# Wintering seaducks in the Moray and Dornoch Firths, Scotland

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## Introduction

In comparison with freshwater and estuarine ducks, which are the subject of an annual monitoring programme (Atkinson-Willes 1970, 1976), relatively little is known about the total populations and wintering areas of seaducks in Great Britain. The particular problems of counting such species mean that in many areas they require special coverage. Milne & Campbell (1973) and Atkinson-Willes (1978), and counts between 1960 and 1977 by R. H. Dennis (pers. com.), suggested that the Moray Firth had become one of the most important wintering areas in Britain for seaducks. Following pilot studies by staff of the Royal Society for the Protection of Birds (R.S.P.B.) this area was closely examined in the winters of 1977–1978 (G.P.M.) and 1978–1979 (D.S.A.), and this paper summarizes the results.

The surveys were stimulated by the potential threat to the wintering and moulting populations of seaducks from oil pollution (Dunnet 1974; Joensen 1978) especially in view of developments in the North Sea, and particularly in the Moray Firth itself. It is important for conservation purposes to have reliable information on their use of the Firth.

The main objectives were to obtain baseline information on the numbers and distribution of seaducks in the Moray and Dornoch Firths; to investigate seasonal and weather-induced changes; and to study movements and general behaviour. The principal species involved were Eider *Somateria mollissima*, Common Scoter *Melanitta nigra*, Velvet scoter *M. fusca*, Long-tailed Duck *Clangula hyemalis*, Scaup *Aythya marila*, Goldeneye *Bucephala clangula*, and Red-breasted Merganser *Mergus serrator*.

## Study area and methods

The study area is shown in Figure 1, and stretched from Kintradwell in the north round to Portgordon in the east. Most of the shorelines are sandy, though rock occurs between Portmahomack and Rosemarkie, and between Burghead and Lossiemouth. The area forms a natural unit for the seaducks. To the north of Kintradwell the coast becomes precipitous without sandy bays, and generally unsuitable for seaducks. Similarly to the east of Portgordon the coast becomes rocky, and only scattered seaducks occur.

In 1977–1978 (late November to the end of March) attention was focussed on stretches of coast facing the open sea. Few visits were made to the sheltered inner firths (the inner Dornoch Firth, Cromarty Firth, inner Moray Firth, and Beauly Firth) except for coverage of sewage outfalls. Five priority seaduck sites were identified: Kintradwell to Dornoch; Cromarty—Rosemarkie—Nairn; Culbin and Nairn Bars; Burghead Bay; and Spey Bay; and these were the focus of a streamlined study in 1978–1979 (December to February).

Details of the methods used are given in Mudge (1978) and Allen (1979). Land-based counts were made from standard count points, using a zoom telescope. Such counts were strongly influenced by weather conditions, and had to be carried out on an opportunistic basis. Three aerial surveys (14 January and 19 February 1978, and 9 February 1979) were made in a two-seater, single-engine Cessna. Their main function was to assess the reliability of land-based coverage. They revealed that, with one exception, all seaduck flocks were located in areas that could be readily viewed from the land. The exception was an extensive area of shallow water between Cromarty, Rosemarkie and Nairn. This held large numbers of feeding Long-tailed Ducks and a few Common Scoters, which could usually only be seen from the land under flat calm conditions and in good light. Even then accurate counts were difficult. These Long-tailed Ducks were best counted as they flew to their night roost in Burghead Bay.

