

POST FIRE REPTILE SUCCESSION

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ABSTRACT.

An area of burned southern California chaparral was sampled for reptiles over a period of three years. Six species were observed the first year, ten the second year and eight the third year. As vegetation density and structure changed on a south facing slope, reptile utilization of that area changed, perhaps due to increased habitat availability. Some species showed increased abundance while other species decreased over the three years. The two most abundant lizard species (*Sceloporus occidentalis* and *Uta stansburiana*) show a pattern of possible ecological separation by temporal activity.

INTRODUCTION

Structural heterogeneity of a habitat has often been associated with faunal diversity (Bell 1974, MacArthur 1965, Pianka 1966, 1967, 1975, Roth 1977, Willson 1974). In studies of desert lizards, Pianka (1966, 1967, 1969, 1975) has shown structure (vertical and horizontal vegetative components) to be more important than climatic stability or productivity in its effect on species diversity. Presumably, this is due to the effect of structure on microhabitat availability (Pianka 1966, 1967, 1969, 1975).

In chaparral environments, lizard abundance seems to be more directly effected by structure than is the number of species present (Lillywhite 1977a, 1977b, Lillywhite and North 1974). Areas of low structural variation, such as mature chaparral, show decreased abundance. Grassland converted areas, lacking shrub cover, show fewer species (Lillywhite 1977a, 1977b).

Chaparral vegetation, however, is not static. After fire, the vegetation goes through a known succession (Hanes 1974, Noble and Slatyer 1977, Philpot 1977). This results in a series of habitats of differing structure in subsequent years.

In this paper, I will discuss a preliminary survey of the reptile community of one area of chaparral over the first three post fire years. It would be expected that as the habitat matures, we should be able to see lizard community changes as they occur. This should result in changes in the number of species and or species abundance in response to resources.

STUDY AREA

Sunset Ridge, in the San Gabriel Mountains of Los Angeles County, in southern California, was selected for the survey. The elevation is approximately 1270 meters. The area had been covered by a dense stand of mature chaparral. The dominant plants were *Adenostoma fasciculatum*, *Quercus dumosa*, *Arctostaphylos* spp., and *Ceanothus* spp. In November, 1975, a fire thoroughly burned the area.

In April, 1976, two survey sites were established. On a south facing slope, a quadrat of 50.8 meters per side was sampled. Also sampled was a transect of approximately 76 meters through a rocky gully near the quadrat.

MATERIALS AND METHODS

The two survey sites were sampled approximately once a week in 1976, 1977, and 1978. In 1976, visual sightings and hand captures of reptiles were recorded. As vegetation density increased, this became impractical. In 1977, pitfall traps were installed. These were used in conjunction with hand captures and visual sightings for the duration of the study. The traps were positioned in a grid on the quadrat and in a line through the rocky gully. Traps were left open between visits.

Captured reptiles were marked by toe or scale clipping. Species, sex, snout-vent length, and area of capture were also recorded. For those sighted but not captured, species and any other characters observed, such as age, sex, etc., were recorded. Sightings and captures were used as indicators of abundance and activity.

In an effort to determine possible patterns in the abundance and activity data, principal component analysis was performed. This was done for the four lizard species present in all three years for the months May, June, July, and August.

RESULTS AND DISCUSSION

Succession:

In November, 1975, following the fire, only charred snags remained. The following spring, crown sprouts began to appear. By fall, vegetative cover was measured (by line intersect methods) at approximately 85% on the quadrat. Much of this was light cover due to annuals (49.3%). Visual cover to the ground was estimated (by eye) at approximately 50%.

In the spring of 1977, cover was measured at 68%. At this time, more cover was due to the crown sprouts of woody perennials. The herbaceous cover was also more dense. Visual cover to the ground was estimated at approximately 80% in the lower, more dense portion of the quadrat. Cover was less dense in the upper third of the area.

In the spring of 1978, crown sprouts were up to two meters tall in most places. Most of the larger woody and herbaceous perennials were located on the lower two-thirds of the quadrat, where visual cover to the ground was almost 100%. The upper one-third of the quadrat contained mostly light grasses and some smaller crown sprouts. Here visual cover was estimated at 40 to 50%.

Over the three years, vegetative cover also increased on the slopes surrounding the rocky gully. The center of the gully remained open.

