DIET OF THE OPOSSUM (*TRICHOSURUS VULPECULA* KERR) ON FARMLAND NORTHEAST OF WAVERLEY, NEW ZEALAND

ALICE E. HARVIE
Ecology Division, DSIR, Lower Hutt

SUMMARY: On farmland near Waverley, New Zealand, 550 opossums (*Trichosurus vulpecula*) were shot between October 1968 and November 1969, and their stomach contents were analysed to find the ratio of pasture species to non-pasture species eaten. Pasture species (grass and clover) formed about 30 percent of their diet. The economic loss to the farmer, where opossums are numerous, could be considerable.

INTRODUCTION

The opossum (*Trichosurus vulpecula* Kerr) seems able to find food in almost any type of vegetation, but it must also have access to suitable sleeping quarters such as hollow trees, thick hedges, rock crevices or any place which provides dry, dark, daytime shelter. It eats leaves of a wide range of species and also eats flowers and fruit when available. Gilmore (1965a and b) also records opossums eating root crops grown for winter feed for stock, and has single records of bark and insects (*Odontria* sp.) in stomachs. Mason (1958) found no animal material in 135 stomachs though Kirk (unpublished letter to the Under-secretary for Internal Affairs, 4 November 1929) found portions of unfledged birds in two stomachs.

Although largely arboreal, the opossum is known to eat pasture species which would otherwise be available for stock (Gilmore 1965a and b); it also browses grass and clover in a predominantly forest habitat. This paper investigates the importance of pasture species in the diet of opossums in an area where a wide variety of vegetation types is available.

MATERIAL

From September 1968 to November 1969, 550 opossums were shot on four farms and adjacent roadsides in country about 6 km northeast of Waverley, near Wanganui, under the administration of the Patea-Waitotara Pest Destruction Board. The farms had a total area of 606 ha of which 324 ha (53%) was improved pasture carrying 20 to 25 ewe equivalents per hectare. The land consisted of flattened interfluvial areas with pasture, hedges and shelter belts and steep-sided gulleys clothed in secondary native bush and introduced scrub. These gulleys provided good sleeping sites as well as many potential food species.

The pasture comprised grass and clover species: perennial ryegrass (*Lolium perenne*), Italian ryegrass (*L. multiflorum*), crested dogstail (*Cynosurus cristatus*), timothy (*Phleum pratense*), Chewings fescue (*Festuca rubra* var. *commutata*), cocksfoot (*Dactylis glomerata*), white clover (*Trifolium repens*) and subterranean clover (*Trifolium subterraneum*). The secondary forest in the gulleys contained many species, the leaves of which are known to be eaten by opossums (Kean and Pracy 1969, Mason 1958, Harvie unpublished). Most important were fivefinger (*Pseudopanax arboreum*), toro (*Myrsine salicina*), titoki (*Alectryon excelsus*), mahoe (*Melicytus ramiflorus*), tutu (*Coriaria arborea*), *supplejack* (*Ripogonum scandens*) and mamaku (*Cyathea medullaris*). Species which provided either fruit or flowers as food included pigeonwood *(Hedycarya arborea)*, hinau (*Elaeocarpus dentatus*) and rewarewa (*Knightia excelsa*). The scrub in the gulleys consisted mainly of gorse (*Ulex europaeus*) and manuka (*Leptospermum scoparium*). Windbreaks of boxthorn (*Lycium ferrocissimum*) were numerous and provided both leaves and fruit as food, while both pine (*Pinus radiata*) and macrocarpa (*Cupressus macrocarpa*), though not numerous, contributed to the diet. The roadside vegetation was mixed poplar (*Populus* sp.) and willow (*Salix* sp.) being the dominant tree species with bluegum (*Eucalyptus* sp.) occurring less frequently.

Although opossum control work continued throughout most of the Patea-Waitotara Pest Destruction Board District the only opossums taken on the four farms involved were those shot at fortnightly intervals for the purpose of this study. Approximately 20 animals were killed each fortnight, being shot from about two hours after dusk until the necessary number had been obtained. The animals were measured and weighed before the stomachs were removed and their condition was visually assessed as poor, good or excellent on the amount of mesenteric fat present. Stomachs and contents were preserved by injection of 20 ml of formalin-acetic acid-alcohol (F.A.A.) solution.