The count data for each species are presented in two ways (Table 1): a peak winter count and a winter bird usage figure. Bird usage was calculated for each area from straight line graphs of the original counts. The number on the graph at the median date between each pair of counts



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**Table 1. Summary of the numbers of seaducks at sites in the Moray and Dornoch Firths, winters of 1977–1978 and 1978–1979.**

| Area | | Scaup | | Eider | | Common Scoter | | Velvet Scoter | | Long-tailed Duck | | Goldeneye | | Red-breasted Merganser | | Total seaducks /day | % of total seaducks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 77–8 | 78–9 | 77–8 | 78–9 | 77–8 | 78–9 | 77–8 | 78–9 | 77–8 | 78–9 | 77–8 | 78–9 | 77–8 | 78–9 | | |
| Kintradwell to | Usage | 0·2 | — | 967 | 1,194 | 579 | 322 | 83 | — | 464 | 357 | — | — | 284 | 38 | 2,393 | 12·1 |
| Dornoch | Peak | 1 | 2 | 1,456 | 1,645 | 670 | 637 | 125 | — | 1,625 | 560 | 35 | 21 | 530 | 100 | | |
| Edderton | Usage | 139 | — | 0 | — | 0 | — | 0 | — | 0 | — | — | — | 0 | — | 139 | 0·7 |
| Bay | Peak | 350 | — | 0 | — | 0 | — | 0 | — | 0 | — | 0 | — | 0 | — | | |
| Dornoch to | Usage | 0 | — | 127 | — | 2 | — | 3 | — | 9 | — | — | — | 45 | — | 186 | 0·9 |
| Cromarty | Peak | 0 | — | 166 | 194 | 6 | 16 | 7 | — | 19 | 1 | 0 | 5 | 172 | 8 | | |
| Cromarty Firth | Usage | 0·4 | — | 0 | — | 0 | — | 0 | — | 0 | — | — | — | 0 | — | 342 | 1·7 |
| Outfalls | Peak | 3 | 31 | 0 | 0 | 0 | 0 | 0 | — | 0 | 0 | 417 | 411 | 0 | 29 | | |
| Cromarty— | Usage | 0 | 0 | 0 | — | 15 | 48 | 2 | — | 2,424 | 3,890 | — | — | 43 | 56 | 2,527 | 12·8 |
| Rosemarkie— | Peak | 0 | 0 | 0 | 14 | 180 | 91 | 10 | — | 2,807 | 6,500 | 8 | 9 | 178 | 67 | | |
| Nairn | | | | | | | | | | | | | | | | | |
| Inner Moray | Usage | 8 | — | 0 | — | 0 | — | 0 | — | 0 | — | — | — | 0 | — | 186 | 0·9 |
| Firth Outfalls | Peak | 17 | — | 0 | — | 0 | — | 0 | — | 0 | — | 308 | — | 0 | — | | |
| Culbin and | Usage | 0·1 | — | 46 | — | 699 | — | 390 | — | 367 | — | — | — | 8 | — | 1,524 | 7·7 |
| Nairn Bars | Peak | 4 | 2 | 117 | 27 | 1,043 | 490 | 914 | — | 760 | 241 | 111 | 16 | 28 | 19 | | |
| Burghead | Usage | 2 | — | 31 | 51 | 1,535 | 853 | 185 | — | 1,274 | 184 | — | — | 10 | 10 | 3,426 | 17·3 |
| Bay | Peak | 15 | 1 | 137 | 81 | 2,372 | 1,332 | 440 | — | 1,850 | 304 | 459 | 35 | 33 | 17 | | |
| Burghead to | Usage | 0 | — | 162 | — | 19 | — | 3 | — | 68 | — | — | — | 1 | — | 253 | 1·3 |
| Lossiemouth | Peak | 0 | — | 250 | — | 71 | — | 15 | — | 300 | — | 0 | — | 1 | — | | |
| Spey | Usage | 22 | 201 | 129 | 45 | 5,239 | 7,101 | 1,814 | — | 1,565 | 1,326 | — | — | 9 | 4 | 8,794 | 44·5 |
| Bay | Peak | 50 | 600 | 220 | 406 | 6,075 | 9,000 | 2,025 | — | 2,155 | 2,607 | 30 | 80 | 36 | 10 | | |
| Total birds/day | 1977/78 | 171 | — | 1,462 | — | 8,088 | — | 2,480 | — | 6,170 | — | (1,000) | — | 398 | — | 19,770 | |

Usage figures are given as birds/day calculated for the whole of each winter; peak figures represent the highest count for each area in each winter. The 1978/1979 counts for Common & Velvet Scoter are combined, and placed under the former. – = No count, or insufficient information to calculate bird usage.

