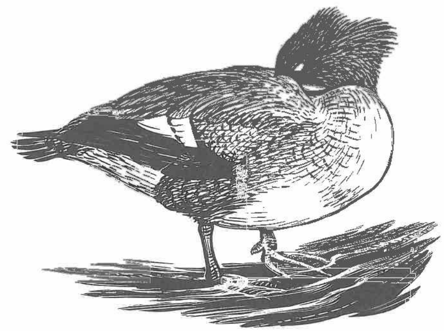
Diurnal activity patterns of Goosanders *Mergus merganser* on a Scottish river system.



M. MARQUISS and K. DUNCAN

Goosanders were counted as they arrived and departed from overnight communal roosts. All birds left the roost before sunrise and returned from 50 minutes prior to, until 10 minutes after sunset. Relative to sunset, they arrived later on short midwinter days, and earlier on the longer days of February and March. Goosanders did not roost communally from April to August, except in May, in an area where males gathered prior to their leaving to moult. The diurnal behaviour of Goosanders, quantified using three methods, showed that most of the daytime was spent foraging and loafing. Foraging peaked in the first two hours of the day, decreasing thereafter for adults, less so for birds in their first winter, and least for ducklings. Calculations of total daily foraging times suggested adults fed for 3-4 hours, young birds for 5-6 hours and ducklings for about 10 hours. Total time spent flying could not be estimated accurately, though there was significant seasonal variation in the frequency with which it was recorded. Other behavioural activities included social interaction which was overt as birds gathered to roost, suggesting communal roosting provided an important venue for pair-formation.

Keywords: Ecology, Rivers, Communal Roosting, Behaviour, Feeding Behaviour, Goosander

Goosanders *Mergus merganser* are piscivorous ducks that catch fish by surface diving (Cramp & Simmons 1977). They can find hidden prey by random probing of the substrate (Lindroth & Bergstom 1959, Sjoberg 1988), and must use this method when feeding nocturnally on Lampreys *Lampetra* spp. (Sjoberg 1989). However most of their prey is located visually, often by scanning from the surface, with eyes and bill submerged (Cramp & Simmons 1977). They thus require light to feed and are largely day-active (Nilsson 1970) congregating on standing waters, or in backwaters to roost communally overnight (Reed 1971, Smaldon 1982, Owen *et al.* 1986).

In our studies to assess the impact of Goosander predation on juvenile Salmon *Salmo salar* populations (Marquiss, Feltham & Duncan 1991, Carss & Marquiss 1992) we found that Goosanders often moved between locations (and habitats) within a single watershed, on both a daily and seasonal basis. The present paper quantifies diurnal patterns of foraging and loafing, and flights to overnight communal roosts.

Study area

The study area comprised the 2000 km^2 catchment of the Dee (centred about Lat. 57°N Long. 3°W, Grampian Region), a large river running 140 km from its source in the Cairngorm granite massif, to the sea at Aberdeen. The biology, geography and land use of the Dee watershed have been comprehensively reviewed (Jenkins 1985). The river has a steep profile, running rapidly throughout its length, with few meandering sections or backwaters, and a short estuarine section. There are relatively few large standing waters (map, **Figure 1** in Duncan & Marquiss, 1994, *Wildfowl*, this issue) all of which were viewed regularly to count ducks. Two of the larger lochs (Kinord and Skene) and a small reservoir adjacent to the river (Inchgarth) were used by Goosanders for overnight roosting. In summer, ducks fished chiefly on the main stem of the river, whereas in winter most birds used only the lower 20 km. From October to March, the three main standing waters used by foraging Goosanders were the lochs of Kinord, Davan and Aboyne.

Methods

Attendance at overnight communal roosts

The timing of arrivals and departures of Goosanders at a communal roost was quantified at the Loch of Kinord, where the birds could be easily and rapidly counted. On 17 nights between 21 September 1988 and 31 March 1989 the roost was monitored in the evening (from 80 minutes before sunset until dark) and the following morning (from 60 minutes before sunrise to 30 minutes after), noting the times that birds arrived and departed. Seasonal patterns of communal roosting were documented by counting the numbers of birds at all three main Deeside roosts, several times each month in 1989. Further data on arrival times in relation to daylength were collected weekly at the Kinord and Inchgarth roosts, from September 1990 to March 1991.

Diurnal behaviour patterns

The behaviour of Goosanders during daytime was broadly classified into four types:

i) foraging (peering into the water, diving, and pursuing or catching fish),

ii) loafing (preening, resting or sleeping),

iii) flying, and

iv) 'other' behaviour (mainly courtship, aggression and swimming that could not be attributed to foraging).

Most Goosanders were wary of humans and were easily disturbed. In our analysis we did not include observations of birds that by their 'escape' behaviour, flying or swimming, were judged to have been disturbed by the observer.

Individual birds were easily identified as adult male (predominantly white with dark heads) or immatures and females (predominantly grey with reddish-brown heads). Young males were usually easy to distinguish from females by their large rounded head profile, strikingly white breast and neck, and from midwinter, by black feathers on the mantle and increasing numbers of white feathers on their flanks. In good viewing conditions, juvenile females could be distinguished from adults by their brown or dull orange legs and feet; adults had bright orange or scarlet legs and feet.

Behaviour was quantified using three methods (Altmann 1974); focal animal sampling, sweep scan instantaneous sampling and an opportunistic form of instantaneous sampling: -

i) *Focal animal sampling* involved the continuous monitoring of individual Goosanders for periods of 30 minutes or more. The 161 hours of data came from birds using the lower 9 km of the river Dee and the lochs of Aboyne and Kinord, in the first two weeks of February 1990. Adult males were observed on 40 occasions for a total of 80.5 hours, and adult females, on 27 occasions for 37.5 hours. There were fewer young birds present; young males watched on 22 occasions contributed 26 hours data, and young females on 11 occasions gave 17 hours. Observations were spread evenly over the hours of daylight, but there were some times for which there were fewer data, particularly from young birds.

