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Food of the Maned Duck *Chenonetta jubata* During the Breeding Season

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Summary

Kingsford, R.T. (1989). Food of the Maned Duck *Chenonetta jubata* during the breeding season. *Emu* 89, 119-124. Grazing represented over 95% of Maned Duck feeding behaviour recorded during the breeding season; the remainder was picking insects off the water. Dabbling occurred only to obtain grit. From oesophageal analysis, over 99% (aggregate percentage) of the diet was terrestrial plant material, with 0.03% being invertebrates. Maned Duck females do not shift their diet in favour of invertebrates when breeding. Nutritional requirements for breeding come from plant food. There was little evidence that particular food items were selected. The diet of ducklings resembled that of adults.

Introduction

Maned Ducks *Chenonetta jubata* are principally vegetarian, grazing on young green herbage (Frith 1957, 1959; Lavery 1971). Frith (1982, p.16) described their food as entirely vegetable but invertebrates have been found in the diet (Frith 1957, 1959; Lavery 1971). These could be the result of accidental ingestion if the duck is truly herbivorous or they may be an intentional component of the diet. Observations of Maned Ducks picking insects off the water surface support the latter hypothesis (Briggs 1983).

This distinction is important. Some primarily vegetarian Anatinae feed on invertebrates while breeding (Swanson & Nelson 1970; Landers *et al.* 1977); females generally have a higher proportion of invertebrates in their diet just before and during laying (Drobney & Fredrickson 1979). This overcomes the increased protein demand of breeding not met by some plant foods that are lower in protein (Krapu & Swanson 1975).

Although Frith (1959) shot Maned Ducks throughout the year, between 1952 and 1957, in his study of diet, no attempt was made to relate this to breeding. This study was designed to do so because such knowledge is important for understanding the breeding ecology of this species.

Methods

Data collection

Maned Ducks begin breeding in winter in the southeast of Australia (Frith 1982, p. 266). Hence, at a site near Taralga, NSW (34°18'S, 149°42'E), I collected data on the feeding behaviour of Maned Ducks over 170 hours on 39 days in the breeding season of 1982 (between July and September). Since records before, 1982 developed into the worst year of drought in this area.

Four farm dams had hides for observational work. Flocks were

scanned instantaneously (Altmann 1974) and the behaviour of each individual recorded every 2 min, over half-hour periods. There were three categories of feeding behaviour identified initially: grazing, surface picking and dabbling. Grazing included pecking and moving between patches of pasture with the head down. Surface picking was picking insects off the surface of the water. Dabbling took place at the edge of the dam and involved the head or bill dipping below the water. To determine the function of this latter behaviour, I collected four scoop samples of substrate (1 l) from the edge of a dam where dabbling had just occurred. These samples were sorted for potential food items. Observations on the feeding behaviours of adults and ducklings were also made throughout the breeding seasons of 1981, 1982, and 1983. Only two feeding categories were used for ducklings: insect feeding and grazing.

At a second site, (on a 2430 ha rural property) near Crookwell NSW (34°34'S, 149°34'E), 70 km from the first site, I shot 40 Maned Ducks between July and October of 1981 and 10 in October 1982. Following methods of Swanson & Bartonek (1970), I watched them feed for 10 min before shooting. The contents of the oesophagus of each bird shot were transferred immediately into 70% ethanol to limit post-mortem digestion (Swanson & Bartonek 1970). Gizzard contents were not used because plant fragments were difficult to identify and because of the problem of differential digestion (Swanson & Bartonek 1970; Briggs *et al.* 1985).

Oesophageal contents were sorted and dried for 48 h at 50-55°C. I measured dry weight because food was predominantly plant material. This overcomes problems of variable water content (Sugden 1973) and has more direct nutritional interpretation (Reinecke & Owen 1980). Each food item in an oesophagus was weighed to the nearest 0.1 mg. Grasses and legumes were identified to family; other oesophageal plant items were identified to genus or species (Leigh & Mulham 1965; Lamp & Collet 1976) and invertebrate items to order.

Reproductive status of females shot in 1981 was categorised using a combination of methods developed by Braithwaite & Frith (1969) and Krapu (1974). Females with ovaries weighing less than 3 g with no follicular development were judged not to have initiated laying. Those with ovaries weighing a minimum of 3 g and, showing some follicular development, were considered to be

pre-laying. Laying females had one or more ruptured follicles. The oviduct of laying females was also usually greatly enlarged.