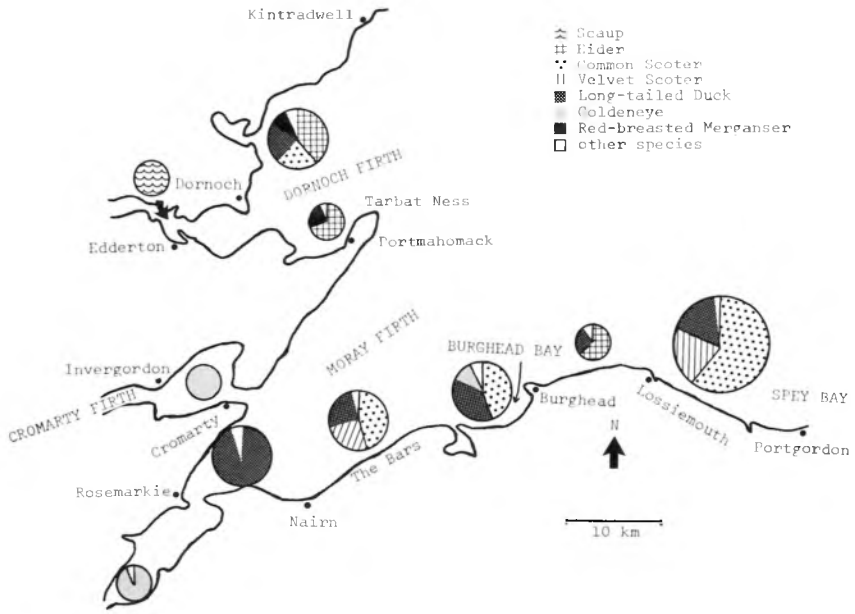


**Figure 1. The study area, showing the overall numbers and distribution of seaducks in the winter of 1977–1978.** Small circle 100–1,000 seaducks; medium circle 1,001–5,000 seaducks; large circle 5,001–10,000 seaducks. Species are only included if they formed 10% or more of the area's seaduck total.

was multiplied by the number of days spanned, and the totals summed to give 'bird days'. These, divided by the interval between the first and last count of the winter, give 'birds/day', the average number of a species using that area through the winter. Because of the opportunistic nature of the counts themselves, bird usage is the most practical way of assessing the relative importance of the different areas. Usage figures on a monthly basis were calculated in a similar way. Due to the difference in the period of surveillance, bird usage figures for 1977–1978 cannot be directly compared with those for 1978–1979.

## Results

### Scaup *Aythya marila*

The largest concentration was at Edderton Bay in the Dornoch Firth, holding about 81% of the birds in 1977–1978. Smaller flocks occurred at Inverness (usually at the Longman sewage outfall), and in Spey Bay (usually near the mouth of the river Spey). Numbers at these latter sites remained relatively stable over the winter, but there were considerable fluctuations in Edderton Bay, with a peak of 350 birds in December. Only Spey Bay was surveyed in 1978–1979, when 600 birds were recorded for a short period in January.

### Eider *Somateria mollissima*

The most important site was the mouth of Loch Fleet where there were up to 2,000 birds in early winter. Other regular flocks were found elsewhere between Kintradwell and Dornoch, at Tarbat Ness, in Burghead Bay, at Covesea and Halliman Skerries, and in Spey Bay. The Loch Fleet flock declined in size over the course of each winter, while those at other sites generally increased. This suggests a redistribution of Eiders within the area. At most sites there was little difference in numbers between the two winters.

