

Impact of Grazing on a Riparian Garter Snake¹

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Abstract.--Numbers of wandering garter snakes (*Thamnophis elegans vagrans*) were significantly higher where cattle grazing was excluded than along grazed portions of Rio de las Vacas, a high elevation thin-leaf alder - willow riparian community in northern New Mexico. Differences can be attributed to the regeneration of streamside vegetation and the increased amount of organic debris.

INTRODUCTION

Riparian habitats of the southwestern United States are widely recognized as being critical to wildlife communities (Ohmart and Anderson 1982). However, little is known about the microhabitat requirements of many riparian species, particularly reptiles and amphibians. Even less is known about how these animals are impacted by changes in the structure and composition of plant communities brought about by grazing and other habitat modifications (Jones 1981). Numerous studies on the habitat requirements (Fleaharty 1967, Scott et al. 1982, White and Kolb 1974) and diet (Arnold and Wassersug 1978, Campbell 1969, Drummond 1983, Gregory et al. 1980, Kephart and Arnold 1982) of the wandering garter snake (*Thamnophis elegans vagrans*) have been published, but Fitch (1940), Drummond and Burghardt (1983) and others have demonstrated large variations in the ecological characteristics between local populations of this abundant and wide-ranging species (fig. 1). The primary objective of this study, therefore, was to document the effects of domestic livestock grazing upon a riparian population of wandering garter snakes by comparing snake abundances and habitat parameters between a grazed stream section and a nongrazed enclosure. Food habits and habitat use patterns

were determined in order to help explain differences in abundance between the two sites.

SITE DESCRIPTION

The study area is along the Rio de las Vacas, a third-order montane stream draining the San Pedro Parks Wilderness Area, Santa Fe National Forest, New Mexico. The area is about 17 km southeast of Cuba in Sandoval County, at a longitude of 106° 46' 30" and latitude of 35° 55' 57" north (T20N R1E S12). The site is at an elevation of 2,600 m.

The surrounding watershed is primarily mixed conifer on the north-facing slopes and ponderosa pine (*Pinus ponderosa*) interspersed with grassy meadows on the south-facing slopes. Under low flow conditions, stream width ranged from 2.8 to 10.5 m and averaged 7.6 m (Rinne 1985). Stream gradient is low ranging from 0.5 to 2.0%.

Two cattle enclosures each about a kilometer long and 50 m wide, straddle the stream. Vegetation within both enclosures is utilized by elk (*Cervus canadensis*) and beaver (*Castor canadensis*). The enclosures, established in 1972 and 1975, are within the Cuba Community Allotment of approximately 11,600 ha. Within the allotment there are 610 ha of private land (5.3%), 680 ha of riparian grassy meadows and shrubland (5.8%), and 5,675 ha of no-allowable-capacity lands (48.9%). No-allowable-capacity lands fall into two broad categories 1) areas under natural conditions that are not capable of producing vegetation, i.e., barren rock outcrops, talus slopes, etc. and 2) areas where the soil is not capable of producing more vegetation than is needed to prevent erosion. From 1949 to 1980 an average of 448 cattle (2,688 AUM) have been grazed on a continuous, season-long basis (June 1 to October 31). Since 1980, grazing has continued on this basis but will be altered to a 3-pasture rest-rotation system in the near future.

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The most apparent difference between the grazed and exclosed stream segments is the band of small riparian trees and shrubs along the exclosed reach of stream (fig. 2). More than 18% of the exclosed study plots were covered by a mixture of thin-leaf alder (Alnus tenuifolia), irrorata willow (Salix irrorata), scouler's willow (Salix scouleriana), coyote willow (Salix exigua), and cliff-rose (Cowania mexicana). In contrast, only 0.1% of the grazed study plots were covered by thin-leaf alder and irrorata willow (fig. 3). Herbaceous ground cover was significantly lower on the grazed plots ($71 \pm 4.5\%$ (S.E.)) than on the ungrazed plots ($88 \pm 2.4\%$) ($p < 0.05$, t-test). Moreover, there was significantly more dead and down debris on the ungrazed plots ($5.3 \pm 2.25\%$) than on the grazed plots ($0.4 \pm 0.31\%$) ($p < 0.05$, t-test). The presence of organic debris on the exclosure is directly related to the presence of the riparian shrubs, which sift out the material as it moves downstream during floods. Repeated flood accumulations have created debris heaps up to 4 m in diameter and 2 m high. The soil directly below the debris is high in organic content and supports large numbers of terrestrial annelid worms.

