

Diurnal and tidal behaviour patterns of Eiders wintering at Leith

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Tidal and diurnal patterns of distribution and feeding behaviour have been described for the Eider *Somateria mollissima* by several workers. In the Ythan and Tay estuaries in eastern Scotland the tide was considered to be the dominant factor (Gorman 1970, Milne 1974, Pounder 1971) whereas in Norway (Pethon 1967) and western Scotland (Dunthorne 1971) diurnal routines were more evident. Player (1971) suggested that the feeding cycle of a flock at Leith, near Edinburgh, was influenced by both factors. This paper describes further investigations at Leith carried out during 1975–1976 and 1976–1977.

The study area (Figure 1) was centred on a dense bed of mussels *Mytilus edulis* on a rocky outcrop (the Middle Craigs) off Leith Docks. At extreme low spring tides the whole rocky area was exposed, revealing a complex of rocky ridges, channels and pools. At low neap tides, or in stormy weather, little or no rock was uncovered. The surrounding

substrate was soft mud or mud and stones.

Up to 1972–1973 the Middle Craigs were the main feeding ground for a population of 2,000–3,000 Eiders wintering off Edinburgh, but in recent winters total numbers have increased to around 4,000 and additional feeding areas have been exploited to the east of Musselburgh (Campbell 1978 and unpubl.). Peak numbers recorded off Leith during the two winters of this study were 1759 and 1764. Numbers were highest in the first part of the winter.

All observations were made from standard observation points (Figure 1) using a telescope on a tripod. Watches were carried out during the day to quantify feeding behaviour. Systematic scans were made of the study area, each eider or group of eiders being watched for 10 seconds and classed as feeding or non-feeding. Counts of total numbers present were made at the start and end of each scan.

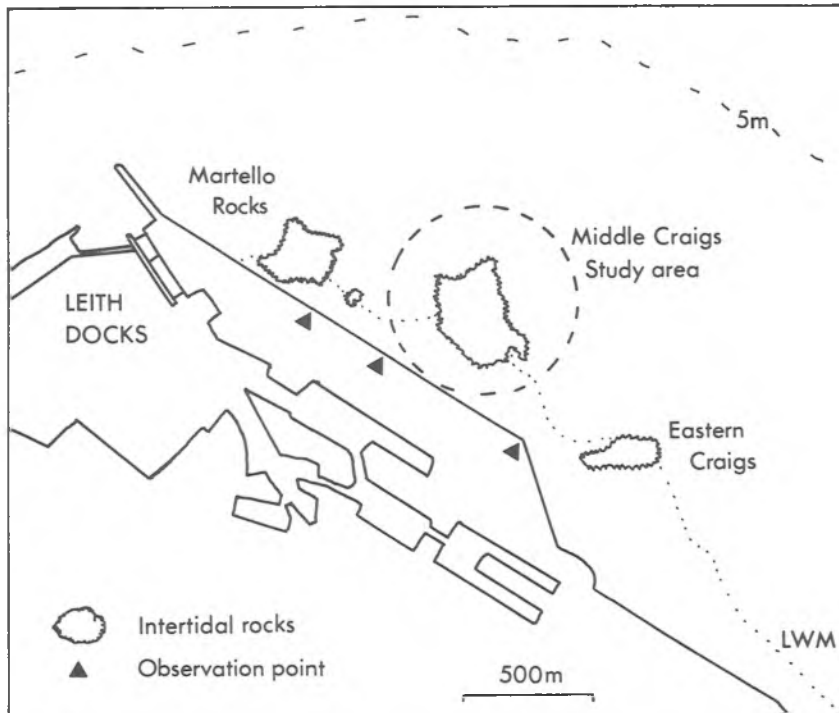


Figure 1. Leith Docks study area.

Daily activity

The basic routine was similar to that briefly described by Player (1971). Eiders flighted into the area at dawn from the north or north-east and moved away east again during the course of the day towards dusk. The pattern of the dawn influx is shown in Figure 2, the first birds arriving 25–30 minutes before dawn and the majority being present at sunrise.

