

Food habits of the Freckled Duck and associated waterfowl in North-western New South Wales

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Introduction

The type specimen of the Freckled Duck *Stictonetta naevosa* was described more than 140 years ago (Gould 1840) but this endemic Australian waterfowl remains an enigma. Freckled Ducks are usually regarded as rare or even endangered (Slater 1978), although at times they seem to be quite common. Their taxonomic relationships are still the subject of debate (see Delacour & Mayr 1945; Johnsgard 1960, 1961; Frith 1964, 1977) and their sexual behaviour is undescribed. Frith (1965), Johnsgard (1965) and Lowe & Lowe (1974) give accounts of the species' feeding behaviour; and their diet in southern inland New South Wales has been studied by Frith (1965) and Frith *et al.* (1969) from gizzard contents.

Freckled Ducks were relatively common

in south-eastern Australia in the late 1970's and in 1980. In New South Wales they were especially abundant in the north-west, a region where little waterfowl and no Freckled Duck research has been undertaken. Many of the temporary wetlands here had been flooded since 1974 and as they dried back during the late 1970's spectacular concentrations of waterbirds including Freckled Ducks developed. This provided the opportunity to study the diet of Freckled Ducks and two associated species of waterfowl at one of these temporary wetlands in January 1980.

The results of Swanson & Bartonek (1970) and later studies summarized in Swanson *et al.* (1979) have shown the desirability of using oesophageal contents from feeding birds in dietary studies. Gizzard contents provide highly biased results, because of different breakdown rates of

Figure 1. Freckled Duck feeding in shallows.



food items during digestion. Notably, hard seeds are retained much longer than soft-bodied invertebrates.

This paper reports on the diets of Freckled Duck, and of Pink-eared Duck *Malacorhynchus membranaceus* and Australian Grey Teal *Anas gibberifrons gracilis* feeding with Freckled Duck, at Fort Grey Basin in north-western New South Wales, Australia.

Study area

Fort Grey Basin is a shallow, temporary lake in north-western New South Wales, Australia (29°5'S, 141°9'E). Its area varies with water level; in January 1980 it covered about 5 sq km and was generally less than 2 m deep. The lake had filled in 1974 and it dried up completely in 1981. It was devoid of macrophytes but supported phytoplankton and filamentous algae at the time of the study.

Methods

All birds were watched feeding for at least 10 minutes prior to collection. Oesophagus and proventriculus (together) and gizzard contents were separately washed into 70% ethanol immediately following retrieval. The ducks were aged and sexed by methods described in Braithwaite & Norman (1974), and checked for gonad enlargement which would indicate breeding activity. With the exception of one Grey Teal taken at night, the birds were collected between 06.30 and 08.00 hours. All specimens were obtained from three adja-

cent bays on the north-western side of Fort Grey Basin between 5 and 16 January 1980.

Food items were sorted and counted with the aid of a 20 × binocular microscope, against both a white background (to facilitate observation of seeds) and a black one (to facilitate observation of zooplankton). Individual food items were dried at 65°C prior to weighing. The food analysis data were expressed as aggregate percent dry weight following the recommendations of Sugden (1973), Swanson *et al.* (1974a) and Reinecke & Owen (1980). Invertebrate samples were collected from where ducks had been feeding, using a mud corer, and dip and plankton nets.

Results

Invertebrate abundance varied with depth (Figure 1). Ceratopogonids were most abundant in the unconsolidated mud and very shallow water at the edge of the lake in Zones A and B; ostracods and *Micronecta* were most common in the very shallow water (≤ 4 cm deep) in Zone B; other corixids, notonectids, caddis-flies, beetles, and cladocerans were abundant in relatively deeper water (11–50 cm deep) in Zones D and F; and highest numbers of chironomids were in the substrate to Zone B in shallow water and Zone F in deeper water. All the invertebrates favoured the mud over the sandy substrate.

