PRACTICAL AND THEORETICAL IMPLICATIONS OF PERCH USE FOR AVIAN PREDATORS ON RODENT POPULATIONS

María I. BELLOCQ* & Fernando O. KRAVETZ**

ABSTRACT

We hypothesized that the vertical structure of the habitat is a determining feature of avian predation intensity on rodents, other habitat conditions being equal.

Two trap grids for rodents were set up in a field with corn stubble at two times, before and after setting up perches in the experimental plot; one of the trap grids served as a control. There was no significant difference in captures between control and experimental grids before setting up perches (control validation). However, more rodents were captured in the control than in the experimental plot after the treatment. Predation lowered rodent density by roughly 40%. *Calomys laucha* was the affected species. Differential predation was not observed according to size or sex. We conclude that habitat vertical structure causes significant changes in rodent abundance, and it should be considered in rodent control and raptor management.

1. INTRODUCTION

The role of predators in the regulation of rodent populations is a subject of controversy. While some authors dismissed the importance of predation in determining rodent numbers (Errington 1946), at present there is a trend reaffirming an important role to predation as a mortality factor (Anddersson and Erlinge 1977, Erlinge et al. 1983, Pearson 1985, Korpimaki and Norrdahl 1989). Among others, Pearson (1966) observed local extinctions of rodents as a result of predation by carnivores. Beachman (1979) recorded at least 25% mortality in a population of *Microtus townsendii* in a single week caused by predation, while Ryszkowski et al. (1971) recorded as much as 70% mortality in Polish woodlands.

Sudden variations in plant coverage favor and focalize the action of predation by birds (Green and Taylor 1975). According to Birney et al. (1976) there is a coverage threshold value which can affect amplitude, duration, and synchrony of *Microtus* population cycles; these authors consider avian predation as a component of the coverage effect. Taitt and Krebs (1983) extend this concept by stressing that coverage has an influence not only on predation but also on food availability and interaction behaviors. Morris et al. (1958) postulated that avian predators are

Universidad de Buenos Aires, Facultad de Medicina, Departamento de Microbiología.
Present address:
* Faculty of Forestry, University of Toronto, 33 Willcocks Street, Toronto, Ontario, M5S 3B3 Canada.
** Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales, Dept. Ciencias Biológicas, Ciudad Universitaria, Pab. II, 1429 Buenos Aires, Argentina

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unable to prevent prey demographic explosions, but can act on population decline by modulating cycle amplitude.

In previous studies (Bellocq 1988), carried out in agricultural fields, we have observed that *Tyto alba* and *Athene cunicularia* predation produced non-compensatory and subcompensatory effects on rodent population respectively. Both predators would be able to affect rodent population decline, but the percentage of predation obtained was low because of low predator densities.

The development of summer crops results in changes in both vegetation coverage and rodent abundance. Rodents increase from low levels during spring to a peak during the corn stubble stage in fall, continuing about a month and a half (Kravetz et al. 1981). over this period the stubble provides good coverage, whereas harvesting reduces structure to a single low height stratum allowing ready access of predatory birds, but without providing observation spots. Cropfields in the Pampa currently afford few observation spots, and most of them (mainly fencing and electric cable posts) are outside cropfields.

Evidence shows that the habitat acts on raptor-rodent interactions not only through changes in coverage, but also in vertical structure which provides observation spots making prey detection more economical by favoring passive search. This becomes relevant since the effect of various types of foraging tactics may be involved in determining capture patterns (Green 1986).

We hypothesized that an increase in the vertical habitat component could produce a decline in rodent population due to avian predation. By acting upon the increasing fluctuation phase of rodent population numbers, maximal annual abundance may be lowered.

2. MATERIAL AND METHODS

The study was carried out in a cropfield near Diego Gaynor (34 18'S, 59 14'W), Buenos Aires province, Argentina. The area has large stretches of land devoted to cereal crops, alternating with a few fields where cattle graze. Corn production favors the development of rodent populations, especially *Calomys* (de Villafane et al. 1977).