I measured food abundance, as percentage cover, using a square metre quadrat. Percentage cover was estimated in four quadrats, for each Maned Duck shot between July and September 1981. Food abundance was not assessed for Maned Ducks shot subsequently because analysis indicated that there was little selection for food items. After shooting, each estimate was randomly taken within 10 m of where each bird was shot. Identification of plants in percentage cover estimates was on the same basis as for oesophageal analysis. However, a list of the grasses and legumes on this site was compiled after later identification to species or genus (Burbidge 1966; Lamp & Collett 1976), when they were in flower or had seeds.

Data analysis

The three feeding behaviours in each half-hour period were totalled and converted to percentages for adult Maned Ducks. Data on the feeding behaviours of ducklings are presented as observation-days. These were days on which duckling feeding behaviour was recorded during regular surveys, about every four days between September and December 1981-1983.

I have presented data from the oesophagi using methods developed by Swanson *et al.* (1974), which reduce bias. Three measures were used: aggregate dry weight, aggregate percentage and frequency of occurrence.

Aggregate dry weight is the total dry weight of a particular food item from all birds divided by the total dry weight of all food items from all oesophagi. The volumetric equivalent is commonly reported in dietary studies of Australian waterfowl (Frith 1957, 1959; Lavery 1971; Goodrick 1979; Norman & Mumford 1982). The second, aggregate percentage, is the proportion of a particular food item in a particular bird, averaged over all birds. This is the least biased estimate (Swanson *et al.* 1974; Landers *et al.* 1977). Finally, frequency of occurrence is the number of birds containing a particular food item divided by the number of birds in the sample. This method typically over estimates the importance of rare foods and should be considered in association with other estimates. However, it is important because it shows the whole range of items. Nine Maned Ducks had fewer than five food items and were excluded from the analysis.

Paired Student *t*-tests (Zar 1974) were used to test for differences between the percentage dry weight of each plant item in the oesophagi and the mean abundance measure of the same item for all Maned Ducks shot. Comparison was only possible for plant items which were found in either abundance estimates or oesophagi or both. Data were transformed (arcsin) to improve normality before analysis (Zar 1974).

One factor unbalanced analysis of variance (Zar 1974) was used to compare the proportion of grasses in the diet (after angular transformation) from four reproductive categories: females not reproductively active ($n = 3$), pre-laying females ($n = 5$), laying females ($n = 3$) and all males ($n = 15$). Other food types were not analysed because of dependence of the data.

Results

Maned Ducks were predominantly grazers (96% of the feeding behaviours) (Fig. 1). Results of oesophageal contents from 1981 ($n = 31$) were similar. Legume and grass

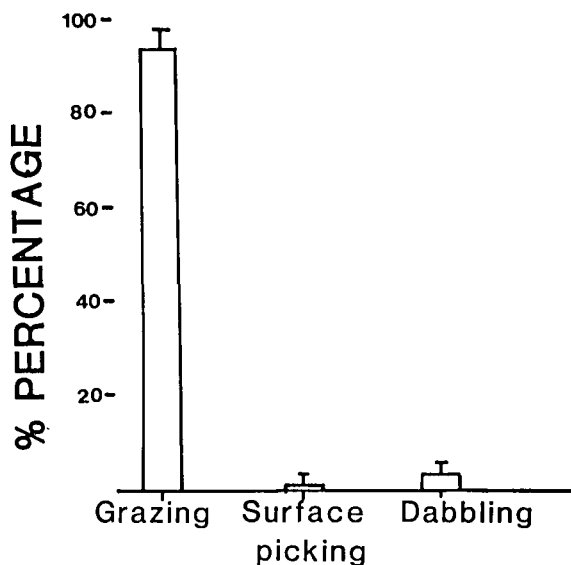


FIGURE 1 Maned Duck feeding behaviours (mean % \pm 95% confidence limits, arcsin transformed) from instantaneous sampling in 1982 ($n = 170$ hours). Data are the total of each of the three feeding behaviours, for 16 scans (one every 2 min for a half-hour), for a particular flock, expressed as a percentage.