METHODS

Wandering garter snakes were sampled using a 3-day removal method (Bury 1982) conducted from 8 to 10 July 1983 between 0900 and 1300 hours. Eight plots, 10 by 25 m, were established in the grazed control and the area exclosed in 1972. Each plot was intensively searched daily for a 20-minute period for 3 days (Bury 1982). We alternated both starting points and investigators between days in order to reduce observer bias. Snakes that escaped were not recorded as they could be captured during a later sampling period. All captured snakes were retained in a separate bucket for each plot until the end of the sampling period, and then released on the plot where they were captured.

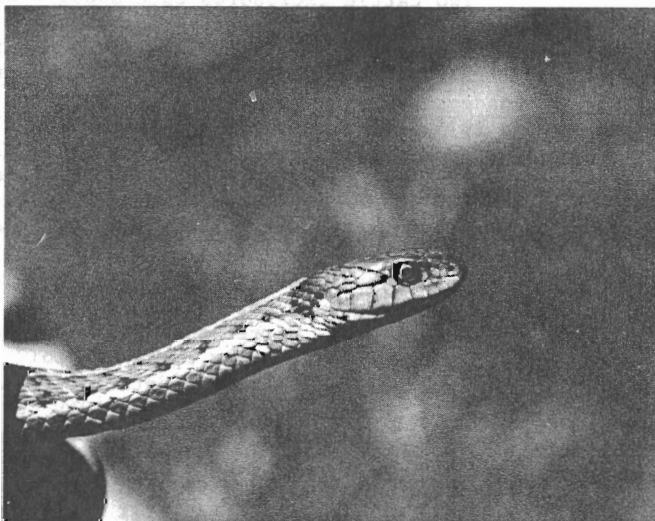


Figure 1.--Wandering garter snake: (Thamnophis elegans vagrans).



Figure 2.--Shrubby growth in the exclosure along the Rio de las Vacas.

Active and inactive snakes were observed during the abundance sampling period and from 22 to 24 June and 18 to 19 July 1983. For each snake, we recorded weight (± 1 g), stomach contents, the habitat in which it was first observed, and if fleeing, the cover it chose. The taxa in stomach contents were examined after stripping the snakes (Carpenter 1952). Habitat categories were divided into organic (tree base, debris heap, log or board, tree, shrub) and inorganic (rock slope, bedrock or talus, water, rocks) components.

RESULTS

Snake abundance and biomass were significantly higher ($p < 0.05$, t-test) in the plots exclosed from cattle grazing (table 1). Even though the vegetational complexity of the exclosed area made it much more difficult to sample, five times as many snakes were captured in the exclosed area as in the grazed area.

Stomach analyses showed that earthworms (62%) were by far the most frequently consumed food item, followed by slugs (18%) and fish (9%) (table 2). Although it is possible that the data underestimate the importance of fish on a volumetric basis, most earthworm observations consisted of large boluses. It is clear that worms were the primary food item.

Even though 61% of the snakes were first observed on the open grassy bank (table 3), most were usually less than 1 m from vegetative or structural cover. Snakes were also frequently observed on rocky slopes and in tree bases. Fleeing snakes were often observed heading toward the more structurally diverse streamside habitat. Over 70% of all snakes fled toward tree bases with or without debris or separate debris heaps (fig. 4, table 3).

Table 1.--Numbers and biomass of wandering garter snakes (*Thamnophis elegans*) captured on grazed and ungrazed exclosed plots

Sampling day	Ungrazed		Grazed	
	Number ^a	Biomass ^b	Number	Biomass
1	1.00±0.46	58.13±27.38	0.25±0.25	15.0±15.00
2	0.63±0.42	26.88±19.34	0.25±0.16	12.5± 8.18
3	0.87±0.24	32.00±11.63	0	0
Total	2.50±0.71	117.00±38.04	0.50±0.27	27.5±15.44

^a Mean number of snakes per 10 x 25 m study plot ± standard error, N = 8.