The study area consisted of corn stubble pastured by cattle. The soil was trodden and 50% was bare (20% with litter and 30% without it). Dominant plants were *Senecio grisebacchi* (40%-45% coverage, mean height = 46 cm) and *Cynodon dactilon* (10%-15% coverage). The area was homogeneous in floristic composition, coverage, and vegetation structure.

The experiment was carried out in April and May 1986, during the annual increase of rodent populations (Kravetz et al. 1981).

A field was divided in control and experimental plots. Trap grids for rodents were set up in both plots, before and after setting up perches in the experimental plot. Grids were set up 300 m apart. Each grid consisted of 100 live traps. Traps were placed every 10 m and were operative during 4 days for each sampling. Capture effort for each grid and sampling was 400 trap/nights.

The mark-recapture technique was employed. Captured rodents were identified to species, and sex, weight, and standard measurements taken. The Minimum Number Alive method was used to measured rodent abundance (de Villafane et al. 1988). Three size classes of *C. laucha* based on the total body length were discerned: Class I (<109.7 mm), Class II (from 109.7 mm to 137.3 mm), and Class III (>137.3 mm). The effect of perch placing was evaluated on *C. laucha* population according to sex and size.

Following the first rodent sampling, a 9-perch grid roughly 2 m high, 30 m apart, was set up in the experimental plot. The perch grid was included within the trap grid. One month after setting up perches the rodent populations were reevaluated in both plots, as already described.

To validate the control, the original rodent capture numbers in the control and experimental plots, were compared by the Chi-square test for the sampling prior to perch erection. In all cases the expected number was a function of the number of traps actually operated in each grid; only original captures were considered.

The frequency of perch use was determined by counting the number of droppings at each one's base. To evaluate whether the roosts were equally used, the number of bird droppings were counted in the base on each perch twice during the experiment.

3. RESULTS

The number of rodents in control and experimental plots (37 and 43 respectively) was not significantly different before setting up perches ($X^2 = 0.45$, df = 1). However, there was a significant difference after the perches were erected (89 and 54 rodents respectively; $X^2 = 8.57$, $P < 0.001$, df = 1). The perches may have acted to arrest population growth. The drop in total capture recorded in the experimental plot was 39.3% relative to the control, as a consequence of setting up perches in the experimental one. Considering only *C. laucha* it was at least 50%.

After treatment, more *C. laucha* were captured in the control than in the experimental plot. *Calomys laucha* was the affected species, whereas perch placing did not affect *Akodon azarae* abundance (Table 1).

The age structure of the population ($X^2 = 1.634$, df = 2) and the sex ratio ($X = 0.239$, df = 1) were similar in both experimental and control plots (Fig. 1), even though there were more medium-size females *C. laucha* in the experimental plot before the treatment.

All the perches showed equal use. The variance/mean ratio of the number of droppings found daily at the base of perches was 0.13. *Polyborus chimango* and *Elanus leucurus* were observed using the perches.

TABLE 1

Numbers of *Calomys laucha* (a) and *Akodon azarae* (b) captured in the control and experimental sectors b efore and after setting up perches in the experimental sector. Values were corrected taking into account the numbers of traps actually operative in each grid

a			b		
	Before	After		Before	After
Control	26	84	Control	10	10
Experimental	33	41	Experimental	10	13