For any one cohort (birds of the same age and sex), continuously monitored focal animal sampled data were subdivided to produce average estimates of the time (in minutes per hour) that birds spent foraging, loafing, flying and in other activities, for every hour of the day relative to sunrise.

ii) *Sweep scan instantaneous sampling* was carried out at the same time of year and in the same places as focal animal sampling. It involved scanning all goosanders in view, at ten minute intervals, throughout watches, recording the numbers that were engaged at that time in each of the four behaviour categories. Observations totalled 30 hours, evenly spread over an approximately ten hour day, from 50 minutes before sunrise to 30 minutes after sunset. The numbers of individuals in view varied between 3 and 41 (mostly between 6 and 13), of which on average 37% were adult males, 37% females and 26% young males in their first winter. Young and adult females were grouped in scan samples because they could not all be aged at a glance.

iii) *Opportunistic instantaneous sampling* made use of records collected in the process of year-round fieldwork, counting Goosanders and finding nests and broods for population studies. Whenever birds were observed, the behaviour when first seen was noted. Observations were drawn from the period, April 1987 to March 1990, and were divided into four seasons: November-February (winter), March-April (spring), May-July (summer) and August-October (autumn). Most fieldwork was done in the first few hours of daylight, so sample sizes were smaller from midday. We therefore combined data from all cohorts of birds and grouped them into 2-hour periods. Data from broods of ducklings were treated separately. Each

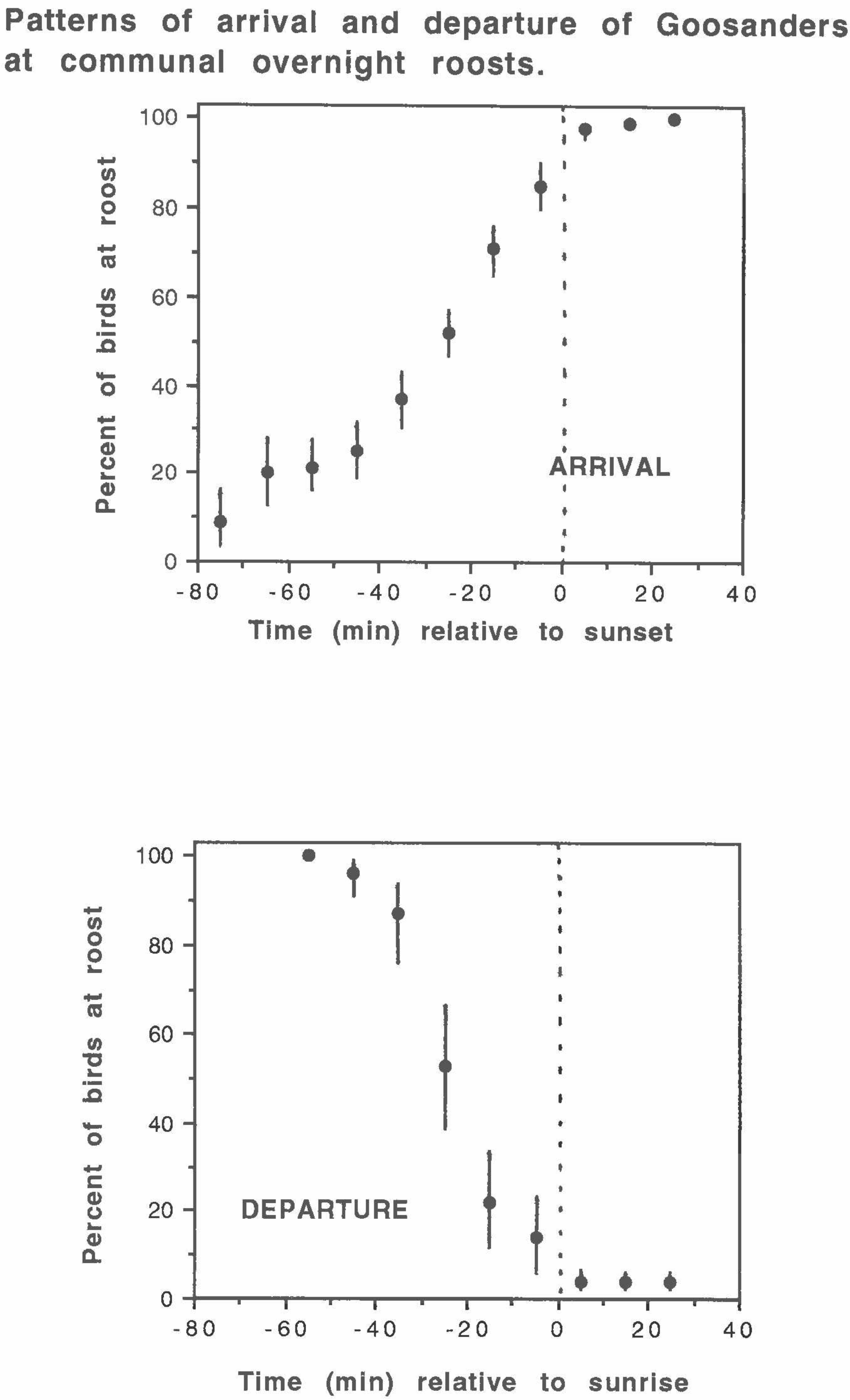


Figure 1. Average patterns of arrival and departure of Goosanders at a communal roost over 17 nights. Each point represents the proportion of roosting birds present in 10 minute intervals before and after, sunrise and sunset. Bars above and below the points are standard errors of the mean (calculated from arcsin transformed data).

occasion a brood was seen provided only a single observation (Hill & Ellis 1984) because ducklings (together with brood females) behaved cohesively, most (usually all) fishing or loafing at the same time.

