# Selection by Brent Geese *Branta bernicla* for different leaf lengths of *Aster tripolium* on saltmarsh

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*In early winter Brent Geese feeding on lower saltmarsh selected* Aster tripolium *leaves in the length classes 30-89 mm and especially 40-59 mm; i.e. in the mid-range of available sizes. Small leaves (mean size 25 mm) had proportionately more crude protein and water-soluble carbohydrates than large leaves (113 mm), and a lower ash, water and salt content. Thus, Brent Geese were not selecting the most nutritious leaves though they may have been selecting the mid-range to maximise the rate of intake of nutrients.*

Dark-bellied Brent Geese *Branta b. bernicla* frequently forage on saltmarsh outside the breeding season. Saltmarsh communities vary in species composition and sward structure, and Charman & Macey (1978) have shown that Brent Geese are selective about the plants that they eat there.

During growth, saltmarsh plants undergo changes in their nutrient composition partly through the mechanism of maintaining their osmotic balance in a salty environment (Stewart *et al.* 1979). Thus, it is likely that, within a given plant species, Brent Geese would obtain a different suite of nutrients depending on the size of leaf eaten. In autumn and early winter, when Brent Geese immigrate into Britain, the biomass of saltmarsh plants is large and in one species, *Aster tripolium*, a large range of leaf sizes is available. At this time *Aster tripolium* comprises a small proportion of the diet, before there is an extensive winter die-back of this and other species and a switch to feeding inland (Summers *et al.* in prep.). In this study, we examined nutrient differences in different leaf sizes of *Aster tripolium* and the extent to which Brent Geese select different sizes.

## Study area and methods

Saltmarshes can be divided into three zones, upper, middle and lower saltmarsh, with each zone having a different vegetation community, dominated by certain species (Burd 1989). This study concentrated on the lower saltmarsh which contains pioneer plants; *Salicornia europaea* agg., *Spartina anglica* and *Aster tripolium*. The study was carried out at Brancaster Marsh (grid ref. TF 804 453) on the north Norfolk coast during early winter.

Eighteen *Aster tripolium* plants were collected between 4 and 27 November 1987 and all 1305 leaves sorted into the following categories; fully grazed (stems only left), partially grazed and ungrazed. The widths of all leaf-stems were measured with dial callipers to 0.1 mm (Fig. 1). A sample of ungrazed leaves was collected in order to obtain the relationship between stem width and leaf length (Fig. 1).

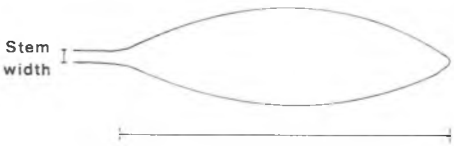


**Figure 1. An *Aster tripolium* leaf showing where length and stem width measurements were taken.**

In order to establish whether Brent Geese were selecting a particular size of leaf, the proportion of grazed leaves of a given size was compared with the proportion of all leaves of the same size, using the equation,

$$Q = (p\,(1 - r))/(r\,(1 - p))$$

where p is the proportion of grazed leaves and r is the proportions of all leaves (Jacobs 1974). Preference for a given length is shown where the selection Q is over 1, whereas values less than 1 indicate avoidance. The analysis was performed


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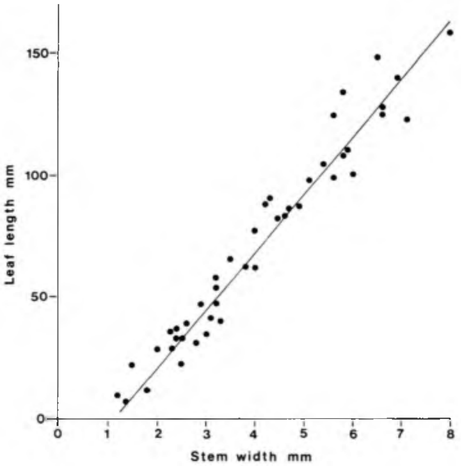


**Figure 2. The relationship between leaf length (mm) and stem width (mm) for *Aster tripolium* leaves.** The regression equation, y = 23.33 x - 23.67 is fitted (r = 0.97, $P<0.001$).

on 1305 leaf measurements.

