

THE BIOGEOGRAPHY OF A HERPETOFAUNAL TRANSITION BETWEEN THE GREAT BASIN AND MOJAVE DESERTS

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ABSTRACT

The valleys that surround the Inyo and White Mountains form a transition between the Great Basin and Mojave deserts. The amphibians and reptiles in the area are represented by five distributional tracts: southern species, wide ranging species, northern species, endemic species, and western species. Faunal resemblance factors were used to analyze the relationships of these valleys to each other and to selected sites in the Great Basin and Mojave deserts. It was found that the transition between the two herpetofaunas is gradual in the valleys to the west of the Inyo and White mountains and rather abrupt in the valleys to the east.

1 INTRODUCTION

The valleys that surround the Inyo and White Mountains are herpetologically a poorly known region. Banta (1962) reported on the Saline Valley, the only valley previously examined. These valleys are situated in a transition between the Great Basin Desert to the north and the Mojave Desert to the south. A major differentia between these two deserts is the presence of Creosote Bush (*Larrea tridentata*) in the Mojave Desert. Banta & Tanner (1964) felt that the Great Basin Desert deserved recognition as a herpetofaunal region and defined it, as Banta (1962) did, as the interior drainage lying between the Sierra Nevada and the Wasatch Mountains of Utah. For the purpose of this study, I am defining the Great Basin Desert as the high elevation desert that lacks Creosote Bush. Shadscale (*Atriplex confertifolia*), present both in the Great Basin and Mojave deserts, replaces Creosote Bush as one of the dominant plants in much of the Great Basin Scrub floral zone of the Great Basin Desert. The herpetofauna of the Great Basin Desert is mesophilic, semi-mesophilic, semi-xerophilic and xerophilic. In contrast the Creosote Bush Desert of the Mojave is inhabited by xerophilic species with the exception of a single mesophilic, spring restricted species.

There are 10 principal valleys in the Inyo and White Mountains region (Fig. 1). Three valleys to the east of the Inyo Mountains contain Creosote Bush. These, south to north, are the Panamint, Saline (Fig. 2), and Eureka valleys. Situated to the north of the Eureka Valley is Fish Lake Valley (Fig. 3), which lacks Creosote Bush. The Deep Springs Valley (Fig. 4) is an interior valley, lacking Creosote Bush, that is surrounded by the Inyo and White mountains. The Owens, Chalfant (Fig. 5), Hammil, Benton and Queen (Fig. 6) valleys run from south to north on the west side of the Inyo and White mountains. For the purpose of this study I have split the Owens Valley at Independence and refer to the four northern valleys (Chalfant, Hammil, Benton and Queen valleys) as the Chalfant Valley. In these areas, Creosote Bush is present only on the eastern side of the southern Owens Valley (Fig. 7) as far north as Mazourka Canyon, east of Independence.

The change in vegetation zones between Creosote Bush desert and Great Basin Scrub desert is mainly attributed to three factors. First, as latitudes increase in the northern hemisphere, the temperature tends to decrease. The second factor is elevation (Fig. 8). Most valley floors of the Mojave Desert are below 4000 feet; in contrast, most valley floors in the Great Basin Desert are above 5,000 feet. In the western Great Basin the northwestern Mojave Desert valleys are connected to a low elevation corridor that stretches from the Inyo and White mountains region to the Black Rock Desert north of Reno. This low elevation Great Basin corridor contains valley floors between 4,000 and 5,000

feet. Rainfall is the third factor responsible for the change in deserts. This is partially attributed to the south to north elevational decrease of the Sierra Nevada ridge line. Most of the precipitation in the Great Basin and Mojave Deserts comes from the Pacific Northwest storm systems. Subsequently, greater amounts of rainfall occur in the Great Basin Desert to the north because the rainshadow effect of the Sierra Nevada is less, and because the Great Basin Desert is closer to these northern storms.

2 METHODS

This study was conducted from March of 1983 to May of 1986. Specimens were collected with pit-fall traps, which were checked at regular intervals; by general collecting; and by road hunting. Literature records have been examined and distribution records were obtained from the American Museum of Natural History, Brigham Young University, California Academy of Sciences, Carnegie Museum of Natural History, Field Museum of Natural History, University of Kansas Museum of Natural History, Los Angeles County Museum, Museum of Comparative Zoology, Museum of Vertebrate Zoology, Nevada State Museum, Santa Barbara Museum of Natural History, San Diego Natural History Museum, University of Colorado Museum, University of California at Santa Barbara, University of Michigan Museum of Zoology, University of Nevada at Reno, University of New Mexico, and the United States National Museum of Natural History.

