AN ANALYSIS OF PELLETS CAST BY HARRIER HAWKS

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For the research mentioned here two Harrier Hawks *(Circus approximans gouldi)* were kept in captivity (using normal falconry procedure) one for 8 months and the other for 3 months. The main food for tracing the length between food ingestion and pellet casting was mice. Mice of four different colours, black, white, champagne and grey were used, thus making it relatively easy to trace the intake and release by means of the hair colour.

For example, two mice of one of these colours would be fed to the hawk on a given day. The hawk would not be fed any other mice until a pellet was cast containing fur of this mouse's colour of fur or a period of three weeks had elapsed. Then two mice of another colour would be fed to the hawk, thus enabling any pellets containing hair of the previous mice to be traced if regurgitation is late. This made the minimum time, between feeding the hawk two lots of mice of the same colour, four weeks.

Between the time of feeding with these marked mice and the casting of a pellet the hawk would be fed on road-killed Brush-tailed Opossums *(Trichosurus vulpecula)*, European Rabbit *(Oryctolagus cuniculus)* or occasionally a European Hedgehog *(Erinaceus europaeus)* or European Hare *(Lepus europaeus)*.

An analysis was also undertaken of 20 pellets collected in the Drummond area of the Southland Acclimatisation District. Measurements were made of the length and width of the pellet, and its weight noted. After the weighing and measuring had been completed their volumes were taken by measuring their displacement of fine sand in a graduated cylinder.

The pellet is a collection of the undigested portions of a bird's food which, rather than being passed out with the faeces, is regurgitated from the stomach through the crop to the mouth.

The pellet of the Harrier Hawk is usually composed of hard materials such as: bones, claws, chitinous insect skeletons, egg shells, beaks, feathers and hair. Often, other indigestible material that is either taken in accidentally or on purpose, such as plant matter, is evacuated in the same manner. In short, any indigestible items that cannot pass through the pyloric sphincter into the duodenal portion of the small intestine may be ejected this way.

A characteristic hawk pellet consists of an outer layer of feathers or wool, often bound together by grass, surrounding an inner core of hard materials. At times, sufficient protective substances or binding cannot be obtained with their normal diet and then it is not uncommon for a bird to pick up materials not usually taken with the normal food. Some pellets have been found containing paper and cellophane forming a protective binding around the solid inner core.

The hawks that were kept in captivity have been noticed picking at straw and grass but only a very small amount was ingested during these periods of observation. Whether this was sufficient to form a protective outer cover for the core one cannot say.

One of the 129 hawks dissected contained a rather large quantity of grass or plant material. Some of this material may have been ingested accidentally with their normal food. Although, in one bird, specimen 54, almost the whole crop contents were of a plant nature. I would think that in the rest, judging by the small amounts of plant matter found, the quantities would be too small to be of much aid in covering the hard central contents of the pellets.

The pellets perform another function besides the ejection of indigestible material and that is they remove a layer of sediment that builds up in the stomach. This is necessary if the bird is to remain healthy. If a bird is unable to obtain enough detritus to form at least one pellet a week to remove this lining it becomes lethargic and inattentive. In other words, the general health of the bird declines.

Pellets of the Harrier Hawk are usually broader at the front end than the back end. The taper between the two ends is very seldom a regular one, in some pellets it is a sharp taper and in others it is slow if at all. Other pellets are oval in shape with their widest section near the centre. Occasionally they are very peculiarly shaped as far as pellets are concerned in that they are in the form of a triangle or a circle.

The pellets of hawks are unreliable as a quantitative indication of food habits and even a rough quantitative estimate of items found is suspect. It was found that some food items fed to hawks in captivity did not show up in any of the pellets examined after the feeding. For example, of two distinctively coloured mice fed to a captive hawk, no traces came through in the pellets.

During a crop, stomach and pellet analysis certain unavoidable difficulties are bound to be encountered which may lead to vagueness or in some cases error. Some of these difficulties apply to both gut content and pellet analysis while others apply only to gut analysis. The main areas where these problems are likely to arise in this gut content analysis are: determining the number of individual items in gut or pellet; the failure to examine each hair or feather in the gut or pellet; and the lack of knowledge of differentiating characteristics.

