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Food Selection in Geese

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Introduction

The aim of this paper is to summarise some of the work carried out on food selection in geese in recent years and to make suggestions for future work. The questions which will be examined are: do geese select, and if so what are the reasons for and mechanism of that selection?

The availability of food to geese is influenced by factors such as disturbance, tidal rhythms and distance from a safe roost and these must be taken into account when considering feeding area preferences. Two criteria of preference are used here:

1. Preferred foods are used first when a variety is on offer.
2. Preferred foods are used more intensively, i. e. the birds take a greater proportion of the available stock.

Do geese select?

White-fronted Geese *Anser albifrons* feeding on a salting pasture on which there were several distinguishable vegetation zones, showed preferences according to both the above criteria. The zones were used in sequence and those used first were also the ones where least vegetation was left after grazing by the geese. The preferences shown were not related either to distance from disturbance or to their closeness to the roost (OWEN 1971).

The proportions of different plant species eaten by geese on the same salting was determined by faecal analysis. This showed that the birds did not take the different species in proportion to their availability in the sward but consistently preferred some plants and rejected others (OWEN 1976).

Because of differences in growth forms of grasses, a grazing animal feeding from the surface will show preference almost unavoidably (Fig. 1). This may have accounted for some, but not all of the preferences demonstrated in White-fronted Geese.

In a simple choice experiment, captive Pink-footed *Anser brachrhynchus* and Barnacle Geese *Branta leucopsis* were presented with 8 species of dicotyledonous plants in two-species combinations. Their preference, measured on a simple 0-4 index, for each plant species in a total of 56 tests (OWEN and J. KEAR unpublished), is shown in Fig. 2. It

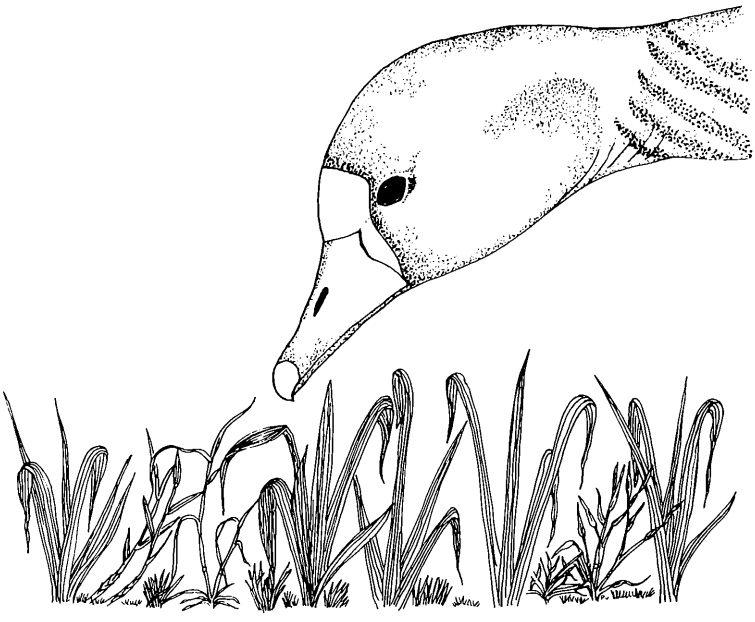

Fig. 1.
Different species of grass have different growth forms which makes some degree of selection by geese grazing from above unavoidable.

is evident that the order of preference is broadly similar in the two goose species. Because the plants presented were not the same as those naturally available or in the same stage of growth as they would be in field conditions, these preferences cannot be related to the wild situation. They simply illustrate that preferences can be demonstrated under experimental conditions as well as in the field. A similar test involving the presentation of 8 grass species also demonstrated preferences, though not to such a marked extent.

