the restrictions imposed by seasonal changes in the temperature in fir-spruce habitats at elevations that range from 2200 to well over 2800 m.

from the Jemez Mountains

Various authors have realized that salamanders/tentatively identified as "Eurycea multiplicata" were mentioned at least fifty years ago (Reagan, 1972) even though Plethodon neomexicanus was not described until 1950, by Stebbins and Riemer. An earlier reference to the species, as well as to other amphibians and reptiles, has been generally overlooked. Under the heading "Spelerpes multiplicata Cope (?)" Henderson and Harrington (1914) report: "We found a small salamander rather common under aspen logs near Valle Grande, in the Jemez Mountains. Specimens badly injured in transit were doubtfully identified as this species by Dr. Leonhard Stejneger. The Indians to whom it was shown were not familiar with it and had no name for it."

Order Anura: Tailless Amphibians, Frogs and Toads

Family Pelobatidae: Spadefoot Toads

New Mexico Spadefoot, Spea multiplicata Cope

Adult spadefoots are likely to be seen or heard in northern New Mexico only when they form breeding aggregations in pools formed by drenching summer rains. The minimum amount of rain required to induce spadefoots to venture to the surface long enough to mate and deposit their eggs must approximate 20 mm. Until data have accumulated over a period of at least a decade, however, no precise figure can be given. I found no evidence of any breeding on the Pajarito Plateau by spadefoots during the summer of 1978. Their breeding is as sporadic and uncertain as the rainfall in many arid and semi-arid portions of the West.

Spadefoots are usually encountered in open, more or less sandy terrain, often in flood plains. In the Peloncillo Mountains in the extreme southwestern corner of New Mexico, spadefoots shun the canyons and breed where water accumulates below the alluvial fans. Even though these toads can be heard calling occasionally around Santa Fe at elevations of 2200 m and sometimes breed in the stock tanks on La Bajada Mesa west of the city, it was uncertain whether the genus Spea would prove to be represented in the foothills of the Jemez Mountains.

All doubt was removed on the evening of July ¹⁹⁷⁹ 7, however, when Mr. William Atkins found a specimen of S. multiplicata near the pools in Pajarito Canyon/not far below the junction of Threemile Canyon. The spadefoot was crossing the paved road in the evening after a relatively brief but heavy rain had fallen at dusk. The ponds at the site of capture had formed weeks earlier, and they were surrounded by a dense growth of grass and weeds, unlike the open ponds where spadefoots ordinarily ~~are known to breed~~. The spadefoot taken on the road was a female that had already ovulated when I examined it the following day, for the eggs were visible through the thin translucent skin of the abdomen. When I investigated the pools on 8 July in the area adjacent to the site where the female had been captured, I was unable

to find eggs in any of the pools. Unlike breeding sites in many areas frequented by breeding spadefoots, the water was clear, although plants were present in shallow areas. Tadpoles of the Rocky Mountain Toad, Bufo woodhousei had been thriving in these ponds for several weeks, but no tadpoles of spadefoots were ever detected even though I examined these ponds at ~~regular~~ intervals until the end of September. Plainly the female found near the pools on July 7 was prepared for amplexus and deposition of her eggs. It seems highly unlikely that other spadefoots were ^{not} aroused by the same downpour that brought at least one female to the surface. Perhaps the amount of rain that fell in Pajarito Canyon barely reached the threshold of the minimum required to stimulate breeding activity in this population of Spea multiplicata. The precipitation was appreciably below normal during June and July in 1979, when over 10 cm would ordinarily approximate the mean for the two-month period.