Daily activity budgets

Daily activity budgets were calculated from focal animal sample data, by adding up the times spent on the four behaviour categories over the hours of the day. With sweep scan and opportunistically collected instantaneous sample data it was assumed that the time spent on the four categories was directly proportional to the frequencies with which such behaviour was observed. This assumption was probably invalid (see Discussion) but nevertheless, for each sampling method, gave figures for comparison between cohorts of birds, and between seasons.

Data on behaviour were analysed using nonparametric tests; Chi-squared tests to search for heterogeneity, Spearman rank correlation coefficients (r_S) to test for daytime trends, and Friedman two-way ANOVA to compare cohorts of birds, controlling for time of day.

Results

Communal roosts

A few goosanders were at the Kinord roost site early in the evening, but the majority (80%) arrived from 50 minutes before, to 10 minutes after sunset (**Figure 1**). We could not tell whether any birds came in after dark but thought it unlikely because the numbers of birds seen just before dark was always the same as the number counted the following morning. The departure of birds in the morning was rapid, all birds leaving by sunrise, the first having left about 50 minutes before. On individual mornings the departure was synchronised with most birds leaving within a few minutes. The time interval between the first and last birds leaving ranged between 6 and 36 minutes, but averaged 15.2 (sd=9.0) minutes. There was no obvious pattern to the variation in departure schedules. Neither the numbers of birds at the roost, nor daylength was significantly correlated with the duration of the exodus, or its timing relative to sunrise.

In contrast, variation in the timing of arrivals was related to daylength (**Figure 2**). Using data from 97 roost counts between November 1987 and March 1990; on shorter days a lower proportion of birds had arrived by sunset than on longer days (Spearman r_S=0.236, P<0.05). Most of this effect was due to very late arrivals in November and December, and early arrivals in February and March.

Goosanders did not roost communally in June, July and August (**Figure 3**), but numbers built up rapidly in early September, peaking in that month (Skene) and October (Kinord and Inchgarth). These were also the months when counts at roosts were most variable and on several occasions in autumn, birds were seen to approach a roost, fly around the site quacking, then depart again without returning. From late November to March, numbers were more stable, but declined in April as birds roosted in pairs on the river and tributaries in the breeding areas. At Inchgarth (lower Deeside) numbers increased in April and May but these were males which gathered on the lower Dee prior to their leaving to moult.

Daily activity budgets

Goosanders spent most of their time foraging and loafing. Within both the focal animal and sweep scan sample data sets, there were significant tendencies for adults to forage for 1-2 hours less than young birds, and for males to feed for almost an hour less than females (**Table 1**). Such differences between cohorts in total foraging times were reflected in inverse differences in loafing; there were no consistent differences in flying or other activities. The two sampling methods gave differing estimates for the time budget of adult males, but very similar estimates for young males. The data for unaged females (sweep scan sample) could not be compared directly, but lay between the values (focal animal samples) for adult and young females.

In contrast, the winter time budget derived from opportunistically sampled behaviour was markedly different (**Table 1**). The lower value for loafing might have been expected because of the short day, but the value for flying was five times the greatest value derived from the other two sampling methods. There was considerable seasonal variation in the estimate of

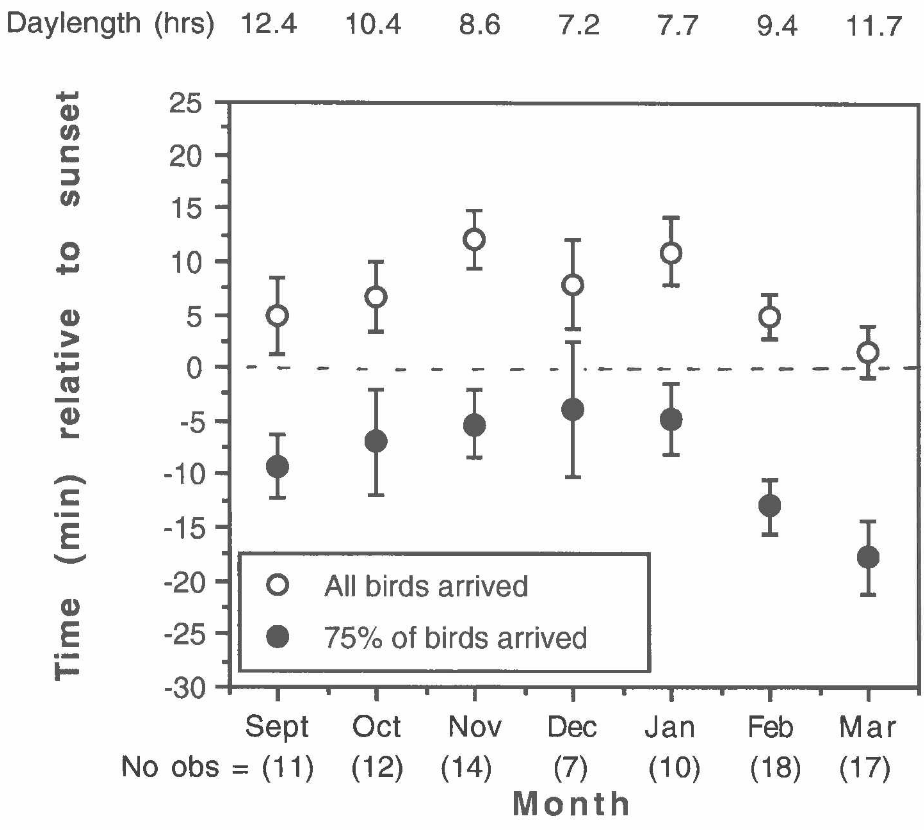


Figure 2. Seasonal trends in the timing of arrivals of Goosanders at communal roosts. Points represent the mean arrival time (± standard error) in minutes relative to sunset, of 75% of birds (o) and all birds (o).

