FOODS OF THE WHITE-FACED HERON

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SUMMARY

A study of the stomach contents of 89 White-faced Herons showed them to be primarily wetland-pasture and aquatic feeders. Although predominantly carnivorous, 65 birds had eaten plant material, usually in small amounts. Vegetative parts of sedge, grass and clover occurred most frequently, but in two specimens water-weed comprised the bulk of plant food.

Invertebrate food, present in every specimen except one, was predominantly crustaceans, insects, annelids and arachnids. Molluscs and a proportion of smaller invertebrates were considered in most cases to be be present as a result of their liberation from gut of digested fish.

All birds were collected from habitats where fish, especially trout, were present or within feeding range. Fish occurred in 49 stomachs. In order of weight consumed they were bully, smelt, trout and whitebait (adult and immature). Elvers and carp were eaten so rarely that they were unimportant in this study.

INTRODUCTION

White-faced Herons (*Ardea novaehollandiae*) are not indigenous to New Zealand but have been carried to this country from Australia by weather systems. Oliver (1955) noted that a small population was already established in Nelson and that a few specimens had been recorded in the North Island when Buller first listed the species in this country in 1865. During the following seventy years their numbers increased as a result of breeding by resident birds, augmented periodically by the arrival of Australian vagrants.

The species remained scarce and restricted almost exclusively to the South Island until the 1930's when the population began to increase rapidly and disperse throughout the country. New areas are still being actively colonized particularly in North Auckland and the Bay of Plenty.

Colonies have been established successfully not only in coastal areas but far inland beside streams and rivers or in other wetland habitats. This increase in population has caused anxiety among fishermen in some districts, who report serious depletion of trout stocks, which they attribute to excessive predation by herons. As a result of continued complaints, the Department of Internal Affairs undertook a study of the food habits of these birds.

MATERIAL

Between May 1963 and October 1965, 93 birds were examined. Collecting was done in places where trout were known to be present or within feeding range. South Island samples were from localities in Canterbury:— Ellesmere 30, Hororata-Selwyn 18, Christchurch environs 6, Pareora district 2. Most North Island specimens were taken in the Rotorua Conservancy as follws:— Rotorua-Taupo 15, Wairoa-Gisborne 6, Whakatane 8, Mangakino 1. Those remaining were from Waikato 3, Mt. Bruce 1, Pautahanui 1, Dannevirke 1, Rangitikei R. estuary 1.

Collecting was done chiefly by field staff of the North Canterbury Acclimatisation Society and Wildlife Branch of the Department of Internal Affairs. Six specimens were given by the Canterbury Museum.

Birds were frozen whole as soon as possible after death. Analysis of stomach contents entailed measurement of weight and volume of total food, together with a count of individual items. Recently ingested organisms are readily identifiable but as digestion proceeds the food becomes increasingly macerated by the action of strongly-acid digestive juices. Eventually there collects at the base of the stomach a residue

of indigestible fragments. Here it is possible to make a reasonably accurate assessment by a count of diagnostic fragments e.g. mouth-parts of insects, otoliths of fish and shells of gastropods.

When stomachs contain fish there arises the problem of determining what proportion of organisms present in the lower stomach has been liberated from the gut of previously-digested fish. Many smaller organisms recorded must certainly originate in this way. A study was made of all specimens with regard to degree of digestion of ingested fish in relation to kind and condition of other organisms present in the stomach. A comparison of types of invertebrates occurring in the presence or absence of fish indicates that the greater part of food found in heron stomachs has been selected as such. Table 1 shows on a seasonal basis the number of occurrences of food organisms and number of birds taking each kind.

Table 2 shows the average weights and volumes of total stomach contents.

Identification of plants was based on Allan (1940), Hubbard (1954), Hyde (1957), Martin and Barkley (1961) and Mason (1964); and that of animals on Parker and Haswell (1940), Powell (1947), Imms (1947 and 1951), Stokell (1955) and Torrie (1962).

STOMACH CONTENTS

Inorganic Material. In some specimens a little fine sand or mud was found. This was almost certainly taken in with the food and could in no way be considered as grit, as herons depend on chemical, and not mechanical, processes for the breaking down of their food.

Plants. Although food in all stomachs was predominantly animal, 65 specimens contained plant material. Thirty-five held only traces, probably accidentally ingested. Grass and sedge leaves occurred in 38 specimens, clover leaves in 16, *Azolla* sp. in four and *Lemna* sp. in three. Seeds from a variety of plants of pasture and wetlands were found but either singly or in numbers too small to be significant.

Animal.

