THE FEEDING HABITS OF FOUR RAPTORS IN CENTRAL ITALY

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ABSTRACT. The crop and gizzard contents of 84 Common Kestrels (*Falco tinnunculus*) and 49 Common Buzzards (*Buteo buteo*), as well as the gizzard contents of 113 Little Owls (*Athene noctua*) and 70 Barn Owls (*Tyto alba*) were examined in the district of Siena in Central Italy. Collections were made over three years during the shooting seasons. For all species except the Barn Owl, and in contrast to their diets in European countries further north, insects (instead of birds and small mammals) become the staple food during the colder seasons. This may be due to the high availability of arthropods in the Mediterranean area during autumn and winter.

Introduction

This paper provides quantitative food habit data on two species of diurnal raptors (Common Kestrel and Common Buzzard) and two owls (Little Owl and Barn Owl). All are frequently killed as "pests" in Italy.

Italian shooters, game wardens and farmers kill birds of prey indiscriminately, justifying this practice as "Pest Control." Hundreds of thousands of raptors are eliminated lawfully and unlawfully each year without regard to their ecological role (Lovari 1970, 1973a, 1973b); e.g., Schenk (1972) reports that for Sardinia alone $360,000 (216,000,000 Italian lira) were spent to destroy raptors frum 1957 to 1960. In only the district of Sassari, 959 hawks were killed in 1968.

The mass killing of birds of prey in Italy is all the more unjustified as almost nothing is known of their food habits except for a scant report published by Moltoni in 1937.

Materials and Methods

The district of Siena (3,820 km^2) in Tuscany was chosen as a study area. It includes different types of habitats: hills and plains, cultivated and uncultivated lands, woods and streams. The contents of the crops and gizzards of 84 Common Kestrels and 49 Common Buzzards, and the gizzards of 113 Little Owls and 70 Barn Owls were examined. The birds had been killed during three shooting seasons–1970-71, 1971-72, and 1972-73. Each was delivered to a taxidermist for stuffing, generally on the day of its death. The shooting season in Italy lasts from September to April, thus including both the autumn and spring migrations.

Crop contents studies retrieve more information about prey consumed than

do pellet analyses (Hartley 1948). Delicate insect teguments, for example, can be recovered and identified from crop samples. Moreover, the species of raptor under examination is easily identified, whereas this is not always possible from pellets alone.

The crops were teased apart with pincers. Skulls and parts of skulls of mammals, as well as teguments of arthropods, were saved for identification. Two primary parameters were calculated: (1) total number of individuals of each prey species (or other taxonomic category), and (2) the total number of crops a prey species (or other category) occurred in (i.e., occurrence). Since many crops were empty, percentages of occurrence were calculated using the total number of crops with food, i.e. 65 for Common Kestrels, 26 for Common Buzzards, 79 for Little Owls and 23 for Barn Owls.

Results

Common Kestrel. Thirty-nine crops and gizzards out of the 84 examined were empty. All species preyed upon are listed in Table 1. These are separated

Table 1. Prey of Common Kestrels, September-March.

	Individuals
MAMMALIA	
Rodents	
Pitymys savii	2
Apodemus sylvaticus	2
Mus musculus	1
Clethrionomys glareolus	1
Insectivores	
Sorex minutus	3
Sorex araneus	1
Unidentified	2
AVES	
Carduelis sp.	1
Cisticola sp.	1
Unidentified Passeriformes	3
REPTILIA	
Lacerta (Podargis) muralis	13
INSECTA	
Coleoptera	
Carabidae	9
Tenebrionidae	2
Carabus violaceus	1
Geotrupes sp.	1
Hymenoptera	
Formicidae	27
Orthoptera	
Decticus verrucivorus	40
Decticus sp.	15
Locustidae	9
Decticus albifrons	5
Phasgonura viridissima	5
Oedipoda sp.	1
Acheta campestris	1
Unidentified	16
Others	
Mantis religiosa	6
Libellula sp.	1
OTHER ARTHROPODA	
Arachnida	2
Myriapoda	1
Unidentified	2

by major category and by season in Tables 2a and 2b.