The presence of spadefoots on the Pajarito Plateau can no longer be questioned. Much more remains to be learned about this population, however, although any effort to study these amphibians must await the advent of unusually heavy rains. Populations may well prove to inhabit most of the canyons. Such areas as the portion of Mortandad Canyon where State Highway 4 traverses it would seem to provide the relatively flat, open areas normally preferred by spadefoots. Conceivably they will also prove to be inhabitants of such flat areas as North Mesa, at least in areas where temporary pools form after thundershowers, and the soil is deep enough to allow spadefoots ^{to} burrow to the requisite depths. It would be of much interest if anyone could ascertain how far below the surface spadefoots actually descend. The adaptability of Spea multiplicata is reflected in its broad distribution, from Arizona, Colorado and the Panhandle of Oklahoma southward through western Texas and Mexican Plateau to the Valley of Oaxaca in southern Mexico. Its distinctive mating call in populations inhabiting the Mexican state of Jalisco is indistinguishable from calls heard in New Mexico. The call of S. multiplicata in Oaxaca is similar although spectrographic analysis reveals minor differences.

The spadefoot toads of California are superficially similar to the spadefoots east of the Colorado River, including populations in New Mexico, and until recently they were all referred to Scaphiopus hammondi. The situation in New Mexico, Arizona, and elsewhere was confused owing to the hybridization between the spadefoots then called S. hammondi and the Plains Spadefoot, S. bombifrons where they occurred sympatrically. The situation was clarified by Brown (1976), however, after he had investigated the morphology, reproduction, breeding behavior (including mating call structure), and the genetic compatibility of populations on opposite sides of the Colorado River.

Brown found marked differences in the breeding habits, mating calls, thermal adaptations, as well as morphological differences when he compared allopatric populations. With considerable justification, therefore, Brown found it desirable to recognize populations in California and Baja California as belonging to the species that Baird had described from Californian specimens in 1839 as Scaphiopus hammondi. The populations from Arizona and New Mexico eastward into Texas and western Oklahoma, with a distribution extending southeastward as far as the east end of the Valley of Oaxaca in Mexico, were assigned to S. multiplicatus; this name had been applied by Cope in 1863 to specimens from "Valley of Mexico," later restricted to Coyoacán, in the Distrito Federal of Mexico. Although populations have inevitably diverged in external morphological characters, including coloration and markings, the mating calls of specimens at the southern extremity of the range are readily identifiable by anyone who has listened to choruses of the species in New Mexico. The specimens obtained in Pajarito Canyon had a reddish spot on each side of the anus. Similar, virtually identical markings were noted on specimens from Chapala, in the Mexican state of Jalisco, where these amphibians varied extensively in color, with extraordinarily dark individuals occurring in areas once probably covered with black volcanic ash. It remains to be ascertained whether this distinctive marking occurs consistently throughout the range of the species.

Family Bufonidae: Toads

Woodhouse's Toad, Bufo woodhousei Girard

No toads were seen in 1978 until 17 September, on the morning after a few millimeters of rain had fallen the previous night. An adult Woodhouse's Toad was found under a log at 9:45 (daylight-saving time) approximately two kilometers above the junction of the north fork of the Cañada del Buey. The soil under the log was dry, but evidently the toad had absorbed considerable moisture from wet surfaces for the contents of its bladder were expelled in repeated jets.

Woodhouse's Toad was breeding in Pajarito Canyon at least as early as the middle of May in 1979, for tadpoles of ^{the species} / were abundant in the pools below the junction of Threemile Canyon on June 1. These pools were at an elevation of 2040 m., but pools from two to three kilometers farther downstream also contained tadpoles. During the ensuing weeks tadpoles diminished in abundance, presumably from predation by Wandering Gartersnakes, Thamnophis elegans and other animals, although tadpoles were leaving the water as they metamorphosed. After a moderately heavy rain on the afternoon of 7 July numerous immature toads were leaving the ponds, and presumably fanning out in all directions in search of feeding sites. Those most readily detected were on the paved road to the north of the ponds, moving toward the edge of the Mesita del Buey. Adult toads were inexplicably difficult to find although one large female was dead on the bank of the pool first examined on June 1. Two other adults were seen, one at the edge of the water in the uppermost pool, and another on the bank of a stream in a deep channel near the lowest pools.

Even though I failed to find the eggs of B. woodhousei, the breeding initiated in May must have continued for well over a month. Tadpoles were still to be found in the pools that persisted on the north side of the road at least as late as 14 August. Transformed toads were leaving the pools through most of July and August.