Samples of leaves in different length categories were collected in late October and November, washed in fresh water, damp dried, weighed, and dried in a convection oven at 80°C to obtain the wet to dry ratio. The dried samples were then milled and analysed for MAD (modified acid detergent) fibre, water-soluble carbohydrates, crude protein (nitrogen x 6.25), lipid, sodium ions and chloride ions (MAFF 1986).

## Results

The relationship between stem width and leaf length was obtained from 45 leaves (Fig. 2). The regression equation was used to estimate the leaf lengths of grazed and ungrazed leaves (Fig. 3). The modal size of ungrazed leaves was 10-19 mm whereas it was 70-79 mm for partially grazed leaves and 40-49 for fully grazed leaves. The indices of selection show that Brent Geese pre-

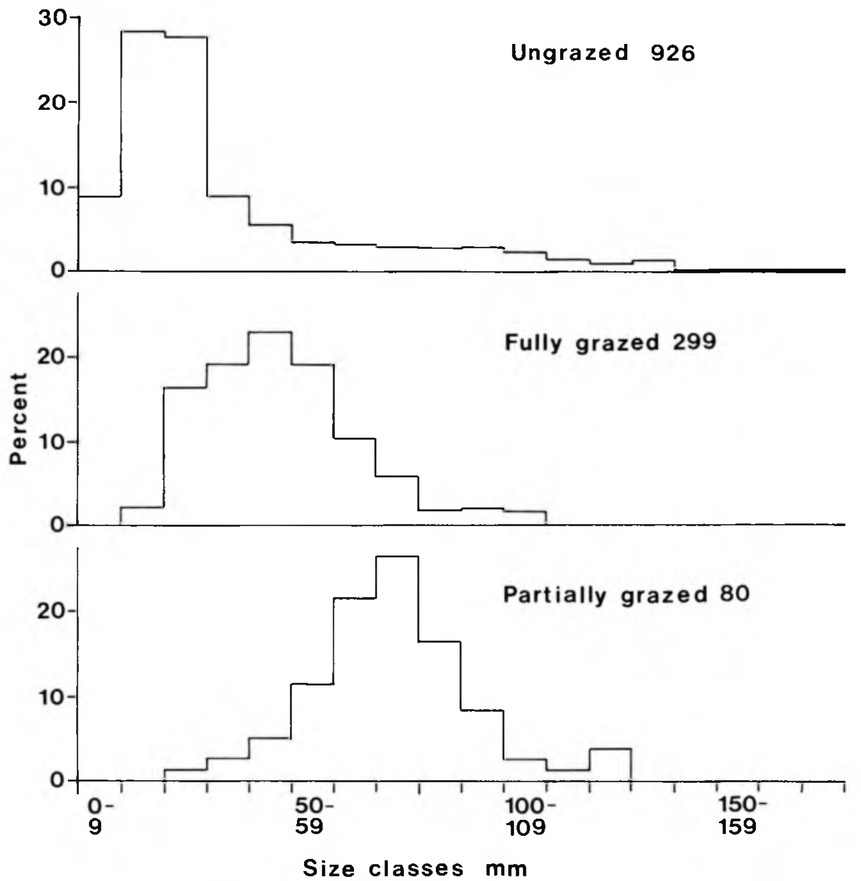


**Figure 3. Leaf length distributions for *Aster tripolium* leaves that were ungrazed, fully grazed and partially grazed by Brent Geese.**

**Table 1. Indices of selection for different length classes of *Aster tripolium* grazed by Brent Geese.**

| Length class (mm) | Selection indices: Grazed, partially or fully | Selection indices: Fully grazed |
|---|---|---|
| 0-9 | 0.0 | 0.0 |
| 10-19 | 0.1 | 0.1 |
| 20-29 | 0.5 | 0.6 |
| 30-39 | 1.5 | 1.9 |
| 40-49 | 2.3 | 2.9 |
| 50-59 | 2.6 | 2.9 |
| 60-69 | 2.3 | 1.8 |
| 70-79 | 2.1 | 1.2 |
| 80-89 | 1.5 | 0.5 |
| 90-99 | 1.1 | 0.6 |
| 100-109 | 0.9 | 0.8 |
| 110-119 | 0.2 | 0.0 |
| 120-129 | 1.0 | 0.0 |
| 130-139 | 0.0 | 0.0 |
| 140-149 | 0.0 | 0.0 |
| 150-159 | 0.0 | 0.0 |
| 160-169 | 0.0 | 0.0 |
| 170-179 | 0.0 | 0.0 |

ferred leaves within the range 30-89 mm, and especially those in the 40-59 mm range (Table 1).

