

Local variations in the proportion of adult males in flocks of Goldeneye wintering in the Firth of Forth

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Regional and seasonal variations in the sex ratio of Goldeneye *Bucephala clangula* wintering in north-western Europe have been described by Nilsson (1969, 1970) indicating differential migration of the sexes, probably in response to climatic factors. However he also recorded considerable local variability in Sweden and this was also evident during a recent survey of seaducks wintering off the east coast of Scotland (Milne and Campbell 1973). For example, flocks at Invergordon in the Cromarty Firth held less than 20% adult males while at Peterhead there were over 45%. Similar variability has been described by Pounder (1976). This paper describes the results of an investigation into flock composition at a number of adjacent sites in the Firth of Forth.

Study area and methods

The area selected was the coastline between Cramond and Port Seton (Figure 1) where four flocks of Goldeneye regularly occur each winter at four sewer outfalls: West Granton, Leith sewers, Seafield, and Levenhall. Additional flocks occur off the mouths of the Almond (at Cramond) and the Esk (at Musselburgh).

Regular visits were made to the area from the beginning of November 1975 to the end of February 1976. Because of the difficulties of identification no attempts were made to distinguish between immature males and females. The proportion of adult males (percentage of total numbers counted) was regularly recorded at three of the main outfalls. At the fourth, Seafield, it was not possible to obtain regular reliable counts because of the greater distance offshore of the flocks and their frequent mixing with more numerous Scaup *Aythya marila*. However, estimates of the proportion of adult males were made whenever possible.

Occasional counts were made at other parts of the study area and short watches, mainly at dawn and dusk, were carried out to detect any major flightlines within the area.

Numbers

A maximum of 2,919 were recorded during the study period and at least 50% of these were concentrated around Seafield sewer. Flocks in excess of 100 were regular at the other outfalls but more irregular elsewhere. Mean numbers recorded each month at the

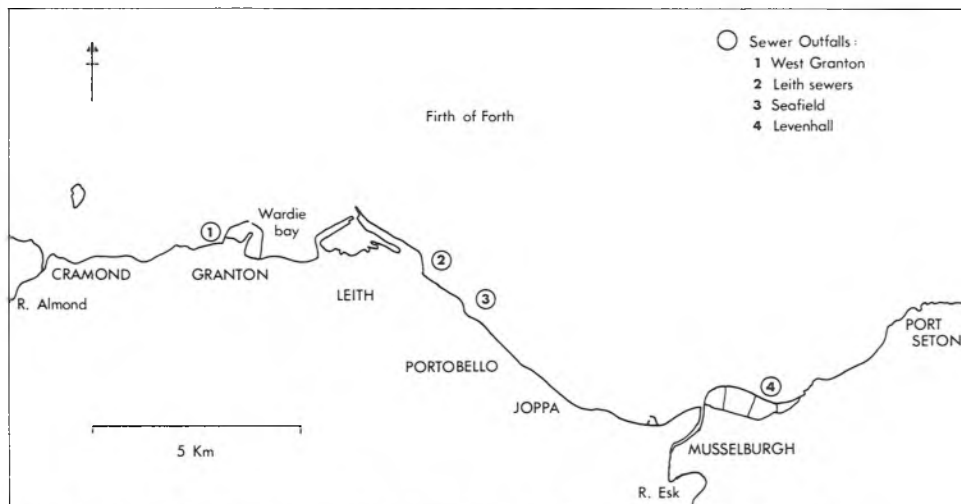


Figure 1. Map of the coastline between Cramond and Port Seton in the Firth of Forth.

four outfalls are shown in Table 1. Numbers built up to a peak in January at each outfall. At Leith and Seafeld numbers fell considerably in February, but remained high at both West Granton and Levenhall.

The proportion of adult males in flocks

The proportion of adult males recorded throughout the period at the three outfalls is shown in Figure 2. While irregular variations were evident at each, the proportions remained very constant over the period as a whole. There were distinct differences between the three outfalls.

In Table 2 overall percentages and the ranges of percentage values of adult males

recorded are shown for the three outfalls and various other locations. In terms of both overall and range percentages there appeared to be three groups of Goldeneye: a predominantly male group to the west at Cramond, West Granton and Wardie bay; a female/immature dominated group at Leith and Seafeld; and a more evenly mixed group to the east at Levenhall. Musselburgh was the only location where the range of percentages recorded overlapped with those of both male and female/immature dominated groups.

While no regular data were collected during previous winters, overall percentages appeared to be similar (Table 3).

Table 1. Mean numbers of Goldeneye counted at four sewer outfalls.

Outfall	November 1975	December 1975	January 1976	February 1976
West Granton	286 (6)	300 (6)	361 (5)	334 (4)
Leith	168 (4)	190 (5)	325 (8)	180 (6)
Seafeld	731 (3)	526 (3)	1029 (4)	558 (3)
Levenhall	104 (2)	126 (3)	156 (6)	150 (5)

(Number of counts are shown in brackets).

