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RESPONSE OF REPTILE POPULATIONS TO DIFFERENT LAND MANAGEMENT PRACTICES ON THE IDAHO NATIONAL ENGINEERING LABORATORY SITE

Timothy D. Reynolds[1]

Abstract.— Populations of reptiles were examined in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) or by crested wheatgrass (*Agropyron cirstatum*) on the Idaho National Engineering Laboratory (INEL) Site in southeastern Idaho. The sagebrush lizard (*Sceloporus graciosus*) and the short-horned lizard (*Phrynosoma douglassi*) were the only species of reptiles encountered in sufficient numbers to permit statistical analysis. Both of these species preferred sagebrush habitats to areas dominated by crested wheatgrass. The sagebrush lizard was most abundant in the native, ungrazed, sagebrush habitat, and the short-horned lizard was most plentiful in the sheep-grazed area dominated by big sagebrush.

Sagebrush, mostly big sagebrush (*Artemisia tridentata*), was once the dominant vegetation over 100 million ha of western rangelands in the United States (Beetle 1960). In this century, at least 10 percent of the sagebrush range has been altered in an attempt to increase forage production for livestock (Braun et al. 1976). In Idaho, approximately 850 thousand ha of public and private rangeland, most of which was dominated by big sagebrush, have been chemically or mechanically treated and reseeded with crested wheatgrass (*Agropyron cristatum* and *A. desertorum*) (BLM document 1974, L. Sharp, pers. comm.).

With few exceptions, studies concerning the effects of the alteration of sagebrush communities on wildlife have concentrated on game species such as mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*), elk (*Cervus canadensis*), and Sage Grouse (*Centrocercus urophasianus*) (Patterson 1952, Mackie 1965, Anderson 1969, Peteron 1971). The effects of altering the sagebrush habitat on nongame species have received little attention (Braun et al. 1976).

Reptiles, especially lizards, are important components of North American ecosystems, rivaling mammals and birds with respect to numbers, biomass, and energetics in the desert community (Turner et al. 1976). This vertebrate group is frequently overlooked in environmental studies. The objective of this study was to evaluate the response of reptile populations to different land management practices on the Idaho National Engineering Laboratory (INEL) Site.

Study Sites

This study was conducted on the INEL National Environmental Research Park Site in southeastern Idaho. The INEL Site occupies 2,315 km^2 of cool desert on the Snake River Plain, approximately 48 km west of Idaho Falls, Idaho (Fig. 1). The topography of the site is flat to gently rolling, with frequent lava outcroppings characteristic of the Columbia Plateau Province (Atwood 1970). The elevation ranges from 1454 to 1554 m, with the median about 1500 m. The climate is characterized by hot summers and cold winters, with record high and low temperatures of 39 and −41 C. The mean annual temperature at the Central Facilities Area (CFA) (Fig. 1) is 5.8 C. Precipitation, mostly in the form of spring rains, averages 21.6 cm annually, with a 30-year range of 11.4–36.3 cm. The vegetation of the INEL Site is dominated by big sagebrush (Jeppson and Holte 1976).

Four areas of different land use were selected for study. Two of these were domi-

