Foods of male Mallard, before and during moult, as determined by faecal analysis

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Introduction

The feeding habits of Mallard *Anas platyrhynchos* show considerable variation during the year and between different geographical regions. Several investigations give information of the foods of Mallard (Perret 1962; Olney 1964; Toufar 1965) but the feeding habits during the moulting period are not so thoroughly known.

The moult is a critical period for ducks, they are not able to fly for about a month and are probably more exposed to predation. The loss of insulating plumage and growth of new feathers probably implies an increase in energy requirements and demands for the protein of which feathers are composed (Payne 1972; King 1974). Together with a change in behaviour these might be likely to affect their feeding habits.

The usual method for studying the food choice of waterfowl is analysis of viscera contents. With this method it is often difficult to get a large number of samples, and problems like disturbance of the birds and reduction of small populations may arise. Complementary methods could therefore be of interest.

Faecal analysis based on epidermal characters of food plants is a well established technique for studying herbivore diets. Most investigations have dealt with mammals, but the technique has also been successfully used on swans and geese (Luther 1963; Owen 1972, 1975). The diet of Mallard, however, includes not only green plant matter but also seeds and invertebrates. The aim of this study was to see whether faecal analysis can give any useful information of their feeding habits and to study the males' food choice before and during the moult.

Study area

The man-made Lake Dalkarlskärret (59°47′N, 17°35′E) lies about 70 km north of Stockholm. It has an area of about 7 ha. and a depth varying between 20 cm and 1 m. except for the central parts where the depth locally is about 2 m. The pH-value of the water is neutral. The lake is surrounded by open pasture and coniferous forest with an intermixture of deciduous species.

Most of the surface is covered by emergent hydrohytes. *Carex rostrata* and *Equisetum fluviatile* occurs in larger homogenous stands. *Carex vesicaria* and *C. acuta* are also found. *Potamogeton natans, Polygonum amphibium* and *Utricularia vulgaris* are common in the open water areas. *Lemna trisulca* occurs in great amounts. *Lemna minor* and *Spirodela polhyrriza* are also common.

In 1983, 11 Mallard pairs were observed in the lake and there were about nine broods. Other dabbling ducks present were four breeding pairs of Teal *Anas crecca* and occasionally visiting Garganey *A. querquedula* and Gadwall *A. strepera*. The number of moulting male Mallard was estimated to about 10 individuals. A smaller number of male Teal were occasionally observed on the lake during the moulting period, but they probably did not complete their moult there.

Materials and methods

Field sampling was done approximately every fourth day during the periods 4 May – 31 July 1983 and 4 May – 19 June 1984. In order to find droppings and to avoid collecting faeces from female Mallard, duckling, or the other duck species droppings were collected from those loafing sites where only male Mallard had been seen. Altogether 113 droppings were collected and preserved in 70% ethanol. Reference material was prepared using the method described by Storr (1961) and then mounted in glycerine and photographed. The material was collected from the study area since epidermal characters may differ between plants of the same species growing in different localities.

The faecal samples were first examined qualitatively under a binocular dissecting microscope (10 – 40X). Unidentified fragments and, where necessary, one or more

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subsamples were then further examined under a microscope (50 – 500X). The method of grinding the faecal material before examination was not used, since seeds and invertibrates would be made unrecognizable.

After the first examination a rough quantitative estimation was made under a binocular dissecting microscope. The dominating food item (providing more than 50% of food volume) in each sample was noted. Such an inexact method will of course involve some errors, but the samples were examined successively and by one person, making comparisons within the material possible.

In Figures 1 and 2 the data are divided into 5-day periods. "*Lemna*" includes *Spirodela polhyrriza* as well as two species of *Lemna*. "*Carex* seeds" are not divided into species. Seeds and seed fragments from other genera than *Carex* occurred comparatively seldom and in such small amounts that they are here brought together under "Other seeds". Green plant matter from other genera than *Lemna* is, for the same reason, called "Other plants".