Orthoptera were the main food of the Common Kestrel during autumn (September-November) (Table 2a). Coleoptera and reptiles were also preyed on frequently. The occurrences of both birds and Hymenoptera were low, although a rather large number of Hymenoptera were eaten. Very few birds were taken. Remains of mice and voles were found occasionally, while shrews and vegetable matter seemed to be unimportant.

During the cold season (December-March), Common Kestrels still fed mostly on Orthoptera (Table 2b). The use of rodents, shrews and passerines also increased, whereas plant material and lizards disappeared.

Table 2a. Prey of Common Kestrels, autumn only (September-November 1970-1972).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	4	2	2	5
Insectivora	2	1	1	3
Unidentified	2	1	2	5
AVES	3	2	3	8
REPTILIA	13	8	5	13
INSECTA				
Coleoptera	17	10	6	15
Hymenoptera	27	16	3	8
Orthoptera	93	55	18	45
VEGETALIA	2	1	1	3
OTHER	6	4	6	15

Table 2b. Prey of Common Kestrels, winter only (December 1970-72 and January-March 1971-73).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	2	7	2	33
Insectivora	2	7	2	33
AVES	2	7	2	33
INSECTA				
Coleoptera	1	3	1	16
Orthoptera	21	72	2	33
OTHER	1	3	1	16

Common Buzzard. Twenty-three crops and gizzards of the 49 birds examined were empty. The species preyed upon from September to March are listed in Table 3. These data are detailed with regard to season in Tables 4a and 4b.

Orthoptera appeared to be the main prey during the autumn (Table 4a). A remarkable number of lizards and snakes were also preyed upon. Coleoptera, insectivores and rodents did not constitute an important part of the Common Buzzard's diet. Vegetable matter was found in three crops, whereas—unexpectedly—no bird remains were recovered.

Table 3. Prey of Common Buzzards, September-March.

MAMMALIA	**Individuals**
Rodents	
Pitymys savii	5
Apodemus sylvaticus	1
Clethrionomys glareolus	1
Insectivores	
Crocidura suaveolens	3
Crocidura russula	1
Talpa europaea	1
Carnivores	
Mustela nivalis	1
Unidentified	2
AVES	
Unidentified Passeriformes	1
REPTILIA	
Lacerta (Podargis) muralis	10
Natrix natrix	6
ANURA	
Rana esculenta	3
Unidentified	1

INSECTA	**Individuals**
Coleoptera	
Scarabaeidae	3
Carabus violaceus	1
Procrustes coriaceus	1
Ocypus olens	1
Geotrupes sp.	1
larva (*Cebrio* sp.)	1
Orthoptera	
Decticus verrucivorus	22
Decticus albifrons	14
Decticus sp.	2
Phasgonura viridissima	1
Locustidae	1
Others	
larvae (Lepidoptera)	4
Mantis religiosa	1

During winter, Common Buzzards seemed to feed mostly on rodents and still on Orthoptera (Table 4b). Lizards, snakes and frogs were also preyed upon frequently. Shrews, moles, beetles, passerines and vegetable matter were used only rarely.

Table 4a. Prey of Common Buzzards, autumn only (September-November 1970-72).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	1	2	1	7
Insectivora	2	3	2	14
REPTILIA	12	18	4	29
INSECTA				
Coleoptera	5	8	2	14
Orthoptera	37	56	8	57
VEGETALIA	3	5	3	21
OTHER	6	9	3	21

Table 4b. Prey of Common Buzzards, winter only (December 1970-72 and January-March 1971-73).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	6	21	6	50
Insectivora	3	10	2	17
Unidentified	2	7	2	17
AVES	1	3	1	8
REPTILIA	4	14	2	17
ANURA	4	14	2	17
INSECTA				
Coleoptera	2	7	2	17
Orthoptera	5	17	2	17
VEGETALIA	1	3	1	8
OTHER	1	3	1	8

Little Owl. Thirty-four gizzards out of the 113 examined were empty. The species preyed upon from September to March are listed in Table 5. These are separated by season in Tables 6a and 6b.