An analysis of the valleys that surround the Inyo and White mountains was conducted based on these distributional records and the material gathered during the field work. To delineate the boundaries of each valley, faunas extending from the valley floors to 1000 feet up the slopes of any surrounding mountains were used in the analysis. Reference points were chosen in the Great Basin and Mojave deserts based on typical habitats and herpetofaunas. In the Great Basin Desert, Pyramid Lake, Washoe Co., Nevada was selected, as it is situated at the northern extent of the low elevation western Great Basin corridor, and represents typical west central Great Basin Desert habitat. Pisgah Crater, San Bernardino Co., California, in the central Mojave Desert, provided an ideal site for this analysis because it has no Colorado, Sonoran, or Great Basin Desert restricted species. It should be noted that *Crotalus scutulatus*, *Lichanura trivirgata*, and *Salvadora hexalepis* have not been recorded from the actual site of Pisgah Crater but undoubtedly occur there or nearby.

To illustrate the relationships of the valleys to each other and to the two reference sites, two faunal resemblance factors were used. For a more detailed description of the uses of these faunal resemblance factors see Murphy (1983). The Braun-Blanquet Faunal Resemblance Factor (BFRF), emphasizes the differences between taxa of geographic regions. To calculate the BFRF, the number of species in common (C) between two sites is divided by the larger of the two samples (N_L).

$$BFRF = \left(\frac{C}{N_L} \right) 100$$

Alternately, the Simpson Faunal Resemblance Factor (SFRF) emphasizes the similarities between selected sites; it is calculated by dividing

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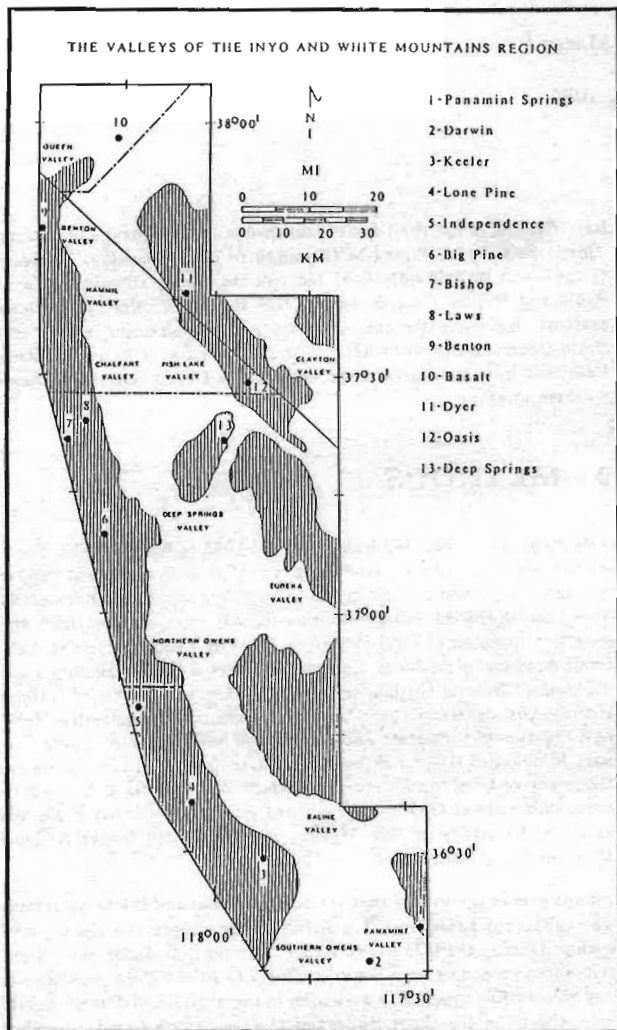


Fig. 1. The locations of the valleys surrounding the Inyo and White Mountains. Shaded areas represent valley floors.

the number of species in common (C) between two sites by the smaller of the samples (N_s).

$$SFRF = \left(\frac{C}{N_s} \right) 100$$

3 RESULTS

The amphibians and reptiles that occur in this region can be divided into five distributional tracts: southern species, wide ranging species, northern species, endemic species, and western species (Table 1). The southern species, to the south in the Mojave Desert, normally occur in Creosote Bush desert. In the Inyo and White mountains region, *Dipsosaurus dorsalis* and *Leptotyphlops humilis* appear to follow this pattern and correspond exactly to the range of Creosote Bush. However,