Virtually nothing seems to have been recorded concerning the distances travelled
 In mid-morning on 30 August
 by immature toads dispersing from breeding sites./ an immature toad found on the
 north slope of the Mesita del Buey perhaps a kilometer northwest of Tshirege Ruins
 had almost certainly come from one of the breeding ponds in Pajarito Canyon. This
 small toad was active, presumably foraging, on the north side of a perpendicular
 outcrop, where the ground was moss-covered and moist from seepage. The toad taken
 in 1978 was found at least five kilometers to the northwest, in the bottom of the
 Cañada del Buey. I investigated this canyon from its mouth to the upper reaches of
 both of its branches without ever discovering any place where pools providing suitable
 breeding sites for toads might have formed. Their occurrence in the Cañada can most
 readily be explained, therefore, if it be assumed that each of these two toads had
 clambered up the talus on the south side of the Mesita del Buey, which they crossed
 before they descended into the Cañada. The one in the bottom of the canyon might
 have travelled three or four / kilometers over rough terrain to reach the site where
 found it.

on 30 August

A somewhat smaller, more recently transformed toad was found/in Mortandad Canyon
 in the humid, densely shaded area where it narrows to a few meters in width at an
 elevation of nearly 2050 m. No breeding sites could be found at the time, but suitable
 pools perhaps existed in the immediate area earlier in the month. Woodhouse's toads
 must be widely distributed below the 2000 m. contour throughout the upper Río Grande
 area, for they appear in truck gardens, green houses, or around lawns, almost where-
 ever water becomes available on the surface. They are likely to be seen in large
 numbers when recently transformed young are leaving breeding sites after heavy rains,
 although the adults are occasionally plentiful under such conditions. Miss Chris
 Judson, who is familiar with Woodhouse's toad in Bandelier National Monument, informs
 me that when she visited the stream in Pueblo Canyon one evening after a heavy rain
 many adult toads of the species were abroad in the area. Woodhouse's toad is widely
 distributed, from Massachusetts to parts of Washington, Oregon, and southeastern
 California. Subspecies are recognized, but the mating call varies from one local
 population to the next, and few morphological characters are consistent.

Red-spotted Toad, Bufo punctatus Baird and Girard

Of the 18 species of the genus Bufo in the United States, only the Red-spotted toad is adaptively specialized for arid environments. It is primarily an inhabitant of deserts, desert grassland, and the foothills of mountains bordering the deserts. It is less often seen in floodplains of washes than in rocky canyons. The flattened head and body of the species can be construed as adaptations that facilitate its seeking shelter in crevices. This toad ordinarily breeds in pools of intermittent streams, in reservoirs and cattle tanks. The only specimen obtained was a female in breeding condition that was found on the road near the ponds in Pajarito Canyon at an elevation of ca. 2000 m. It was abroad in the evening after rain had fallen late in the afternoon of 7 July. Despite the presence of this one female in the vicinity of the ponds, no evidence could be obtained that B. punctatus ^{had} succeeded in breeding, either in 1979 or ^{during} the previous year. Numerous transforming toads were in and around the pools, but all of them were readily identifiable as B. woodhousei.

Despite the scarcity of Red-spotted Toads on the surface on years with subnormal summer precipitation, it seems probable that the species will eventually prove to inhabit many canyons in the ^{Pajarito Plateau that} ~~the/drain~~, into the Rio Grande. This river has undoubtedly been the main avenue of dispersal, although Red-spotted Toads may not occur much farther north than Espanola in this drainage. Such toads cannot be expected much above the 2000 m level, and they shun heavily forested areas as well as humid climates. On the whole they are restricted to semiarid portions of Utah, and Colorado, ~~Kansas~~, ^{and} ~~at the~~ northern edge of their range, ^{Farther south the range extends} from the deserts of California eastward to Texas, mainly west of the 100th Meridian, and thence southward in the arid and seasonally dry portions of Mexico as far as the state of Hidalgo.