For analysis the stomachs were weighed intact, then the contents were weighed separately. These were then thoroughly mixed and a 25 g sample taken, which was oven dried and reweighed; the comparative dry weight value of the total content of each stomach was calculated. A further sample was taken from the wet contents of each stomach: this was divided into four subsamples. Fifty plant fragments were identified macroscopically in each subsample. Fine grasses and clover were classified as pasture foods while leaves of all other species and other types of food were listed as non-pasture. The 200 identifications per animal in each fortnightly sample were totalled and the ratio of pasture to non-pasture foods calculated.

RESULTS AND DISCUSSION

The mean body weight of all adult animals shot throughout the 13 months was 2.36 kg. Mean adult weight was calculated from animals above 1.4 kg. The mean body weight of adult males was 2.37 kg and for adult females 2.35 kg. This compares with similarly calculated mean body weights of adult opossums in the Orongorongo Valley, near Wellington, of 2.30 kg for males and 2.22 kg for females (Dr B. D. Bell, pers. comm.). The heaviest male from Waverley weighed 3.9 kg and the heaviest female 3.3 kg.

The weight of the wet stomach contents of the 450 animals ranged from 8.9 to 383.7 g, with a mean of 133.1 g (5.9% of the mean body weight). Gilmore (1965b) found that, in 100 animals from Banks Peninsula, the stomach contents formed 4.3 percent of body weight. It was not known how much of the 20 ml of F.A.A. preservative remained in the Waverley stomach contents and this may have slightly modified the results. The dry weight of the contents may be more reliable than the wet weight and ranged from 1.1 g to 62.7 g (mean 18.2 g). There was no obvious relationship between weight of stomach contents and the time of night that the animal was shot, nor was there any difference in the weight of food eaten by males and females. More must be known of the total food requirements of the opossum, the species composition of the diet, the gastric activity and other related facts before these results can be correctly interpreted.

TABLE 1. *The Seasonal Mean Body Weight and Condition of 468 Adult Opossums Above 1.4 kg.*

Season		N	Condition Rating % Frequency Occurrence Poor	Good	Excellent	Mean Body Weight
Spring	1968	76	74	26	0	2.42
Summer	1969	83	54	42	4	2.48
Autumn	1969	121	38	55	7	2.25
Winter	1969	95	35	58	7	2.31
Spring	1969	93	43	44	13	2.39

The results of the visual estimation of animal condition from the amount of mesenteric fat are presented in Table 1. Of 517 animals assessed, 51 percent were poor, 43 percent good and 6 percent excellent. The condition of the animals was apparently best in winter 1969 when 58 percent of the opossums were rated "good", and poorest in spring 1968 (73 percent "poor"). Gilmore (1965b) considered that, on Banks Peninsula, "with few exceptions, all the animals examined were in extremely good condition". As there was no apparent scarcity of food in Waverley, it would be interesting to know what determines the condition of the animals, or even if a low fat reserve is any disadvantage if food is plentiful throughout the year.

Table 2 and Figure 1 give results from macroscopic examination of the well-mixed stomach contents of each animal. It was necessary to mix the contents well because when the stomach wall was cut longitudinally, and laid back carefully so that the contents remained intact, the ingesta was

often in clearly defined strata, indicating that animals often browse fairly heavily on one species or type of food before moving to another. Three or four strata were usually present, supporting Mason's (1958) average of three species per stomach.

Although no measurements of leaf fragments were taken, there appeared to be no obvious, constant discrepancy in the sizes of fragments in the two categories of pasture and non-pasture species. Opossums do not masticate food finely; generally, leaf fragments were large enough to be easily identified (up to 0.5 mm square).