### King Eider *Somateria spectabilis*

There were several sightings each winter, mainly with the Eider flock at Loch Fleet (where at least three different males were present). Records for the Moray Firth in recent years indicate that King Eiders are

now regularly present in very small numbers.

### Common Scoter *Melanitta nigra*

This species generally occurred in mixed flocks with Velvet Scoters. While the total scoter numbers were readily counted, it was usually difficult to assess accurately the proportions of the species. Weather conditions made this particularly difficult in 1978–1979, and the two species are grouped for that year (Table 1). When separate counts could be made, Velvet Scoters formed less than 10% of the flock at Dornoch and in Burghead Bay, but over 30% in Spey Bay. This corresponded closely with the situation in 1977–1978.

Most Common Scoters occurred along the south side of the Moray Firth (Figure 1); the most important area in both winters was Spey Bay, which held, on average, 65% of the total population in 1977–1978. Other important sites were Burghead Bay, off the Culbin and Nairn Bars, and in the outer Dornoch Firth at Dornoch. Numbers in Spey Bay increased gradually over the 1977–1978 winter, but elsewhere flock sizes remained relatively constant.

### Velvet Scoter *Melanitta fusca*

The principal site in both winters was Spey Bay. In 1977–1978 it held on average 73% of the area population. Other important sites were Burghead Bay and off the Culbin and Nairn Bars. Numbers in 1977–1978 increased from 2,144 birds/day in December to 2,910 birds/day in March, and reached a peak of 5,000 birds on 13 April (R. H. Dennis, pers. com.). This was the trend both in Spey Bay and off the Culbin and Nairn Bars, but in Burghead Bay and at Dornoch numbers remained more stable.

### Surf Scoter *Melanitta perspicillata*

A single male Surf Scoter was seen on two occasions in Spey Bay in the winter of 1977–1978. In the following winter up to eight individual males and one female were located there. This species has in recent years established itself as a regular winter visitor to the area. However, the 1978–1979 numbers are unprecedented in the British Isles.

### Long-tailed Duck *Clangula hyemalis*

The majority of Long-tailed Ducks occurred along the south side of the Moray Firth (Figure 1). The shallow waters between Cromarty, Rosemarkie and Nairn held up to 2,800 in the winter of 1977–1978 (probably an underestimate due to counting problems), and up to 6,500 in 1978–1979. Next in order of importance was Spey Bay, followed by Burghead Bay. Peak numbers in 1977–1978 were in December when an average of 7,308 birds/day was recorded for the area as a whole. As most counts for this species were probably underestimates, it is likely that, at peak, over 10,000 birds were present in both winters. After December overall numbers declined gradually at most sites.

### Goldeneye *Bucephala clangula*

The main concentrations of this species occurred at sewage or distillery outfalls. In 1977–1978 the Burghead malting plant outfall held, on average, 35% of the population. Of similar importance (34%) was the Invergordon distillery outfall, with the Longman outfall at Inverness (domestic plus distillery effluent) holding a further 18%. The overall population of the area changed little during the winter, but some redistribution of birds was apparent.

### Red-breasted Merganser *Mergus serrator*

Along open-sea coasts, the outer Dornoch Firth held the bulk of the population in both winters (over 80% on average in 1977–1978). Few occurred along the south side of the Moray Firth. Flocks of Red-breasted Mergansers were very mobile. This was presumably related to the locations of shoals of sprats and other small fish. Frequent movements occurred in and out of the inner firths, leading to considerable fluctuations in numbers along open-sea coasts.

### Divers (Gaviidae)

Three species of diver occurred regularly in the Moray Firth area—Red-throated Diver *Gavia stellata*, Black-throated Diver *G. arctica*, and Great Northern Diver *G. immer*. They were usually present well offshore, and were often difficult to iden-

tify. The percentages of each species recorded are set out in Table 2.