Reptile Community:

Reptile species diversity observed on the site was as follows: 1976 (S=6), 1977 (S=10), 1978 (S=8), (Table 1).

In 1976, a total of 73 reptiles were seen or captured--27 on the quadrat, 46 in the rocky gully. This first year differs from the other two years in capture technique and sampling period. Therefore, the total number may be underestimated. The proportion of individuals sighted, however, is usually correlated with the proportion trapped for the major species involved (Lillywhite 1977b). Although the gully transect covered less area, more reptiles were observed there. This difference may have been due to a combination of factors. Reptiles are known to survive fires with little damage under such cover (Kahn 1960). The quadrat area also afforded little dense cover. It is possible that the rock gully provided a more preferable mixture of cover and open space during this early period. This mixture would make available more microhabitats (Lillywhite 1977a, 1977b). Strict quantitative measures of these variables are needed.

TABLE 1. Number of each species on the quadrat (Q), transect (T), and proportion of total in 1976, 1977, and 1978: a) Lizard species b) Snake species

	1976			1977			1978		
	Q	T	P	Q	T	P	Q	T	P
LIZARDS									
<i>Anniella pulchra</i>	0	0	0	1	0	.01	0	0	0
<i>Cnemidophorus tigris</i>	5	5	.15	10	1	.07	18	3	.13
<i>Gerrhonotus multicarinatus</i>	0	0	0	1	1	.01	0	2	.01
<i>Phrynosoma coronatum</i>	1	0	.01	4	9	.09	3	1	.02
<i>Sceloporus occidentalis</i>	6	19	.37	34	19	.36	47	22	.41
<i>Uta stansburiana</i>	11	21	.47	41	26	.46	53	19	.43
SNAKE									
<i>Crotalus viridis</i>	1	1	.40	6	1	.54	0	0	0
<i>Lampropeltis zonta</i>	0	0	0	0	0	0	1	0	.33
<i>Masticophis lateralis</i>	3	0	.60	2	2	.30	1	0	.33
<i>Pituophis melanoleucus</i>	0	0	0	0	1	.08	0	0	0
<i>Salvadora hexalepis</i>	0	0	0	1	0	.08	1	0	.33

In 1977, a total of 154 reptiles were seen or captured--97 on the quadrat, 57 in the gully. Increased total abundance may well have been due to the use of pitfall traps. Another factor, high insect abundance in 1976 (Force, pers. comm.), may have contributed to abundance by increasing reproductive success. What is of note is the increased relative proportion of reptiles on the quadrat area as compared to the gully (Table 1).

In 1978, a total of 171 reptiles--124 on the quadrat, 47 in the gully--were seen or captured. The trend of increased relative activity on the quadrat continued as in 1977, though capture techniques remained constant. Increased vegetative cover, particularly by woody crown sprouting plants, may be a factor in this increase. The regrowth presumably provided increased microhabitat variety on the quadrat. Such areas have been shown to have higher lizard carrying capacities (Lillywhite and North 1974). More detailed quantitative vegetative structure data would be helpful in the interpretation.

The frequency of recapture of all reptiles in the first and second years (27%) was slightly lower than the 38% found by Kahn (1960). In 1978, the frequency of recapture was 37%. Recapture frequency was not found to be significantly different among the years (contingency table analysis, $p > 0.05$). These low numbers seem to indicate some degree of movement through the area. Such instability would be expected after a disturbance (Rand 1967). Also, some of the species involved (such as *Sceloporus occidentalis*) are known to show unstable territories under undisturbed conditions (Fitch 1940), while others (such as *Uta stansburiana*) do not (Tinkle 1967). High predation rates may well have been involved at this time, particularly in the low cover of the first year.

Only four individuals were recaptured in consecutive years. This further emphasized the probability of movement or predation. Higher recapture rates between years for long lived species (such as *Cnemidophorus tigris*) would have been expected. Low rate of recapture may also have been affected by the trapping technique. Captured lizards could not defend their territories during the period of time they were in the traps. Daily checking of the traps is suggested.