The size of the dawn influx was dependent on the state of the tide at sunrise. 92 counts, carried out during the hour following sunrise, were made and the results are shown in Figure 3. The state of the tide at sunrise has been expressed as hours after the preceding high tide. Despite considerable variability a clear trend was evident, numbers being highest when sunrise coincided with the last stages of the ebbing tide and lowest on a flooding tide.

The subsequent pattern of numbers throughout the day, recorded during 9 watches in 1976–1977, is shown in Figure 4a. Generally numbers declined throughout the day, the pattern of the fall being influenced by the tide. With high tide in the middle of the day, numbers either remained

fairly stable until a rapid fall towards dusk, or fell steadily all day. When low tide was around dawn and peak numbers were present there was a rapid fall after low tide, few remaining in the area by midday. With low tide later in the day numbers stayed relatively high until after low tide when they fell rapidly or more gradually towards sunset.

Dawn and dusk peaks on 15th February 1977 were brought about by the atypical movement of a large group of birds westwards from the study area to feed around the Martello Rocks (Figure 1) whence they returned to feed on the ebbing tide at sunset, moving eastwards after it became too dark to continue counting.

The fall in numbers during the morning was mainly brought about by birds flighting away to the east, but as the day progressed passive drifting with the tide or more active swimming eastwards became dominant. Movements at dusk were preceded by the formation of conspicuous dense rafts along the offshore edge of the Middle Craigs. These flocks swam straight offshore for several hundred metres, often in long sinuous lines, before veering away to the east. The pattern of numbers is summarised in Table 1.

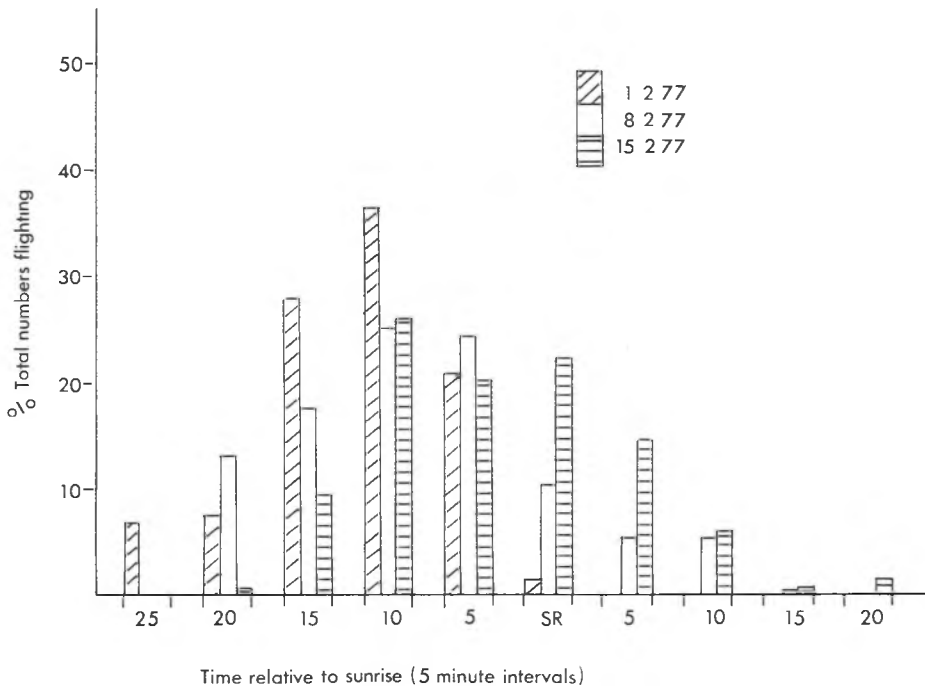


Figure 2. Pattern of flighting of Eiders into the Leith area at dawn.