^b Mean grams of snakes per study plot ± standard error.

Evening searches of potential overnight cover sites showed that snakes used rocks (48%) and dead vegetation (52%) about equally (table 4). Presence of shed skins suggested that the abundant mammal burrows may also be used as cover sites, but these sites could not be searched adequately.

DISCUSSION

Thamnophis elegans occupies a wide variety of habitats in different parts of its distribution, and is well known for its tendency to range over relatively large areas (Fitch 1940, 1983, Stebbins 1954, Wright and Wright 1957). However, during the study period at our site, we rarely observed any snakes more than 25 m from the stream's edge. White and Kolb (1974) also found this species mostly limited to stream habitat in a study conducted near Sagehen Creek, California. Although several snakes were observed along small tributaries and marshy

meadows of Rio de las Vacas, none were seen in the adjacent ponderosa pine or mixed conifer habitats, probably because they had a thermally intolerable microclimate (Scott et al. 1982) or provided insufficient food.

Cattle grazing has significantly impacted the riparian habitat along the Rio de las Vacas (fig. 5). There are only a few large, decadent, thin-leaf alder trees on the stream banks and virtually no other shrubby vegetation or riparian development along the grazed portions of the stream. A study of summer grazing of a high elevation willow community in Jackson County, Colorado, similarly showed a riparian stand in poor condition (Cannon and Knopf 1984). Willow shrubs were larger, more decadent and more widely spaced. The width of riparian vegetation was also significantly reduced.

The marked contrast in vegetation emphasizes the importance of the exclosures to this population of snakes. Degradation of the



Figure 3.--Grazed section of the Rio de las Vacas. Notice the lack of living shrubs and the unstable stream banks.

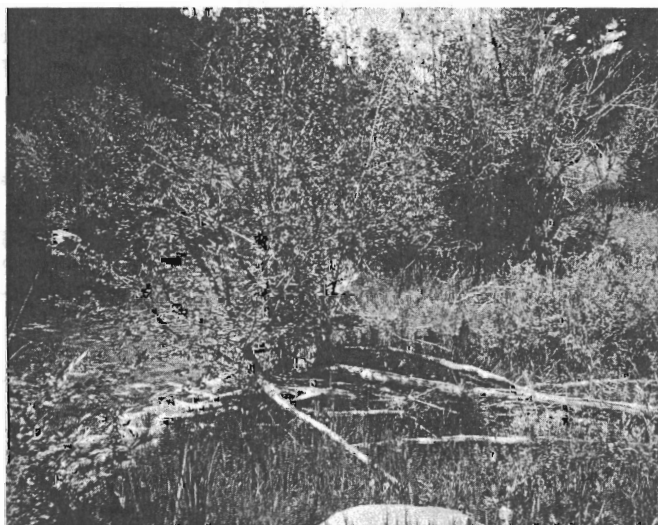


Figure 4.--Small debris heap at the base of a thin-leaf alder (*Alnus tenuifolia*).

Table 2.--Stomach contents of wandering garter snake (*Thamnophis elegans*) along Rio de las Vacas, summer 1983

Stomach contents	Number of stomachs	Percent stomachs
Empty	26	37
Worms	28	39
Slugs	8	11
Fish	4	6
Mammal	3	4
Insect larvae	2	3
Total	71	100

riparian zone by cattle grazing would negatively influence snake populations in the area. Grazing has been shown to negatively affect populations of other reptiles (Berry 1978, Reynolds and Trost 1980). Bury and Busack (1974) ascribed declines in lizard biomass to grazing-caused vegetative degradation. Similarly, Jones (1981) found that lizard populations on heavily grazed mixed riparian scrub and cottonwood-willow vegetative communities were characterized by lower relative abundance and species diversity than those of similar, lightly grazed sites.