Table 1 shows the number of each reptile species on the quadrat and transect. Also shown is the proportion of the total snakes or lizards each species comprised. In 1976, the first year after fire, six species of reptiles were observed. Ten species comprised the majority of observations in all four years. These were *Cnemidophorus tigris*, *Phrynosoma coronatum*, *Sceloporus occidentalis*, and *Uta stansburiana*. The other seven species occurred somewhat sporadically and in low numbers. It is, therefore, not possible to assess any species diversity changes in these three years. Less common species may have been present yet not observed each year. This would be particularly true for snakes.

Reptile Species:

One individual *Anniella pulchra* was observed and that was in 1977. Due to this species fossorial habits (Stebbins 1966), they may well have been present in higher numbers, but not captured by the techniques used.

C. tigris is an active lizard found in areas of sparse vegetation (Echternacht 1967, Pianka 1966, 1970). Most were found in the upper portion of the quadrat area where vegetation was comparatively sparse and bare ground was present. The number of these lizards observed, as well as their relative proportion, increased in 1978 (Table 1).

Gerrhonotus multicarinatus is known to frequent areas of high plant cover, plant litter and moisture (Stebbins 1966). As these requirements were not readily available at this time of succession, the abundance of this species was low, as would be expected (Table 1).

P. coronatum were found in low numbers (Table 1). The high numbers in 1977 are slightly biased due to several recaptures of one individual. The relative proportion of these lizards decreased in 1978. These lizards prefer open space and would be expected to decrease as vegetation density increases.

S. occidentalis was the second most abundant species observed (Table 1). In 1976 and 1977, this species made up approximately 36% of the total lizards. In 1978, the relative proportion of this species was 41%, almost equal to *U. stansburiana* (Figure 1). *S. occidentalis* is somewhat arboreal and known to utilize dark snags as basking and ambush sites (Libblywhite and North 1974, Marcellini and Mackey 1970, Schoenherr 1976), as long as bare branches for basking extend beyond the new vegetative growth (Lillywhite and North 1974, Lillywhite, Friedman and Ford 1977). This species would be expected to remain active on the quadrat area for a longer period of time than other species and show a relative increase in abundance as seen in 1978. Their shifting territories (Fitch 1940) may partially account for low recapture rates.

U. stansburiana was the most abundant lizard observed in the area (Table 1). The proportion of total lizard species made up by *U. stansburiana* showed a decrease relative to other species in 1978. This decrease is especially evident when compared to *S. occidentalis* (Figure 1). Since this species prefers open areas and rocks, this decrease would be expected as vegetation density increased.

Overall, there was relative increase in lizard captures on the quadrat area as compared to the transect over the three years. Increased utilization would be expected as vegetation structure increased and more habitat types become available (Lillywhite 1977b). More activity was noted in the upper, more patchy portions of the quadrat.

Of the four major species present, the relative proportion of two were found to increase (*C. tigris* and *S. occidentalis*), and two to decrease (*P. coronatum* and *U. stansburiana*) (Figure 1). These changes coincide with the known habitat preferences of the species, except *C. tigris*. The majority of *C. tigris*, however, did occur in more open sections.

Of the five snake species observed, only *Crotalus viridis* was observed frequently (Table 1). By the third year, however, *C. viridis* was not observed and a total of only three individual snakes were seen. Since pitfall traps are not effective in the sampling of larger snakes, these data may not be totally representative of the snakes in the area.

