



## The Origins of moulting Goosanders on the Eden Estuary

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Moulting Goosanders were counted on the Eden estuary, Fife, UK from 1979 to 1994, and some of these birds were caught and wing-tagged from 1992 to 1994. This paper documents changes in numbers of moulting birds, and their provenance, as determined from subsequent sightings. Goosanders only started to moult on the Eden estuary in the 1980s and their numbers have increased since the late 1980s. This increase also occurred elsewhere on other, geographically similar, Scottish east-coast estuaries. The birds are adult females, and many, though not all, seem faithful to their moult site. Moulting flocks persist from June to October, with a turnover of birds occurring during this period. The moulting birds are drawn primarily from wintering and breeding areas to the south and west of the Eden estuary, in southwest Scotland, England and Wales.

Like most other wildfowl, Goosanders *Mergus merganser* undertake a complete post-nuptial moult, during which they experience a flightless period lasting approximately a month (Cramp & Simmons 1977, Owen & Black 1990). Males moult earlier in the year than females and most males from western European breeding populations migrate to northern Norway to moult their flight feathers (Little & Furness 1985). Some females, mainly those with late broods (Marquiss & Duncan 1994a), moult on their riparian breeding grounds. All early and failed breeding females, however, leave their breeding sites to moult elsewhere in Britain, usually in estuaries and shallow coastal firths (Little & Marchant 2002). This paper documents the increase in size of moulting flocks of female Goosanders on the Eden estuary, Fife, UK from the 1970s to the 1990s, and presents information on their origin.

### METHODS

#### Study area

The Eden estuary (56° 22'N 2° 50'W) is one of a series of small estuaries situated on the Scottish east coast. It lies immediately north of St Andrews and is characterised by its extensive sheltered shallows. The area is designated as a Local Nature Reserve, Site of Special Scientific Interest and a Special Protection Area under the Ramsar Convention (NEFDC 1993). The Eden estuary has a total area of 891 hectares, mostly

comprising intertidal mud and sand flats. It is managed by Fife Council (formerly North East Fife District Council).

The Eden estuary has a number of features that make it attractive to moulting Goosanders. It contains areas of expansive sand flats at low tide, which provide safe roosting sites with good all round visibility. Additionally, at high tide, birds are protected from land predators by a large expanse of water, which is relatively sheltered by a sand bar at the mouth of the River Eden. At low water, birds frequently congregate in the main river channel, often feeding collectively (Marquiss & Carss 1994). Food is plentiful in the estuary. Substantial numbers of young Herring *Clupea harengus* are known to be present in the estuary during the moult period (A Walker pers comm). The estuary also holds good numbers of flatfish, as well Brown and Sea Trout *Salmo trutta*, and Salmon *Salmo salar*.

#### Bird counts

Goosanders have been counted on the Eden estuary since the 1970s, and the data are used here to document annual changes up until the 1990s. Variation in numbers during the moult period was recorded by additional, approximately weekly, counting from June to September in three years, 1992 to 1994. Counts of moulting birds at other estuary sites were received from R Anderson of East Lothian Ranger Service (Tynningham) and R Goater of Scottish Wildlife Trust (Montrose Basin).

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### Capture and wing-tagging

The origin of birds moulting on the Eden was investigated by capturing some birds whilst they were flightless and fitting them with coloured wing-tags. The birds were caught at low tide by using a salmon net placed across the river. Each bird was fitted with a British Trust for Ornithology (BTO) numbered ring and on the left wing, given an individually lettered patagial tag, using different colours for each of three years (blue = 1992, red = 1993, pink = 1994). Requests for information on subsequent sightings were placed each year in the newsletters of the BTO and Scottish Ornithologists' Club.

Recaptures showed that whilst some tags were retained for at least two years, others were lost within twelve months. In addition, in 1993, three recaptured birds had damaged feathers on the propatagium, due either to abrasion from the tag itself, or to the birds' attempts to remove it. The tags were therefore removed from these three birds. In an attempt to prevent feather wear, tags fitted the following year (1994) had only single (rather than double) nylon washers applied top and bottom of the pin through the propatagium. None of these 1994-tagged birds were seen after they left the Eden estuary. This might have been because the colour (pink) was less obvious, but a more likely reason was the change in the tag attachment method led to greater loss of tags.

