ACTA THERIOLOGICA
Vol. 23, 6: 127—143, 1978

Fragmenta Theriologica

A New Killing Technique of the Long-Tailed Weasel

Nowy sposób zabijania przez *Mustela frenata*

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Byrne A., Stebbins L. L. & Delude L., 1978: A new killing techniques of the long-tailed weasel. Acta theriol., 23, 6: 127—131 [With 1 table].

Techniques of killing 25 Richardson's ground squirrels, *Citellus richardsoni*, by an adult male long-tailed weasel, *Mustela frenata*, was studied in a large cage. Kills occurred both above ground and in burrows dug by the squirrels. Above ground a nape bite was the preferred method of killing. Below ground a throat bite was most often used. Adaptive value of the two killing techniques is discused in relation to conservation of energy by the predator.

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I. INTRODUCTION

Mustelids below 1 kg have evolved a metabolic adjustment to compensate for heat loss due to the abnormally large surface area resulting from their long-thin shape (Inversen 1972, Brown & Lasiewski 1972). The weasel's metabolic rate varies from 50 to 100 per cent above the standard mammalian curve in the large *Mustela frenata* (Brown & Lasiewski 1972) and up to 300 per cent above standard in the small *M. nivalis* (Scholander *et al.* 1950). This sacrifice of metabolic efficiency in favour of an elongate shape suggests that increased predatory efficiency may be achieved as a consequence of this particular body shape (Brown & Lasiewski, 1972). Controversy exists as to the manner in which such a body shape would be advantageous to weasels. Brown & Lasiewski (1972) and Allen (1938) suggest that weasels kill primarily below ground and that their long thin shape is advantageous in allowing them to enter confined spaces in search of prey. Quick (1957) however, suggests that the advantage lies in the ability to move through snow tunnels and dense thickets above ground while hunting, as prey are better equipped to defend themselves in the confined spaces below ground.

Purpose of this study was to compare killing technique of a long-tailed weasel (*M. frenata longicaudata* Bonaparte, 1938) preying on ground squirrels (*Citellus richardsoni* Sabine, 1822) above and below ground in hopes of determining whether body shape is an advantage in killing below ground.

II. METHODS

One wild trapped adult male *Mustela frenata* was observed killing 25 *Citellus richardsoni.* Squirrels were placed individually in a 54×110×94 cm high hardwarecloth cage for at least two days before the kill and were either restriced above ground or allowed to burrow in a 110×64×10 cm wide soil filled space between two plexiglass sheets in the floor of the cage. 11 squirrels (wt range 202.1 to 318.3 gms, $\bar{x}$=259.1 gms) were above ground and 14 (wt range 144.6 to 408.1, $\bar{x}$=263.2 gms) below ground when the weasel was introduced. Of the 14 squirrels originally below ground, five moved above ground during the kill. Results of these attacks are not discussed as methods of attack changed during the kills as the prey changed locations. The cage and burrow were illuminated and back lighted with three 100 watt lights during the kills.

Table 1

A description of skeletal damage to 5 throat and 5 nape killed prey. Prey were removed directly after death and their skeletons cleaned in H_2O_2.

KILLING BITE ONLY						
THROAT						
Animal Number	Skull	Atlas	Axis	Post. Cerv. Vert.	Thoracic Vert.	Scapulae
10	2		4			
13						
14						
21						
23	1					8 (L, R)
NAPE						
8	1	6	4, 5	5	4	
11	2, 3	5	4, 5	5	4	
12			4, 5	5		8 (L)
16		5	4, 5	5, 6	4	7, 8 (L)
17		5	4, 5	5		8 (L, R)

Code: 1 — zygomatic arch broken; 2 — parietals fractured; 3 — occipitals fractured; 4 — neural spine broken; 5 — transverse process broken; 6 — neural arch broken; 7 — scapula severed; 8 — scapula ridge broken.

Between kills the weasel was maintained in a large cage in a separate room and fed dog food and wild mice. His weight increased from 273 to 334 gms during the experimental period.

Method of kill was recorded for all prey and time from the first bite until prey resistance ceased and from first bite until prey were released by the weasel was measured for 13 prey. The prey were cleaned and examined for skeletal damage.

III. RESULTS

Two distinct killing methods were observed; the weasel either attacked dorsally, biting the nape area or attacked ventrally, grasping the throat and suffocating the prey. The type of kill method used was significantly related to the location of the kill. 88.8% (8 of 9) of nape kills occurred above ground and 11.2% below ground while 100% (8) of suffocated prey were killed below ground ($P<0.00037$, Fishers exact probability test). Three kills using a combined nape and throat attack occurred above ground but in each case the nape bite was applied first and only when the prey were unable to defend themselves was the throat attacked. No prey were killed by suffocation alone above ground.

Table 1 compares skeletal damage caused by nape and throat attacks, clearly illustrating different osteological consequences of the two kill methods.

There was no significant difference in the time from first bite until release of prey after its death between the two methods of attack, but the percentage of this time that the prey actively defended itself was significantly greater for nape killed prey ($\bar{x}=87.7\%$) than for throat killed prey ($\bar{x}=31.3\%$) ($\chi^2<0.0$).

The major defence of the prey was kicking and scraping with its powerful hind legs. Above ground while being attacked by the nape the prey kicked wildly, although usually without contacting the weasel while the weasel held the prey in the lateral rolling hold (Gossow, 1970). Below ground, however, confinement severely restricted the squirrel's ability to kick with its hind legs and thereby apparently neutralized the only major method of defence of the squirrel.