During autumn, insects made up 95% of the total number of prey (Table 6a). Most exploited were earwigs, Hymenoptera and Coleoptera. Little Owls also fed upon small mammals and vegetable matter, but preyed on passerine birds, liz-

Table 5. Prey of Little Owls, September-March.

	Individuals
MAMMALIA	
Rodents	
Pitymys savii	3
Apodemus sylvaticus	2
Insectivores	
Crocidura leucodon	1
Suncus etruscus	1
Sorex sp.	1
Unidentified	7
AVES	
Unidentified Passeriformes	1
REPTILIA	
Lacerta (Podargis) muralis	1
ANURA	
Hyla arborea	1
INSECTA	
Coleoptera	
Carabidae	65
Pentodon punctatus	13
Geotrupes stercorarius	2
Ocypus olens	8
Geotrupes sp.	5
Tenebrionidae	5
Procrustes coriaceus	4
Sphodrus sp.	4
Curculionidae	3
Carabus cancellatus	2
Saperda carcharias	1
Bubas sp.	1
Carabus violaceus	1
larva (Carabidae)	1
larva (Staphylinidae)	1
Helops sp.	1
Unidentified	36
Dermaptera	
Forficula auricularia	356
Hymenoptera	
Formicidae	141
Vespa crabro	1
Orthoptera	
Decticus verrucivorus	8
Decticus albifrons	5
Phasgonura viridissima	2
Locustidae	2
Oedipodae	2
Ephippigerida sp.	1
Unidentified	8
Others	
larvae (Lepidoptera)	7
OTHER ARTHROPODA	
Arachnida	3
Julus sp.	3
Glomeris sp.	1
Scolopendra sp.	1
Unidentified	3
MOLLUSCA	
Helix sp.	1

ards and frogs only occasionally.

During the cold season, there was an increase of small mammals, although earwigs still remained the staple food (Table 6b). Coleoptera were also used frequently, and a small amount of vegetable matter was consumed.

Table 6a. Prey of Little Owls, autumn only (September-November 1970-72).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	2	0.4	2	4
Insectivora	1	0.2	1	2
Unidentified	2	0.4	2	4
AVES	1	0.2	1	2
REPTILIA	1	0.2	1	2
ANURA	1	0.2	1	2
INSECTA				
Coleoptera	121	25	24	47
Dermaptera	179	36	22	43
Hymenoptera	142	29	4	8
Orthoptera	25	5	13	26
VEGETALIA	6	1	4	8
OTHER	12	2	8	16

Table 6b. Prey of Little Owls, winter only (December 1970-72, January-March 1971-73).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	3	1	3	7
Insectivora	2	1	2	5
Unidentified	5	2	5	11
INSECTA				
Coleoptera	42	17	12	27
Dermaptera	177	73	14	32
Orthoptera	2	1	2	5
VEGETALIA	2	1	2	5
OTHER	9	4	4	9

Barn Owl. Forty-seven gizzards out of the 70 examined were empty. The species preyed upon from September to March are listed in Table 7, while Tables 8a and 8b give these data by season.

The analysis of full crops showed a high percentage of rodents and shrews in the autumn diet (Table 8a). Two Barn Owls also preyed upon a large number of Orthoptera.

During the cold season, only rodents and shrews were recovered (Table 8b).

Table 7. Prey of Barn Owls, September-March.