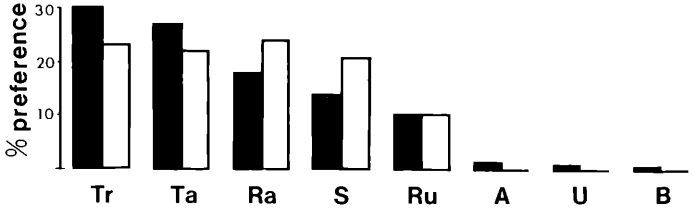

Fig. 2.
Preferences of captive Pink-footed Geese (shaded histograms) and Barnacle Geese (unshaded) for eight dicotyledonous plants. Tr - *Trifolium repens,* Ta - *Taraxacum officinale,* Ra - *Ranunculus repens,* S - *Stellaria media,* Ru - *Rumex acetosa,* A - *Allium* sp. (onion), U - *Urtica dioica,* B - *Brassica oleracea.*

The reasons for selection

The preferences of herbivorous animals have been shown to be related to the nutritive value of the foods (e. g. ARNOLD et al 1966) or to the animals'need for specific dietary components (e. g. MOSS 1972). Toxic or repellent elements in plants may also discourage animals to use them.

Repellent elements

Little is known about the effect of plant components on birds although it is known that domestic geese *Anser anser* are sensitive to the taste of certain substances and used this as a basis for their rejection (ENGELMANN 1960). Saltmarsh plants have a variable proportion of salt in their tissues (TYLER 1971) and since geese have actively to

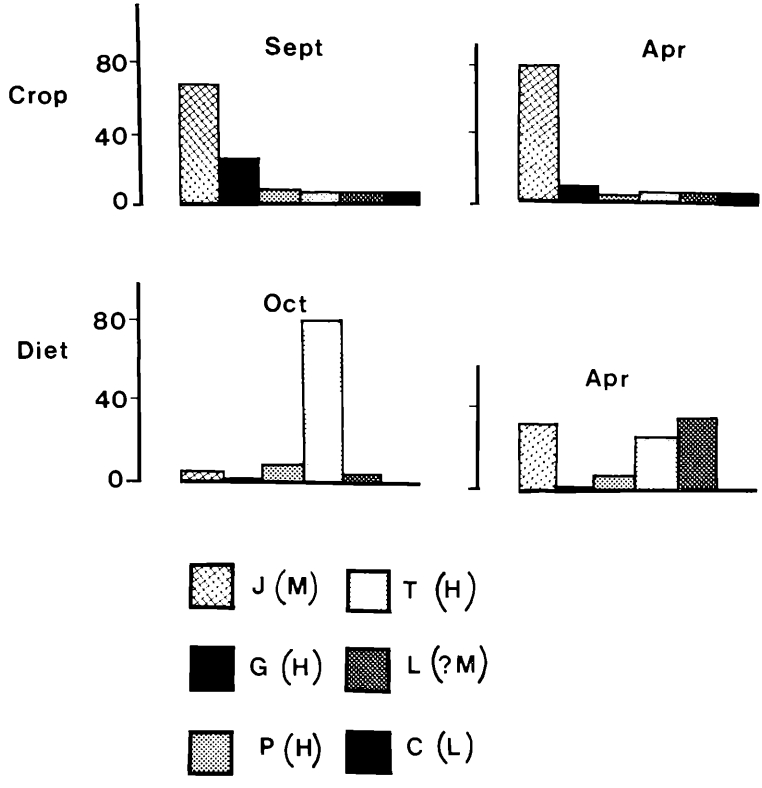

Fig. 3.
The selection of saltmarsh plants by wild Barnacle Geese in relation to the quantities available in autumn and spring. Species: J - *Juncus gerardii*, G - *Glaux maritima*, P - *Plantago maritima*, T - *Triglochin maritima*, L - *Leontodon autumnalis*, C - *Carex* spp. Letters in parantheses indicate levels of salt in plant tissues: L - Low, M - Medium, H - High.

excrete salt from the blood, salt content could provide a basis for the rejection of certain species. Fig. 3 shows the proportion of non-gramineous plants in the diet of saltmarsh-feeding Barnacle Geese compared to that available. Approximate salt levels (from TYLER 1971 or [?] assessed by tasting) are also given. Although the geese show definite preferences, these are not related to salt content. The highly saline *Triglochin maritima* is markedly selected in autumn, while *Carex* sp. with low salt content is avoided in both seasons.