A number of trends were found in the nutritional value of *Aster tripolium* leaves (Table 2). Large leaves tended to have proportionally less crude protein and water-soluble carbohydrates than small leaves, and they also contained more chloride ions showing they had a higher salt content. There was also an increase in water and ash content as the leaves increased in size.

## Discussion

The results showed that Brent Geese selected leaves in the mid-range found on *Aster tripolium* plants, and that they did not select the most nutritious leaves (the smallest). The smallest leaves occur at the base of the plant and are partly obscured by the larger leaves (Fig. 4).

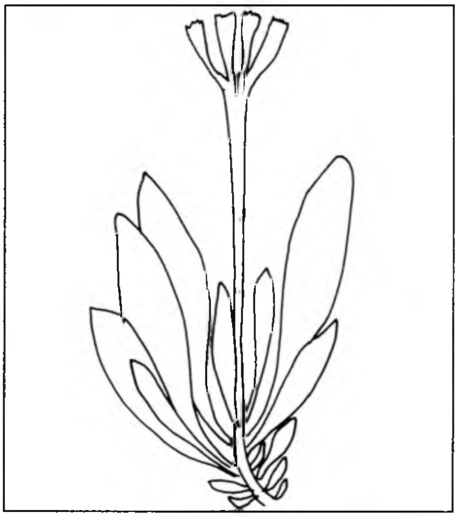

**Figure 4. Leaf positions of an *Aster tripolium* plant in the lower saltmarsh on Brancaster Marsh in early winter.**

**Table 2. Mean (±SD) measurements, nutrients and mineral content in *Aster tripolium* leaves of different sizes.** Sample sizes in brackets. Analyses of variance were performed on arcsine transformed values.

| | | Small | Medium | Large | F | *P* |
|---|---|---|---|---|---|---|
| Length | (mm) | 25.3 ± 7.9 (70) | 43.2 ± 9.7 (24) | 113 ± 25.1 (50) | | |
| Dry matter | (%) | 11.6 ± 1.2 (5) | 10.6 ± 0.4 (5) | 7.7 ± 0.5 (6) | 38.9 | <0.001 |
| Ash | (%DM) | 22.2 ± 5.2 (2) | 29.4 ± 3.6 (5) | 41.5 ± 12.7 (8) | 4.2 | <0.05 |
| MAD fibre | (%DM) | 10.7 ± 0.8 (3) | 10.3 ± 1.1 (5) | 10.1 ± 0.5 (8) | 0.6 | NS |
| Crude protein | (%DM) | 17.8 ± 3.1 (3) | 14.4 ± 1.2 (5) | 12.4 ± 1.3 (8) | 11.7 | <0.001 |
| WSC | (%DM) | 28.2 ± 1.0 (3) | 15.9 ± 4.3 (5) | 4.9 ± 1.9 (7) | 74.6 | <0.001 |
| Lipid | (%DM) | 2.7 (1) | 3.3 ± 0.2 (5) | 3.2 ± 0.3 (5) | 2.2 | NS |
| Chloride | (%DM) | 7.9 (1) | 15.0 ± 2.2 (5) | 22.6 ± 2.4 (5) | 23.6 | <0.001 |
| Sodium | (%DM) | 4.6 (1) | 8.4 ± 2.2 (5) | 9.1 ± 4.4 (5) | 0.7 | NS |

Therefore, by selecting the medium-sized leaves, Brent Geese were probably maximising their nutrient intake rate. A study of intake rates would show which are the most profitable leaves to graze.

Some leaves were only partially grazed; these were larger than those which were fully grazed (Fig. 3) and therefore may have been leaves that birds subsequently rejected because of their poorer nutritional value or higher salt content.

*Nutrient analyses were carried out by the Dept. of Nutrition Chemistry, MAFF, Cambridge. The drafts were commented upon by Drs C. Fairbairn and C.J. Feare.*

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