Coleonyx variegatus, *Sauromalus obesus*, *Xantusia vigilis*, *Crotalus cerastes*, *C. mitchellii*, and *Tantilla hobartsmithi* extend north of the Creosote Bush desert into Great Basin Scrub desert. *Bufo punctatus*, the only southern amphibian in the area, requires a mesic habitat with permanent water; it appears to be absent from the Eureka and southern Owens valleys. *Arizona elegans* and *Crotalus cerastes* seem to be absent from the Saline and Eureka valleys. *Lichanura trivirgata*, *Phyllorhynchus decurtatus*, and *Trimorphodon biscutatus* have yet to be recorded from any valley except the Panamint.

The wide ranging species are found in both the Great Basin and Mojave deserts. All 14 of the wide ranging species occur in every valley, at Pyramid Lake and at Pisgah Crater. The only exception is *Callisaurus draconoides* which appears to be absent from Deep Springs Valley.

The northern species usually avoid Creosote Bush desert. The species in this group may have origins to the south but at the present time their range extends well north of the area. The mesophilic species *Bufo boreas*, *Hyla regilla*, and *Scaphiopus intermontanus* each have one record in the range of Creosote Bush. *Eumeces gilberti* occurs mainly in mountain areas and is treated as one species with *E. skiltonianus* because of their close relation and possible hybridization. *Sceloporus graciosus* occurs on the valley floors of the southern Owens, northern Owens, Chalfant and Fish Lake valleys. *Sceloporus occidentalis* occurs in or around all valleys, but at higher elevations around the Panamint. *Crotalus viridis* is present only in the Chalfant and Fish Lake valleys where it may be hybridizing with *C. mitchellii*. *Masticophis taeniatus* is present in all Great Basin valleys, as is *Thamnophis elegans*. The latter is also in the southern Owens Valley.

There are five endemic species in the region. *Batrachoseps campi* occurs at 13 springs of the Inyo Mountains (Yanev and Wake, 1981), and is thus in the Saline, southern Owens, and northern Owens valleys. An undescribed *Batrachoseps* occurs in the southern Owens Valley on the east side of the Sierra Nevada in at least three canyons south of Owens Lake. *Bufo exsul*, a close relative of *Bufo boreas* (Feder 1977) occurs only in the Deep Springs Valley. An undescribed *Hydromantes* is present in the northern Owens Valley on the east side of the Sierra Nevada in at least two canyons near Independence. *Elgaria panamintina* has been recorded in the Panamint, Saline, southern Owens, northern Owens, and Chalfant valleys and may be expected in the others.

The western species have the majority of their range west of the Sierra Nevada. *Elgaria multicarinata* is distributed along the east side of the Sierra Nevada at least as far north as Mono Lake (Stebbins, 1985). Hence it occurs in the southern and northern portions of the Owens Valley. *Thamnophis couchi* is present in the southern Owens, northern Owens, and Chalfant valleys.

The valleys to the east of the Inyo and White mountains show an abrupt transition between Great Basin and Mojave herpetofaunas (Fig. 9). In the Panamint, Saline, and Eureka valleys, which contain Creosote Bush, a few northern species occur. In contrast, the Fish Lake Valley to the north, in which no Creosote is present, has eight northern species. Additionally the only southern species in the Fish Lake Valley is *Crotalus mitchellii*. To the south in the Eureka Valley there are six southern species, in the Saline Valley nine, and fourteen in the Panamint Valley. On the west side of the Inyo and White mountains a more gradual transition between the two desert herpetofaunas exists. The southern Owens Valley and the northern Owens Valley each contain six northern species, although the southern Owens Valley contains Creosote Bush desert flora. The Chalfant Valley to the north of the northern Owens Valley has eight northern species. In the Chalfant Valley the only southern species are *Crotalus cerastes* and *C. mitchellii*, yet in the northern Owens Valley, which lacks Creosote Bush, six southern species are found. In the southern Owens Valley ten southern species occur.

The Deep Springs Valley between the Inyo and White mountains contains Great Basin Scrub desert (Fig. 10). *Crotalus mitchellii* is the only southern species present in the valley. The wide ranging, *Callisaurus draconoides* is absent from this high elevation valley. In addition, only five northern species occur here along with one endemic, *Bufo exsul*, a close relative of the northern species, *B. boreas*.