Repellent elements may be important in other situations, for example an application of the commercial bird repellent anthaquinone caused captive geese to reject their favourite food (J. KEAR pers. comm.). Barnacle Geese in summer avoid completely several *Saxifraga* species although these are often the most abundant plants and are at an early stage of growth. Some element in the composition of the plants could be responsible for their rejection.

Net energy intake

Wild geese arrive at their wintering grounds in poor condition following breeding and autumn migration. They need to replenish body reserves and lay down fat in preparation for the winter. Most species at this time choose plant seeds and storage organs in preference to green vegetation, which is poorer in nutrients and less easily digestible. The Brent Goose *Branta bernicla* is one species which feeds on plant leaves throughout autumn and early winter and the sequence of use of various food sources is shown in Fig. 4 (data from CHARMAN in press).

Zostera forms the major part of the diet for the first three months after arrival, but as supplies become depleted, the birds move to the alga *Enteromorpha* and later to salt-

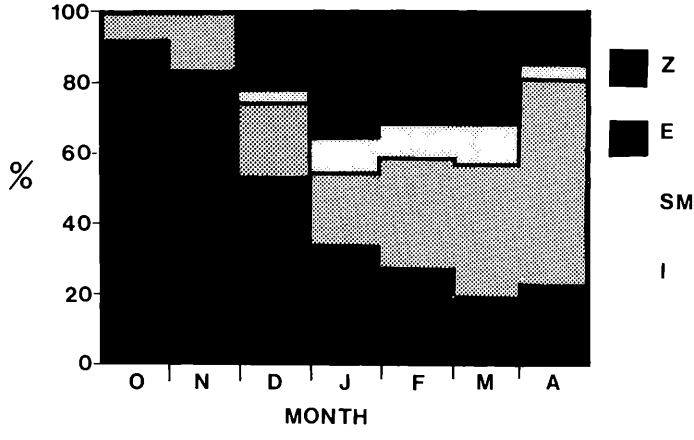

Fig. 4.
The sequence of use of four food sources by Brent Geese in Eastern England. Percentages calculated on the proportion of the total on each food source in frequent counts. Z - *Zostera* spp., E - *Enteromorpha* spp., SM - Saltmarsh, I - inland (mainly growing cereals). Original data from CHARMAN (in press).

marsh and inland fields. Differences in the net daily energy intake from the various food sources provide at least a partial explanation for their preference by the Brent.

Charman calculated the theoretical energy requirement for a bird of the size of the Brent (1.3 kg) and having assessed the bird's digestive efficiency of each food using digestibility markers, calculated the daily dry matter intake of each food required to satisfy the energy requirements. The values were: *Zostera* 88 gm, *Enteromorpha* 172 gm, Saltmarsh 75 gm and growing cereals 212 gm. Estimates of actual intake based on faecal output indicated that in the early part of two winters the geese ate respectively 235 % and 172 % of their requirement when feeding on *Zostera*. Actual intake of *Enteromorpha* was only 62 % of requirement. This was probably because its high water content restricted the dry matter intake (the birds have to ingest 14 gm. of the fresh alga to obtain 1 gm. dry wt. compared with only 4 gms of *Zostera*). There are no comparable estimates for cereals or saltmarsh but the large dry weight requirement on cereals could probably not be met in a short midwinter feeding day. The birds could probably fulfil their requirement on saltmarsh but most of the areas available are small and more likely to be disturbed, and this may discourage the geese.

Specific nutrients

The nitrogen (protein) content of plants determines the preferences of many herbivores. For example MILLER (1968) showed that hares, *Lepus timidus*, rabbits *Oryctolagus cuniculus* and Red Grouse *Lagopus lagopus* selected heather fertilised with nitrogen in winter. OWEN (1975) demonstrated that grassland fertilised with nitrogen was selected by White-fronted Geese. The fertilised areas were used first and their overall usage was 42 % greater than unfertilised plots.