(a) *Insects.*

Most consistently occurring were flies (Diptera) and beetles (Coleoptera) in both adult and larval forms. Species of Diptera occurred in 67 specimen (11.4 per stomach), members of the genus *Calliphora* predominating. This supports observations made of White-faced Herons feeding at carrion where blowflies congregate in great numbers. Coleoptera, found in 59 specimens (19.8 per stomach), were predominantly larval and adult water-beetles (*Dytiscus* sp).

Water-boatmen (Hemiptera) were found in 29 stomachs (11.8 per stomach). Caddis larvae (Trichoptera) were also in 29 (45.3 per stomach). This average number is high because great numbers of minute *Oxyethira* sp. were sometimes present, almost certainly accidentally taken in with other organisms.

Dragon-fly larvae and damsel-flies (both Odonata) in either adult or larval form were present in 21 specimens (4.2 per stomach). Moth larvae (Lepidoptera) had been taken by 20 birds (7.7 per stomach). Grasshoppers and crickets (Orthoptera) occurred in 14 (18.5 per stomach).

Other insects found occasionally were, mayfly adults and larvae (Ephemeroptera) in six specimens (18.8 per stomach), stone-fly adults and larvae (Plecoptera) in three (1.3 per stomach), lace-wing adults and larvae (Neuroptera) in four (1.3 per stomach).

(b) *Other Invertebrates.*

Although present in 32 specimens, Arachnids were not numerous (4.6 per stomach). They were spiders and harvestmen.

Earthworms (Oligichaeta) had been taken by 26 birds. They disintegrated very rapidly, leaving insufficient identifiable fragments to make an accurate count possible. When present they often formed the bulk of stomach contents.

Crustaceans were present in 26 specimens (33.6 per stomach). These were most commonly crabs and shrimps picked up on tidal flats and ostracods from fresh water. Fresh-water crayfish and shield shrimps occurred twice. The latter were very numerous in two stomachs collected from Ellesmere in August 1963.

Molluscs, found in 25 (8.8 per stomach), were predominantly *Potamopyrgus* sp., which occurred in 16 stomachs and were the only species of importance. *Isidora* sp. appeared in six specimens, *Planorbis* sp, and minute bivalves in three, but singly or in numbers too small to be significant. Molluscs were associated with fish remains in all but four instances.

Nematodes were found in seven specimens but numerous only in one. They were free in the stomach cavity and food was also present.

(c) *Fish.*

Forty-nine of the 93 stomachs contained fish or portions of fish (see Table 3). Numbers of fish were estimated by counting those with entire heads and, where heads were disintegrated, pairs of otoliths. This followed the example of Dickinson (1951), who considered that otoliths, found in stomachs of shags, probably came from fish consumed on the day the birds were shot.

Bullies (*Gobiomorphus* spp.) occurred in 31 specimens (23.6 per stomach), smelt (*Retropinna* spp.) in 18 (17.8 per stomach), immature and adult whitebait (*Galaxias* spp.) in 14 (22.1 per stomach), trout (*Salmo* spp.) in 10 (4.3 per stomach), elvers (*Anguilla* spp.) in two (11.5 per stomach) and one stomach contained 30 carp (*Carassius* sp.)

Sizes ranged from bullies 20 mm. in length to two headless brown trout 85 mm and 90 mm respectively. Trout occurred in nine birds collected from February to May and in one in September. Stomachs containing one species of fish only were:— eleven with bullies, seven with smelt, four with trout and one with whitebait. The remaining 26 stomachs contained usually two, and sometimes three, species.

In all seasons bullies maintained their importance among food fish (See Table 4). Although smelt were taken in greater numbers than bullies from November to January, they occurred in fewer stomachs. Excluding bullies, whitebait (adult and immature) were most numerous from August to October and February to April. Trout were found in the greatest number of