IV. DISCUSSION

A killing bite is decribed by Leyhausen (Lorenz & Leyhausen, 1973) as an attack directed fairly precisely towards a fatal spot. He notes the nape bite of the *Mustelidae* as a highly developed example of such a bite. The nape bite as observed here for *M. frenata longicauda* preying on ground squirrels has also been documented for many other species of *Mustela*. Nape bites have been observed in the above ground killing of mice by the least weasel, *Mustela nivalis* (Ellis, 1959; Allen, 1938, Heidt *et al.*, 1968; Heidt, 1972; East & Lockie, 1964; Nagel, 1972; Gossow, 1970; Llewellyn, 1942; Rubina, 1960), prairie dogs by *M. nigripes* (Progulskie, 1969), rats by *M. erminea* (Gossow, 1970), and the cottontail rabbit by an unnamed weasel (Leopold, 1937). The nape killing bite has also been documented in *Mustela frenata* killing cottontails (Allen, 1938); Glover, 1943), rats (Hamilton, 1933; Glover, 1943), mice (Glover, 1943) and chipmunks (Quick, 1951), all in above ground situations. The nape bite is aimed primarily at the bony structures (Gossow, 1970), fatally damaging the cervical spinal cord or medulla (Lorenz & Leyhausen, 1973). This is accomplished by a combination of crushed and punctured bones, cervical dislocation and direct penetration of the nerve cord through intervertebral spaces (Nagel, 1972).

The throat bite, however, has to our knowledge, only previously been described for any weasel by Allen (1938) with the New York weasel killing adult cottontails above ground. However, in his description, the prey had previously been seriously wounded using the nape bite before the throat bite was attempted. Allen describes the bite as follows: »The weasel quickly sought its throat (*i.e.* the prey) and closed its jaws on the trachea. There was no longer any motion of the weasel's jaws, and it was apparent that the breathing of the rabbit was completely cut off. It gasped a few times and expired«.

In this study the throat was the only fatal area attacked in eight below ground kills and on all occasions prey were observed to gasp heavily for breath after its initiation. These results show that the throat bite is a true killing bite (Lorenz & Leyhausen, 1973) being directed precisely at the throat and causing death by suffocation. The light vertebral damage found in throat killed prey supports suffocation as the cause of death, in contrast to nape kills where osteological damage is characteristic (Gossow, 1970; Nagel, 1972; Lorenz & Leyhausen, 1973).

Prey resistance is probably not an important factor in small prey, such as mice, which are easily killed by a few rapid nape bites. Large prey, however, possess the ability to fatally injure the attacking weasel (Allen, 1938). Below ground the confined space prevents the prey from effectively kicking the weasel with its hind legs when grasped by the throat. Above ground, however, a throat attack would leave the weasel open to extensive gouging by the powerful hind legs of the prey. This may explain why, when killing occurs above ground, large prey are characteristically held by the lateral rolling hold from behind (Gossow, 1970; Llewellyn, 1942, and Glover, 1943) preventing a throat bite but presenting the cervical region. The throat kill therefore would only be expected to occur, as was found, when the prey's ability to resist was decreased, such as below ground or above ground after the prey had been seriously injured.

The significant decrease in the ability of the prey to actively defend itself while being suffocated in a underground attack may be important to the energetics of the weasel. Since the nape attack, typically seen above ground, involved strenuous action of a significantly longer duration than the throat kill, a significant saving in energy may result from the latter kill method. Since the energy required of a predator to overcome prey probably has a bearing on the frequency with which prey are taken (Quick, 1951), use of the throat killing bite, especially below ground, may be important to the ecology of predation in the weasel and in particular may support the theory that body shape of the weasel is an adaptation to underground pursuit and killing.

The authors thank G. DeWitt, N. Previsich, B. Sallenbach and F. Wright for technical assistance. This work was aided by Alberta S.T.E.P. grant no. 73—1257 to A.B.

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Accepted, June 28., 1977.

Feeding Behavior, Coprophagy and Passage of Foodstuffs in a Captive Least Shrew

Behawior pokarmowy, koprofagia i tempo przechodzenia treści pokarmowej u *Sorex minutissimus*

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Skarén U., 1978: Feeding behavior, coprophagy and passage of foodstuffs in a captive least shrev. Acta theriol., 23, 6: 131—140 [With 2 Tables & 2 Figs].

Observations of a single old adult male of the least shrew *Sorex minutissimus* Z i m m e r m a n, 1780 in captivity show that it ate willingly *Araneae, Opiliones, Chilopoda, Orthoptera, Lepidoptera, Hymenoptera* larvae, *Diptera* adults and small *Coleoptera* adults. The animal did not eat slugs, snails or lumbricids even though hungry. The first arthropod remnants appeared in feces on an average twenty minutes after eating started; spiders passed most quickly (12 min.), centipedes slowest (53 min.) throughout the digestive tract. The bulk of the arthropod remnants seemed to have passed after an hour and as a rule they were no longer found after 1.5—2 hours. Coprophagy was evident at times. The shrew ate about twice its own weight (2.5 g) per day. It seldom drank water. Hearing seemed to be important in hunting. The satisfied animal immobilized larvae and crickets, which lived even 30 hours afterwards .The shrew used these stores and sometimes moved them to new places.

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1. INTRODUCTION

Sympatric living of many *Sorex* species has stimulated the investigation of possible differences in their diet (S t r o g a n o v, 1957; O h o t i n a, 1974; P e r n e t t a, 1976 and others). The natural diet of *Sorex minutissimus* is difficult to study, because as a rule this species