Because of the difficulty of collecting the plant parts eaten by geese, it is extremely difficult to relate species preferences to nutritional characteristics in the field. In captivity handreared Barnacle Geese showed preferences for different plant species and nitrogen fertilised vegetation in choice experiments (OWEN et al 1977). The geese were presented with combinations of species, (or fertiliser treatments) sown in seed trays, in pairs and their preferences assessed by the number of pecks directed at each tray. The total pecks at 4 grass species and 4 fertiliser treatments are given in Fig. 5, together with the water and nitrogen content of the vegetation. The geese showed a high and significant degree of selection for *Festuca* and *Lolium* as against *Poa* and *Agrostis*, and similar preferences are shown by wild geese (OWEN 1976 and unpublished). Significant preferences were also shown for fertilised vegetation. There was a significant correlation between the water content and nitrogen content of the test vegetation but the degree of selection by the geese corresponded more closely with water than with nitrogen content. The correlations were similar for fertiliser tests but for the species, the correlation coefficient (r) was 0.97 for total pecks/water and 0.74 for pecks/N.

The fragmentation index (Fig. 5) is the percentage of fragments appearing in droppings which have a single surface intact and this is highly correlated with preference (r for N. experiment 0.995).

If the fragmentation index gives a good estimate of the proportion of the plant's protein available to geese, then the available protein can be plotted against preference (Fig. 6). This shows a very close correlation, (r 0.998) and suggests that the birds

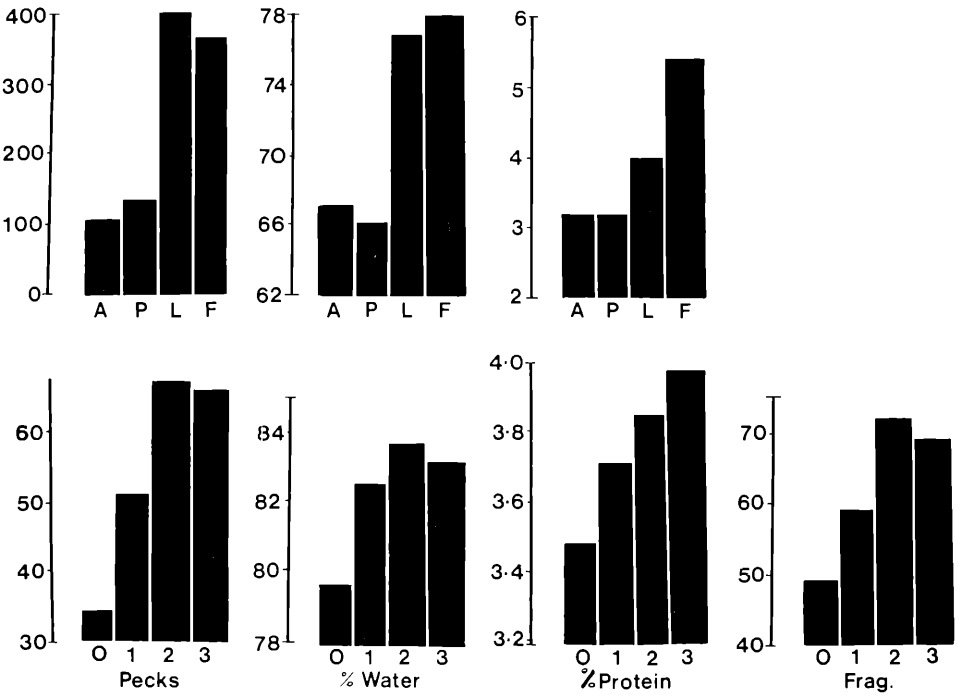

Fig. 5.

