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Shiraishi, Satoshi
Zoological Laboratory, Faculty of Agriculture, Kyushu University

Koga, Kimiya
Zoological Laboratory, Faculty of Agriculture, Kyushu University

Kawaji, Noritomo
Zoological Laboratory, Faculty of Agriculture, Kyushu University

https://doi.org/10.5109/23900

出版情報：九州大学大学院農学研究院紀要. 34 (3), pp.247-254, 1990-02. Kyushu University
バージョン：
権利関係：

J. Fac. Agr., Kyushu Univ., 34 (3), 247-254 (1990)

Food Habits of the Black-eared Kite, *Milvus migrans Zineatus*, in Nagasaki Airport and Its Adjacent Areas

Satoshi Shiraishi, Kimiya Koga and Noritomo Kawaji*

Zoological Laboratory, Faculty of Agriculture,
Kyushu University 46-06, Fukuoka 812, Japan

(Received July** 24, **1989)

Food habits of the black-eared kite *Milvus migrans lineatus* were analysed based on the stomach contents obtained from 241 kites, which were shot to reduce strike damage to aircraft or hit by aircraft at Nagasaki Airport, Nagasaki Prefecture, during the five-year period from 1977 to 1981. Most of the samples were collected in summer and autumn when the number of the kites was large. The kites fed mainly on fishes and insects in this period ; especially in August and September, the former was their main diet. This fact was presumed to be related to the following two factors : 1) a mass death of fishes due to both an outbreak of a red tide and a lack of oxygen dissolved in bottom waters, and 2) abandonment of a quantity of worthless fishes, which thronged into well-conditioned environments owing to deterioration in water quality and consequently became easily captured by fishermen. In October and November the kite chiefly preyed on locusts. During this period, a large number of them inhabited green belts in the airport ; thus the kite seemed to eat preferentially locusts which were easy to catch. It was concluded that the black-eared kite fed on prey animals obtained easily according to habitats and/or seasons.

INTRODUCTION

For understanding the life cycle of a given species, it is essential to investigate food habits. The black kite *Milvus migrans* is one of the most successful diurnal raptors in the world, and it occurs widely in Europe, Africa, the Middle East, India, Asia and Australia (Brown and Amadon, 1968). The black-eared kite *M. m. lineatus*, the representative subspecies in the eastern Asia, is one of common birds throughout Japan except for the Ryukyu Islands. In spite of this familiarity, there have been a few studies on its diet in Japan (Kawaguchi, 1931 ; Ishizawa and Chiba, 1967 ; Kawaji and Shiraishi, 1980).

At Nagasaki Airport, in Ōmura Bay, Nagasaki Prefecture, the black-eared kite is the most hazardous species to aircraft. It roosts in Usu-jima Islet, 1.5 km away to the southeast from the airport. The food habits of the kite in the airport area have been preliminarily examined based on small samples of the stomach contents obtained from August to October in 1977 and 1978 (Kawaji and Shiraishi, 1980). In this paper, we combined the previous samples with the subsequently accumulated ones, and analysed the stomach contents in more detail. The purpose of this study is to clarify the food habits of the kite, and to discuss the main diet in different habitats or seasons.

*Present address : Hokkaido Research Center, Forestry and Forest Products Research Institute, Sapporo 004, Japan

MATERIALS AND METHODS

The samples of the stomach contents were obtained from black-eared kites which were either shot to reduce aircraft collisions or hit by aircraft at Nagasaki Airport from August 1977 to November 1981. The stomach contents were preserved in 10% formalin, and then divided broadly into the following food items : mammals, birds, lizards, frogs, fishes, insects, centipedes, crabs, isopods, spiders, land snails, unidentified animal matter and miscellaneous matter (plant etc.). Furthermore, the contents separated into the respective food items were washed through a 0.5-mm mesh sieve to remove silt-like matter, and the wet weight of residual matter was measured. Data on each food item were expressed monthly by the occurrence frequency and the percentage of the total wet weight of a food item to the summed wet weight of all items. In addition, insects were identified at the family or order level with a low-power stereostatic microscope, and their numbers were counted based on the number of mouthparts, head capsules, wings, genitalia and so forth. When a certain insect was observed only in fragments, the number was estimated at one.

RESULTS

During the five-year period the number of the stomach samples totalled 241, and most of them were obtained from July to October (Table 1). Accordingly, the food habits in both winter and spring remained unclear because of small sample size.