Table 1. The activity budgets (mean hours per day ± 95% C.I.) of Goosanders, estimated using three sampling methods.

Cohort	Season[1]	Daylength (hours)	Method[1]	Average time spent per day Foraging	Loafing	Flying	'Other'
ad' male	w	10	focal	3.16+0.58	6.31+0.59	0.08+0.03	0.45+0.17
ad' female	w	10	focal	4.06±0.65	4.75±0.72	0.09±0.08	1.10±0.43
y'g male[2]	w	10	focal	5.14±0.96	4.14±0.91	0.04±0.02	0.68±0.29
y'g female[2]	w	10	focal	5.88±0.80	3.74±0.79	0.10±0.09	0.28±0.11
ad' male	w	10	sweep	4.31±0.39	4.97±0.41	0.03±0.04	0.69±0.25
females	w	10	sweep	4.86±0.65	4.42±0.57	0.09±0.08	0.63±0.21
y'g male	w	10	sweep	5.25±0.49	4.22±0.49	0.07±0.07	0.46±0.24
all birds	w	8	opp.inst	3.93±0.37	2.71±0.35	0.48±0.19	0.87±0.21
all birds	sp	12	opp.inst	3.79±0.47	5.91±0.57	1.63±0.40	0.67±0.18
all birds	su	16	opp.inst	4.46±0.54	8.07±0.55	2.59±0.49	0.88±0.30
broods	su	16	opp.inst	10.02±1.41	4.81±1.31	0.00	1.17±0.83
all birds	a	12	opp.inst	4.87+0.47	6.63+0.49	0.36+0.21	0.14+0.08

[1]See methods
[2]Overall average values used for the two times of day (see Fig. 4) when there were no data.

time spent flying (greater values in spring and summer) and in loafing (greatest value in summer and least in winter) yet relatively little in the time spent foraging. Full grown birds were calculated to spend approximately four to five hours foraging per day irrespective of daylength, whereas the estimate for broods of ducklings was more than twice this amount.

Diurnal and seasonal trends in behaviour, and differences between cohorts

Patterns in the data from focal animals showed that throughout the day, these Goosanders spent most of their time foraging and loafing so that in hours when there was less foraging, there was consequently more loafing (**Figure 4**). Foraging increased immediately after sunrise, falling thereafter, significantly so for adults (males rs= -0.291, n=159, P<0.001; females rs= -0.696, n=71, P<0.001), but less so for birds in their first winter (males rs= -0.004, n=52, ns; females rs= -0.442, n=32, P<0.05). Young birds thus foraged for longer than adults in the later hours of the day. An overall analysis (Friedman two-way ANOVA of ranked data) showed that on average, for each of the 10 hours of day, adult males (mean rank 1.6) foraged for less time than did adult females (2.3), adult females less than young males (2.7), and young males less than young females (3.4) (Chi^2 3=9.6, P<0.05).

There was also a suggestion that adults spent more time flying and on 'other' activities in the early and late hours of the day (**Figure 4**) but such trends were not consistent and so were difficult to test objectively.

Sweep scan data gave similar results (**Figure 5**), endorsing the increase in foraging at sunrise and the decrease thereafter in all three cohorts (adult males r_S= -0.507, *n*=157, *P*<0.001; young males r_S= -0.376, *n*=128, *P*<0.001; females r_S= -0.297, *n*=128, *P*<0.01). Also, on average for each of the 10 hours of day, a lower proportion of the adult males seen were foraging compared with young males or females (Friedman ANOVA, Chi^2 2=6.0, *P*<0.05). Sweep scan data also provided more evidence of the greater amount of time spent flying and in 'other' behaviour in the hour before sunrise, as the birds left their roost, and late in the day as they returned.

Opportunistic sample data showed that the tendency for birds to forage most, early in the day, applied to full grown birds year-round (**Figure 6**). Foraging varied significantly (P<0.001) over different periods of the day, for full grown birds (Nov-Feb, Chi^2 3 =20.0; Mar-Apr, Chi^2 5=66.8; May-July, Chi^2 7 =66.7; Aug-Oct, Chi^2 5=81.1) though not for broods of ducklings (Chi^2 5=1.8, ns). At all hours of the day but one, more than half of the duckling broods we observed were foraging.

Discussion

Time budgets of wildfowl have been estimated using focal animal sampling (e.g. Salathe & Boy 1987, Savard 1988) or instantaneous sweep scan sampling (e.g. Goudie & Ankney 1986, Madsen 1988) often depending on how easily individual animals can be followed. Where both methods are