The individual obtained in Pajarito Canyon is relatively large for the species, with a head-body length of 58 mm. Larger specimens have been recorded, and some populations, notably the one inhabiting Zion Canyon and adjacent parts of southwestern ^{Utah,} are conspicuously different in their morphology as well as in their mating calls.

Family Hylidae: Treefrogs and close relatives.

Canyon Treefrog, Hyla arenicolor Cope

Contrary to the implications of the vernacular name, this 'treefrog' is rarely seen in trees. In most parts of its range it is mainly an inhabitant of of boulder-strewn canyons, particularly those with permanent streams. Ordinarily it can be found resting on the cliffs or boulders bordering streams, where their color and markings permit them to blend into their surroundings. H. arenicolor has been reported from canyons in Bandelier National Monument at elevations ranging from 1700 to 2000 m, and a series in the collection of the University of New Mexico was obtained near the mouth of Ancho Canyon within the boundaries of ~~LA/NERP~~ at an elevation of ca. 1650 m. One found in this area on 20 September, 1979 was resting on a boulder in the Rio Grande not far from the edge of the stream. I had expected to find this frog/in Sandia Canyon, where the stream, which continued to flow throughout the summers of 1978 and 1979, is bordered by bedrock or boulders. No frogs were ever found in Sandia, but they were finally discovered in other canyons, where they seemed to shun boulders.

One taken on the morning of 16 June was in the stream that emerges from the walled portion of Pueblo Canyon. Mr. William Atkins and I were searching for toads in the tall grass that grew in the shallow water bordering the stream, when an adult female Canyon Treefrog landed in ~~open area/~~ pool. Mr. Atkins had a glimpse of the frog just before it jumped, and it apparently had been clinging to grass nearly a meter above the water. Ten days later I found an adult female in Pajarito Canyon at an elevation of 2000 m and it too was some distance away from any rocks or boulders. It was in short, relatively sparse grass near the edge of a shallow pool. A few minutes ^{later,} /shortly after 9:00 a.m. (Mountain daylight saving time) I discovered a pair of H. arenicolor in amplexus. They were resting on a sandy bottom in water from 10 to 15 cm in depth, at a temperature of 14.5°C. Upon my return to my laboratory that evening I placed this mated pair

in a small aquarium, with enough water in the bottom to permit them to submerge.
 on 27 June,
 When I looked the following morning the female had deposited her eggs. The species
 had evidently bred at an earlier date in the same ponds in Pajarito Canyon, for
 an incompletely transformed individual only 18 mm in head-body length, and with
 conspicuous vestiges of a tail, was found only a few meters away from the pair
 in amplexis.

The male of the mated pair measured 47 mm from snout to vent, and the female
 53. The other female from Pajarito Canyon obtained on 26 June measured 51 mm,
 only a millimeter more than the adult female found near the mouth of Pueblo Canyon.
 More treefrogs might have been found if the area had received appreciably larger
 amounts of precipitation in July or August. Gehlbach (1965), who studied populations
 of this hylid in northwestern New Mexico, suggests that it may have two or more
 breeding seasons in that area. Heavy July rains initiated the issuance of mating
 calls ~~in pools~~ where no H. arenicolor had been observed previously. Gehlbach ob-
 serves that these treefrogs often breed in potholes shared with the larvae of toads,
 leopard frogs,
Bufo woodhousei and Rana pipiens. Thus far the presence of leopard frogs in LA/NERP
 has remained unsubstantiated, but the treefrogs were associated with Bufo woodhousei
 in their breeding activities.

The Canyon Treefrog occupies an extensive range, from Colorado and Utah
 southward on both sides of the Continental Divide to the semiarid northern
 part of the Mexican state of Oaxaca. Owing to its dependence on riparian habitats
 in most parts of its range, its distribution can scarcely be continuous. These
 treefrogs are occasionally discovered far enough from streams to suggest that
 they may forage some distance away from breeding sites. In August, 1942 I was
 surprised to discover a canyon treefrog only a few ^{meters} from the summit of
 Mount Wrightson in the Santa Rita Mountains of southern Arizona. In this part
 of its range, therefore, it is evident that it reaches elevations above 2800 m.
 It is questionable whether it reaches levels much above 2000 m on the Pajarito
 Plateau.