Feeding behaviour

Three feeding techniques were observed. Dabbling, including up-ending and crater-feeding as described by Player (1971), occurred mainly on the ebb and at low tide, when areas of mussel-bed were exposed. Diving occurred throughout the tidal cycle but least frequently around low tide. The third technique, subsequently referred to as raft-feeding, involved high intensity syn-

chronised or progressive diving amongst tight rafts of Eider. This occurred in late afternoon and at dusk, preceding the departure of the flock from the study area. The only exception was a 3-minute burst of activity around midday on 1st February 1977 involving a small part of the flock which then moved away from the area.

The occurrence of these techniques during 9 watches is indicated in Figure 4b.

Table 1. Daily pattern of numbers of Eider at the Middle Craigs.

Tide/time of day	Initial numbers	Subsequent pattern
Low at dawn	High	Rapid decline
Low at midday	Moderate	Relatively stable, decline after low tide
High at midday	Low	Steady fall, or stable with rapid fall at dusk

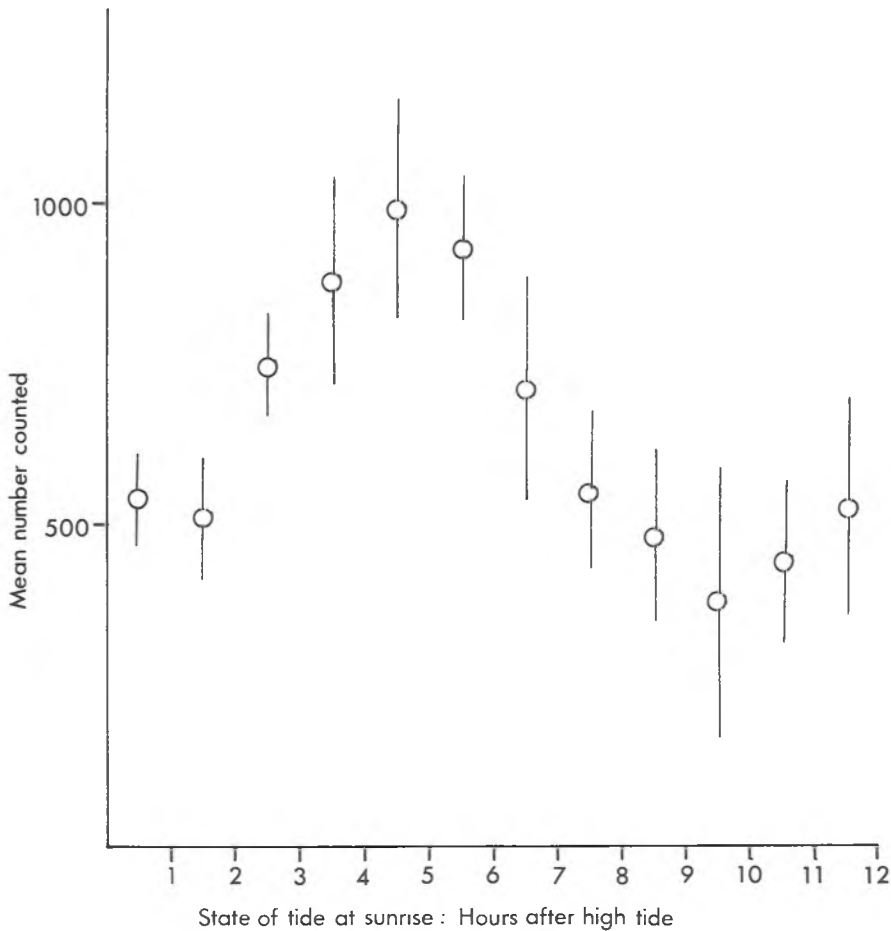


Figure 3. Pattern of numbers of Eiders in the Leith area around dawn. Means and 2 x S.E. bars are shown.