## RESULTS

### The increase in moulting Goosanders on Scottish east coast estuaries

Figure 1 shows the peak counts of Goosanders on the Eden estuary since 1979. There were few recorded until 1990. The sharp rise in numbers of moulting birds since the late 1980s to early 1990s is not an artefact of the counting method, as correspondence with people active in counting the estuary in the late 1970s confirms the lack of Goosander at that time (T Dougall pers comm) and Smout (1986) draws attention to the species absence during the summer months. Regular monthly counts for the Eden exist from 1983. The highest counts occur during the period June to August, with a few birds remaining into September (Fig 2). Outside this period, counts on the estuary were usually of less than five birds (NEFDC Annual Reports), although small numbers winter on the river upstream of the tidal limit (pers obs).

The rise in numbers of moulting female Goosanders has also occurred elsewhere on the Scottish east coast (Fig 3) at Tynningham (John Muir Country Park) and the Montrose Basin, two estuaries sharing the shallow and sheltered topography of the Eden. Moulting

Goosanders also increased on the Inner Beaully Firth during the 1980s (Aspinall & Dennis 1988).

Goosander numbers on the River Tay were also high during the moult period, with over 150 birds present in August 1994 (C McKay pers comm), and Wildfowl and Wetland Trust data (Cranswick *et al* 1997) show an average of 144 birds from 1989 to 1994. It is not known whether these Goosanders were from the Tay breeding population. The river catchments of the Eden, Montrose and Tynningham estuaries do not support sufficient numbers of breeding Goosanders to account for the influx of birds during the moulting period, so these birds must have come from elsewhere.

### Wing-tagging

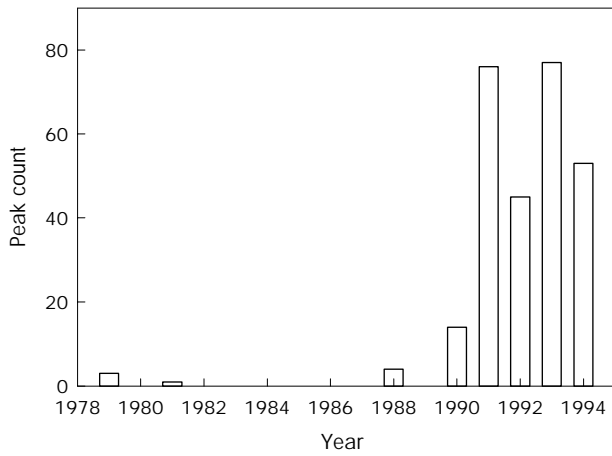
In August 1992, 22 adult female Goosanders were captured and marked with blue wing tags (including a bird previously ringed as an adult at Rhayader, Powys, UK, on the 30 June 1990). In 1993, a further eight were marked with red wing-tags. In 1994, ten birds were marked with pink tags and three blue-tagged birds were recaptured. In all, a total of 40 adult female Goosanders were tagged over the three-year period. There was some wing tag loss (see Methods) but we have insufficient data to estimate the rate of loss with precision. We were, therefore, unable to use the proportion of resighted tagged birds to infer rates of death or emigration.

Birds tagged on the Eden were resighted there during the moult period of the tagging year but not after 8 October. Moreover, the first tagged birds seen elsewhere were on 11 September, showing that birds left on the completion of moult and no tagged birds spent the winter on the Eden. Table 1 summarises the monthly reports of tagged birds found on the Eden estuary in the years subsequent to capture.