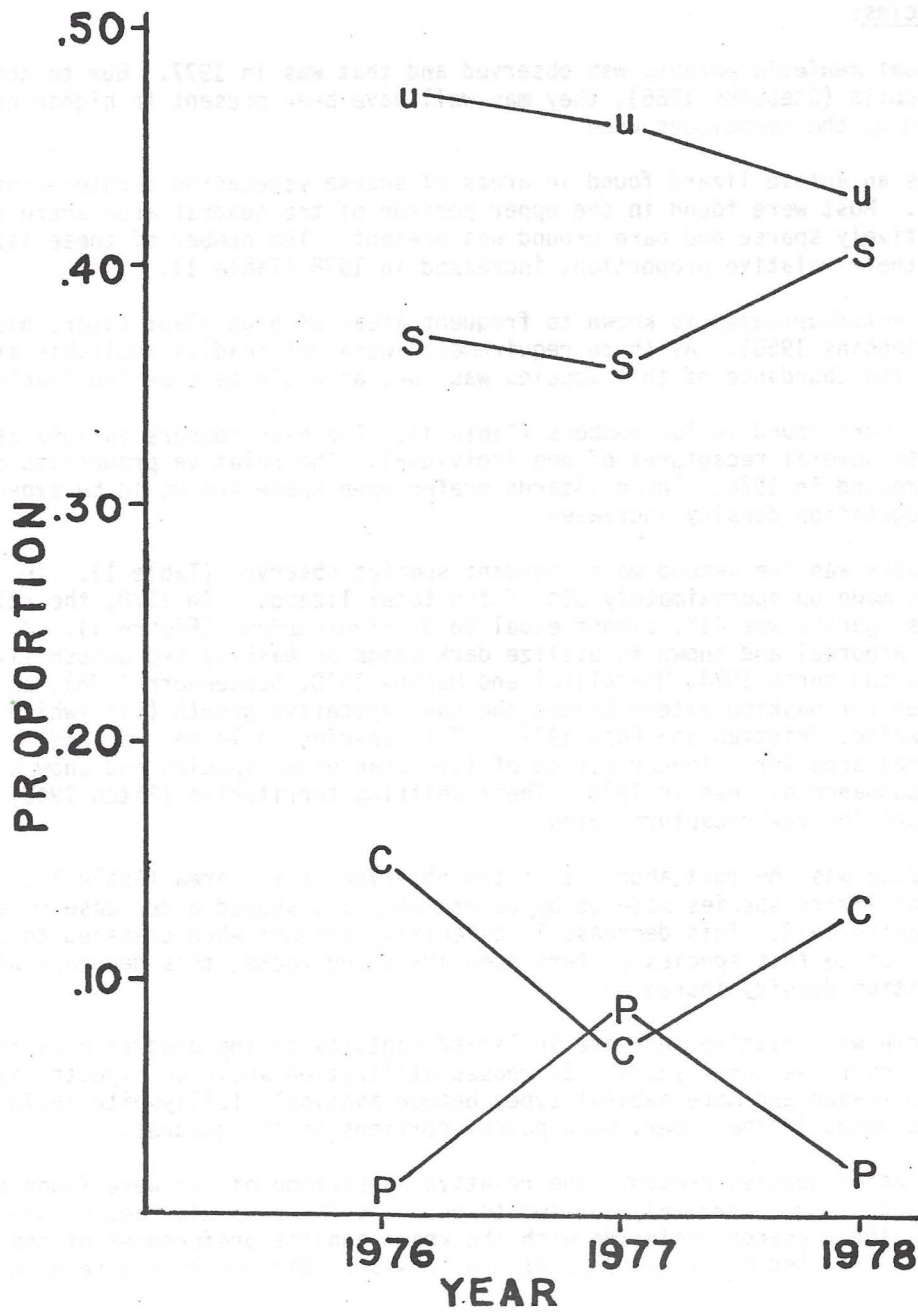


Figure 1. Relative proportion of four major species in 1976, 1977, 1978.
 C = *C. tigris*; P = *P. coronatum*; S = *S. occidentalis*; U = *U. stansburiana*

TEMPORAL PATTERNS IN LIZARD SPECIES ABUNDANCE

Principal component analysis was performed on the abundance data for the four lizard species present in all three years. This was done on data from the months of peak activity, May, June, July, and August. Principal component analysis is a heuristic test which brings forward patterns in the data. These numerical patterns may indicate the presence of biological patterns.

In this analysis, principal component one was sensitive to species abundance. Principal component two was sensitive to abundance in different months. When the factor scores were graphed (Figures 2, 3, 4) one pattern was found consistently in all three years. This was temporal separation in the activity of *S. occidentalis* and *U. stansburiana*.

S. occidentalis and *U. stansburiana*, the two most abundant species, are somewhat similar in terms of their ecology (Pianka 1966). The major separation of their niches is by size and by habitat preference (Davis and Verbeek 1972, Schoenherr 1976). This study brings to light the very interesting possibility of temporal avoidance occurring between these species. This may be due to offset breeding periods. Reproductive data on this aspect are needed from this specific area.