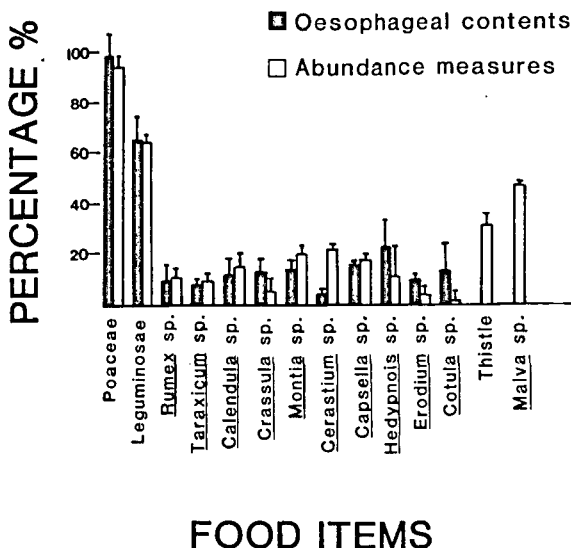


FIGURE 2 Mean percentage dry weight (\pm 95% confidence limits) of each food item in oesophagi of Maned Ducks shot between July and September 1981 ($n = 26$), compared to mean abundance where the duck was shot. Data transformed by arcsin.

TABLE 1 Oesophageal contents of Maned Ducks shot during the breeding season of 1981 ($n = 31$) and 1982 ($n = 10$).

Food item plants	Aggregate %		Aggregate Dry weight		% Occurrence	
	1981	1982	1981	1982	1981	1982
Poaceae	39.8	0.2	29.5	0.19	90.6	11.1
<i>Avena sativa</i> (oat grain)	8.7	85.5	39.5	99.4	9.5	88.9
Leguminosae	40.1	0	26.6	0	90.6	0
<i>Rumex acetosella</i>	2.9	4.9	0.3	0.1	12.5	22.2
<i>Montia fontana</i>	2.1	0	1.0	0	40.6	0
<i>Cerastium fontanum</i>	0.6	0	0.4	0	18.8	0
<i>Capsella bursa-pastoris</i>	0.2	0	0.1	0	6.3	0
<i>Crassula sieberana</i>	0.3	0	0.2	0	9.4	0
<i>Plantago lanceolata</i>	0.1	0	0.1	0	12.5	0
<i>Arctotheca calendula</i>	2.9	0	1.2	0	15.5	0
<i>Taraxicum officinale</i>	0.4	0	0.3	0	21.9	0
<i>Hedypnois</i> sp.	0.6	6.6	0.1	0.1	6.3	11.1
<i>Cotula australis</i>	0.3	0	0.2	0	3.1	0
<i>Isoetopsis</i> sp.	0.8	0	0.3	0	9.5	0
<i>Podolepis</i> sp.	0.1	0	0.1	0	3.1	0
<i>Salix</i> sp.	0	0.9	0	0.2	0	11.1
Total	99.9	98.1	99.9	99.6		
Food item invertebrates						
Diptera	0.009	0.003	0.013	0	21.9	0
Collembola	0.004	0	0.002	0	9.4	0
Coleoptera	0.015	1.950	0.021	0.05	6.3	44.4
Heteroptera	0.001	0	0.001	0	3.1	0
Pscoptera	0.001	0	0.001	0	3.1	0
Total	0.03	1.953	0.038	0.05		

species dominated the diet, both occurring in over 90% of the ducks, and accounting for nearly 80% of the food eaten, as measured by aggregate percentage (Table 1). Grasses identified later when plants had seeded included: *Phalaris tuberosa* (phalaris), *Hordeum* sp. (barley), *Lolium perenneum* (rye), *Dactylis glomerata* (cocksfoot), *Poa annua* (snow), *Arrhenatherum elatius* (oat) *Bromus* sp. (brome). Legumes were *Trifolium subterraneum* (subterranean clover), *T. repens* (white clover) and various *Medicago* spp. (medics). There is also a list of other plant species which occurred in oesophagi (Table 1). All plant material was in the form of leaves; no seeds were found in either oesophagi or percentage cover estimates. I found no brown or old plant material in oesophagi, in 1981.

The percentage dry weight of food items were similar to the percentage cover estimates for most plant food items (Fig. 2). Despite this, Maned Ducks were occasionally seen moving to patches of clover to graze, ignoring other plants on the way. Three food items were found in significantly greater proportion in the environment than in the oesophagi (Table 2); neither thistles (Asteraceae) nor *Malva* sp.