The selection of species and nitrogen fertilised vegetation by captive Barnacle Geese in choice experiments and some characteristics of the test vegetation. Species A - *Agrostis tenuis,* P - *Poa pratensis,* L - *Lolium perenne,* F - *Festuca rubra.*

Fertiliser treatments (on *Lolium* only) are equivalent to 0, 200, 400, and 600 Kg/ha. of Nitrochalk (25 % N). Frag. - Fragmentation index - the proportion of leaf fragments that appear in goose droppings with one surface intact (indicates the degree of mechanical breakdown in the gizzard). From OWEN et al 1977.

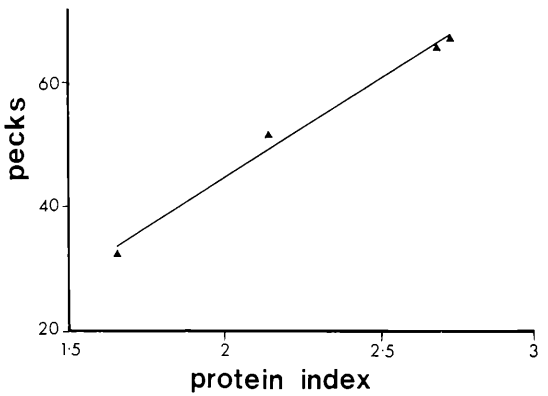

Fig. 6.

The relationship between an index of available protein (% protein in vegetation × % fragmentation) and the preferences of captive Barnacle Geese (r = 0.998). From OWEN et al 1977.

would obtain more protein by selecting for water content which is correlated closely with apparent digestibility than they would by selecting for protein itself. This would also hold for other plant nutrients, for example ARNOLD et al (1966) established significant relationships between protein and soluble carbohydrate content of diets and their digestibility to sheep.

The mechanism of selection

Geese undoubtedly visually distinguish between different types and different quality of food. Goose flocks usually alight on brighter green fields when given the choice and the degree of green-ness is related to the water and protein content of grass. However, in the experiment described above the young Barnacle Geese did not apparently select visually. The vegetation used first was not related to eventual preference as assessed by total pecks, although in both species and fertiliser experiments humans could easily distinguish between treatments.

Since it is possible that geese select vegetation on the basis of its water content, it may be possible for them to detect differences in water by mechanical means, using different degrees of pressure by the bill to ingest or reject vegetation encountered. This would allow the birds not only to select different species but also different plant parts or leaves at an earlier stage of growth without identifying them as such.

Future work

It has been established that wild geese show feeding preferences which are related to the nutritional characteristics of their food. They are also capable of selecting plant species from mixed swards on a very small scale and these preferences are related to water and nitrogen content, and probably to digestibility. The following experiments are needed to establish more firmly the reasons for and the mechanisms of selection.

1. Preferences should be related to the digestive efficiency of the birds on the various foods. This should be possible using digestibility markers as described by DRENT (this symposium). The digestibility should be related to fragmentation index. If there is a good correlation fragmentation index could be used as a simple means of assessing the digestibility of different species taken in complex mixtures or of monitoring temporal changes in digestibility.
2. Nitrogen and water content should be varied independently of one another to establish which characteristic is used as a clue by the geese. Mechanical properties of leaves of different protein and water content should be investigated in order to determine whether there is sufficient variability to enable birds to select on mechanical criteria.

Summary

This paper reviews recent work on food selection in geese. The birds have been shown to be capable of selecting feeding sites and of taking certain species preferentially from mixed swards.

The salt content of saltmarsh plants does not influence their selection by Barnacle Geese but repellent or toxic plant constituents may be important in some situations. Their ability to obtain their daily energy requirements from various food sources partly explains the feeding preferences of Brent Geese in winter. Geese prefer nitrogen-fertilised to unfertilised vegetation and experiments in captivity suggest that the birds are using water content, which is correlated with nitrogen content and probably with digestibility, as a clue in selection.

Future work should concentrate on relating preference to digestibility using markers, and on investigating possible relationships between the nutritive and mechanical properties of plants.

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