To get information of the timing of the moult, feathers were collected approximately each fourth day during May, June and July 1983, from three specific sites in the lake. In order to determine the amount of *Carex* seeds lying on the lake bottom and possibly available to the Mallard, four bottom samples were collected with a Rzoska core-sampler (123 cm^2, Rzoska 1931) at different places in the lake with water depths between 10 and 50 cm. The *Carex* seeds in the upper 3 cm of each sample were counted.

Results

Qualitative analysis

Insect fragments were significantly more common in samples from May and June compared with those from July (Figure 1, Table 1). The result of the attempt to identify the insect fragments is shown in Table 2. *Lemna* occurred frequently in the samples throughout the whole period, with a significant peak in June. Fragments of *Carex* seeds occurred in all except six samples, which were all from May. Plant matter of other genera occurred in samples from May and June, but were more scarce in July. The four samples from July where "Other plants" occurred contained *Ricciocarpus natans*. One or a few seeds other than *Carex*

Table 1. Statistical analysis of frequencies of occurrence in male Mallard faeces. ns is $p>0.05$; Fisher exact test.

	May		June		July		May
Insects		ns		$p<0.001$		$p<0.001$	
Lemna		$p<0.001$		$p<0.001$		ns	
Carex seeds		$p<0.005$		ns		$p<0.001$	

Table 2. Items identified in Mallard faeces.

Invertebrates	Plant matter	Seeds
Ephemeroptera spp., nymphs	*Lemna minor*	*Carex rostrata*
	Lemna trisulca	*Carex vesicaria*
Trichoptera spp., nymphs	*Spirodela polhyrriza*	*Carex acuta*
	Ricciocarpus natans	*Potamogeton sp.*
Coleoptera spp., larvae and imagos	Unidentified monocotyledons	*Graminae sp.* *(Alopecurus sp.?)*
Hydrophyllidae spp.	dicotyledons	Unidentified seed *(Bidens sp.?)*
Anisoptera spp., nymphs		
Diptera spp., larvae		
Nematocera sp., imago		
Chironomidae spp., larvae		
Unidentified insects		
Annelidae sp.		