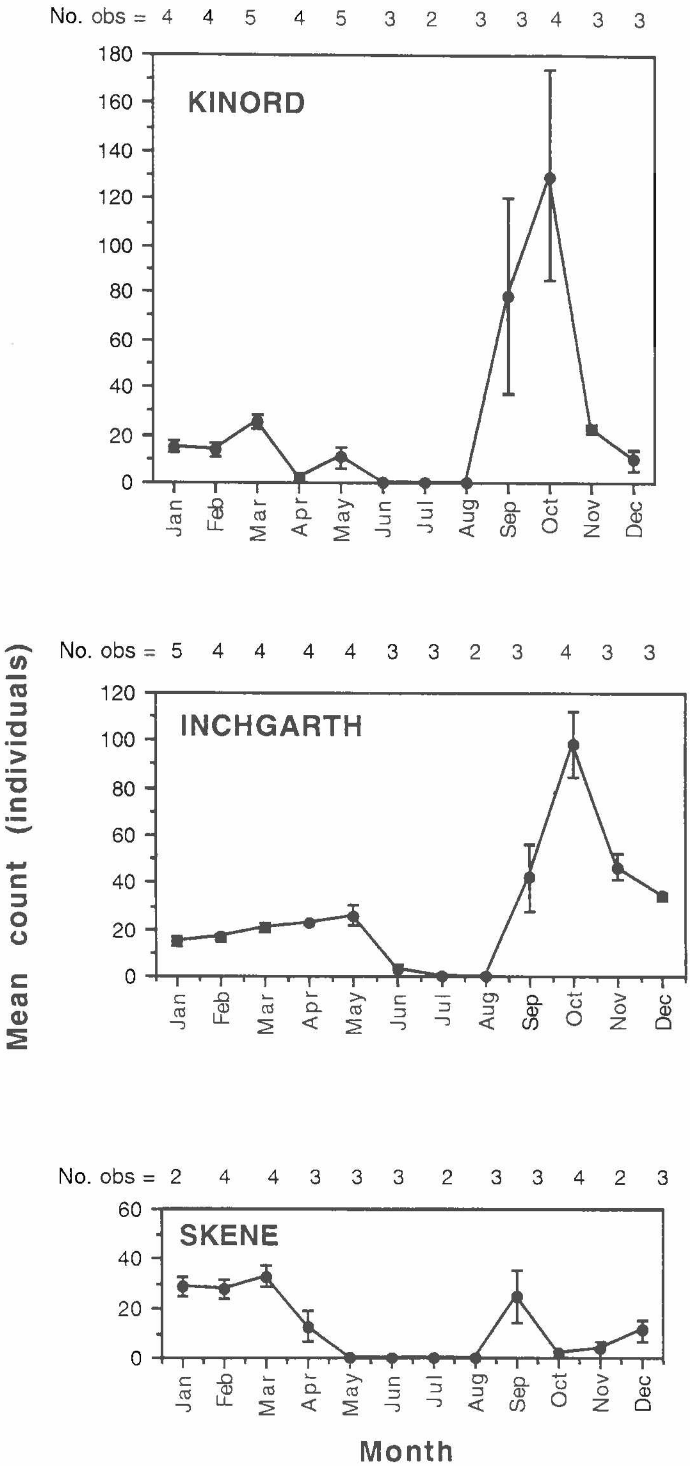


Figure 3. Seasonal trends in the mean (± standard error) counts of Goosanders at three overnight communal roosts in 1989.

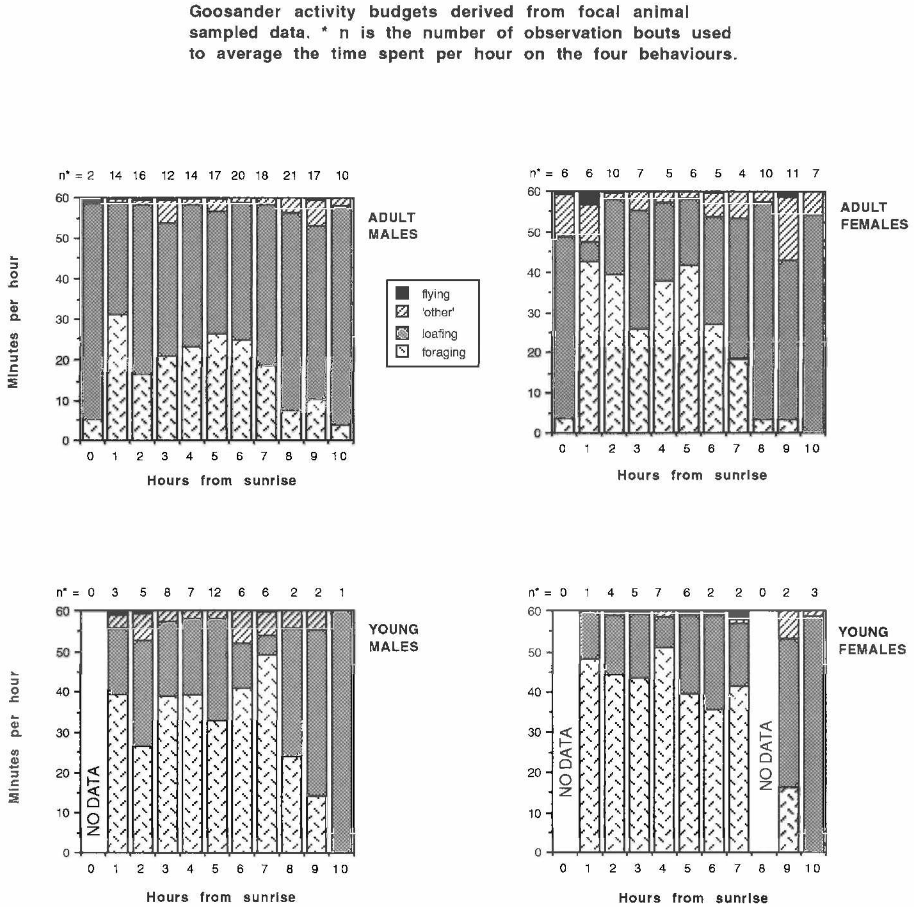


Figure 4. Daytime trends in Goosander behaviour, sampled from the continuous monitoring of focal animals in winter. *n is the number of observation bouts used to average the time spent on the four different types of behaviour.

used simultaneously the results can be almost identical (e.g. Keane & O'Halloran 1992). We tried sampling Goosander behaviour in three different ways, but none of them proved entirely satisfactory.