Fig. 2. Saline Valley with the Panamint Mountains to the east in the background.



Fig. 3. Fish Lake Valley looking northwest with the White Mountains in the background.



Fig. 4. Deep Springs Valley. To the south is Deep Springs Lake adjacent to the Inyo Mountains.



Fig. 5. Chalfant Valley looking north with the White Mountains to the right and the Volcanic Tableland to the left.



Fig. 6. Queen Valley looking south towards the northern portion of the White Mountains.



Fig. 7. Southern Owens Valley looking northwest with the Sierra Nevada in the background. To the right are the Inyo Mountains and to the left is Owens Lake.

Table 1. Distribution of amphibians and reptiles in the valleys of the Inyo and White Mountains Region and Mojave and Great Basin Desert reference sites. PA = Panamint Valley; SA = Saline Valley; EU = Eureka Valley; SO = Southern Owens Valley; NO = Northern Owens Valley; CH = Chalfant Valley; DS = Deep Springs Valley; PL = Pyramid Lake; PC = Pisgah Crater.

	PA	SA	EU	SO	NO	CH	DS	FL	PL	PC
<u>SOUTHERN</u>										
<u>Bufo punctatus</u>	x	x	-	-	-	-	-	-	-	-
<u>Gopherus agassizii</u>	-	-	-	-	-	-	-	-	-	x
<u>Coleonyx variegatus</u>	x	x	x	x	x	-	-	-	-	x
<u>Dipsosaurus dorsalis</u>	x	x	x	x	-	-	-	-	-	x
<u>Sauromalus obesus</u>	x	x	x	x	x	-	-	-	-	x
<u>Uma scoparia</u>	-	-	-	-	-	-	-	-	-	x
<u>Urosaurus graciosus</u>	-	-	-	-	-	-	-	-	-	x
<u>Xantusia vigilis</u>	x	x	x	x	x	-	-	-	-	x
<u>Arizona elegans</u>	x	-	-	x	-	-	-	-	-	x
<u>Chionactis occipitalis</u>	x	x	-	x	-	-	-	-	-	x
<u>Crotalus cerastes</u>	x	-	-	x	x	x	-	-	-	x
<u>Crotalus mitchelli</u>	x	x	x	x	x	x	x	x	-	x
<u>Crotalus scutulatus</u>	-	-	-	-	-	-	-	-	-	x
<u>Leptotyphlops humilis</u>	x	x	x	x	-	-	-	-	-	x
<u>Lichanura trivirgata</u>	x	-	-	-	-	-	-	-	-	x
<u>Tantilla hobartsmithi</u>	x	x	-	x	x	-	-	-	-	-
<u>Phyllorhynchus decurtatus</u>	x	-	-	-	-	-	-	-	-	x
<u>Trimorphodon biscutatus</u>	x	-	-	-	-	-	-	-	-	x
<u>WIDE RANGING</u>										
<u>Callisaurus draconoides</u>	x	x	x	x	x	x	-	x	x	x
<u>Cnemidophorus tigris</u>	x	x	x	x	x	x	x	x	x	x
<u>Crotaphytus bicinctores</u>	x	x	x	x	x	x	x	x	x	x
<u>Gambelia wislizenii</u>	x	x	x	x	x	x	x	x	x	x
<u>Phrynosoma platyrhinos</u>	x	x	x	x	x	x	x	x	x	x
<u>Sceloporus magister</u>	x	x	x	x	x	x	x	x	x	x
<u>Uta stansburiana</u>	x	x	x	x	x	x	x	x	x	x
<u>Hypsiglena torquata</u>	x	x	x	x	x	x	x	x	x	x
<u>Lampropeltis getulus</u>	x	x	x	x	x	x	x	x	x	x
<u>Masticophis flagellum</u>	x	x	x	x	x	x	x	x	x	x
<u>Pituophis melanoleucus</u>	x	x	x	x	x	x	x	x	x	x
<u>Rhinocheilus lecontei</u>	x	x	x	x	x	x	x	x	x	x
<u>Salvadora hexalepis</u>	x	x	x	x	x	x	x	x	x	x
<u>Sonora semionnolata</u>	x	x	x	x	x	x	x	x	x	x
<u>NORTHERN</u>										
<u>Bufo boreas</u>	x	-	-	x	x	x	-	x	x	-
<u>Hyla regilla</u>	x	-	-	x	-	x	-	-	-	-
<u>Scaphiopus intermontanus</u>	-	-	-	x	x	x	x	x	x	-
<u>Eumeces gilberti-skiltonianus complex</u>	x	x	-	-	-	x	x	x	x	-
<u>Sceloporus graciosus</u>	-	-	-	x	x	x	-	x	x	-
<u>Sceloporus occidentalis</u>	-	x	x	x	x	x	x	x	x	-
<u>Coluber constrictor</u>	-	-	-	-	-	-	-	-	x	-
<u>Crotalus viridis</u>	-	-	-	-	-	x	-	x	x	-
<u>Masticophis taeniatus</u>	-	-	-	-	x	x	x	x	x	-
<u>Thamnophis elegans</u>	-	-	-	x	x	x	x	x	x	-
<u>ENDEMIC</u>										
<u>Batrachoseps sp. nov.</u>	-	-	-	x	-	-	-	-	-	-
<u>Batrachoseps compi</u>	-	x	-	x	x	-	-	-	-	-
<u>Bufo exsul</u>	-	-	-	-	-	-	x	-	-	-
<u>Hydromantes sp. nov.</u>	-	-	-	-	x	-	-	-	-	-
<u>Elgaria panamintina</u>	x	x	-	x	x	x	-	-	-	-
<u>WESTERN</u>										
<u>Elgaria multicarinata</u>	-	-	-	x	x	-	-	-	-	-
<u>Thamnophis couchi</u>	-	-	-	x	x	x	-	-	x	-