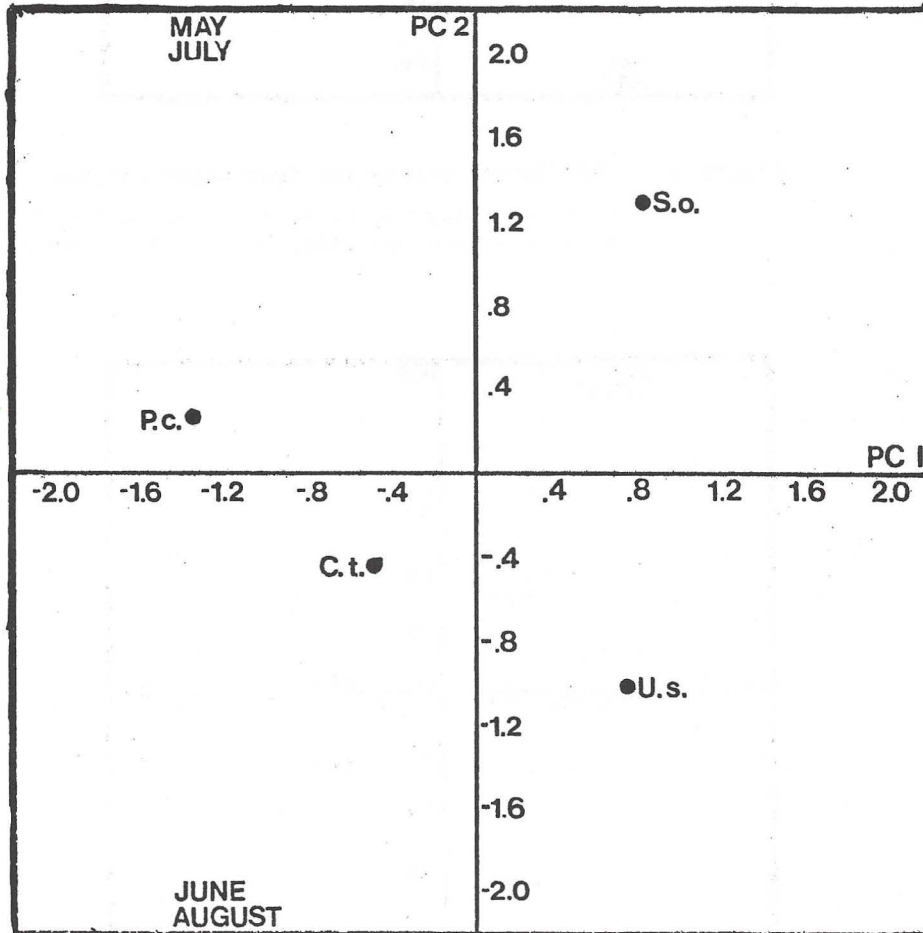


Figure 2. 1976 factor scores for four major species.
 C. t. = *C. tigris*; P. c. = *P. coronatum*;
 S. o. = *S. occidentalis*; U. s. = *U. stansburiana*.

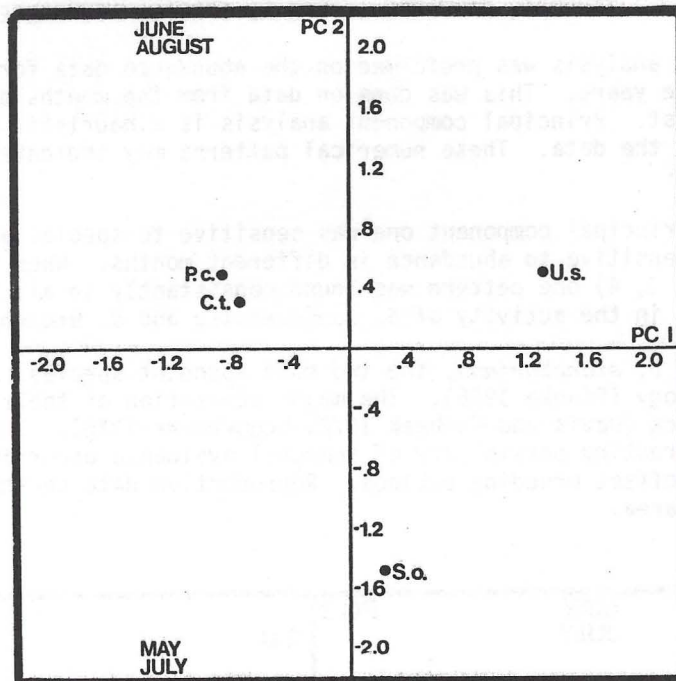


Figure 3. 1977 factor scores for four major species.

c. t. = *C. tigris*; P. c. = *P. coronatum*;
 s. o. = *S. occidentalis*; U. s. = *U. stansburiana*.