Focal animal sampling was the most time consuming, but was probably the most accurate for overall activity budgeting. The method was not without some bias because wide ranging activities could not be completely timed, as for example when birds flew out of sight the duration of that activity was prematurely curtailed. There was no way around this problem because excluding such flights biased the data set towards short flights. Instantaneous sweep scan sampling suffered less from this problem but had other disadvantages as for example it was impossible to quickly distinguish young from old females in scans, so these cohorts could not be sampled separately using this method. Opportunistic instantaneous sampling was most easily done, but probably produced the least accurate time budgets because there was strong bias towards those activities, such as flying, which readily drew attention to birds.

Such anticipated bias was sufficient to explain the differences in our estimates of time spent flying on winter days using different sampling techniques. The real figure was probably greater than our smallest estimates of 0.03-0.10 hours (2-6 minutes), but much less than the largest of 0.48 hours (29 minutes). The figures for birds flying in

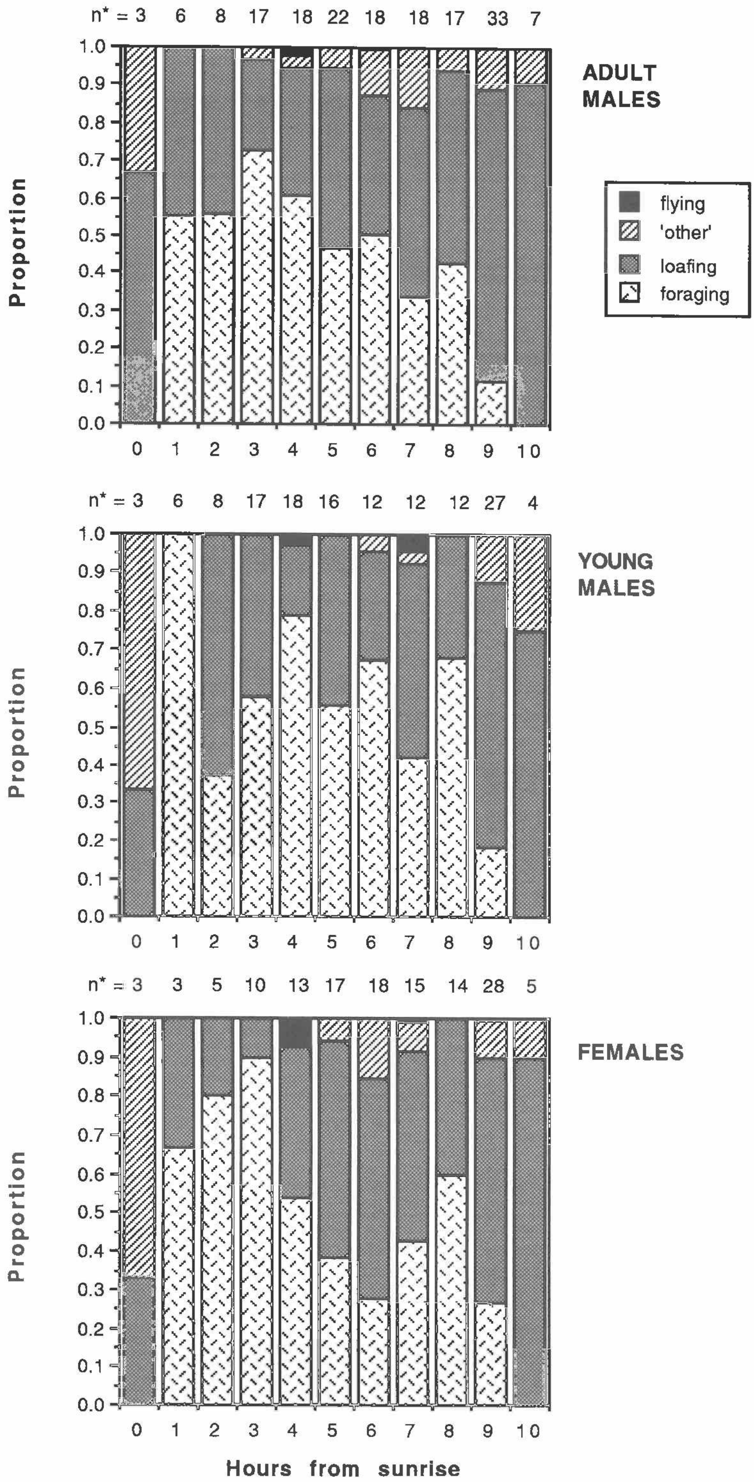


Figure 5. Daytime trends in Goosander behaviour, sampled from sweep scanning groups of ducks in winter. *n is the number of scans used to estimate the proportion of birds occupied in the four different types of behaviour.