TABLE 1

No. of Specimens	26		22		23		18		89		100
Food Organisms	May June July		Aug. Sept. Oct.		Nov. Dec. Jan.		Feb. March April		T o t a l		Percentage
Vertebrates	Total no. of items eaten	No. of birds feeding on item	Total no. of items eaten	No. of birds feeding on item	Total no. of items eaten	No. of birds feeding on item	Total no. of items eaten	No. of birds feeding on item	Total no. of items eaten	No. of birds feeding on item	of birds feeding on item
Anguilla spp. Elvers	-	-	22+	1	-	-	1	1	23+	2	2.3
Carassius sp. Carp	-	-	-	-	-	-	30	1	30	1	1.1
Galaxias spp. Whitebait	6	2	174+	7	26	2	104+	3	310+	14	15.7
Gobiomorphus spp. Bully	221	3	267	7	120	14	124+	7	732+	31	34.9
Retropinna spp. Smelt	3	1	66	3	158	8	54	6	321	18	20.2
Salmo spp. Trout	2	1	4	1	-	-	37	8	43	10	11.2
Rana sp. Tadpoles	3	1	-	-	-	-	-	-	3	1	1.1
Invertebrates Insects											
Coleoptera. Beetles adults	287+	17	74+	12	188	14	22	10	581	53	59.5
larvae	30	5	395+	7	146	4	19	6	590+	22	24.7
Diptera. Flies adults	201	17	65	11	152	16	117+	17	536	61	68.5
larvae	1	1	63	5	47	8	119+	5	230+	19	20.1
Ephemeroptera. Mayflies adults	-	-	8	1	-	-	-	-	8	1	1.1
larvae	-	-	11	2	-	-	94	3	105	5	5.6
Hemiptera. Water-boatmen	54	8	108	5	14	9	166	7	342+	29	32.5
Hymenoptera.	-	-	-	-	1	1	1	1	2	2	2.3
Lepidoptera. Moths larvae	117	10	31	6	5	3	1	1	154	20	11.4
Neuroptera. Lacewings adults	-	-	-	-	1	1	3	2	4	3	3.5
larvae	-	-	-	-	-	-	1	1	1	1	1.1
Odonata. Dragonfly adults	-	-	-	-	15	6	8	3	23	9	10.2
Damsel-fly larvae	6	3	6	2	52	10	1	1	65	16	17.9
Orthoptera. Grasshoppers and Crickets	231	8	1	1	1	1	25+	4	259	14	15.7
Plecoptera. Stenoperla adults	-	-	-	-	-	-	1	1	1	1	1.1
larvae	-	-	-	-	1	1	2	2	3	3	3.5
Trichoptera. Caddis flies adults	1	1	1	1	2	1	∞	1	4+	4	4.5
larvae	19	6	49	4	37	5	1,210+	14	1,315+	29	32.6
Others											
Annelida. Earthworms	∞	11	∞	7	∞	7	2	1	∞	26	29.1
Arachnida. Spiders	20	7	21	7	87	9	19	9	147	32	35.9
Crustacea. Crabs, Crayfish etc.	95	8	624+	7	121+	8	32+	3	872+	26	29.1
Mollusca. Fresh-water Snails	127+	8	22	4	41	7	31	6	221+	25	28.1
Myriapoda. Centipedes and Millipedes	1	1	1	1	-	-	-	-	2	2	2.3
Plant		24		13		19		9		65	73.0
Azollaceae. Waterfern		2		1		1		-		4	4.5
Caryophyllaceae. Chickweed seeds		-		1		3		-		4	4.5
Gramineae. Grass leaves		15		8		9		6		38	42.7
Juncaceae. Rush seeds		6		1		3		-		10	11.2
Leguminosae. Clover leaves		7		5		3		1		16	17.9
seeds		3		-		2		1		6	6.7
Lemnaceae. Duckweed		2		-		1		-		3	3.3
Polygonaceae. Willow-weed seeds		2		1		1		-		4	4.5
Salviniaceae. Salvinia natans seed		-		1		-		-		1	1.1

birds from February to April; they were few, but usually of a relatively large size.

Elvers occurred in two stomachs and carp in one and thus were of little significance in this study.

(d) *Other Vertebrates.*

With the exception of three tadpoles found in one stomach and a portion of intestine, almost certainly of a swan, in another, no further vertebrate remains were found. This second bird, shot at Lake Ellesmere in November during the swan breeding season, also contained 93 flies and was probably feeding on carrion.

Assuming that all remains in stomachs were part of the day's intake, an estimate was made of the total wet weight of each animal food species consumed. This was done by weighing as large a number as possible of whole specimens of each species and calculating the average weight, which was then multiplied by the estimated total number of the species occurring in all stomachs. It should be clearly understood that these results can be regarded as approximate only.

Total weights were roughly in the proportion of invertebrates 40 per cent to vertebrates 60 per cent. Invertebrates having the greatest importance by weight were crustaceans, earthworms, larval moths and beetles, grasshoppers and crickets and adult beetles and flies. Vertebrates were predominantly fish. Carp were not weighed, as only tails were found and the total weight of elvers was no more than 1.4 grams, so it was decided to exclude these two species from the study. (See Table 5). It should be borne in mind that this omission has made the percentages appearing in Table 5 slightly higher than they really are.