In the occurrence frequency of the food items (Table 2), the commoner items were of insects and fishes, being recognized in 181 (75%) and 157 (65%) of the 241 samples examined, respectively. The occurrence frequencies of these items were high especially in summer (August) and autumn (September and October). Next in order were birds (40 samples), frogs (16 samples) and mammals (12 samples). Other kinds of food items appeared in less frequencies. In the wet weight composition (Table 3), the insects and fishes were again the most important food items. Particularly, the former was the major part of the food in July, October and November, and made up 59-74% of the summed wet weight. The latter contributed 69 and 60% of the summed wet weight in August and September, respectively.

In insects, the most frequently occurring items were of locusts (Acrididae), chafers (Scarabaeidae) and mantises (Mantidae) (Table 4). The chafers were eaten by the kite

Table 1. Number of stomachs collected during 1977 to 1981.

Year	Month											Total
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1977						—	13	10	3	1	—	27
1978							—	11	8	—	1	20
1979	1	—	—	—	—	—	3	12	8	4	—	28
1980	—	_	1	1	1	4	23	24	11		—	69
1981	2	4	2	—	—	7	12	19	40	1:	—	97
Total	3	4	3	1	1	11	51	76	70	20	1	241

Table 2. Occurrence frequency of food items in the stomach contents.

Item	Month											Frequency
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Mammal	2	–	–	–	1	1	3	1	2	2	–	12
Bird	–	3	1	–	3	–	4	12	12	5	–	40
Lizard	–	–	–	–	–	–	–	–	1	–	–	1
Frog	2	–	1	–	–	2	2	7	2	–	–	16
Fish	1	3	1	1	–	6	37	59	39	9	1	157
Insect			1	–	1	10	37	52	62	17	1	181
Centipede								1	-	1	–	2
Crab							1	1	1	–	–	3
Isopod								1	1	–	–	2
Spider	–	–	–	–	–	–	1	–	1	–	–	2
Land snail									1	–	–	1
Animal matter	–	–	1	-	-	-	2	2	2	-	-	7
Miscellaneous matter		2	-	-	-	-	1	4	4	-	-	11
No. of samples	3	4	3	1	1	11	51	76	70	20	1	241

Table 3. Wet weight composition (%) of items obtained from the stomachs.

Item	Month											Total
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Mammal	25.3	–	–	–	79.2	9.8	3.5	0.8	0.1	7.2	–	2.5
Bird	–	80.8	25.8	–	–	1.7	12.4	13.4	4.4	9.2	–	10.0
Frog	68.8	–	0.5	–	–	0.1	0.3	4.8	0.4	–	–	2.1
Fish	5.9	0.1	55.7	100.0	–	29.7	69.1	60.4	20.9	13.5	16.8	36.8
Insect	–	–	0.3	–	20.8	58.7	13.2	18.8	73.6	69.2	83.2	46.9
Other	–	19.1	17.7	–	–	–	1.5	1.8	0.6	0.9	–	1.7

in April and from July to October, especially they were found with a high frequency of occurrence from July to September. The locusts and mantises were present in the stomach contents from July to December and from August to November, respectively. Particularly, both of the insects occurred frequently in the stomach contents during October and November.

With respect to the number of insects present in the stomach samples (Table 5), the locusts were the most prominent, and most of them were consumed by the kite in October and November. Since the Asiatic locust *Locusta migratoria* accounted for 78% (255 individuals) of the 328 locusts encountered in the samples throughout the year, this species formed an important component of the diet. The number of mantises (165 individuals) taken by the kite was half as many as that of the locusts. However, most mantises found in the stomach contents were large in size and they also seemed to be one of the important food items. Both the insects were followed by chafers and burying beetles (Silphidae) congregating at a carcass. Many other kinds of insects were detected in the samples, but their number was smaller than those of the above four insects.

Table 4. Occurrence frequency of insects in the stomach contents.