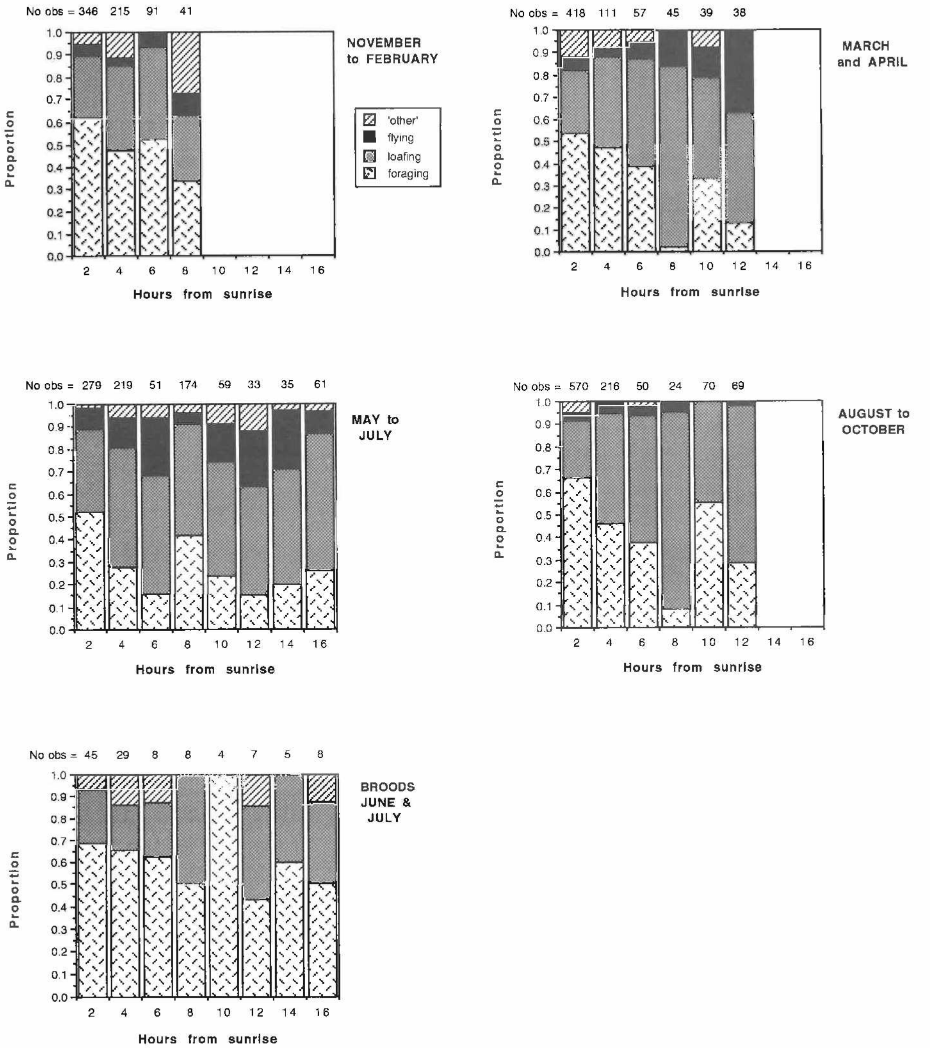


Figure 6. Daytime trends in the behaviour of Goosanders at four times of year, from opportunistically instantaneous sampled data.

spring and summer were probably also grossly exaggerated, arising from the large number of observations of birds flying in nesting areas. This involved pairs of birds in April and young females in May, repeatedly flying around woodland, cliffs and screes, apparently investigating nest sites (as do other cavity nesting ducks, Zicus & Hennes 1989).

The strong bias towards observations of flying birds meant that the estimates for foraging, derived from opportunistic sampling, were minimal. We could however, calculate maximal values by assuming flight time was negligible, and excluding observations of flying birds. The total time spent foraging in winter thus becomes 4.2 hours, closer to the value we might expect considering those derived from focal animal and sweep scan sampling. The same calculations for other times of year give estimates of 4.4 hours spent foraging in spring, 5.3 in summer and 5.0 in autumn.

Despite the inaccuracies associated with the three methods, the same general daily trends existed within all three data sets; foraging was at its peak in the first two hours of the day and decreased thereafter for adults, less so for young birds and least for ducklings. This pattern is consistent with the idea that young birds are less good at foraging than adults (well established for other piscivorous birds such as cormorants, Morrison *et al.* 1978, pelicans , Brandt 1984, herons, Quinney & Smith 1980 and terns, Dunn 1972) and that the energetic requirements of ducklings are particularly high to enable growth.

The differences in foraging times, between cohorts of birds might reflect differences in the rate of food intake; males and adults catching larger prey, or catching prey more often. No matter what the mechanism, this implies that some individuals require more foraging time than others, and under conditions of poor food availability, shorter days could limit daily food intake. The pattern of late arrival times at overnight roosts in midwinter suggests this could be happening in Deeside.

Many wildfowl congregate on large bodies of standing water to roost, and the main advantages suggested for such behaviour are threefold -security from predation/disturbance, information transfer and pair formation (review in Tamisier 1985). All three could apply to Goosanders:-

(i) Overnight roosts on standing waters probably give greater security than roosting on river islets and in backwaters, where the sound of running water could obscure the approach of predators, and where in any case ducks are vulnerable to being dislodged by spate. Nevertheless from April onwards most breeding Goosanders do roost in such places so the disadvantages are not prohibitive.

(ii) Food availability can vary erratically for Goosanders because the abundance and activity of fish can change rapidly with temperature and water flow. Goosanders are also known to aggregate where fish are available and recruit to a feeding site seeded with decoys (Wood & Hand 1985, Wood 1985). It is therefore credible that birds might aggregate overnight to ease food-finding by following other Goosanders to profitable feeding sites the next day. However, although the idea is attractive it is very difficult to demonstrate, and for almost all situations where the phenomenon has been investigated, it remains speculative (reviewed in Mock, Lamey & Thompson 1988, Richner & Marclay 1991).

(iii) The communal roosting of Goosanders is associated with intense social interaction and courtship behaviour, (categorised as 'other' activities above). Irrespective of season, arriving birds show similar behaviour, landing, drinking, then swimming towards any Goosanders already present. As birds approach one another they point their bills upwards ('salute', Cramp & Simmons 1977) usually several times before joining the flock. From November to March adult males are present and they approach females, simultaneously chasing other approaching males. If a female is already paired the attendant male can be involved in a series of aggressive encounters before 'spare' males redirect their attentions to other birds. Such behaviour continues whilst birds are arriving, so that the flock of birds gets larger, swimming back and forth over the water body, accompanied by much interaction, aggression, some splashing and ringing calls. Once birds stop arriving most individuals start preening and by dark most are in a sleeping pose. Some similar behaviour is shown prior to the exodus the following morning, but there is more swimming than courtship or aggression. Such overt social interaction was rarely seen at foraging sites so it is possible that most Goosanders paired up at communal roost sites.