TABLE 2 Paired comparison between amount of plant food items found in oesophagi (percentage dry weight) and food abundance (percentage cover estimate) for Maned Ducks shot in 1981 between July and September.

Plant food item	<i>n</i>	Mean ^a	<i>T</i> Value	Signif. ^b
Poaceae	26	1.83	0.38	ns
Leguminosae	26	0.64	0.15	ns
<i>Rumex acetosella</i>	6	-1.17	0.23	ns
<i>Montia fontana</i>	21	-3.81	1.62	ns
<i>Cerastium fontanum</i>	20	-9.08	4.17	*
<i>Capsella bursa-pastoris</i>	15	-3.42	0.94	ns
<i>Crassula sieberana</i>	4	4.17	0.79	ns
<i>Plantago lanceolata</i>	4	4.21	0.40	ns
<i>Arctotheca calendula</i>	18	-2.45	0.65	ns
<i>Taraxicum officinale</i>	12	-0.66	0.27	ns
Thistle (Asteraceae)	10	-15.78	6.65	*
<i>Cotula australis</i>	3	4.98	0.80	ns
<i>Malva</i> sp.	3	-18.90	39.68	*

^amean = % oesophagus - % abundance

^bns = $P < 0.05$; * = $P < 0.001$

were ever found in the oesophagi of ducks, although both occurred in abundance estimates. There was no difference in the percentage dry weight of grass in the diet of the different reproductive classes ($F_{3,22} = 1.35$, $P > 0.05$). Oesophagi of breeding females contained a similar dry weight of grass to those of males and those of females which were not breeding. Females, which were known to be laying or incubating, were almost always seen grazing during the breeding seasons of 1981-1983.

Maned Ducks also fed on invertebrates. Surface picking (Fig. 1) occurred when flying ants (Hymenoptera) or midges (Diptera) were emerging. Some of these fell on the water, where they remained, and a flock of Maned Ducks would usually cease grazing to pick the insects off the water. In December 1982, after quantitative observations had ceased, I also saw them exhibit a different feeding behaviour. Instead of the regular movements of a bird feeding on static food, plants or seeds, birds moved haphazardly over the ground, changing direction quickly and often. They picked at the ground using their bills in a fast stabbing action. This behaviour was not seen again in the study (1981-1983).

There were few invertebrates in oesophagi in 1981 although they did occur in over 43% of all ducks (Table 1). They made up less than 0.05% of the total food, as measured by aggregate percentage. All were terrestrial and were predominantly dipterans (Family Sciaridae) with some collembolans. The few invertebrates in oesophagi precluded analysis of frequency against reproductive condition.

In 1982, only ten Maned Ducks were shot but, despite the sample size, diet was different from the previous year. Food was dominated by oat grain (Table 1) picked up from where sheep had been fed oat grain as a drought relief measure. Other herbage was rare (Table 1) and was mostly brown. The leaf from a willow tree (*Salix* sp.) was the only green item in any oesophagi. Invertebrates were mainly coleopterans, including an aquatic beetle (Family Hydrophilidae), although some dipteran aquatic larvae were also eaten. Near Taralga, where behavioural observations were made, Maned Ducks fed principally on grain (wheat) given to livestock, from October until the end of the year.

Other feeding behaviours were rare although there were always a few Maned Ducks dabbling in each half-hour observation period. Dabbling birds take substrate in their bills and then perform rapid bill movements just under the water. The four scoop samples taken from the edge of the dam had two dragonfly larvae (Odonata) but no other potential food items. I saw 'upending' once when a Maned Duck fed on *Juncus* sp. (spiny rush) which had been flattened by cattle and was lying in the shallows.

Maned Duck ducklings were predominantly grazers. I

saw them feed on invertebrates on only four out of 244 observation-days, when they picked insects off aquatic vegetation and the surface of the dam; the rest of the time was spent grazing. There was no evidence that feeding on invertebrates was age related; broods were seen grazing within days of hatching.