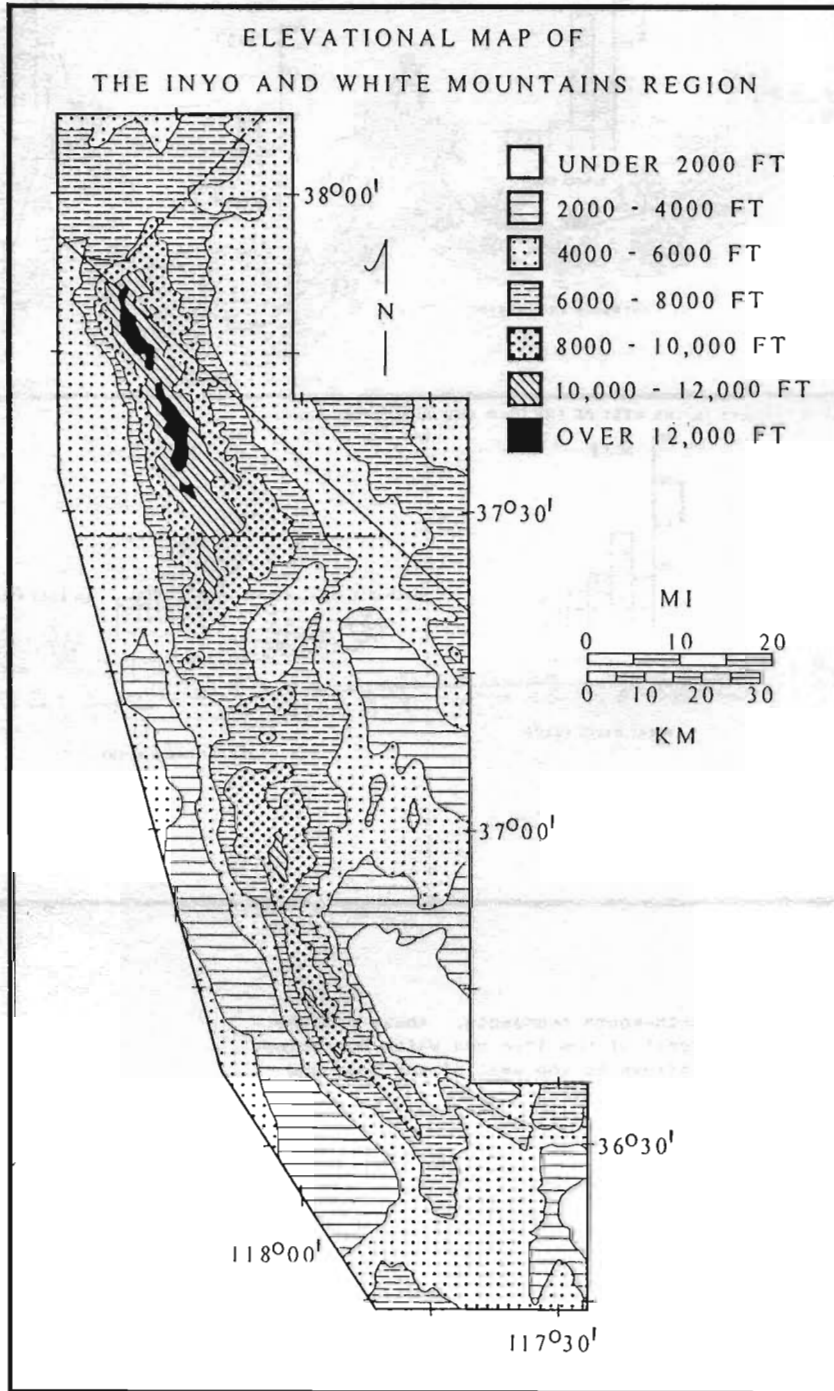


Fig. 8. Elevational map of the Inyo and White Mountains Region.