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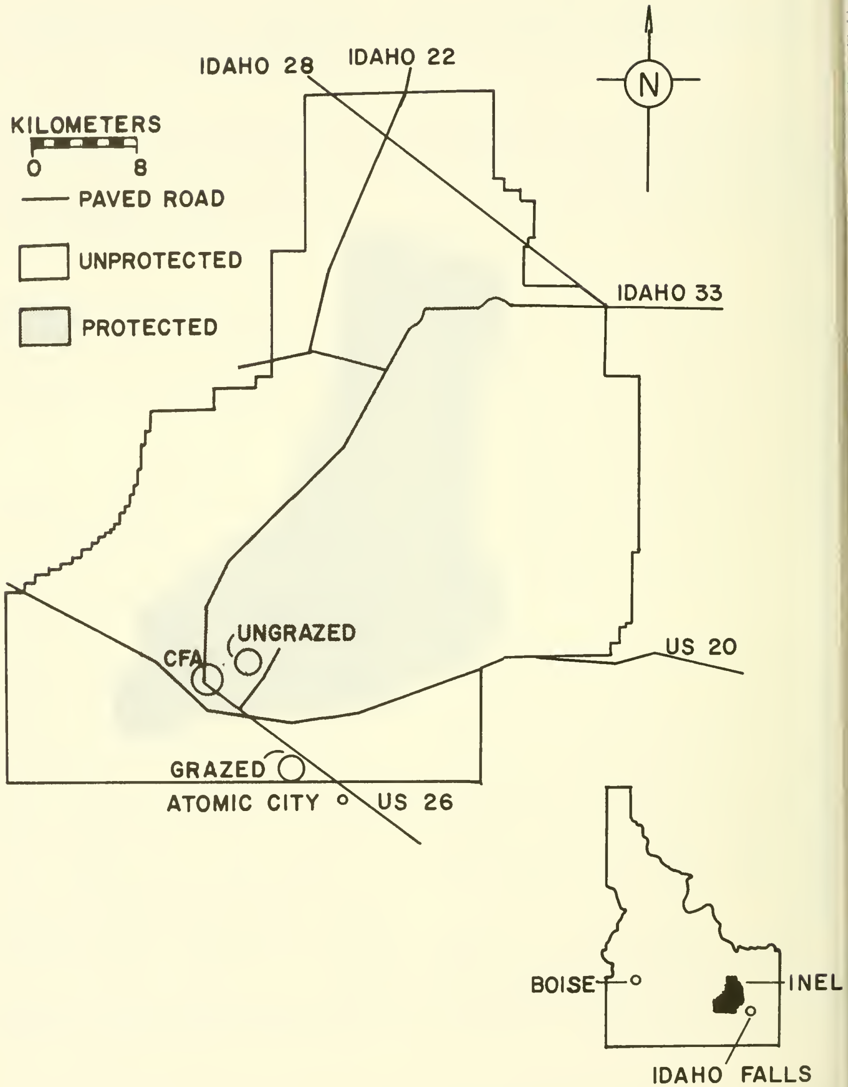

Fig. 1. Location of the grazed and ungrazed study areas on the INEL Site used in determining the response of reptile populations to different land management practices. The grazed and ungrazed sites each contained a habitat dominated by sagebrush (*Artemisia tridentata*) (SAGE) and crested wheatgrass (*Agropyron cristatum*) (CWG). Those portions of the INEL Site protected from livestock grazing are shown.

nated by big sagebrush, and two were former sagebrush range reseeded with crested wheatgrass. One sagebrush and one crested wheatgrass study area were 1.3 km northwest of Atomic City, Idaho, just within the southern boundary of the INEL Site (Fig. 1). The crested wheatgrass here was planted in 1958 or 1959 (INEL Site records vary) after the native vegetation was removed by disking. These two areas were contiguous and have been grazed by 1000–1200 domestic sheep each spring since 1960. These study areas are referred to as grazed sage and grazed CWG.

The other sagebrush and crested wheatgrass study areas were approximately 12 km northwest of the grazed areas (Fig. 1). The sagebrush in this area (ungrazed sage) had received no grazing pressures since 1950, and served as the control plot for this study. The adjacent crested wheatgrass planting (ungrazed CWG) was seeded in 1960, after winter flooding inundated and killed the native vegetation (A. Olson, pers. comm.). Livestock were last permitted in this area 10 years prior to the planting of crested wheatgrass.

Materials and Methods

Vegetation was sampled in each study area along 400 m of line transects with 20 × 50 cm sampling frames (Daubenmire 1959). The percent coverage for each plant species was estimated using six cover classes (0–5, 5–25, 25–50, 50–75, 75–95, and 95–100). The midpoints of each class were used to calculate the average canopy coverage for each species. These values were used in calculating the percent similarity (PS) of the vegetal communities among the study areas (Orloci 1967).