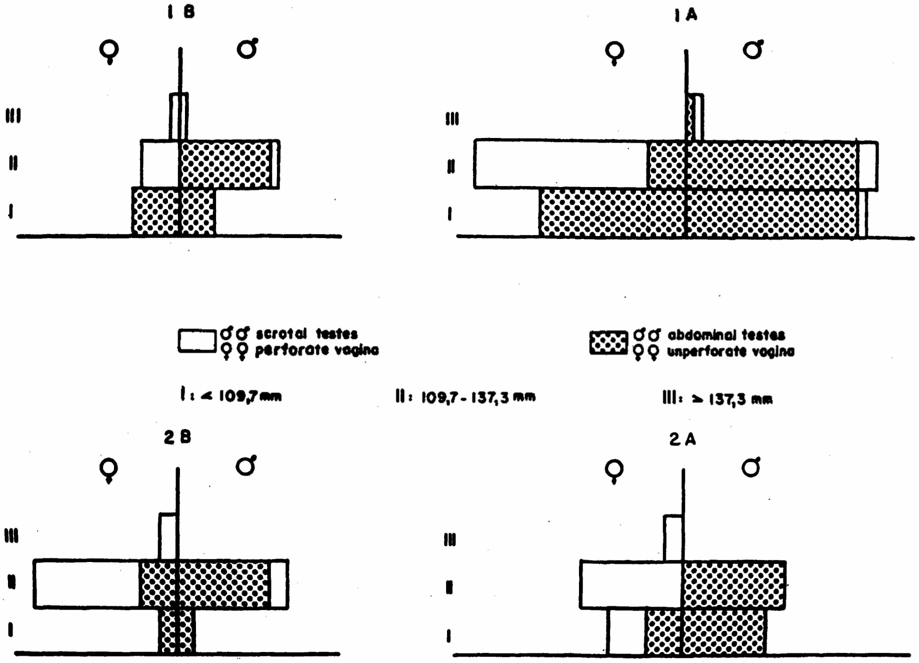

Fig. 1.— *Calomys laucha* population structure in control (1) and experimental (2) plots, before (B) and after (A) setting up perches in the experimental plot.

4. DISCUSSION

The difference found in the total rodent capture between control and experimental plots after setting up the perches, is similar to the predation values reported by Andersson and Erlinge (1977) for *Microtus*, without applying handling techniques. Ryszkowski et al. (1971) observed a 70% reduction in cropfield rodent population, owing to high predation pressure during the months of low rodent abundance. The 39% difference observed in our work does not exclude mortality by predation which may also occur in the control plot.

The fact that no animals marked in the treated field were captured in the control grid strongly suggests that the estimation of predation cannot be ascribed to rodent displacement as an escape behavior towards predation as proposed by Kotler (1984).

The results obtained support the hypothesis that predatory birds tend to maximize their net gain. According to local features, reductions in search cost, whether by greater visibility determined by lower coverage or by having observation spots with the same coverage, are all key factors in selecting capture sites with an equal food availability.

We should complete the concept advanced by Birney et al. (1976), to the extent that predation by birds may be interpreted as a component of the vegetation coverage on rodent populations. Our results strongly show that, under equal plant coverage and food supply, the action of predators varies according to the habitat vertical structure.

The vertical structure of the habitat acquires special significance where the lack of trees appears to be a limiting factor due to both its eventual role as perches and its refuge value (Bellocq 1988). We suggest that small increases in vertical structure are reflected in greater predator density, in their impact on the prey, and in the diversity of predatory birds as a whole.

In previous work, it was shown that *C. laucha* born later than March fail to reproduce till September (Kravetz et al. 1981). Any management strategies inducing additional mortality, applied from March to June, will therefore lower the populational peak occurring in June-July, when high density-independent mortality related to winter frost may often be observed (Crespo 1966). Furthermore, such strategies would in turn lead to a drop in minmal annual abundance recorded at the beginning of reproductive activity in October. In the absence of compensatory mechanisms, an increase in predation during the increasing populational phase would induce a drop in the following populational minimum.

It remains to be answered in future work how far such results pose a counterexample to the cascade of decisions in foraging hierarchy (Charnov and Orians 1973), particularly as regard the sequence between habitat selection and foraging method chosen: the selection of capture method and hunting habitat would remain at the same hierarchical level by mutual conditioning in generalist predators.

Rodent capture by birds may be oriented in cropfields belonging to the Pampean agrosystems by means of habitat manipulations which determine a drop in search cost. Under equal plant coverage, predatory birds will select those habitats with vertical structure which allowed a behavior of observation and capture, therefore more rodents will be predated. It should be considered both plant coverage and vertical structure to analyze predation as an habitat modulate activity.

The employment of perches by *E. leucurus* is crucial since this is an specialist predator. Pearson (1985) reported that this species captures 21 rodents per day, devoting less than 20% of daylight hours to foraging activity, which stresses its efficiency in rodent capture.

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