The effects of grazing are twofold. First, grazing has a direct impact by affecting the structural characteristics of the habitat. Lack of available cover sites for use by fleeing snakes increases the potential for predation, whereas ungrazed sites, with abundant cover, provide excellent escape and thermal cover. Moreover, the availability of cover sites for inactive snakes may also be a contributing factor; more than half of the overnight cover sites were debris heaps or down logs (table 4). Many of the debris heaps in the ungrazed section were so large (diameter >2 m) they were not thoroughly searched, and the fact many snakes were still found in them suggests even higher

Table 3.--Habitat used by wandering garter snakes when first observed and when fleeing

Habitat	First observed		Fleeing snakes	
	Number	Percent	Number	Percent
Grassy bank	45	61	7	14
Rocky slope	10	14		
Rock slope with grass	4	5		
Tree base with debris	7	9	25	50
Tree base without debris	4	5	4	8
Debris heap			6	12
Talus or bedrock	1	1		
Water's edge	2	3		
Stream			3	6
Tree	1	1	2	4
Shrub			2	4
Log or board			1	2
Total	74	100	50	100

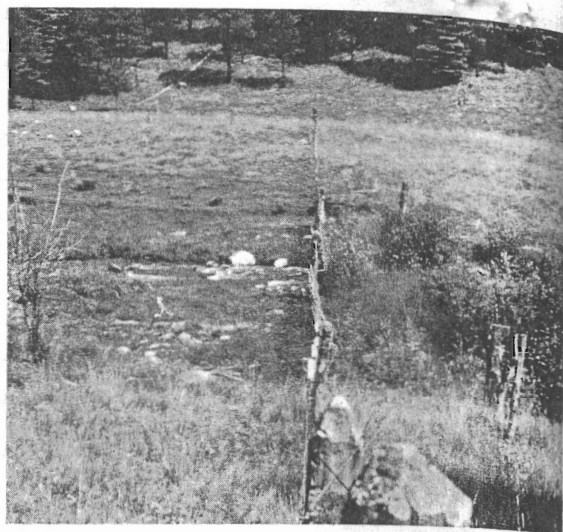


Figure 5.--Contrast at the fence line between grazed (to the left) and exclosed (to the right) stream sections along the Rio de las Vacas.

importance for them. Thermal cover is also necessary for wandering garter snakes to maintain optimum body temperature (Scott et al. 1982). Larimer County, Colorado, Scott et al. (1982) found that snakes were not seen in the open between 1100 and 1700 h during the warmer months. The lack of thermal cover in the grazed area probably makes the area intolerable for most of the day.

Second, grazing is known to reduce the abundance and biomass of many invertebrates (Hutchinson and King 1980), the snakes' primary food sources. Both earthworms and slugs were observed only in organic debris heaps during snakes' activity periods (0800 - 1600 h on cool, warm days). Because *Thamnophis elegans* is neither fossorial nor active during rain storms, it is unlikely that it would encounter food in situations other than within debris heaps under some other cover. Since organic cover was drastically reduced in the grazed area, the difference in food availability is very likely a contributing factor to the observed differences in snake numbers.

Table 4.--Wandering garter snake overnight sites along the Rio de las Vacas, summer 1983

Cover	Number of snakes
Small rocks (≤ 3 m)	5
Large rocks (> 3 m)	6
Debris heap	5
Down logs	7
Total	23

In spring and early summer, it is highly unlikely that the snakes are able to maintain energy levels by increasing their use of the abundant fish resources (Rinne 1985). Relatively low water temperature (8-12° C) and the fact that fish are probably harder to catch than worms would seem to discourage aquatic feeding. However, snakes enter the water and were observed foraging for fish once water temperatures reached 15 to 18° C in the late summer.

In conclusion, riparian vegetation and associated organic drift, resulting from the establishment of the fenced exclosures, has greatly increased local populations of Thamnophis elegans. The relatively high canopy cover and accumulated organics provide a favorable microhabitat for preferred food items, an expanded amount of foraging substrate, cover for predator avoidance and a favorable thermal regime.

Considerably more information is needed to adequately describe the effects of cattle grazing on this riparian system. Seasonal and yearly differences in microhabitat and food use as well as home ranges and movement patterns need to be determined to fully understand the importance of riparian structure on high elevation snake populations.

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