	Individuals		Individuals
MAMMALIA		*Sorex araneus*	2
Rodents		*Sorex minutus*	1
Apodemus sylvaticus	14	*Suncus etruscus*	1
Pitymys savii	2	Unidentified	2
Mus musculus	5	INSECTA	
Muscardinus avellanarius	2	Orthoptera	
Insectivores		*Decticus albifrons*	2
Crocidura suaveolens	4	Unidentified	16
Crocidura russula	2		

Table 8a. Prey of Barn Owls, autumn only (September-November 1970-72).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	22	45	11	79
Insectivora	7	14	6	43
Unidentified	2	4	2	14
INSECTA				
Orthoptera	18	37	2	14

Table 8b. Prey of Barn Owls, winter only (December 1970-72 and January-March 1971-73).

Prey	Number	%	Occurrence	%
MAMMALIA				
Rodentia	10	77	8	89
Insectivora	3	23	3	33

Discussion

Common Kestrel. This falcon normally hunts in flight, hovering from time to time and swooping down when a prey is in sight. Kestrels usually seize their pery on the ground and only exceptionally in flight (Uttendörfer 1952). They may also remain for long periods on a branch from which they then strike their prey (Cavé 1968).

Long-tailed Field Mice (*Apodemus sylvaticus*) constituted 80% of food items taken by Common Kestrels in Germany (Uttendörfer 1952), whereas Cavé (1968) found that the Common Vole (*Microtus arvalis*) was the main source of food in the Netherlands, except when voles were scarce: then insects and birds—mostly young Starlings (*Sturnus vulgaris*)—were preyed upon.

Ellis (1946) reported that Field Voles (*Microtus agrestis*) were the main prey in England during autumn with a change to birds with the onset of cold weather. A definite rise in beetle consumption (mostly *Geotrupes* sp.) occurred in September and October. According to Davis (1960) many late winter pellets contained much earth and, sometimes, vegetable material.

In France, Thiollay (1963) wrote that the main prey items found in pellets during autumn were rodents (87% of the total number of prey), insects (9.3%) and birds (2.1%). He also found that the exploitation of insects increased during winter (15%). Rodents, however, still constituted the major part of the diet (73%). Birds (0.5%) and reptiles (0.3%) were also preyed upon, though inconsistently.

From the data listed by Moltoni (1937) arthropods and mice seem to be the commonest prey in Italy. On the basis of my results, however, insects (mostly crickets and grasshoppers) constitute the staple food of Common Kestrels during autumn and winter. This is not in agreement with the findings reported in Germany, the Netherlands, Great Britain and France, nor wholly with those of Moltoni in Italy.

Italian Common Kestrels may have developed a food preference for insects, possibly due to the Mediterranean climate (winter rains); insects are available throughout the year, though they are not so numerous in winter (Blondel 1969). Individual food preferences have been reported by Slijper (1960) for captive Common Kestrels. This tendency, together with climatic peculiarities, may facilitate the onset of a local feeding behavior.

Common Buzzard. Buzzards are active from sunrise to sunset, and their usual hunting techniques very much resemble those of the Common Kestrel (Géroudet 1965). Pinowski and Ryszkowski (1962) have shown that Common Buzzards may adapt their hunting methods to available prey.

In Germany Wendland (1952) and Mebs (1964) have found that Common Buzzards feed mostly on voles, particularly on Common Voles, and also on *Arvicola* sp. and moles (*Talpa europaea*). The most commonly preyed upon birds are Jays (*Garrulus glandarius*). Great Spotted Woodpeckers (*Dendrocopos major*), Starlings and Mistle Thrushes (*Turdus viscivorus*).

Glutz *et al.* (1971) have reviewed the available data for Central Europe. From

their report one can infer that about 70% of vertebrates caught are small mammals–particularly voles–15% are birds, 10% are reptiles and 4% amphibians.

In Poland Czarnecki and Foksowicz (1954) have found that 50% of the prey items brought to nestling Common Buzzards are moles; 33% are Common Voles. The authors attribute such a high predation upon moles to particular environmental conditions. It is possible that Common Buzzards, by observing the movements of the soil, are able to locate moles in the process of digging. Pinowski and Ryszkowski (1962) have shown that Common Voles and moles are the most frequent prey in spring, whereas during winter the diet is more varied. However Common Voles and Root Voles (*Microtus ratticeps*) still constitute 40% of the prey.