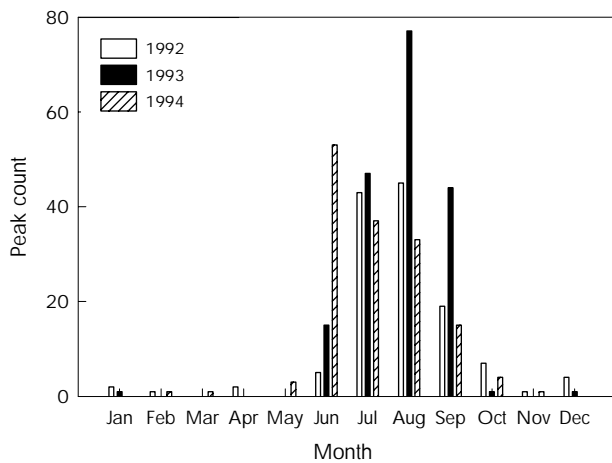
The Eden moulting flock persisted for longer than it took an individual bird to moult and observations of

**Table 1.** Numbers of Goosanders wing-tagged and subsequently resighted on the Eden estuary, by month and year. Records refer to Goosanders resighted on the Eden estuary in the year subsequent to capture, to avoid over counting long staying within-season moulting birds. Birds were only resighted in the months shown. B = blue tag, fitted in 1992; R = red tag, fitted in 1993.

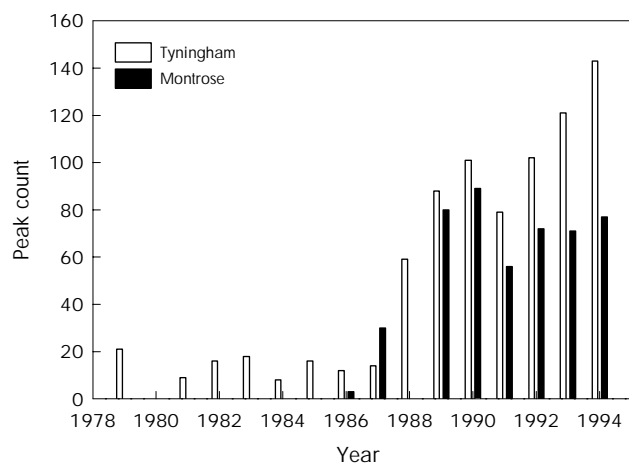
	1993	1994	1995
Jun		BR	
Jul	2B		
Aug	2B	7B	R
Sep	3R	R	
Oct		R	
Total	7	11	1



**Figure 1.** Peak counts of Goosanders moulting on the Eden estuary, 1979-1994.



**Figure 2.** Seasonal pattern in peak counts of Goosanders on the Eden estuary, 1992-1994.



**Figure 3.** Peak counts of Goosanders moulting on the Tynningham estuary and the Montrose Basin, 1979-1994.

identified individuals during regular counts suggested different wing tagged birds joined and left the flock between June and October. This suggests that the total number of birds using the Eden was higher than any single peak count.

Fifty-six subsequent resightings were reported, and these were categorised as records during the winter (October-February), breeding season (March-July) or moulting period (August-September). All sightings outside the moulting period lay to the south and west of the Eden, with little difference in the distribution of records from the winter and breeding season (Fig 4). Birds moulting on the Eden estuary were thus drawn primarily from relatively recently colonised breeding areas to the south and west of the Eden. The only birds of Scottish origin found on the Eden were from the long established breeding areas in southwest Scotland.

Resightings of wing-tagged Goosanders away from the site of capture are summarised in Table 2. During the breeding season, wing-tagged Goosanders were seen in the Scottish and Cumbrian Solway area, Northumberland, Wales and Derbyshire. All these regions, with the exception of Wales, also hold birds during the winter. In Wales, we received sightings of a tagged bird in September and another in February in Hereford. In Derbyshire at least three different birds tagged in 1992 were recorded on the River Dove between 1992-1995, an area where tagged birds have been reported in most months except May-August. It is, therefore, likely that wintering areas are often relatively close to breeding sites, with seasonal switches between habitats within watersheds (Marquiss & Duncan 1994a). In Yorkshire and Lancashire, tagged birds were seen during winter but none were recorded in the breeding period.

Records from outside the breeding and wintering periods included a single sighting in southern Tayside. There were also two additional sightings from Derbyshire in September, which may have been birds arriving early at their wintering grounds, or still on passage to areas further south.