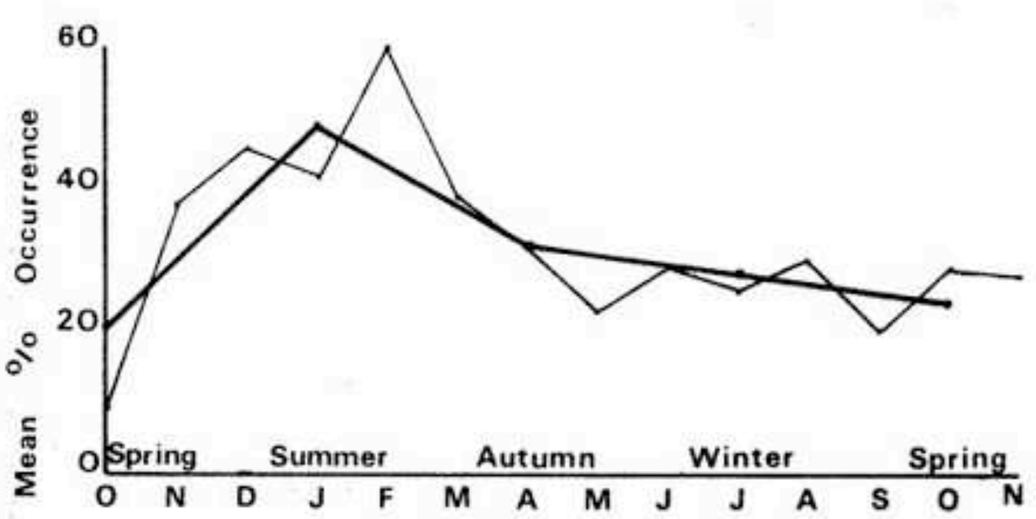

FIGURE 1. *Mean monthly and seasonal percentage frequency of pasture species eaten, based on identification of 200 food fragments per stomach.*

TABLE 2. *Details of Samples of Shot Opossums and of Their Stomach Contents.*

Season	Date Shot	Sample Size	Mean % Pasture Eaten	Mean % Non-Pasture Eaten	Standard Deviation	% of Stomachs with Pasture Content	% of Stomachs with No Pasture Content
Spring	1.10.68	7	27	73	26.8	86	100
	15.10.68	27	3	97	5.1	52	100
	30.10.68	20	12	88	12.3	80	100
	11.11.68	20	34	66	40.2	75	100
	25.11.68	18	42	58	34.9	100	100
Summer	9.12.68	20	34	66	24.8	95	100
	17.12.68	20	58	42	35.9	95	100
	8. 1. 69	14	38	62	28.6	100	100
	20. 1. 69	20	45	55	32.1	85	100
	3. 2. 69	15	76	24	25.0	100	93
	17. 2. 69	14	43	57	27.3	100	100
Autumn	2. 3. 69	16	20	80	22.3	81	100
	17. 3. 69	20	43	57	26.5	100	100
	30. 3. 69	20	49	51	28.2	100	100
	14. 4. 69	19	34	66	32.4	100	100
	29. 4. 69	20	29	71	30.9	85	100
	11. 5. 69	20	16	84	12.2	100	100
	25. 5. 69	16	32	68	23.6	94	100
Winter	10. 6. 69	17	22	78	27.4	82	100
	24. 6. 69	12	38	62	31.2	92	100
	8. 7. 69	15	18	82	18.4	80	100
	22. 7. 69	14	35	65	24.1	100	100
	5. 8. 69	20	23	77	19.1	95	100
	18. 8. 69	24	36	64	26.7	96	100
Spring	2. 9. 69	20	26	74	22.2	90	100
	15. 9. 69	19	9	91	11.9	58	100
	29. 9. 69	20	23	77	23.2	90	100
	13.10.69	19	14	86	18.6	84	100
	29.10.69	20	43	57	20.2	100	100
	10.11.69	24	28	72	21.5	100	100

Table 2 shows that though the opossums seemingly had equal opportunity to eat both pasture and non-pasture food, in only two of the fortnightly samples did the percentage of pasture foods exceed that of non-pasture foods. Over the 13 months the ratio of fragments of pasture species to non-pasture species was 32:68. When the batches from each month were combined (Fig. 1) it can be seen that in only one month (February 1969) did pasture foods form more than 50 percent of the stomach content. Pasture content throughout the summer of 1968-69 (November-March) is significantly higher than in any of the other seasons ($P < 0.005$) differences between other seasons are not significant ($P > 0.10$).

Table 2 also gives the percentage of stomachs per batch which contained pasture and non-pasture species. Non-pasture species occurred in all but one of the stomachs (99.8%) and pasture species occurred in 89.8 percent of all stomachs. Seasonal ratios of pasture to non-pasture species in the stomach contents were: Spring 1968, 78.6:100; Summer 1969, 95.8:98.9; Autumn 1969, 94.3:100; Winter 1969, 90.8:100; and Spring 1969, 87:100.