The invertebrate fauna was sampled in an attempt to determine the potential prey available to reptiles in each area of different land use. A 4-ha-square grid was established in each of the study areas, and sweep netting was performed along four transect lines parallel to each axis of the grids. Sweep samples were taken using a standard 38 cm (15 in) canvas sweep net. All transects were swept twice, resulting in 5600 sweeps in each study area.

Pit-fall (sink) traps and a "noose on a stick" (Linder and Fichter 1977) were used to capture lizards. The sink traps were number 10 tin cans buried in the ground at 50 m intervals in a 4-ha grid system, for a total of 25 pitfall traps in each study area. Masonite covers (23 × 23 × 0.5 cm) were placed over the traps when not in use. Initially, these covers were removed for periods not exceeding 4 hours, thus precluding heat prostration of any reptiles in the trap. I found that trapping success was improved and trap mortality reduced to zero when the lids were not totally removed, but propped open slightly with a stick. Thus, the traps were effectively open continuously, but the lids shaded any animals in the trap. Traps were checked at 1- or 2-day intervals from May through October 1977. The noose consisted of a small copper wire or monofilament fishing line fashioned into a slipping noose and attached to the tip portion of a fishing rod. All lizards captured by either method were color-marked with indelible ink for individual identification.

Serpentine species, with the exception of rattlesnakes (*Crotalus viridis*), were hand-captured and color-marked when they were encountered. When a rattlesnake was found, its size was estimated and recorded along with the location of the sighting and any distinguishing characteristics of the snake. The paucity of snakes encountered, and the small number of lizards recaptured, prohibited meaningful estimates of population size by conventional methods. Therefore, the number of reptiles encountered was taken as an indication of the relative density of each species in each of the habitats studied.

Results and Discussion

As expected, big sagebrush was the dominant plant species in the sage study areas, and crested wheatgrass was the dominant species on both CWG areas (Table 1). The ungrazed sage had a significantly greater vegetal species diversity ($H = 2.85$) than did any other area (Table 2). The two CWG study areas exhibited a greater floristic percent similarity ($PS = 90$ percent) than any other habitat comparisons (Table 2).

Similar numbers of invertebrates were collected in the ungrazed and grazed habitats dominated by sagebrush (181 and 185, respectively) (Table 3). Equal sweep-netting efforts resulted in the capture of approximately 50 percent more invertebrates in each of the crested wheatgrass stands than in either of the sagebrush areas. These differences were significant ($X^2_{.05(1)} = 90.2$).

Four species of reptiles were encountered during the study (Table 4). No serpentine species were found in either of the ungrazed study areas. Gopher snakes (*Pituophis melanoleucus*) and rattlesnakes are generally common and widespread over the INEL Site (Linder and Sehman 1977). The absence of snakes in the ungrazed study areas may not be an accurate indication of the effects of different land use practices on these species. Woodbury et al. (1951), Hirth et al. (1969), and Sehman (1977) recorded maximum dispersal distances of snakes from a hibernaculum of 2.0, 1.3, and 1.9 km, respectively. It is likely that the ungrazed study areas were

TABLE 1. Percent coverage (%) and frequency (f) of plant species in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) and by crested wheatgrass (*Agropyron cristatum*) on the INEL Site. Only those species with a frequency of 10 or more, or a percent coverage of at least 1 percent are included.

	Ungrazed				Grazed			
	Sagebrush		Crested wheatgrass		Sagebrush		Crested wheatgrass	
	%	f	%	f	%	f	%	f
Opuntia polyacantha	1.3	13						
Chenopodium leptophyllum	0.6	17						
Artemisia tridentata	17.00	105			25.00	113	0.5	5
Aster scopulorum	0.7	23						
Chrysothamnus nauseosus	0.2	3			1.6	15	0.4	5
Arabis spersiflora	0.3	11	1.0	15				
Agropyron cristatum	1.9	15	52.0	160			39.4	154
Agropyron spicatum	6.0	35						
Oryzopsis hymenoides	5.2	34	0.2	3				
Poa sanbergii	1.8	16						
Sitanion hystrix	3.0	35			9.2	93		
Astragalis purshii	1.9	16						
Phlox hoodii					1.4	11		
Halogeton glomeratus					1.4	4	3.9	13
Total number of species	31		3		6		5	
Total percent coverage	41.6		53.2		38.7		44.1	
Species diversity (H)	2.85		0.37		1.17		0.54	