All ducks sampled were non-breeding adults. The samples comprised seven Freckled Duck, five Pink-eared Duck and four Grey Teal. The Freckled Duck were collected while feeding on wet mud or in very shallow water (Zones A and B in

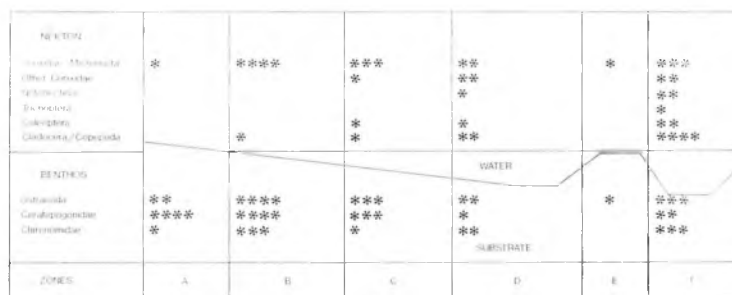


Figure 2. Relative abundance of invertebrates in depth and substrate zones in Fort Grey Basin. ****, very common; ***, common; **, uncommon; *, rare. Zone A, soft, unconsolidated mud with small pools of water in duck footprints; Zone B, very shallow water ≤ 4 cm deep; Zone C, water 5–10 cm deep; Zone D, water 11–20 cm deep, thin (2 cm) layer of silt overlaying sand; Zone E, sandbank; Zone F, channel, < 50 cm deep.

Figure 1). The Pink-eared Duck were taken while feeding in deeper water (Zones D and F) or in shallow water similar to Freckled Duck (Zone B), and the Grey Teal were taken from Zones B, C and D. The ducks could have fed elsewhere previously.

On the basis of oesophageal contents, the diet of Freckled Duck consisted mostly of ostracods (53.0%), with smaller quantities of seeds (34.4%) mainly *Portulaca*, and cladocerans (8.8%) (Table 1). Pink-eared Duck mainly ingested the corixid *Micronecta* (30.4%), microcrustaceans (25.7%) and chironomid larvae (20.0%). Grey Teal fed principally on *Micronecta* and other corixids (59.8%) and *Polygonum* seeds (16.1%). Gizzards from the three species contained much lower proportions of animal material and much higher proportions of seeds, particularly of *Polygonum*. Disparities between gizzard and oesophagus contents were especially marked for crustaceans in Freckled Duck, chironomids in Pink-eared Duck and corixids in Grey Teal. Pink-eared Duck gizzards and oesophagi contained the least plant material and Freckled Duck the most. In gizzards from Freckled Duck and Grey Teal plant material predominated whereas oesophagi from the three ducks contained predominately animal material.

Discussion

Although only small samples were used in this study, it indicates that Freckled Duck, Pink-eared Duck and Grey Teal took different foods. The feeding methods and preferred locations of the three species differed in several respects. Freckled Duck fed in very shallow water, pulling water and mud through their rather flexible bills. As observed previously by Frith (1965) and Johnsgard (1965), they are filter feeders, with the ability to strain very small particles from water. Pink-eared Duck fed in both shallow and deep water, straining water through their bills on which are very fine lamellae. Grey Teal fed in shallow, and occasionally in deeper water by dabbling. The three species appeared to be selecting for different food items by their different feeding methods, probably supplemented by their choice of feeding area.

The results from this study can be compared with those from previous studies, whose results were expressed on a volumetric rather than a dry weight basis. The percentage of animal food in Freckled

Duck gizzards collected from the Riverina area of New South Wales, some 700 km south-east of Fort Grey Basin, by Frith (1965), was 11% of which insects comprised the bulk. Algae accounted for 30%, and seeds of *Polygonum* and *Rumex* 22%. The rest of the material was mainly aquatic grasses and seeds of other plants.

Animal foods accounted for 94.4% of gizzard contents of Pink-eared Duck in the same Riverina area (Frith 1959), and for 53.8% in a later study (Frith *et al.* 1969). In the first of these studies, insects comprised 86.9%, but in the second, microcrustaceans, principally cladocerans, made up the bulk of the animal food and 31.4% of the total volume. In this same study insects constituted 18.5% and total plants 46.2% of gizzard volume. Grey Teal gizzards collected by Frith (1959) consisted of 32.8% animal foods and 67.2% plants. Insects, mainly beetles, comprised most of the animals, but a number of families were represented in the plants. Animals, again mainly insects but not predominately beetles, constituted 12.9% of the Grey Teal gizzards studied by Frith *et al.* (1969); and grasses, sedges, *Polygonum* and floating plants predominated among the plants.

The percentage of animal foods in Freckled Duck gizzards from Fort Grey Basin was higher than in the Riverina study. There were no aquatic plants at Fort Grey Basin, and filamentous algae whilst present, were not abundant. Hence a higher proportion of animal matter would be expected. The percentages of *Polygonaceae* seeds were almost the same in the two areas. The proportion of animal material in the Pink-eared Duck gizzards in this study was similar to that in the gizzards collected by Frith *et al.* (1969), although in the dominance of Hemiptera, the results were similar to those of Frith (1959). The percentage of animal material in Grey Teal closely approximated that found by Frith (1959), it exceeded that found by Frith *et al.* (1969); but the composition was unlike either in the dominance of Hemiptera.