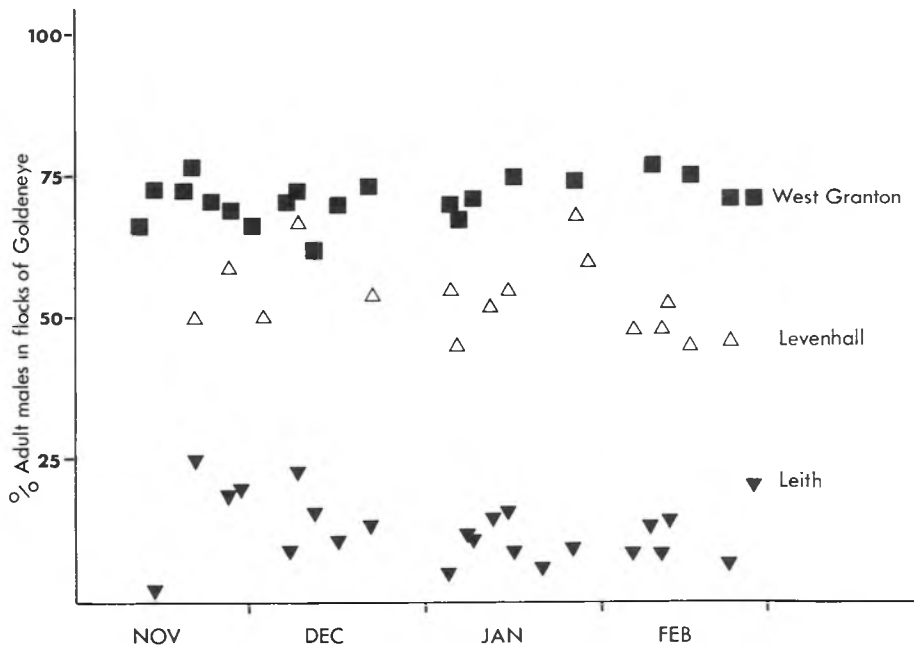


Figure 2. Percentage of adult males in flocks of Goldeneye at three sewer outfalls from November 1975 to February 1976.

Table 2. Overall and range percentages of adult male Goldeneye recorded at various locations.

Location	Overall percentage of adult males	Range	Sample size
Cramond	63.5	53.5–87.0	6
West Granton	70.8	61.4–77.4	21
Wardie bay	53.7	42.7–75.0	15
Leith sewers	14.2	2.4–25.2	23
Seafield	35.2	32.9–36.8	2
Seafield (estimates)	—	20–40	6
Musselburgh	34.3	16.7–60.4	9
Levenhall	51.4	44.5–67.7	16
Dusk flight from Leith and Seafield	20.4	10.4–25.5	7

Table 3. Percentages of adult male Goldeneye in flocks in previous winters.

Location	Winter	Overall percentage of adult males	Total numbers in samples counted
West Granton	1974–1975	65.9	870
Leith Sewers	1974–1975	19.6	1802
Leith and Seafield	1971–1973	30.3	4174

Flight routines

When undisturbed during the day the flocks spent most of the time feeding or resting within the general area of the sewer outfalls. Three regular dawn and dusk flight movements of ducks moving to and from the feeding grounds were recorded. Those at West Granton flew west to roost off Cramond, while the large flocks concentrated at Leith and Seafield moved east to roost, in particular, off Portobello and Joppa. The Levenhall flock roosted in the Musselburgh area.

If disturbed by day, the Goldeneye tended to follow the same dusk flightlines.

Small scale tidal movements were also noted. At the mouths of the Esk and Almond Goldeneye from adjacent sewers (Levenhall and West Granton respectively) tended to move in at high tide and on extreme low tides at Leith very few were present, flocks then being centred on Seafield.

Discussion

In terms of both the proportion of adult males and the flight routines recorded, there appeared to be three relatively discrete groups of Goldeneye within the study area. Only at Musselburgh was there any obvious overlap between groups. In addition, within the female/immature dominated group at Leith and Seafield it was evident that there was further differential usage. The overall

percentage of adult males for the two locations as a whole, based on dusk fighting data, was 20.4, but for Leith alone was only 14.2%. ($\chi^2 = 26.1$, $p < 0.001$).

Adult male percentage values for the study area as a whole, calculated using the values in Table 2 and the numbers on the day of the peak count (26.1.76) were 39.9% (using separate Leith and Seafield values) or 32.8% (using the dusk fighting values for Leith and Seafield combined).

The significance of such differential usage of adjacent feeding areas is obscure. Pounder (1976) has argued that it may indicate differences in male and female feeding habits, but Campbell and Milne (1977), studying a small flock at Peterhead, found no evidence of any differences between the sexes in feeding and distribution patterns, although feeding was concentrated around an outfall at dawn and dusk. Thus, while the attraction of greater numbers of Goldeneye as a whole to Leith and Seafield may be related to the enhanced feeding conditions which seem most marked around these sewers, sex and age differences in exploitation may well be controlled by other parameters.

If, as Nilsson (*loc. cit.*) has indicated, climatic factors are important in influencing the distribution of females and immatures on a regional basis, local variations in climate may be important in determining local flock composition. In the present context, while temperature is unlikely to differ greatly

between adjacent sites, the degree of shelter from predominant westerly winds obviously varies. Although detailed data are not available, it is clear that flocks lying off Leith and Seafield will be more protected by land from the westerly winds than either West Granton or Levenhall.

Thus sex and age differences in local distribution may merely reflect differences in the balance of importance of a number of parameters. While shelter may be the dominant factor influencing females and immatures, other factors, such as disturbance levels, may be of greater importance for the larger males.

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Summary

Variation in the percentages of adult males in flocks of Goldeneye *Bucephala clangula* wintering between Cramond and Port Seton in 1975–1976 are described. Overall percentages at three sewer outfalls were: 70.8, 51.4 and 14.2, values at neighbouring locations falling within this range. In terms of both adult male percentages and flighting behaviour, there appeared to be three discrete groups present, the lowest percentage being in the area most sheltered from predominant westerly winds. It is suggested that sex and age differences in local distribution reflect differences in tolerance towards factors such as shelter and disturbance, females and immatures being more susceptible to differences in the degree of shelter.

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Two male Goldeneye *Bucephala clangula* performing their Bowsprit display. (Joe B. Blossom).