The aerial surveys revealed considerable numbers outside the 10 fathom line, which would have been largely undetected from the shore. It is likely that between 500 and 1,000 divers regularly frequent the area in winter. A marked influx of birds was observed in February of both winters.

**Table 2. Percentage occurrence of diver species in 1977–1978 and 1978–1979.**

| Species | 1977–1978 | 1978–1979 |
|---|---|---|
| Red-throated | 36% | 70% |
| Black-throated | 7% | 5% |
| Great Northern | 14% | 9% |
| Unidentified | 43% | 16% |
| Total sightings | 465 | 526 |

Grebes (Podicipedidae)

The most abundant of the grebes was the Slavonian *Podiceps auritus*. Individuals occurred regularly at a number of sites, and the largest count was of 30 birds between Dornoch and Golspie on 24 February 1979. single Red-necked Grebes *Podiceps griseigena* were seen quite frequently, with up to six individuals between Dornoch and Embo on 24 February 1979. Great-crested Grebes *Podiceps cristatus* were scarce, with only two sightings of single birds in each winter, and there was only one record of a Black-necked Grebe *Podiceps nigricollis*, off Nairn in December 1978.

*Sex ratios*

The proportions of males and females in seaduck flocks are known to vary considerably from place to place (Nilsson 1970). Information for our area in 1977–1978 is given in Table 3. Males predominated in the cases of Eider, Common Scoter, Velvet Scoter and Long-tailed Duck, at all sites. In contrast, female Scaup were more numerous than males. With Goldeneye the weighted mean also shows an overall preponderance of females, yet the sex ratio varied considerably from site to site. Females outnumbered males at most outfalls, and this was particularly so at Invergordon (72% females). Away from outfalls males usually predominated.

**Table 3. Sex ratios among seaduck flocks in the Moray and Dornoch Firths in the winter of 1977–1978.**

| Species | Number of counts | Number of birds | Overall% males* (weighted means) |
|---|---|---|---|
| Scaup | 3 | 60 | 17·5 |
| Eider | 24 | 2,361 | 66·7 |
| Common Scoter | 10 | 575 | 69·3 |
| Velvet Scoter | 8 | 468 | 77·3 |
| Long-tailed Duck | 14 | 1,320 | 66·1 |
| Goldeneye | 33 | 3,393 | 44·9 |

* The percentage of males of all ages for Scaup and Common Scoter, but of adult males only for Eider, Velvet Scoter, Long-tailed Duck and Goldeneye.

*Weather-induced movements*

In general, weather conditions had little direct influence on the distribution of the seaduck flocks. Only Eiders were observed to take some advantage of sheltered water when sea conditions were rough. Local shifts of Common and Velvet Scoter flocks (particularly within Spey Bay and between Burghead Bay and the Culbin and Nairn Bars) may have been related to changes in feeding conditions. For example, strong north-easterly gales in January 1978 caused considerable disturbance to the seabed in the bay between the Culbin and Nairn Bars. Large numbers of bivalves were exposed, and there was a temporary influx of scoters (particularly Velvet Scoter) to the area.

*Roosting behaviour*

The behaviour of seaduck flocks at dusk suggested that most species spent the night away from the daytime feeding areas. Eiders, Common Scoters and Velvet Scoters swam offshore at dusk, and probably spent the night on the sea close by. Long-tailed Ducks and Goldeneye, in contrast, regularly flew from the feeding areas to form discrete communal night roosts. This is a well known habit of these species (Nilsson 1969; Cramp & Simmons 1977; Hope Jones 1979).

For Long-tailed Ducks the principal night roost was 3–4 km offshore in Burghead Bay. In December 1977 it held a minimum of 5,000 birds, with about 3,000 arriving from the west (Cromarty-

Rosemarkie-Nairn) and 2,000 from the east (mainly from Spey Bay). On certain nights some birds appeared to remain in Spey Bay. Long-tailed Ducks from the outer Dornoch Firth roosted there. The situation in 1978–1979 was a little different. The main roost was again in Burghead Bay. Over 6,500 birds were counted arriving at it in late January, nearly all coming from the west. Spey Bay held large numbers of feeding birds by day, and these regularly remained there at night.