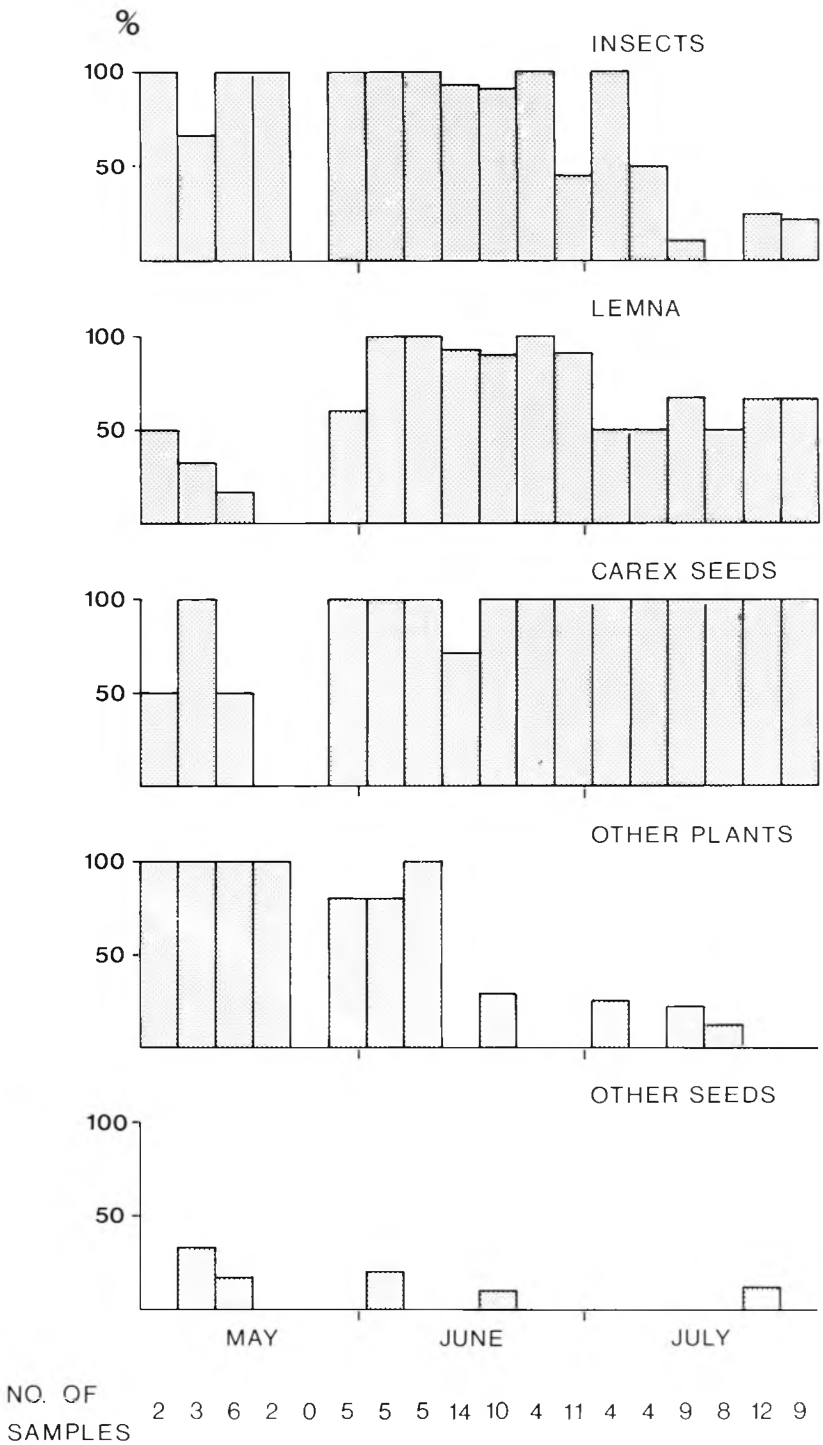

Figure 1. Frequency of occurrence of different food types in male Mallard faeces from May to July. Each column represents a five-day period.

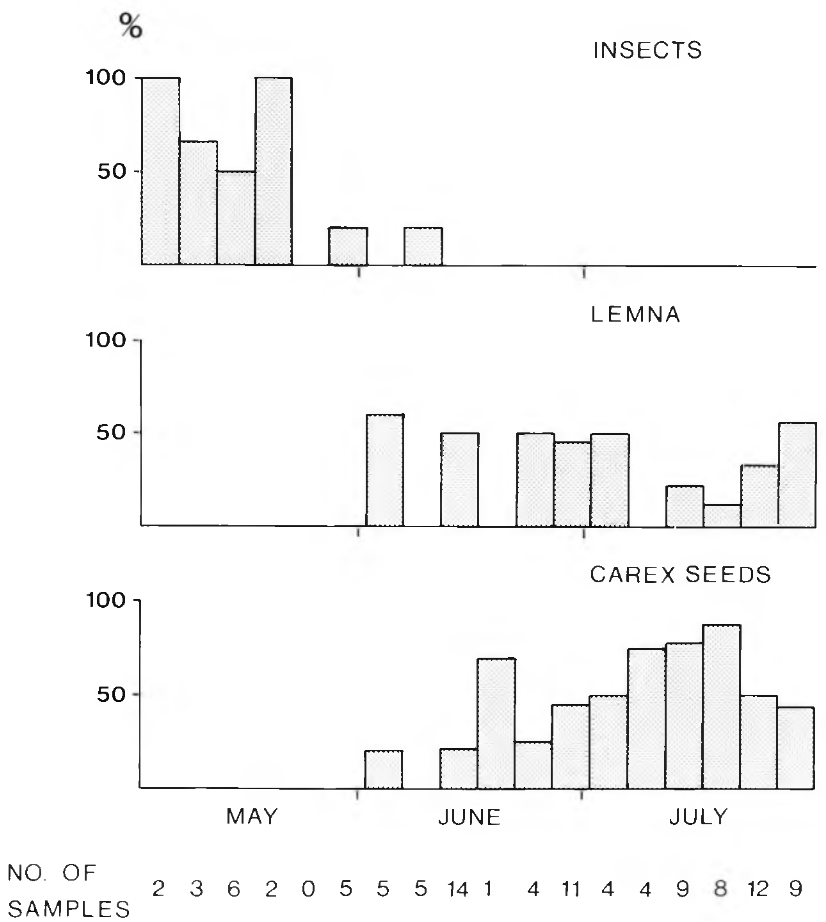

Figure 2. Frequency of dominance (i.e. >50% of sample volume) of different food types in male Mallard faeces from May to July. Each column represents a five-day period.