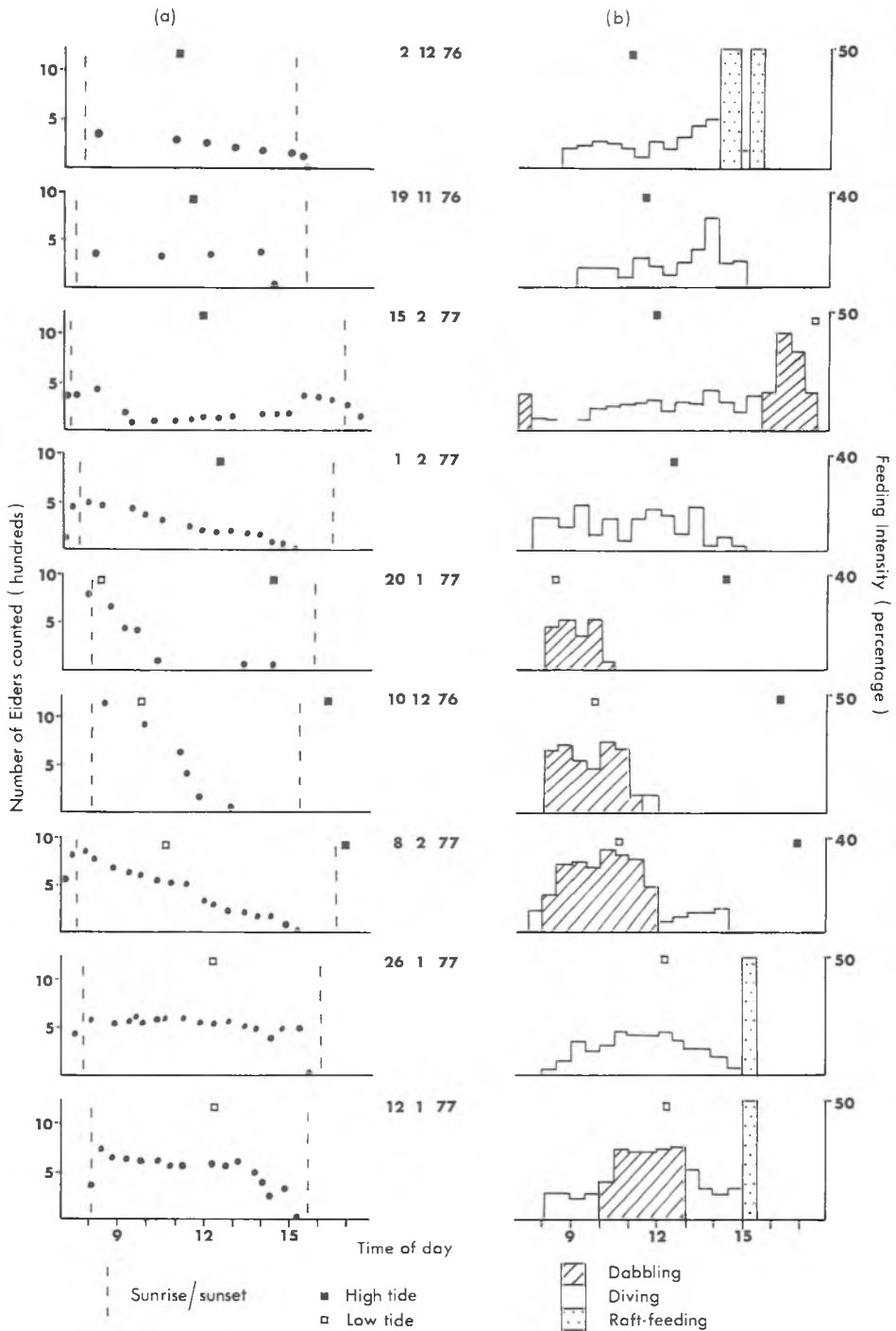


Figure 4. (a) Daily pattern of numbers. (b) Daily pattern of feeding intensity.

Excluding raft-feeding, more than 56% of observed feeding activity involved diving. Crater-feeding was infrequent and involved only small numbers at the lowest states of the tide.

Depending on the size of the flock present, up to 5 scans were carried out every 30 minutes during each watch. Feeding intensity was calculated by expressing the total number recorded as feeding each half hour as a percentage of the sum of the total number estimated to be present during each scan in that period. No allowance was made for any underestimation of numbers feeding by diving arising from birds being submerged when scans were in progress, but this would be partly compensated for by an equivalent underestimation of total numbers present.