Striped Chorus Frog, Pseudacris triseriata Wied

Few other frogs in the United States are quite so widely heard and yet so seldom seen as the chorus frogs. Under exceptional circumstances, particularly during the early spring when they are occasionally found breeding in the runoff from snowbanks, they call from open terrain. Later on, by day as well as by night, males are more often heard issuing their mating calls from clumps of grass or other vegetation growing in or near shallow water. Under such conditions they can be difficult if not virtually impossible to find.

I was not certain that I would find the Striped Chorus Frog on the Pajarito Plateau until I heard them calling from a shallow pond not far below the 2000 m contour in Pajarito Canyon on the morning of 1 June 1979. The site was typical for the species, for the frogs were well concealed in the clumps of vegetation. Males ~~calling~~ ^{their} calls were scattered around the middle of a pond roughly 20 m. in width, in which the water had reached 20°C. It was a relatively small chorus, with perhaps no more than 25 males participating. They called sporadically when one, prompted by some obscure stimulus, would soon be joined by others in the vicinity. The mating call of this species is not so penetrating as that of other members of the family Hylidae, and I would doubt that this small chorus would have been audible to human ears farther than 30 m from the pond. In the absence of concrete evidence that breeding was still in progress, the calls I heard on 1 June, however similar they seemed to be to the mating call of the species, may have played a significant role in the maintenance of territories. Other frogs are known to maintain their spatial configuration within breeding aggregations, with individuals in a chorus spaced at astonishingly uniform distances (Bogert, 1960). Frogs are almost invariably scattered, rather than concentrated in any one part of a breeding pond. Otherwise collectors, as well as predators, would have fewer difficulties in obtaining large samples. My efforts to find even one chorus frog in this breeding aggregation proved to be fruitless.

When I first visited the ponds in Pajarito Canyon in 1979 it was on the afternoon of 29 April, after I had spent the morning in Pueblo Canyon, where the air temperature had reached levels little above 14°C . Shortly after noon when I reached Pajarito Canyon, clouds began to gather as a storm moved in from the east, and the air dropped to 13°C before I left in the middle of the afternoon. If chorus frogs were calling in the ponds at this time I failed to notice them. Perhaps some mating had already taken place, or breeding in this population ~~could have been~~ initiated in May. Otherwise it would be difficult to account for my having found three recently transformed chorus frogs on 26 June. These were found in pools two or three kilometers below the pond where Pseudacris was calling on 1 June. These three frogs, with head-body measurements of 17, 18, and 22 mm, respectively fall within the range reported for adults of the species, from 19 to 38 mm. Recently transformed chorus frogs were not detected in the pond where ~~they~~ were calling on June 1 until 26 July, when I found one with head-body measurements of 19 mm that was feeding in shallow water. While I watched this frog it was just below the surface in water at a temperature of 38°C , and it lunged forward repeatedly, biting at something I was unable to see.

The distribution of the Striped Chorus Frog in New Mexico, largely because of the difficulties entailed in capturing specimens to document breeding choruses readily heard in mountainous areas. In my experience these frogs are most often encountered in swamps and shallow ponds at elevations ranging from slightly below 2000 m to approximately 3000 m. Large series of chorus frogs are seldom obtained and the decision to recognize two subspecies, the nominate subspecies in the White, Sangre de Cristo and Jemez mountains, and P. triseriata maculata only along the northern border of the state should be regarded as tentative until larger samples from all parts of the range in New Mexico become available. Gehlbach (1965), who examined a few small samples from northwestern New Mexico concluded that these were intermediate and he regarded them as intergrades. Chorus frogs inhabit swamps on both sides of the Rio Grande but the Pajarito Canyon population is close to the southeastern extremity of the range that extends into the state from the north.