The contents of most stomachs showed that though opossums relied predominantly on leaves for food, they did eat other foods when available (Table 3). Fruit of various species was taken; blackberry (*Rubus* sp.), *Coprosma* sp., and boxthorn fruit occurred in considerable quantities in many stomachs. Flesh of unidentified yellow and orange fruits which also occurred could have been pigeonwood, hinau or supplejack, all of which are known to be eaten by opossums in the Orongorongo Valley (Mason 1958, Harvie unpublished). Tree bark, lichen, fungi and soil also appeared sporadically in the stomachs, though in small quantities. Flowers of hinau, rewarewa, gorse and clover were also present. Gorse flowers were a very common winter and early spring constituent of the diet. Large amounts of fruit and flowers occurred in some stomachs, sometimes to the exclusion of

TABLE 3. *Abundant or Unusual Foods Eaten by Opossums.*

Month	Flowers	Fruit	Green parts, mostly leaves	Other
October 1968	Hinau (*Elaeocarpus dentatus*)		Fern (probably *Cyathea medullaris*)	
November	Rewarewa (*Knightia excelsa*)		Fern, Totara (*Podocarpus* sp.)	
December				
January 1969				
February	Clover (*Trifolium repens*)	Blackberry (*Rubus* sp.)	*Fern*	Lichen, Cicada wing (*Amphipsalta* sp.)
March		*Coprosma* sp. Blackberry, Boxthorn (*Lycium ferrocissimum*) Other species*		Cicada wing
April		*Coprosma* sp. Other species		Bark Soil
May		*Coprosma* sp.		
June	Gorse (*Ulex europaeus*)	Boxthorn		Bark
July	Gorse	Boxthorn		Pine pollen (*Pinus radiata*)
August	Gorse		Macrocarpa (*Cupressus macrocarpa*)	Pine pollen
September	Gorse		Bluegum (*Eucalyptus* sp.)	Soil
			Willow (*Salix* sp.)	Pine pollen
			Poplar (*Populus* sp.)	
October	Gorse, hinau		Willow	Bark
November			Willow, Poplar	

Other species include mainly fruit with yellow or orange flesh which could be *Hedycarya arborea, Ripogonum scandens, Elaecorpus dentatus.*

all other food. The nutritive quality of these and other types of food and the contribution each makes to the diet of opossums is at present being investigated.

One of the more unusual constituents of the diet was pine pollen, though Gilmore (1956b) noted that staminate cones of macrocarpa were "especially favoured". In July, August and September of 1969 many of the stomachs contained pollen. In seven, pollen was the main food present and, in these and others containing pollen, there was little evidence of other parts of the strobilus or of pine needles. In brief feeding trials, caged animals offered pine branches with male stroboli licked at and inhaled the pollen through the open mouth rather than ate the whole structure. These caged animals also very delicately selected and ate only the flowers from branches of gorse offered.

Unimportant amounts of insect fragments were found in the stomachs. During the late summer, when the common large cicada (*Amphipsalta* sp.) was flying, portions of its wings were found in only three stomachs. No other insect remains were recovered and Gilmore (1965a) found remains of only six adult beetles (*Odontria* sp.) in 217 stomachs. These results indicate that insects are of negligible importance in the diet of opossums.

Finally, the results show that in this area, where many types of food are available, about 30 percent of the opossum diet comprises pasture species. Quinn (1968) gives an estimated opossum density of 15 to 20 animals per acre (37-49/ha) on one of the farms from which opossums were collected for this study. Assuming that an opposum's mean daily intake of foods is 0.35 kg, of which 30 percent (0.11 kg) is pasture and given a mean population density of 43/ha, then opossums will eat 4.7 kg of pasture per hectare per day. These pastures are stocked at a mean density of 23 sheep/ha, and at a mean daily intake per sheep of 3.5 kg, 80.5 kg of pasture will be eaten per hectare per day. Given these figures, 17 opossums will eat as much as one sheep. Consequently, if opossums were not present the stocking rate could possibly be increased by 11 percent (2.5 sheep/ha).

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