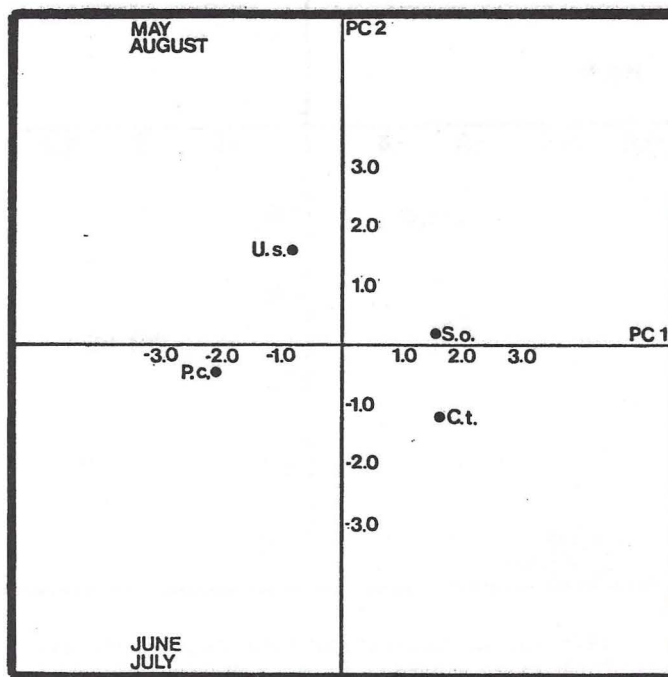


Figure 4. 1978 factor scores for four major species.
 In this year P.C. 1 is weighted toward abundance in June and July.

C. t. = *C. tigris*; P. c. = *P. coronatum*; S.o. = *S. occidentalis*; U. s. = *U. stansburiana*.
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SUMMARY AND IMPLICATIONS

During the first three post fire years, the habitat was conducive to the activities of at least eleven reptile species. Reptile activity was found to increase over time on the south facing slope. Presumably this was due to increased vegetative structure, offering more possibilities for ecological partitioning of space. The relative proportions of some species preferring more open habitats were found to decrease slightly over time. The relative proportion of species more tolerant of dense vegetation were found to increase. Two species showed possible temporal separation of activity.

For a few more years, a diverse and abundant reptile fauna would be expected to continue. As vegetation becomes more dense, further decreases of open area species would be expected. These would include most snakes, *U. stansburiana*, *P. coronatum*, *A. pulchra*, and later possibly *C. tigris*. Temporary relative increases of tolerant species, such as *S. occidentalis*, should continue. As the vegetation becomes a mature solid layer, decreased total abundance of all species would be expected (Lillywhite 1977a, 1977b).

Earlier studies by Lillywhite (1977a, 1977b) have shown that should the area be converted to grassland, decreased reptile species diversity would follow. If no shrub cover remained, lizards would be almost entirely eliminated from the area. In such management efforts, mechanical clearing has been shown to have a more immediate and drastic effect on lizard populations (due to physical injury) than does herbicide treatment (Lillywhite 1977a, 1977b). Management for high reptile diversity should be directed toward the maintenance of patchy habitats of high structural heterogeneity.

Future studies should consider recommendations.

- 1) Quantification of vertical and horizontal components of vegetative structure at frequent, regular intervals.
- 2) Quantification of food resource availability (insect and rodent) over time.
- 3) Quantification of time of reproductive activity and success for the various species in the specific area.
- 4) Development of new methods for the assessment of relative movement and territory status for areas of dense vegetation.
- 5) Daily sampling of the area to reduce the effect of pit traps on territorial species.
- 6) Specific trapping techniques for the survey of reptiles not readily surveyed by pit traps or hand captures, particularly in dense areas.
- 7) Use of preburn data from the same site for comparison purposes.

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