Table 3. Statistical analysis of frequencies of dominance (i.e. >50% of sample volume), of food types in male Mallard faeces. ns is p>0.05; Fisher exact test.

	May		June		July		May
Insects		p<0.001		ns		p<0.001	
Lemna		p<0.005		ns		p<0.001	
Carex seeds		p<0.005		p<0.005		p<0.001	

were found in five samples only. Table 2 shows more in detail what was found and identified.

Quantitative analysis

Out of the 113 samples 87 (77%) were estimated to have one food item providing for more than 50% of the volume. In nine of the 17 (53%) samples from May insects were dominant, but in only two of the 50 (4%) from June and in none from July (Figure 2, Table 3). *Lemna* never dominated in May but did so in several samples from June and July. Dominance of *Carex* seeds never occurred in May and significantly more often in July than in June. No sample had a dominance of "Other plants" or "Other seeds".

Diet variety

The variety of the diet was significantly less (X^2, p<0,001) in July than in May and June. The samples from May and June contained on an average 3,0 types of food, and those from July only 2,0.

Collected feathers

The number of collected wing feathers (i.e. primaries and secondaries) and the day they were found are shown in Table 4. The first wing feathers were found on 23 June and the last on 15 July. Apart from the 25 feathers collected from the three specific sites, 13 other wing feathers were found elsewhere in the lake. These were also found during the period 23 June – 15 July. Hence about 9% of the primaries and secondaries were found, that 10 drakes, moulting in the lake, could be expected to shed.

Seeds on the lake bottom

The number of *Carex* seeds in the upper three centimeters of the four Rzoska core-samples (123 cm^2), varied between 50 and 135, and there were on average 8434 seeds per square metre.

Discussion

Faecal analysis

One of the central problems when applying faecal analysis is the identification of the fragments in the faeces. Seeds are often ground into unrecognizable matter in the gizzard, but some seeds will pass intact which facilitates identification. The epidermal structures of seed-chaff fragments also give valuable information on their origin. Fragments of the chitinous parts of insects are found in the faeces, heads and legs sometimes being intact. There is a clear difference in particle size between different samples due to differences in digestive efficiency.

Invertebrates with only thin chitinous parts or lacking them completely may leave distinguishable traces in the faeces. In one sample remains of what clearly must have been an annelid was found. When working with frequencies of occurrence there is a possibility that harder food types get over-represented. Swanson and Bartonek (1970) have shown that different food types have different throughput rates. Easily digested material passes through very quickly, while hard seeds can remain in the gizzard for a long time. If these hard seeds leave the gizzard a little at a time, and the soft food passes all at once, there will evidently be a bias in frequency of occurrence in the faeces. Since the error will be constant, it will not affect the determination of successions in the feeding pattern.

The origin of samples in terms of sex and species may also be a problem when using faecal analysis. The habits of the ducks in the study area must be known, and it is highly desirable that droppings from different species can be distinguished. During the moult shed feathers on loafing sites are another source of information in this context.

The results of this study clearly show that faecal analysis can give information of food choice of Mallard. One could go further in accuracy and subdivide the food types into genera or species, but it is doubtful whether a detailed and accurate quantitative analysis is possible. Some quantitative analysing methods for obligate herbivores have been described (e.g. Owen 1975), but the varied diet of the Mallard makes these methods less applicable.

Holechek *et al* (1982) have reviewed the advantages and disadvantages of faecal analysis.

Table 4. Numbers of male Mallard wing feathers found on three specific sites in the study area, and day they were found.