The roosting habits of Goldeneye were less consistent. On certain nights the Burghead outfall birds would all depart at dusk and form a roost in Findhorn Bay. On other nights they remained at the outfall. The same was true at the Invergordon outfall (though a different roost was used). Birds at both sites tended to depart when the tide at dusk was high, and feeding conditions were poor due to the cessation of effluent flow, but to remain when it was low (good feeding).

*Feeding behaviour*

Eiders feed by dabbling and diving, asynchronous or synchronous (Player 1971; Campbell 1978). In the Moray Firth, by far the most frequent method was synchronous diving. This contrasts strongly with the situation in the Firth of Forth, where Campbell (1978) observed synchronous diving only occasionally, and then usually only near dusk.

The large, but well dispersed flocks of Common Scoters, Velvet Scoters and Long-tailed Ducks typically consisted of many small sub-groups. Each sub-group behaved as a unit and dived at the same time, or nearly so, but out of synchrony with other sub-groups. Some feeding activity in these flocks occurred at all times of the day, and its intensity was subjectively assessed after prolonged observation of each flock (see Mudge 1978). For Long-tailed Ducks the intensity of feeding did not vary greatly, with usually between 5% and 10% of birds actively feeding at any one time. In contrast, considerable variation was observed in Common Scoter flocks, from about 1% up to about 20%. Feeding intensity was not related to time of day in either species, but, in the Common Scoter, to tidal conditions, as measured by time from high tide, ($r = +0{\cdot}52$, $p < 0{\cdot}01$). Feeding activity for this species was lowest around high tide, when the bivalve beds were most difficult to reach.

## Discussion

The results of these surveys confirm that the Moray/Dornoch Firth is a wintering site of major importance, holding, in both 1977–1978 and 1978–1979, approaching an average of 20,000 seaducks. It is probably the single most important wintering area in Britain in terms of total seaduck numbers. It is placed in national and international contexts in Table 4. At the 1% level (Smart 1976), it is of international importance for Common Scoter, Velvet Scoter, Long-tailed Duck, and Red-breasted Merganser, and is probably the principal British

**Table 4. Moray and Dornoch Firth seaduck populations 1977–1978 in relation to the British and North-west European populations.**

| | Estimated NW European population | Estimated British population | Average Moray and Dornoch Firth population Birds/day | As % of NW European population | As % of British population |
|---|---|---|---|---|---|
| Scaup | 150,000 | 25,000 | 171 | 0·1 | 0·7 |
| Eider | 2,000,000 | 50–60,000 | 1,462 | 0·1 | 2·7 |
| Common Scoter | 4–500,000 | 50,000 | 8,088 | 1·8 | 16·2 |
| Velvet Scoter | 150–200,000 | 3,000 | 2,480 | 1·4 | 82·7 |
| Long-tailed Duck | 500,000 | (20,000) | 6,170 | 0·2 | (30·9) |
| Goldeneye | 200,000 | 13,700 | 1,000 | 0·5 | 7·3 |
| Red-breasted Merganser | 40,000 | 10,000 | 398 | 1·0 | 4·0 |

Sources of information: Atkinson-Willes (1976, 1978), Prater (1972), and Szijj (1972). ( ) = personal assessment.

wintering site for the first three of these species. However, the proportions given in Table 4 must be taken as very tentative due to the poor state of knowledge of the numbers and distribution of seaducks in North-west Europe (Atkinson-Willes 1978). The particular problems of counting seaducks necessitate special attention, including aerial surveys. Britain, together with most other European countries, has yet to initiate a monitoring programme.