Bullies were, by weight as well as numerically, the predominant food fish. Smelt were, on both counts, slightly less than half as important as bullies. Trout were present in greater weight than adult and immature whitebait although comparatively few in number. The latter although numerous, weighed little as most were immature when taken and therefore very small.

DISCUSSION

An atempt has been made to determine what influence the presence of White-faced Herons may have on the trout population.

Although in the sample studied the estimated weight of trout was 15.5 per cent of the estimated total weight of all fish consumed, it could be argued that, by eating other small fish and aquatic invertebrates, herons compete with trout for food, thus indirectly as well as directly threatening their populations.

However, Allen (1951) noted a substantial overlap between the feeding requirements of trout, bully and smelt and Hobbs (1940) reported predation of trout fry by bullies. Thus, as by far the greatest weight of fish taken was bully and smelt, on these two counts the presence of herons could be considered as beneficial to trout.

TABLE 2 — TOTAL STOMACH CONTENTS

Season	Weight	Volume	No. of Birds
May - July	18.0 g	19.1 cc	26
Aug. - Oct.	21.6 g	17.5 cc	22
Nov. - Jan.	27.2 g	20.9 cc	23
Feb. - April	20.4 g	17.8 cc	18
Av. for year	21.7 g	18.8 cc	89 total

TABLE 3 — NUMBERS OF BIRDS CONTAINING FISH

	May-July	Aug.-Oct.	Nov.-Jan.	Feb.-April	Whole Year
Birds with fish	26	22	23	18	89
Total birds	6	10	17	16	49
Percentage of birds with fish	20.1	45.4	73.9	88.9	57.8

TABLE 4 — AVERAGE NUMBER OF FISH PER STOMACH IN STOMACHS WHERE FISH OCCURRED

Total No. of birds	May-July 26	Aug-Oct 22	Nov-Jan 23	Feb-April 18	Total 89
No. of birds with fish	6	10	17	16	49
Anguilla spp	- (-)	22+ (1)	- (-)	1 (1)	11.5 (2)
Carassius sp.	- (-)	- (-)	- (-)	30 (1)	30 (1)
Galaxias sp.	3 (2)	22+ (7)	13 (2)	34.7 (3)	22.1+ (14)
Gobiomorphus spp	73.7 (3)	38.1 (7)	8.6(14)	17.7+ (7)	23.6+ (31)
Retropinna spp	3 (1)	22+ (3)	19.8(8)	9 (6)	17.8+ (18)
Salmo spp	2 (1)	4 (1)	- (-)	4.6 (8)	4.3 (10)

Figures in brackest indicate numbers of birds

TABLE 5 — Mean weight of predominant species of food fish, also total weight of each species expressed as a percentage of total weight of fish consumed.

	Number	Mean Weight	Total Weight	Percentage
Whitebait	310+	0.14 g	40 g	2.4
Trout	43	6.04 g	260 g	15.5
Smelt	321	1.35 g	430 g	25.6
Bully	732	1.30 g	950 g	56.6

Thirty-seven of the total 43 trout found in stomachs were eaten during late summer and autumn. Of these 23, i.e. more than half, were taken in North Canterbury. At this time of year great numbers of fish, including fingerlings, are trapped in diminishing pools left by the annual drying-up of long reaches of many Canterbury rivers. Flocks of birds, including herons, gather here to feed, but their activities are not necessarily harmful as most of these stranded fish would die in any case, despite the salvage operations of North Canterbury Acclimatisation Society field officers.

Consideration should also be given to the fact that, under any conditions, the mortality rate among trout, in their first months of life, is very high. Death, from whatever cause it may be, is certain to come to the great majority of fry and fingerlings. In fact, if this were not so, the waters would soon become over-stocked with under-nourished trout.

Regulation of a population, usually effected by predation, is necessary in a community in order to maintain a vigorous stock in good condition. Thus, in the case of White-faced Herons, their feeding habits cannot be considered inimical to the well-being of the trout population; indeed they could well be beneficial.

CONCLUSION

A fitting conclusion is a quotation from "The Heron" (F. A. Lowe, 1954):— "Because it is partially a fish-eater the heron has been persecuted far beyond its deserts, for it is virtually omnivorous and its feeding habits vary with prevailing conditions."

ACKNOWLEDGEMENTS

I would like to thank all those who provided specimens for this study. My thanks also to members of the Research Section, Wildlife Branch, Department of Internal Affairs, for their valuable information and suggestions and their criticism of the manuscript. I am grateful to Mr. R. Ordish of the Dominion Museum for assisting with identification of insect material.

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