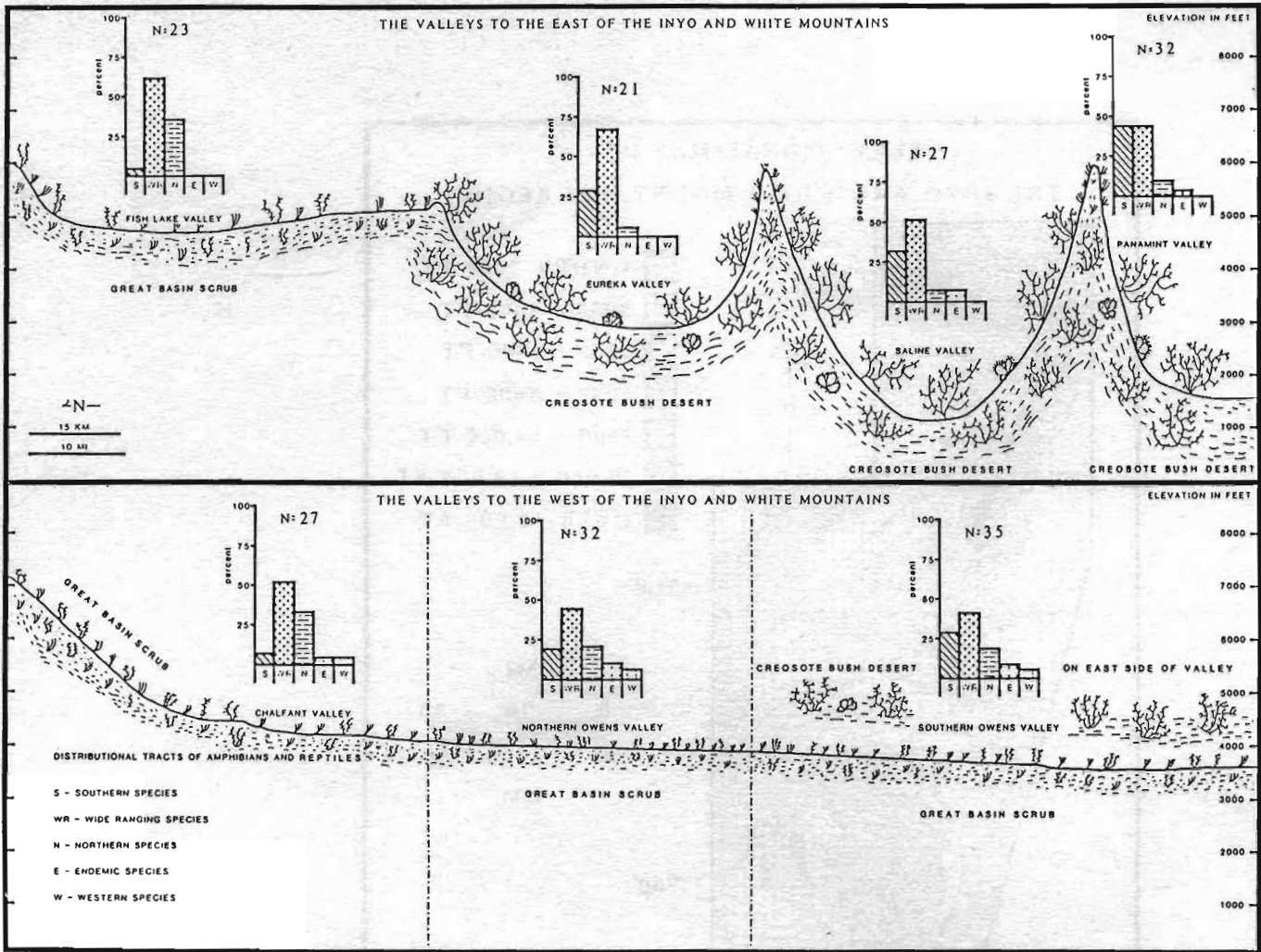


Fig. 9. Two north-south transects. Above are the valleys to the east of the Inyo and White Mountains. Below are the valleys to the west of the Inyo and White Mountains.

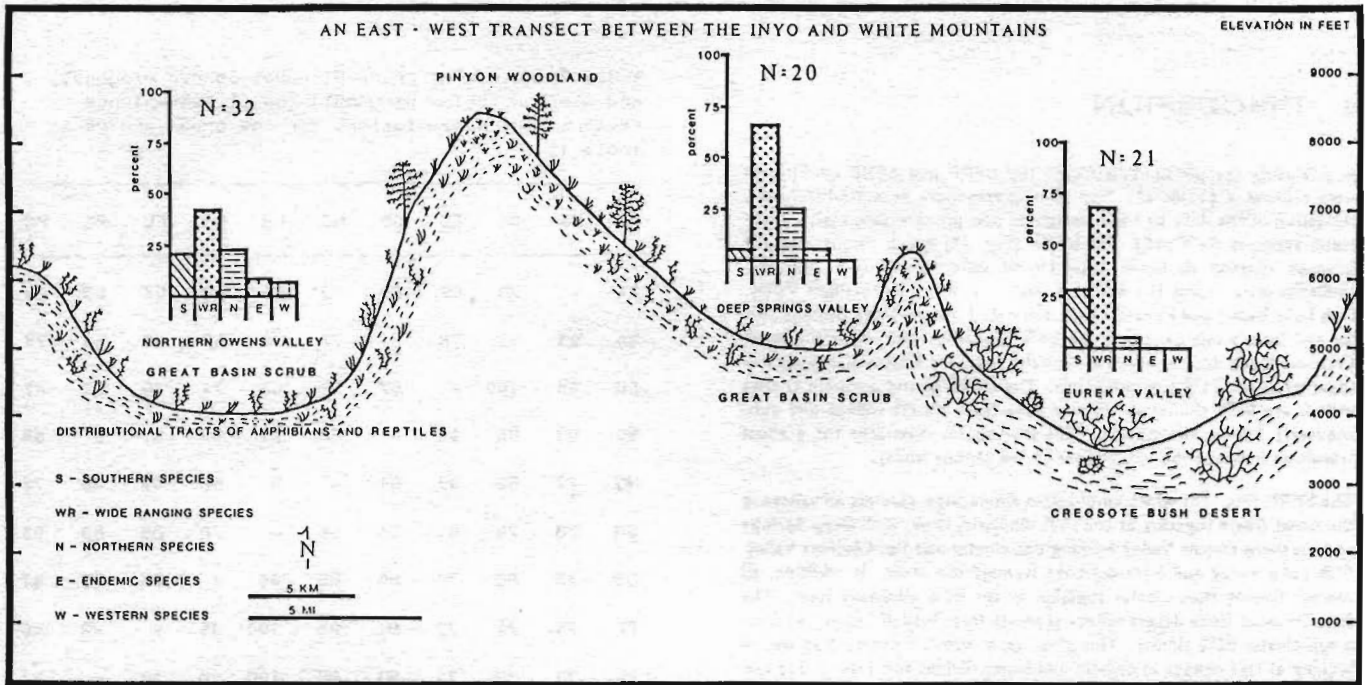


Fig. 10. An east-west transect between the Inyo and White Mountains.

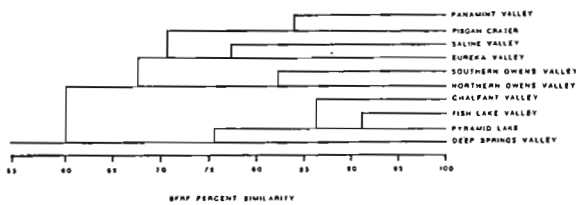


Fig. 11. Braun-Blanquet Faunal Resemblance Factor (BFRF) percent similarity phenogram which gives emphasis to differences among taxa.