This study was funded by the Scottish Office Agriculture and Fisheries Department. We are grateful to the landowners and tenants of the River Dee watershed for granting us access to the study area. Dr S. Wanless and Dr D.N. Carss gave constructive criticism of the manuscript.

References

Altmann, J. 1974. Observational study of behaviour: sampling methods. *Behaviour* 49:227-267.

Brandt, C. 1984. Age and hunting success in the Brown Pelican: inferences of skill and patch choice on foraging efficiency. *Oecologia* 62:132-137.

Carss, D.N. & Marquiss, M. 1992. Avian predation at farmed and natural fisheries. *Proc. 22nd Ann. Institute of Fisheries Management Study Course. Aberdeen 1991.*

Cramp, S. & Simmons, K.E.L. (Eds). 1977. *Birds of the Western Palaearctic, Vol. 1.* Oxford University Press, Oxford.

Dunn, E.K. 1972. Effect of age on the fishing ability of Sandwich Terns *Sterna sandvicensis. Ibis* 114:360-366.

Duncan, K. & Marquiss, M. 1993. The sex/age ratio, diving behaviour and habitat use of Goldeneye *Bucephala clangula* wintering in Northeast Scotland. *Wildfowl* 44:111-120.

Goudie, R.I. & Ankney C.D. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. *Ecology* 67:1475-1482.

Hill, D.A. & Ellis, N. 1984. Survival and age related changes in the foraging behaviour and time budget of Tufted Ducklings *Aythya fuligula. Ibis* 126:544-550.

Jenkins, D.J. (Ed). 1985. *The biology and management of the River Dee.* ITE Symposium 14. ITE, Huntingdon.

Keane, E.M. & O'Halloran, J. 1992. The behaviour of a wintering flock of Mute Swans *Cygnus olor* in Southern Ireland. *Wildfowl* 43:12-19.

Lindroth, A. & Bergstom, E. 1959. Notes on the feeding technique of the Goosander in streams. *Fishery Board of Sweden, Inst. Fresh. Res. Drottingholm Rept.* 40:165-175.

Madsen, J. 1988. Autumn feeding ecology of herbivorous wildfowl in the Danish Wadden Sea, and impact of food supplies and shooting on movements. *Dan. Rev. Game Biol.* 13:1-32.

Marquiss, M., Feltham, M.J. & Duncan, K. 1991. Sawbill ducks and Salmon. *Fisheries Research Services Report* No 18/91. SOAFD, Aberdeen.

Mock, D.W., Lamey, T.C. & Thompson, D.B.A. 1988. Falsifiability and the information centre hypothesis. *Ornis. Scand.* 19:231-248.

Morrison, M.L., Slack, R.D. & Shanley, E. Jr. 1978. Age and foraging ability relationships of Olivaceous Cormorants. *Wilson Bull.* 90:414-422.

Nilsson, L. 1970. Food-seeking activity of south Sweden diving ducks in the non-breeding season. *Oikos* 21:145-154.

Owen, M., Atkinson-Willes, G.L. & Salmon, D.G. 1986. *Wildfowl in Great Britain.* 2nd ed. Cambridge University Press, Cambridge.

Quinney, T.E. & Smith, P.C. 1980. Comparative foraging behaviour and efficiency of adult and juvenile Great Blue Herons. *Can. J. Zool.* 58:1168-1173.

Reed, A. 1971. Pre-dusk rafting flights of wintering Goldeneyes and other diving ducks in the Province of Quebec. *Wildfowl* 22:61-62.

Richner, H. & Marclay, C. 1991. Evolution of avian roosting behaviour: a test of the information centre hypothesis and of a critical assumption. *Anim. Behav.* 41:433-438.

Salathe, T. & Boy, V. 1987. Territoriality and time budget of breeding Coots. *Wildfowl* 38: 70-76.

Savard, J-P.L. 1988. Winter, spring and summer territoriality in Barrow's Goldeneye: characteristics and benefits. *Ornis Scand.* 19:119-128.

Sjoberg, K. 1988. Food seeking patterns and hunting success of captive Goosanders *Mergus merganser* and Red-breasted Mergansers *M. serrator* in relation to the behaviour of their prey. *Ibis* 130:79-93.

Sjoberg, K. 1989. Time-related predator/prey interactions between birds and fish in a northern Swedish river. *Oecologia* 80:1-10.

Smaldon, R. 1982. Diurnal haunts of Burrator Goosanders. *Devon Birds* 35:92-94.

Tamisier, A. 1985. Some considerations on the social requirements of ducks in winter. *Wildfowl* 36:104-108.

Wood, C.C. 1985. Food-searching behaviour of the Common Merganser *Mergus merganser* II: Choice of foraging location. *Can. J. Zool.* 63:1271-1279.

Wood, C.C. & Hand, C.M. 1985. Food-searching behaviour of the Common Merganser *Mergus merganser* I: Functional responses to prey and predator density. *Can. J. Zool.* 63:1260-1270.

Zicus, M.C. & Hennes, S.K. 1989. Nest prospecting by Common Goldeneyes. *Condor* 91:807-812.

M. Marquiss, Institute of Terrestrial Ecology, Hill of Brathens, Banchory AB31 4BY.
K. Duncan, Scottish Natural Heritage, Achantoul, Aviemore, Inverness-shire.