**Fidelity to moulting area**

The large number of records in August and September (Fig 2) are mainly birds returning to the Eden to moult. At least 19 individuals were recorded moulting on the Eden in two years, 15 in three years, and four in four years. Fidelity to the moulting site was not ubiquitous, however, because one tagged bird changed moulting grounds from the Eden in 1993 to the Spey in 1994. The degree of fidelity to moulting site is probably overestimated here because of the systematic observation at Eden compared to other sites. Marquiss & Duncan

(1994a) also recorded a switch in moulting site; a breeding bird moulting at the mouth of the River Dee in Aberdeenshire moulted on the nearby River Don two years later.

### Shooting mortality

A number of the ringed and tagged Goosanders were reported as killed, from both legal and illegal shooting. Three were shot illegally on the Eden estuary in September 1992 and 1993, all victims of wildfowling accidents. A fourth was shot under licence on its probable breeding ground in southwest Scotland in April 1994. The four birds shot represent 10% of the study sample over three years. This is a minimum figure because shot birds are generally under-recorded due to the illegal nature of some of the deaths.

## DISCUSSION

The results of this study show that there has been a significant increase in the number of Goosanders moulting on the Eden estuary since the late 1980s, and that this increase also occurred elsewhere on other, similar Scottish east coast estuaries. These birds were adult females, and many, though not all, seem faithful to their moulting site. Moulting flocks persist from June to October, with a turnover of birds occurring during this period. The moulting birds are drawn primarily from wintering and breeding areas to the south and west of the Eden estuary; southwest Scotland, England and Wales.

Goosanders were first proven to breed in Scotland in 1871 in Perthshire. This has been linked to initial drift migration and then to mass immigration in the autumn

**Table 2.** Numbers of Goosanders wing-tagged on the Eden estuary and subsequently resighted, by region of resighting within Britain & Ireland.

	1992	1993	1994	1995	Total
Cumbria	3	2	1		6
Derbyshire	1	4	4	4	13
Dumfries		1	1		2
Hereford			1	1	2
Lancashire			1		1
Northumberland		5			5
Spey			1		1
Tayside		1			1
Wales		1			1
Yorks		4	1		5
Total	4	18	10	5	37



**Figure 4.** Mapped resightings of Goosanders wing-tagged during their moult on the Eden estuary. Squares show birds resighted during the breeding season, March – July; circles show birds resighted in winter, October – February. The Eden estuary is marked with a star. One bird caught at the Eden was not resighted but had been ringed as a breeding female in Wales.

and winter of 1875-1876 of birds presumably of Fennoscandinavian origin (Bannerman & Lodge 1958). Increases in the population may well have been linked to a variety of factors, including climatic amelioration, increasing eutrophication of rivers (leading to increases in fish biomass), and the removal of predators such as the Pine Marten *Martes martes* (Kear 2003). Range expansion of the population, initially into the highland regions, became most marked in the southern uplands and northern counties of England, with the first English breeding pair being found in Northumberland in 1941 (Owen *et al* 1986). The Lake District, Cumbria, was colonised in the 1950s, Yorkshire in the 1970s, and Lancashire in 1973 (Sharrock 1976). The 1988-91 atlas of breeding birds (Gibbons *et al* 1993) charted this continued expansion with breeding in Derbyshire (1981), Herefordshire (1988), and significant increases in the Welsh population, estimated at 100 pairs by 1985 (Tyler 1985). The link with birds moulting on the Eden and these relatively newly colonised areas is clear and it is likely that the increase in numbers of moulting Goosanders on the Scottish east coast was due to the expansion and increase in the number of birds breeding in these newly colonised areas.

For most of the moulting period, birds were usually found within the estuary rather than upriver. The combination of protection from predators and a predictable food source is probably the most important reason for the use of these Scottish east coast estuaries by Goosanders. This study shows that estuaries are as important as river systems for Goosanders. Like many other waterbirds, Goosanders use a suite of habitats during their life cycle, and any conservation plan for the species needs to identify all key needs. It is still not clear how, for example Goosanders in Wales or Derbyshire find potential moulting sites. It may be that young birds culturally inherit traditional moult migrations by aggregating with experienced birds at communal roosts (Marquiss & Duncan 1994b, Tyler et al 1988). Alternatively, migratory directional tendency might be intrinsically inherited, with the birds stopping to moult as and when they reach suitable habitat.

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