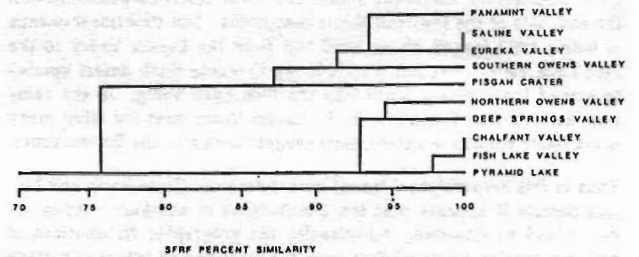


Fig. 12. Simpson Faunal Resemblance Factor (SFRF) percent similarity phenogram which gives emphasis to similarities among taxa.

4 DISCUSSION

In analyzing the distributional data the BFRF and SFRF coefficients were calculated (Table 2). Two phenograms were generated from the clustering of the data by the unweighted pair group method with arithmetic averages (UPGMA). The BFRF (Fig. 11) which emphasizes differences, clusters all Great Basin Desert valleys together at the 76% similarity level except the northern Owens Valley. The Chalfant Valley, Fish Lake Valley and Pyramid Lake separate from the Deep Springs Valley and form a sub-cluster at the 86% similarity level. Additionally all Creosote Bush desert valleys except the southern Owens Valley cluster together at the 71% similarity level. The southern and northern Owens valleys are 68% similar to the Creosote Bush desert valleys and subsequently form a sub-cluster. This phenogram illustrates the gradual transition between the two deserts in the Owens Valley.

The SFRF (Fig. 12) which emphasizes similarities, clusters all valleys in the Great Basin together at the 93% similarity level, with Deep Springs and northern Owens Valley forming one cluster and the Chalfant Valley, Fish Lake Valley and Pyramid Lake forming the other. In addition, all Mojave Desert sites cluster together at the 97% similarity level. The four Creosote Bush desert valleys separate from Pisgah Crater and form a sub-cluster 91% similar. This phenogram shows a contrasting way of looking at this change in deserts and hence divides the deserts into two separate clusters illustrating the abruptness of this transition.

As the BFRF illustrates, the valleys to the west of the Inyo and White mountains show a gradual transition between the two herpetofaunas. This can be attributed to two factors. There is a small elevational change from the southern Owens Valley containing Creosote Bush desert on its east side, to the Great Basin Scrub desert of the northern Owens Valley. Additionally, the northern Owens Valley is partially under 4,000 feet. Hence only a small temperature change occurs. This allows Mojave Desert species to range into this low elevation Great Basin Scrub desert. The second factor is the presence of water in the southern Owens Valley, provided by the Owens River and the creeks that drain the Sierra Nevada Mountains. This water creates Great Basin Scrub desert and mesic habitats which allow Great Basin species to range south into the central and western portions of the southern Owens Valley. The same two factors, temperature controlled by elevation, and water distribution, create the abrupt change in desert herpetofaunas on the east side of the Inyo and White mountains. The elevational change of below 4000 feet to above 5000 feet from the Eureka Valley to the Fish Lake Valley does not permit many Creosote Bush desert species to extend there ranges north into the Fish Lake Valley. In the same way the lack of surface water in the Eureka Valley does not allow many Great Basin species to extend there ranges south into the Eureka Valley.

Thus in this herpetofaunal transition between the Great Basin and Mojave deserts it appears that the distributions of southern species are determined by elevation. Additionally, the geographic distributions of northern species are dependent upon the location and extent of surface water.

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Table 2. Matrix of Braun-Blanquet (above diagonal) and Simpson (below diagonal) Faunal Resemblance Factors. The abbreviations for the areas are as in Table 1.

	PA	SA	EU	SO	NO	CH	DS	FL	PL	PC
PA	-	78	62	80	72	66	47	53	53	84
SA	93	-	78	71	72	70	59	63	59	77
EU	95	100	-	57	59	63	71	70	62	67
SO	88	93	95	-	83	71	49	57	57	69
NO	72	85	90	91	-	81	59	69	69	72
CH	78	70	81	93	96	-	70	85	89	53
DS	75	80	75	85	95	95	-	83	75	47
FL	74	74	76	87	96	100	95	-	92	50
PL	71	67	71	83	88	100	90	96	-	47
PC	90	85	95	80	67	59	70	65	58	-

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