TABLE 2. Percent similarity (PS) and species diversity (H) comparisons of vegetation in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) and by crested wheatgrass (*Agropyron cristatum*) on the INEL Site. Numbers in the upper right portion of the body of the table are PS determinations. Those in the lower left are the results of t-test analysis of species diversity.

		Percent similarity			
		Ungrazed		Grazed	
Diversity	(H)	Sagebrush	Crested wheatgrass	Sagebrush	Crested wheatgrass
Ungrazed					
Sagebrush	2.85	–	33	38	32
Crested wheatgrass	0.37	6.78*	–	41	90
Grazed					
Sagebrush	1.17	20.78*	2.18*	–	22
Crested wheatgrass	0.54	8.72*	0.47	2.37*	–

*H significantly different as P <0.05.

more than 2 km from a suitable denning site. Therefore, snakes were excluded from further analysis.

Two species of lizards were frequently encountered: the short-horned lizard (*Phrynosoma douglassi*) and the sagebrush lizard (*Sceloporus graciosus*). The relative density of both species was significantly greater in each of the sagebrush study areas than in either crested wheatgrass area (Table 5). Significantly more ($X^2_{.05(1)} = 6.92$) sagebrush lizards were encountered in the ungrazed sage than in the grazed sage (Table 5). Conversely, significantly more ($X^2_{.05(1)} = 4.76$) short-horned lizards were found in the grazed sage than in its ungrazed counterpart. The two crested wheatgrass study areas supported populations of both species of lizards that were not statistically different (Table 5).

When the data from the ungrazed sage and ungrazed CWG study areas were combined and compared with the combined data from the two grazed study areas, sagebrush lizards were found to occur significantly more often ($X^2_{.05(1)} = 7.00$) in the absence of grazing. *Phrynosoma douglassi* population levels were not statistically different ($X^2_{.05(1)} = 2.67$) when analyzed in the same manner.

Table 3. Number of invertebrates collected in grazed and ungrazed habitas dominated by sagebrush (*Artemisia tridentata*) and crested wheatgrass (*Agropyron cristatum*) on the INEL Site.

	Ungrazed		Grazed	
Taxon	Sagebrush	Crested wheatgrass	Sagebrush	Crested wheatgrass
Arachnoidea				
Unclassified	11	6	2	55
Homoptera				
Ceropidae	3	119	7	8
Ciradellidae	44	7	40	19
Aphidae	15	0	5	0
Other	2	1	0	2
Unclassified	0	0	10	0
Hemiptera				
Corizidae	6	0	3	1
Miridae	6	0	12	8
Other	5	22	1	15
Unclassified	2	1	2	1
Coleoptera				
Chrysomelidae	0	0	0	12
Other	2	1	5	10
Unclassified	11	10	12	0
Orthoptera				
Acrididae	4	13	1	6
Other	3	3	6	2
Lepidoptera				
Unclassified	3	1	5	1
Diptera				
Other	0	0	1	2
Unclassified	18	25	11	51
Hymenoptera				
Formicidae	27	24	26	23
Other	0	0	0	7
Unclassified	19	37	36	53
Total	181	270	185	276

Conclusions

Populations of lizards responded differently to different land management practices on the INEL Site. Grazing by sheep in a habitat dominated by sagebrush resulted in a significant reduction in the plant diversity of that area. This was not accompanied by a concommitant change in the relative density of either the invertebrate or reptilian fauna. Planting a former sagebrush range with crested wheatgrass resulted in a further re-

TABLE 4. Number of reptiles encountered in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) and by crested wheatgrass (*Argopyron cristatum*) on the INEL Site.