Data reported by Thiollay (1968) in France show that small mammals–mostly rodents–make up 47% of the diet, birds 43%, reptiles and insects 10%.

The winter diet of the Italian Common Buzzards I examined resembles that of those studied in Germany, Poland and France. The autumn diet, on the contrary, appears strikingly different: birds are entirely lacking, and there is unexpectedly little predation upon rodents. Rodents are the staple food of Common Buzzards in the above mentioned countries but seem here to be replaced by insects.

Little Owl. The hunting habits of the Little Owl distinguish it from the other Strigiformes. It is usually very active at sunset and at night, but it is the only European owl seen to hunt during the day as well, especially during the nesting season (Hibbert-Ware 1938). It is also the only owl which eats plant food, at least during winter (Thiollay 1968).

Few studies have been published on its diet, except for a thorough inquiry carried out in Great Britain on the ecological niche occupied by this owl (Hibbert-Ware 1938). The results show that its staple diet throughout the year consists of insects and rodents. Birds are an important food only during the nesting season: the birds most commonly taken are Starlings, House Sparrows (*Passer domesticus*), Blackbirds (*Turdus merula*), and Song Thrushes (*T. philomelos*). According to a report of the Eley Game Advisory Station (1967) in England, the Little Owl preys upon an unimportant number of young gamebirds.

In France Thiollay (1968) found that rodents (17.2% of the total number of prey), shrews (2%) and, above all, insects (80.8%) constitute the diet in March. The same groups of animals are also preyed upon in July, though with slightly different percentages: respectively, 8.4%, 6.7% and 83.5%. Molluscs (*Helix* sp.) are also exploited, making up the remaining 1.5%.

From the report of Moltoni (1937) in Italy one could conclude that insects make up the main part of the diet. My results indicate that the Little Owl feeds mainly upon insects during autumn and winter, with a preference for earwigs, although beetles are frequently eaten, too. Small mammals, birds, reptiles and amphibians are consumed in small quantities.

Barn Owl. Barn Owls hunt during the night, locating their prey by hearing (Payne 1962, 1971).

In Germany Uttendörfer (1952) has reported that Barn Owls feed chiefly on small mammals. Thiollay (1968) has shown that 90% of the prey in France are small mammals, mainly *Microtus* and *Apodemus* sp. Amphibians make up 3.75% whereas birds and insects are very rare. He also points out that the proportion of the prey items during the year is remarkably constant for this owl. Previous data from Italy suggest that rodents are the primary food, followed by insects, shrews and birds (Montoni 1937).

Feeding habits of the Barn Owl have been studied extensively in the United States (e.g., Marti 1969; Greer and Gilstrap 1970; Reese 1972), as well as in Canada (Doerksen 1969), Malaysia (Medway and Yong 1970) and Iraq (Nader 1969). Rodents—mostly voles—make up 75-98% of the total number of prey animals. Birds and insects are preyed upon only in unimportant numbers. In Africa Laurie (1971) has reported that shrews are the commonest prey.

My results also seem to indicate that Barn Owls are specialized in feeding upon small mammals, chiefly *Apodemus* and *Pitymys* sp. in the area of my study.

Conclusions

My data are congruent with reports of the other European authors as far as the Barn Owl is concerned. For the Little Owl the differences are quantitative: the same types of prey are taken in England, France and Italy, but in different amounts. Insects predominate in autumn and winter in my study. For the Common Kestrel, the seasonal differences are even more striking, as insects constitute the staple food in both autumn and winter, whereas in other countries rodents are the staple. For the Common Buzzard, the differences are equally striking, though only in autumn: again rodents as the staple food are replaced by insects, while birds are entirely lacking.

The fact that three out of the four species studied prey so heavily upon insects during autumn and winter may be due to the abundance of arthropods at that time in the Mediterranean area, in contrast to their scarcity further north. Another reason may be the relative rarity of birds caused by the heavy Italian hunting pressure.

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