There are three other principal sites for wintering seaducks in Britain. Carmarthen Bay is notable for Common Scoters, the Firth of Tay for Eiders, and the Firth of Forth for Eiders, Scaup and Goldeneye. However, in the last few decades substantial changes have been noted in the relative importance of the different sites (Milne & Campbell 1973; Atkinson-Willes 1978). For example, the numbers of Eiders wintering in the Firth of Tay have increased substantially, and the same is true at many other sites. Numbers of Scaup built up to a very high level (40,000) in the Firth of Forth, but declined markedly during the last decade. The Solway Firth, the east coast of Ireland, and St. Andrews Bay (eastern Scotland), used to hold large concentrations of Common Scoters, but these flocks have now greatly diminished in size. These declines have coincided with the emerging importance of Camarthen Bay and Moray/Dornoch Firth as wintering sites. These changing situations all point to the need for regular surveys of British wintering seaduck populations.

As British wintering seaducks are concentrated in a few areas, the populations are highly vulnerable to any disasters, such as oil spills. In some species birds from a wide area gather on a single roost. Thus the bulk of the Long-tailed Duck population from the south shore of the Moray Firth roosts offshore in Burghead Bay and any nocturnal oiling incident here could have a substantial impact on the whole population of the area. Beached bird surveys have shown that the Moray Firth has relatively little oil pollution. However, the development of the Beatrice Field in the outer Moray Firth, and the possible construction of an oil refinery at Nigg Bay in the Cromarty Firth may change the situation.

The overall distribution of seaducks in the Moray/Dornoch Firths was very similar in the two winters under consideration. Yet past counts (Campbell 1974; R. H. Dennis, pers. com.; Wildfowl Trust counts; Birds of Estuaries Enquiry) reveal that the relative importance of sites does change. Thus, Spey Bay, of overwhelming importance in 1977–1978 and 1978–1979, held very few seaducks in 1972–1973 (Campbell 1974). Much larger numbers then occurred in Burghead Bay and in the outer Dornoch Firth, e.g. peak of 7,000 at each site in the winter of 1972–1973 (R. H. Dennis pers. com.). Such gross changes from year to year pose problems in establishing an overall conservation strategy for wintering seaduck sites within the Moray and Dornoch Firths. However, the following sites should be considered of major importance, having held, in the past 10 years, 5,000 or more seaducks: Kintradwell to Dornoch; Cromarty-Rosemarkie-Nairn; Findhorn to Burghead (Burghead Bay); Lossiemouth to Kingston (Spey Bay).

Postscript: Studies during the winter of 1979–1980 by R. H. Dennis and R. A. Broad reveal considerable changes. Spey Bay has been virtually deserted, and the numbers of seaducks using Burghead Bay have also been low. Elsewhere in the Moray and Dornoch Firths the numbers of all species of seaducks have been reduced, with Velvet Scoters particularly scarce. Long-tailed Duck numbers have not been affected to the same degree, and the Cromarty-Rosemarkie-Nairn feeding area held c. 4,000 in February, together with appreciable numbers of scoters (500–800).

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**Summary**

The numbers, distribution and behaviour of seaducks in the Moray and Dornoch Firths are described for the winters of 1977–1978 and 1978–1979. This area is at present the major seaduck wintering site in Great Britain, with an average of about 20,000 birds. It holds internationally important concentrations of Common Scoter *Melanitta nigra*, Velvet Scoter *M. fusca*, Long-tailed Duck *Clangula hyemalis* and Red-breasted Merganser *Mergus serrator*, and nationally important concentrations of Eider *Somateria mollissima*, and Goldeneye *Bucephala clangula*. The majority of the ducks occurred at five sites—Spey Bay, Burghead Bay, Culbin and Nairn Bars, Cromarty—Rosemarkie—Nairn, and the northern outer Dornoch Firth. In both winters Spey Bay was of overwhelming importance. However, the relative use of individual sites varies considerably from year to year.

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