The discrepancies between oesophageal and gizzard contents in this study emphasize the need to use oesophageal samples for dietary studies. Freckled Duck and Grey Teal have classically been considered mainly herbivorous on the basis of gizzard studies. Both species were found to be principally invertebrate feeders at Fort Grey Basin, but gizzard contents alone would have indicated that they were seed eaters. The percentages, if not composition, of animal and plant foods in gizzards

Table 1. Food items in oesophagi and gizzards of Freckled Duck, Pink-eared Duck and Grey Teal at Fort Grey Basin.

Food items	Freckled Duck, 5♀, 2♂				Pink-eared Duck, 1♀, 4♂				Grey Teal, 2♀, 2♂			
	Aggregate %		% occurrence		Aggregate %		% occurrence		Aggregate %		% occurrence	
	Oes.	Gizz.	Oes.	Gizz.	Oes.	Gizz.	Oes.	Gizz.	Oes.	Gizz.	Oes.	Gizz.
Animal												
Arachnida-Hydracarina									tr.		50	
Crustaceae-Cladocera	8.8	2.7	86	100	8.9	6.3	80	60				
Copepoda	1.1	tr.	43	133	8.1	5.3	40	20				
Ostracoda	53.0	14.2	71	100	8.7	3.2	60	60	0.3	tr.	50	25
Insecta-Coleoptera a.									3.3	0.6	25	50
Diptera-Ceratopogonidae 1.	0.2	0.1	14	33	1.7	0.8	60	80	0.2	0.2	75	50
Chironomidae a.					10.0	tr.	20	20				
Chironomidae 1.	tr.	tr.	14	17	20.0	1.1	60	60	2.9	1.2	50	25
unidentified a.						0.3		20				
Ephemeroptera n.	0.6		14		0.8	tr.	20	20	2.6		50	
Hemiptera-Corixidae a.						4.7		40	16.1	2.3	50	50
<i>Micronecta</i> a.	0.1		14		24.9	20.4	60	80	24.1	9.2	75	50
<i>Micronecta</i> n.	0.5	0.4	29	33	5.5	4.2	60	40	19.6	10.2	75	50
<i>Micronecta</i> parts						5.5		20		9.5		75
Odonata-Zygoptera 1.	1.5		14									
Trichoptera 1.						0.9	20	20	6.3	0.4	75	25
unidentified eggs						3.7				0.4		25
Plant												
Chenopodiaceae- <i>Chenopodium</i>										0.5		25
Fabaceae- <i>Trifolium</i>		0.4		33	tr.	0.4	20	40		0.9		50
Malvaceae										6.0		25
Polygonaceae- <i>Polygonum</i>		21.5		67	0.7	34.2	40	100	16.1	54.2	75	100
<i>Rumex</i>										0.6		25
Portulacaceae- <i>Portulaca</i>	20.3	58.3	57	100	9.8	9.3	20	60	1.5	3.6	25	25
Unid. seed	14.1	2.2	14	33								
Filamentous algae									2.7		50	
Total animal	65.8	17.4	100	100	88.7	56.9	100	100	79.6	34.1	100	100
Total plant	34.4	82.4	71	100	10.5	42.9	40	100	20.3	65.8	75	100

1. Oesohagus includes proventriculus.

2. Plant items are seeds.

3. One Freckled Duck sample consisted of the oesophagus only.

4. a, adult; 1, larvae; n, nymph

5. tr., trace (less than 0.5% in ≤ 2 samples).

from Fort Grey Basin were broadly similar to those collected in the previous studies. Expressing the results on a dry weight rather than volumetric basis would emphasize seeds rather than invertebrates. It is suggested therefore that oesophageal contents, if they had been analysed in these previous studies, would also have indicated a predominance of animal foods in the diet of Freckled Duck and Grey Teal. In this regard, it is interesting to note that an early account (Gould 1865) states that the 'stomachs' of two Freckled Duck contained 'small fish and minute shells'. The latter may have been ostracods, which resemble small mussels.

Fort Grey Basin lacked aquatic vegetation, and ducks in more highly vegetated wetlands may consume more plant material. Conversely, since breeding females take more invertebrates than non-breeding birds (Krapu 1974; Swanson *et al.* 1974b; Swanson *et al.* 1979), breeding Freckled Duck, Pink-eared Duck and Grey Teal females would be expected to take a higher proportion of animal material than the non-breeding birds sampled in this study.