Item	Month											Frequency
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
ORTHOPTERA												
Gryllotalpidae					–	5	1	1	1	–	–	8
Gryllidae	–	–	–	–	–	2	6	9	1	–		18
Tettigoniidae	–			–	–	–		–	1	1	–	2
Acrididae	–	–	–	–	–	2	4	12	45	13	1	77
unidentified	–	–		–	–	3	1	1	1	–		6
DERMAP-I'ERA												
Labiduridae	–	–		–	–	–		1		–		1
DICTYOPTERA												
Mantidae	–			–	–	–	1	10	31	7		49
Panesthiidae larva	–	–	–	–	–	–	1	–	–	–	–	1
HEMIPTERA												
Reduviidae	–					–		1		–	–	1
Nepidae	–					–	1	–		–		1
Cicadidae	–	–	–			3	16	1	–	–		20
unidentified		–				1	1		5	–	–	7
LEPIDOPTERA												
Attacidae						–			1	–		1
Pieridae					–	–	–	–	–	1		1
Nymphalidae					–	–	1			–	–	1
Noctuidae larva		–	–	–	–	–	2	6	2	–	–	10
unidentified adult	–	–	–	–	–	–	2	1	1	–	–	4
unidentified larva	–			–	–	–	1			–		1
COLEOF'TERA												
Harpalidae	–		1	–	–	1	1	7	6	–		16
Silphidae	–	–	–	–	–	5	6	–	1	–		12
Staphylinidae	–			–	–	1		1		–	–	2
Scarabaeidae	–		1	–	–	10	20	32	7	–	–	70
Scarabaeidae larva	–	–	–	–	–	–	–		1	–	–	1
Buprestidae	–		–	–	–	–	1	5	–	2		8
Meloidae	–	–	–	–	–	–	–	–	1	–	–	1
Cerambycidae	–		–	–	1	–	–	–		–	–	1
unidentified	–		1	–	–	4	5	3	8	1		22
HYMENOF'TERA												
Vespidae	–			–	–	–	1	2	–	–		3
unidentified	–		–	–		2	3	3	4	1	–	13
No. of samples	3	4	3	1	1	11	51	76	70	20	1	241

Since most fishes obtained from the stomach samples were considerably digested, they were difficult to be identified. However, only the pinkgray goby *Chaeturichthys hexanema* (12 individuals) retained nearly intact form. During the period of behavioural observations from September to November in 1982, many kites flew out their communal roost in Usu-jima Islet to an adjacent fishing-port to forage early in the morning. Therefore, the fishing-port was considered to be an important feeding area.

Forty-one individuals of birds occurring in the 40 stomach samples included one individual belonging to the family Anatidae, one of the black-eared kite, three of the domestic fowl *Gallus gallus* var. ***domesticus,*** six of the Kentish plover *Charadrius alexandrinus*, two of the Indian pratincole *Glareola maldivarum*, one of the order

Table 5. Number of insects in the stomach contents.

Item	Month											Total
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
ORTHOPTERA												
Gryllotalpidae	–	–	–			27	1	1	1			30
Gryllidae	–	–			–	2	14	11	3			30
Tettigoniidae	–	–			–			–	2	1	–	3
Acrididae		–	–	–		2	4	22	221	70	9	328
unidentified		–		–	–	3	1	1	2			7
DERMAPTERA												
Labiduridae		–		–			–	1	–	–	–	1
DICTYOPTERA												
Mantidae		–	–	–	–	–	1	20	112	32		165
Panesthiidae larva			–				1			–	–	1
HEMIPTERA												
Reduviidae	–							1				1
Nepidae					–	–	1	–	–	–	–	1
Cicadidae						3	27	1	–			31
unidentified						2	2		33			37
LEPIDOPTERA												
Attacidae	–	–	–	–	–		–	–	1	–	–	1
Pieridae		–	–	–	–			–	–	1	–	1
Nymphalidae		–	–	–	–	–	2	–	–	–	–	2
Noctuidae larva		–	–	–	–	–	6	32	4	–	–	42
unidentified adult		–		–			2	2	1			5
unidentified larva		–	–	–	–	–	1	–	–	–		1
COLEOPTERA												
Harpalidae	–	–	1	–		1	1	20	7	–	–	30
Silphidae		–	–	–		55	20	–	1	–	–	76
Staphylinidae		–	–	–	–	1		1	–			2
Scarabaeidae		–	2	–	–	22	30	49	12	–	–	115
Scarabaeidae larva	–	–		–				–	1	–		1
Buprestidae	–	–		–	–	–	1	5		2		8
Meloidae		–	–	–	–		–	–	1			1
Cerambycidae	–	–		–	1	–	–	–		–	–	1
unidentified		–	1	–		4	5	4	8	2	–	24
HYMENOPTERA												
Vespidae		–	–	–			1	2	–		–	3
unidentified	–		–	–	–	5	3	3	4	1		16
Total	–	–	4	–	1	127	124	176	414	109	9	964