	Number encountered			
	Ungrazed		Grazed	
Taxon	Sagebrush	Crested wheatgrass	Sagebrush	Crested wheatgrass •
Short-horned lizard (*Phyronosoma douglassi*)	17	4	26	7
Sagebrush lizard (*Sceloporus graciosus*)	37	5	21	0
Gopher snake (*Pituophis melanoleucus*)	0	0	2	0
Great Basin rattlesnake (*Crotalus viridis*)	0	0	3	3

TABLE 5. Results of chi square analysis of the number (N) of sagebrush lizards (*Sceloporus graciosus*) and short-horned lizards (*Phrynosoma douglassi*) encountered in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) and by crested wheatgrass (*Argopyron cristatum*) on the INEL Site.

		Study area			
		Ungrazed		Grazed	
Species and number encountered	N	Sagebrush	Crested wheatgrass	Sagebrush	Crested wheatgrass
Short-horned lizard (*Phryonosoma douglassi*)					
Ungrazed					
Sagebrush	(17)	—	9.94*	4.76*	5.88*
Crested wheatgrass	(4)		—	16.13*	0.82
Grazed					
Sagebrush	(26)			—	10.94*
Crested wheatgrass	(7)				—
Sagebrush lizard (*Sceloporus graciosus*)					
Ungrazed					
Sagebrush	(37)	—	27.68*	6.92*	36.01*
Crested wheatgrass	(5)		—	9.58*	3.20
Grazed					
Sagebrush	(21)			—	19.05*
Crested wheatgrass	(0)				—

*Significant at $P < 0.05$.

duction in the diversity of vegetation. This was accompanied by an apparent increase in the relative density of invertebrate fauna (especially arachnids, dipterans, and hymenopterans), although the populations of lizards were significantly below that found in the sagebrush habitats. The increase in invertebrates in the crested wheatgrass plantings may indeed be a very real phenomena, or it may indicate a shortcoming in using sweep-nets as a sampling technique in habitats that are structurally different.

Ants are the primary prey items of both the sagebrush lizard (Burkholder and Tanner 1974) and the short-horned lizard (Guyer 1978), and it is interesting to note that formicids were in equal abundance in each of the four habitats studied (Table 3). Thus, if prey alone was the factor controlling the distribution of lizards, one would expect equal densities of lizards in each of the four habitats of different land use. This, of course, was not the case, indicating that the physiognomy of the vegetation, as well as the presence of potential prey, is vital in determining the density of saurians, and most likely reflects the coevolution of these lizard species with the sagebrush environment.

Grazing a sagebrush habitat appeared to improve that habitat for *P. douglassi*, whereas *S. graciosus* population levels seemed to be lowered by livestock grazing. The mechanism(s) responsible for this disparity in the response of these species to grazing practices is not known. It is possible that the few forbs and grasses in the grazed sage study area (Table 1) resulted in more, or improved, basking sites for the short-horned lizard, but the lack of ground cover had a negative effect on the sagebrush lizard populations. The precise microhabitat affinities of these lizards are not recorded in the literature. Thus, the results presented here may reflect abiotic and biotic differences, as yet undetermined, among the four habitats studied. In any case, converting a sagebrush range to crested wheatgrass resulted in the reduction of the population levels of both the short-horned and sagebrush lizards. And, once the native vegetation was replaced by crested wheatgrass, grazing did not appear to further affect the lizard populations.

As the production of agricultural products increases to keep pace with the ever increasing demand for red meat protein, it is likely that more and more acreage of habitat dominated by sagebrush will be converted to monocultures of crested wheatgrass. Additionally, efforts to reclaim strip-mined lands in the Intermountain West rely heavily on the planting of crested wheatgrass for initial soil stabilization. Thus, crested wheatgrass plantings are becoming more widespread in our environment. This study, and others like it (Reynolds 1978), indicate that the continued conversion of habitats dominated by sagebrush to large expanses of crested wheatgrass will have a long-term and deleterious effect on the populations of native vertebrates.

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