Date	23/6	27/6	31/6	3/7	8/7	12/7	15/7
No.	3	2	1	0	8	6	5

Advantages of faecal analysis:
(1) The population is not reduced. (2) Disturbance of the birds is reduced to a minimum. (3) Field sampling is uncomplicated. (4) It is fairly easy to get a great number of samples. (5) Sampling is not dependent on hunting rights or hunting seasons.
Disadvantages of faecal analysis:
(1) The origin of samples may be uncertain regarding species, sex and age. (2) It cannot be determined exactly where the food was consumed. (3) Some food items may become unidentifiable. (4) Fragmentation during digestion differs between food types. (5) The method is fairly complicated and laborious.

In general faecal analysis can be a useful and valuable complement to analysis of viscera, and in some cases the only possible method.

Food choice

Several authors have discussed the food choice of Mallard, but since sampling usually has been restricted to the hunting season, very few studies cover May, June, and July. In his work from South Central Manitoba, Perret (1962) describes a successional pattern where the proportion of animal foods increases from May to July (but decreases again in August), a pattern reversed to that from Lake Dalkarlskärret. Dementiev and Gladkov (1952) and Bauer and Glutz (1968) describe a food succession more in line with the latter. Dementiev and Gladkov also state that Mallard live "almost exclusively on plant foods" during the moult. Sterbetz (1969) analysed 17 moulting Mallard from the Tisza basin in Hungary and concluded they preferred green plant matter.

In comparison with investigations from elsewhere, seeds from very few plant species were used by the Mallard in Lake Dalkarlskärret. This can be explained by the dominance of *Carex* in the lake and by the fact that most plant species did not have ripe seeds during the time of the study. Ripe *Carex* seeds were first found towards the end of June. That *Carex* seeds occurred in samples from May and June shows that the previous season's crop is still partly available for the ducks. That Mallard frequently sift bottom material in search for food is described by Tiussa (1966). Rzoska core-samples showed that there are on average about 8000 *Carex* seeds per square metre in the feeding areas of Lake Dalkarlskärret. Another indication of the Mallard's sifting of bottom material, is the fact that most of the plant matter from other genera than *Lemna* that occurred in the samples from May and June, resembled that found in bottom material, and had probably been swallowed in a search for seeds and insects.

Determination of the flightless period of the Mallard in a moulting area is rather difficult, since the first bird may shed its feathers weeks before the last one does. The result of the collecting of wing feathers (Table 4) indicates that this difference in time is about three weeks. There is some variation in the literature on the duration of the flightless period. Estimations vary between 24–26 days (Boyd 1961) and 28–37 days (Owen 1979). A very accurate determination of a moulting maximum based on the collection of feathers is not possible, but a safe assumption is that more male Mallard were incapable of flight in July than in June. A comparison between the results of the faecal analysis from June and July clearly shows a difference in both composition and variety. Perret (1962) states that changes in food habits of Mallard during the spring and summer are due to changes in relative availability of the foods. The fact that this study from Lake Dalkarlskärret shows a decrease in consumption of animal foods from May to July, the reverse of the situation described by Perret, supports this statement. The moult itself will surely affect food choice in at least one way, since it implies a limitation of movement, which can reduce the availability of some foods. The energy requirements and nutrient cost of moulting (Payne 1972; King 1974) may have implications on food choice. Some studies report a decrease in Mallard body weight during the moult (Folk *et al.* 1966; Owen & Cook 1977) whereas others do not (Young & Boag 1982). The latter study reported a decrease in protein reserve during the moult. They also reported that the male Mallard store lipid during the prebastic moult, a store that is partially lost during the flightless period. Ways in which these phenomena might affect the food choice in situations with nearly equal availability of different foods, or choice of moulting sites, must be further studied.

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Summary

Male Mallard *Anas platyrhynchos* droppings (113) collected during May, June and July, from a man-made lake in Sweden, were analysed. Faecal analysis was shown to be a useful method when determining food choice of Mallard.

Insects are the major source of food in May, *Lemna* in June, and *Carex* seeds in July. The diet variety was significantly less in July than in June. A determination of the flightless period was made based on collected wing feathers. There is a significant difference in food choice prior to the wing moult and during the flightless period. The food choice of male Mallard is probably mostly dependent on the relative availability of foods, but other factors like energy requirements and nutritional demands cannot be excluded.

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