Charadriiformes, one of the feral pigeon *Columba livia* var. ***domestica,*** two of the skylark *Alauda arvensis*, one of the house swallow *Hirundo rustica*, one of the fan-tailed warbler *Cisticola juncidis,* one of *Emberiza* sp. and 21 of unidentified birds. In the mammal items, 12 of the 13 individuals involved in the 12 samples were identified as follows : one individual of the greater Japanese shrew-mole *Urotrichus talpoides*, two of the house mouse *Mus musculus*, four of the brown rat *Rattus norvegicus*, one of *Rattus* sp., two of a weasel *Mustela sibirica* and two kittens of the domestic cat *Felis catus*. The above birds and mammals were identified by their head, legs, feathers, hairs and so forth.

DISCUSSION

The number of black-eared kites roosting in Usu-jima Islet near Nagasaki Airport increases rapidly in August, attains a maximum between September and November, and declines markedly in December (Kawaji and Shiraishi, 1980). In connection with this, a large number of black-eared kites gather in the airport from late summer to autumn, and consequently the frequencies of shooting kites and of collisions with aircraft become high.

Based on the analysis of food remains collected under or on perching sites, the pinkgray goby, one of bottom fishes, is said to be an important food of the kite living near Nagasaki Airport (Kawaji and Shiraishi, 1980). The plausible reason for this is given as follows : from July to September, a red tide and bottom water mass lacking dissolved oxygen occur over a wide range of Ōmura Bay, and consequently many fishes die ; fishes, avoiding the red tide or low oxygen water, congregate in water with relatively well-conditioned environments (Tsujita, 1953 ; Mori, 1961 ; Mori and Irie, 1966 ; Mori et **al.,** 1973). Pinkgray gobies also throng into such well-conditioned areas, and a large number of them are fished in this period (Yamada, 1957). However, they are usually abandoned because of no market value. Therefore, the black-eared kite can eat easily these abandoned pinkgray gobies in August and September.

In our study area, the Asiatic locust is the main food of the kite in autumn, and the reason for this has been explained as follows : a large number of Asiatic locusts inhabit the green belts in Nagasaki Airport from late September to November ; grass providing locusts with a good shelter is cut once in middle autumn, so that they frequently jump out into the runway and are driven together to a drift by the wind ; as a result, the locust becomes the most available food to the black-eared kite (Shiraishi and Makihara, 1980 ; Shiraishi, 1981).

All of the identified birds found in the stomach contents, except the domestic fowl, are watched at Nagasaki Airport (Kawaji and Shiraishi, 1980), and tunnels and faeces of rats are found in the green belts (Shiraishi and Makihara, 1980). Accordingly, there is a high probability that the kite eats the birds and rats concerned in the airport.

The main diet of the black kite varies with regions. In Japan, the black-eared kite feeds chiefly on fishes in a coastal area (Koga and Shiraishi, 1987), while it depends primarily on murids in inland areas (Haneda **et al.,** 1966 ; Takeuchi, 1983). In Spain, the black kite *M. m. migrans*, nesting near a breeding area of the coot *Fulica atra* and ducks, lives on their chicks and juveniles (Delibes Castro, 1975). In Germany, the black kite breeding near a river and farmland preys on mammals, birds and fishes (Fiuczynski and Wendland, 1968 ; Fiuczynski, 1981). In Australia, the black kite *M. m. affinis*, inhabiting an area with a high density of the feral rabbit *Oryctolagus cuniculus*, subsists on it (Baker-Gabb, 1983).

Thus, it is concluded that the black kites have a varied diet and feed on prey animals obtained easily according to habitats and/or seasons.

ACKNOWLEDGEMENTS

We are much grateful to Professor T. A. Uchida, Zoological Laboratory, Faculty of Agriculture, Kyushu University, and to Professor E. W. Jameson, Jr., University of

California for comments on the manuscript ; to Dr. H. Makihara, Entomological Laboratory, Faculty of Agriculture, Kyushu University (at present, Tohoku Research Center, Forestry and Forest Products Research Institute) for assisting with identification of insects ; to Mr. M. Tateishi, Nagasaki Prefectural Fisheries Experimental Station for his help in obtaining literature on fishes ; to the successive directors and staffs of Nagasaki Airport for a variety of kindness ; to the staff and the then graduate students of our laboratory for their cooperation.

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