The difficulty in enumerating individual items in the gut or pellet contents occurs particularly when the hawk has been eating large prey and all that may remain in the stomach or pellet is hair or feathers. Under these circumstances, it is very difficult, if not impossible, to tell the number of prey or carrion items of that particular species that the hawk has been feeding on, since there is nothing that can be used as a basis for counting the items. When the hawk has been eating smaller food items such as small birds, mice or lizards the task of enumeration is not so difficult. Since, with these smaller items the whole individual is usually consumed there is no difficulty in counting birds' feet, beaks, mouse skulls or even incisors.

The failure to examine every hair or feather of the gut or pellet under the microscope can be well understood. This method of individual examination would take a tremendous amount of time, so hairs and feathers were grouped macroscopically at first and then representative sections of these groups were mounted on slides and identified. In some cases similar hairs of two separate species may have been placed in the same group and identified as one individual.

The lack of knowledge of differentiating characteristics is aggravated by the fact that there is no key available for differentiating the feathers of young passerines. The problem was made even more difficult by the destruction of some of the identifying features by the physical and chemical action of the stomach. In pellets, feathers tend to be well ground and even powdery and the hair broken with the characteristic medullary patterns lacking, thus making very few complete hairs or feathers available for study.

Many of the contents of a gut like seeds and small grit (labelled detritus) may have been the result of the prey having eaten another animal and then having its crop, gizzard or stomach release these contents inside the hawk's stomach. These secondary foods may cause one to assume, for example, that the hawk has been eating insects, where in fact these are secondary foods. One of his prey may have eaten the insects and they were released from the prey's stomach or crop.

Another possibility of error is the fact that the hawk may have ingested some of its own feathers usually after having preened itself. In such cases the author's judgment was used to determine which feathers were from preening and which were actually from prey or carrion.

The main factor that may cause error, besides the ones mentioned above, in a pellet analysis is the holding over of food items for several days.

If, for example, a particular hawk revisited the same roost for several days or even weeks in succession then two, three or even four pellets may be collected containing parts of the same food item. It was found that in one case where pellets were cast more than two weeks apart traces of one particular food item showed up in both cases. This of course is not common but casting of different parts of the same food item in separate pellets happens quite regularly. This could lead to counting the same food item more than once.

The tabulation of pellet contents in the following tables is not a true indication of the food habits of the hawk since they change seasonally. The contents of these pellets should be used only as an indication of some of the food eaten during the late spring and early summer.

The pellets analysed in the following tables were collected by Mr. Roger Sutton in the Drummond area of the Southland Acclimatisation Society.

PERCENTAGE OCCURRENCE OF FOOD ITEMS FOUND IN PELLETS

	Number of Items	*Percent*
Sheep *(Ovis sp.)* remains	6	15.8%
Rabbit *(Oryctolagus cuniculus)*	2	5.3
Hare *(Lepus europaeus)*	2	5.3
Opossum *(Trichosurus vulpecula)*	3	7.0
Yellowhammer *(Emberiza citrinella)*	1	2.6
Song Thrush *(Turdus ericetorum)*	2	5.3
Ducks (*Anas* sp.)	5	13.2
Passerines (unidentified)	10	26.4
Lizards	2	5.2
Skylark eggs *(Alauda arvensis)*	1	2.6
Blackbird eggs *(Turdus merula)*	2	5.2
Unidentified egg shell	2	5.2
	38	99.1%

PELLET STATISTICS

Pellet Number	*Length*	*Width*	*Dry Weight*	*Volume*
1	27.0 mm.	18.0 mm.	1.3 gm.	5.0 cc.
2	23.5	18.0	1.3	4.0
3	37.0	19.0	2.0	5.5
4	20.5	18.0	1.2	5.0
5	28.0	14.0	1.9	4.0
6	35.0	21.0	1.8	9.0
7	31.0	17.0	1.0	6.0
8	27.0	15.5	0.9	4.0
9	30.0	21.0	1.5	7.0
10	26.0	20.0	1.1	4.0
11	31.0	18.5	1.1	4.5
12	33.0	20.0	1.2	6.0
13	32.0	15.0	1.3	4.0
14	48.0	25.0	4.2	9.0
15	32.0	21.0	2.9	6.0
16	27.0	16.0	0.9	3.0
17	21.0	19.0	0.8	6.0
18	33.0	19.0	2.1	7.0
19	29.0	22.0	2.6	7.0
20	47.0	28.0	3.3	9.0
Total	618.0	385.0	34.4	112.0
Average	30.9 mm.	19.3 mm.	1.2 gm.	5.6 cc.