It was not possible to quantify raft-feeding in this way and it was considered conventionally as at the 50% intensity level, although the true value was certainly always greater than this.

Patterns of feeding intensity are shown in Figure 4b. Although poor light prevented the collection of quantitative data around dawn, there did not appear to be any major activity distinct from that subsequently noted. In fact, when only a small part of the rocky area was exposed at dawn, many of the incoming birds came straight in to land on or near the rocks to bathe and preen and did not start to feed until later.

Peaks in feeding intensity were evident on the ebb and around low tide and also, regardless of the tide, towards dusk. Although not shown in Figure 4b, since less than 100 Eiders were present, raft-feeding was also observed late in the afternoon on both 20th January and 8th February 1977.

Behaviour of flocks outwith the study area

As shown by Campbell (1978 and unpubl.) the rest of the wintering population was concentrated off Joppa and Musselburgh and birds that flighted east from Leith were seen to join those eastern flocks. Short watches were carried out and, although flocks of several 100's regularly fed on the musselbeds at the mouth of the Esk at Musselburgh around low tide, the majority appeared to feed by diving in shallow waters offshore. Raft-feeding was observed on two occasions at dusk. Movements of large numbers offshore at dusk and inshore again at dawn were detected on 6 occasions, the predominant direction being along a line running north to north-west of Musselburgh. Some were estimated to have flown at least 4 km offshore before disappearing from sight.

Discussion

The main pattern of behaviour was a diurnal one. Eiders moving at dawn and dusk between separate areas used by day and at night. This was modified by a tidal effect which determined to where the birds first flighted, greater numbers going to Leith when the tide was ebbing around dawn. Daytime feeding activity was influenced by both factors, with peak intensities at low tide or towards dusk. The dusk activity peak and the dawn element in the attraction of birds to Leith were indications that the Eiders did not feed at night.

Player (1971) showed that mussels were the main items in the diet of the Eiders at Leith and the attraction of birds into this area was clearly related to exposure of the musselbeds on the ebbing tide, when conditions were suitable for feeding by up-ending and dabbling. This attraction appeared to operate only around dawn, a normal fighting period for the Eiders, and it seemed that once they had reached alternative daytime areas there was no advantage in subsequently moving to Leith when low tide occurred later in the day. Indeed once they had fed around low tide at Leith many flighted eastwards, suggesting a preference for these other areas later in the day or at other states of the tide. Thus the attraction to the Leith area appeared to involve only a redirection of dawn fighting and not any major change in the basic diurnal routine.

Direct comparisons with Player's study are complicated by the changes that have occurred in overall patterns of distribution, but the Middle Craigs were obviously of greater overall importance up to 1973. However the data on feeding intensity shown by Player are broadly consistent with those given above. The existence of tidal routines in the Ythan and Tay estuaries would appear to be the product of the specialised hydrological characteristics of confined estuarine areas, since tidal amplitudes at these are similar to those within the Forth. Diurnal routines appear to be the general rule for most wildfowl, day or night feeding being influenced by factors such as disturbance, predation and the type of food (Nilsson 1970; Tamisier 1974). Whilst tidal differences in the relative availability of food during the day are probably insufficient to alter the basic diurnal routine in open marine sites, the more extreme conditions within estuaries may make it difficult for feeding except at certain states of the tide so that diurnal routines become replaced by tidal ones.

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Summary

Patterns of behaviour of a flock of Eiders

Somateria mollissima wintering at Leith, near Edinburgh, are described. Birds moved into the area at dawn and away again before dusk, the size of the dawn influx being influenced by the state of the tide at sunrise. Peak feeding intensities were recorded around low tide or towards dusk. It is suggested that Eiders only show marked tidal activity patterns in confined estuarine areas where hydrological conditions prevent the maintenance of a diurnal routine.

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Dark bellied Brent Geese *Branta b. bernicla* feeding on a grass field in Essex. (Philippa Scott)