Discussion

Maned Ducks were mainly grazers during the breeding season (Fig. 1) and all plants found in the diet, in this study, were terrestrial (Table 1). The comparison of food abundance to oesophageal contents in 1981 indicated that this species is a generalist herbivore (Fig. 2), mostly feeding on plant food according to availability which supports Frith's (1957) assertion. Some plant items appeared not to be eaten according to abundance (Table 2); possibly these were less palatable. The birds also fed according to food abundance from October 1982 until the end of the year. Diet shifted, from one composed principally of terrestrial plant material, to one dominated by grain (wheat or oat). This was the principal food available, as on both sites, there was < 5% of the pasture in 1982 compared to 1981 and 1983. Such a diet may not be adequate for breeding. Pintails *Anas crecca*, fed a diet of wheat, failed to breed (Krapu & Swanson 1975). In 1982, few Maned Ducks bred on the site near Taralga, compared to 1981 and 1983 (Kingsford 1986).

Similarly, other studies of their food habits tend to reflect local habitat differences. Unlike some studies of the food habits of Australian waterfowl that may be biased (Briggs *et al.* 1985), those on Maned Ducks (Frith 1959; Lavery 1971) can be used for comparison because they used contents from the upper digestive tract. Frith (1959) found 42% of the food, although plant material, was from plants which grew in or near water. Frith collected data from along the Murray, Murrumbidgee and Lachlan river systems, all areas with more aquatic vegetation than farm dams on my site. Lavery's (1971) results were similar to those of this study, reflecting similar habitats. Legumes, which are high in crude protein compared to grasses (Shapter 1935), were a more important component of the diet in my study compared to previous studies. Agriculture may have further contributed to the success of this species by not only putting in farm dams (Frith 1982, p. 34) but also by establishing nutritious pastures which replaced native pasture species.

Invertebrates accounted for less than 0.05% of the diet of Maned Ducks in this study. These were Sciaridae and collembolans in 1981; both are small detritus feeders and were found in large numbers amongst the vegetation. Their presence in the diet was likely to be the result of accidental ingestion. However, Maned Ducks do actively ingest invertebrates, although rarely. Thus, there were beetles and dipterans in the diet in 1982 (Table 1) and birds were seen

picking insects off the water. This was rare (Fig. 1) but became a primary feeding activity when flying ants emerged and some inevitably fell on the water. Also, they appeared to be feeding on mobile prey, probably beetles, in the latter months of 1982. I never saw Maned Ducks catch fast-moving terrestrial invertebrates (Order Orthoptera) although these were abundant in 1982. Invertebrates in the diet seem limited to those that were either slow moving or incapacitated. Other studies also found few invertebrates; Frith (1959) found them in samples from only two months in the year (overall mean = 0.7%) and Lavery (1971) found even fewer (0.1-0.6%).

It follows that dietary protein for breeding females, which is essential for egg laying, must come from plant foods. Breeding females fed on the same food as males and as females which were not reproductively active. The extra energy demands on the breeding female may be overcome by feeding more; laying and incubating females spend much of their diurnal activity grazing, when not on the nest (Kingsford 1986).

Maned Ducks also dabbled and upended, as noted by Weller (1964). The latter was seen only once but dabbling was more frequent and usually occurred at the end of the day (Kingsford 1986). Dabbling was probably not a feeding behaviour as few food items were found in scoop samples, which were predominantly grit and sand. More likely, dabbling allows Maned Ducks to obtain this material which aids digestion and provides minerals (Weller 1964). Grit and sand are common in the gizzards of this species (Norman & Brown 1985) and occurred in all gizzards in this study. During extensive observations of diurnal activity and two nights observation of nocturnal activity, this was the only behaviour through which they could have obtained the grit in their gizzards.

Maned Duck ducklings mostly graze. Frith (1982, p. 266) maintained that the young downy ducklings feed on small insects, gradually reducing this dependence until, at six weeks, they eat mainly herbage. This study provided contrary evidence. I found no age-related differences in the feeding behaviour of ducklings. Newly hatched ducklings were usually observed grazing on vegetation and seldom seen feeding on invertebrates (1.6% of feeding time). Although such data are prone to bias, this usually favours the rarer event (Altmann 1974) of invertebrate feeding. Invertebrate feeding is probably less important than indicated. Perhaps Frith's observations of duckling diet were made in a habitat where more invertebrates were present.

Diet and activity of this species were similar to those of geese (Anserinae). Maned Ducks mostly graze during the breeding season, obtaining energy for breeding from plant foods. This may not be true when environmental conditions deteriorate. As with other studies of food habits in this

species, long lists of food items reflect habitat and seasonal differences.

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