Much remains to be discovered about the ecology of Freckled Duck. The reasons for its periodical apparent increases in population will be the subject of another paper, but its breeding requirements, responses to drought and principal breeding areas must be better understood before its future can be assured.

References

- Braithwaite, L. W. & Norman, F. I. 1974. The 1972 open season on waterfowl in southeastern Australia. *CSIRO Div. Wildl. Res. Tech. Pap.* No. 29.
- Delacour, J. & Mayr, E. 1945. The family Anatidae. *Wilson Bull.* 57: 3–55.
- Frith, H. J. 1964. Taxonomic relationships of *Stictonetta naevosa* (Gould). *Nature* 202: 1352–3.
- Frith, H. J. 1965. Ecology of the Freckled Duck *Stictonetta naevosa* (Gould). *CSIRO Wildl. Res.* 10: 125–39.
- Frith, H. J. 1977. *Waterfowl in Australia*. 2nd ed. Sydney: A. H. and A. W. Reed.
- Frith, H. J., Braithwaite, L. W. & McKean, J. L. 1969. Waterfowl in an inland swamp in New South Wales. II. Food. *CSIRO Wildl. Res.* 14: 17–64.
- Gould, J. 1840. Descriptions of new birds from Australia. *Proc. Zool. Soc. Lond.*: 169–79.
- Gould, J. 1865. *Handbook to the Birds of Australia*. London: J. Gould.
- Johnsgard, P. A. 1960. Comparative behaviour of the Anatidae and its evolutionary implications. *Wildfowl Trust Ann. Rep.* 11: 31–45.
- Johnsgard, P. A. 1961. The taxonomy of the Anatidae—a behavioural analysis. *Ibis* 103: 71–85.
- Johnsgard, P. A. 1965. Observations on some aberrant Australian Anatidae. *Wildfowl Trust Ann. Rep.* 16: 73–83.
- Krapu, G. L. 1974. Foods of breeding pintails in North Dakota. *J. Wildl. Manage.* 38: 408–17.
- Lowe, V. T. & Lowe, T. G. 1974. The Freckled Duck in Victoria. *Aust. Bird Watcher* 5: 175–80.
- Reinecke, K. J. & Owen, R. B. 1980. Food use and nutrition of black ducks nesting in Maine. *J. Wildl. Manage.* 44: 549–58.
- Slater, P. 1978. *Rare and Vanishing Australian Birds*. Adelaide: Rigby.

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Summary

Dietary habits of Freckled Duck *Stictonetta naevosa*, Pink-eared Duck *Malacorhynchus membranaceus* and Australian Grey Teal *Anas gibberifrons gracilis* were investigated at Fort Grey Basin in north-western New South Wales, Australia. On the basis of their oesophagus contents, Freckled Duck fed mainly on ostracods (53.0%) and *Portulaca* seeds (20.3%), Pink-eared Duck mainly on *Micronecta* (30.4%), microcrustaceans (25.7%), and chironomid larvae (20.0%), and Grey Teal mainly on *Micronecta* (43.7%), other corixids (16.1%) and *Polygonum* seeds (16.1%). The three species of waterfowl fed by different means and appeared to favour different zones.

Gizzards from the three species contained markedly lower proportions of animal foods, than did their oesophagi. In these three species of Australian waterfowl, invertebrates formed a larger part of the diet than previous gizzard studies have indicated.

- Sugden, L. G. 1973. Feeding ecology of Pintail, Gadwall, American Widgeon and lesser Scaup ducklings. *Can. Wildl. Serv. Rep. Ser. No. 24*.
- Swanson, G. A. & Bartonek, J. C. 1970. Bias associated with food analyses in gizzards of blue-winged teal. *J. Wildl. Manage.* 34: 739-46.
- Swanson, G. A., Krapu, G. L. & Serie, J. R. 1979. Foods of laying female dabbling ducks on the breeding grounds. In *Waterfowl and Wetlands—An Integrated Review*, ed. T. A. Bookhouse. Madison: Wildlife Society.
- Swanson, G. A., Krapu, G. L., Bartonek, J. C., Serie, J. R. & Johnson, D. H. 1974a. Advantages in mathematically weighting waterfowl food habits data. *J. Wildl. Manage.* 38: 302-7.
- Swanson, G. A., Meyer, M. I. & Serie, J. R. 1974b. Feeding ecology of breeding blue-winged teals. *J. Wildl. Manage.* 38: 396-407.

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