

ASAB Video Practical

Vigilance Behaviour in Barnacle Geese

Introduction

All the barnacle geese (*Branta leucopsis*) in the world spend the winter in western Europe.

Nearly one third of them overwinter in the UK on large nature reserves such as Loch Gruinart on the inner Hebrides—an island of Islay, Solway Firth, Caerlaverock (Dumfries) and Vane Farm (Tayside).

These traditional feeding grounds are protected and run by the RSPB and the Wildfowl and Wetlands Trust.



Migration

Barnacle geese that arrive at Loch Gruinart to overwinter have spent the preceding spring and summer in Greenland raising their chicks. In late autumn they leave Greenland and migrate, via Iceland, to the rich feeding grounds of the UK, a total of 3 000 km. The geese migrate by instinct, past experience and the position of the sun and the stars.

In good weather the flocks may begin their long flight south at heights of up to ten thousand metres. They are strong, fast flyers and can reach speeds of 65 km/h and usually take about 96 hours to fly from Greenland to Scotland, including a stop-over of around two days in Iceland. In most years seven out of ten birds survive their first migration.

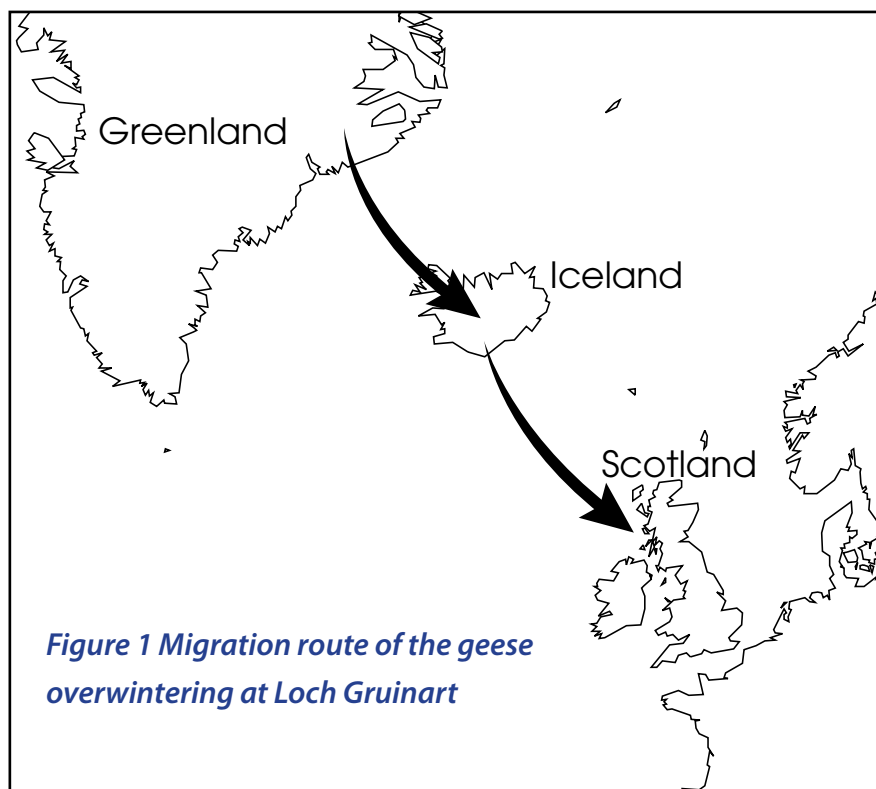


Figure 1 Migration route of the geese overwintering at Loch Gruinart

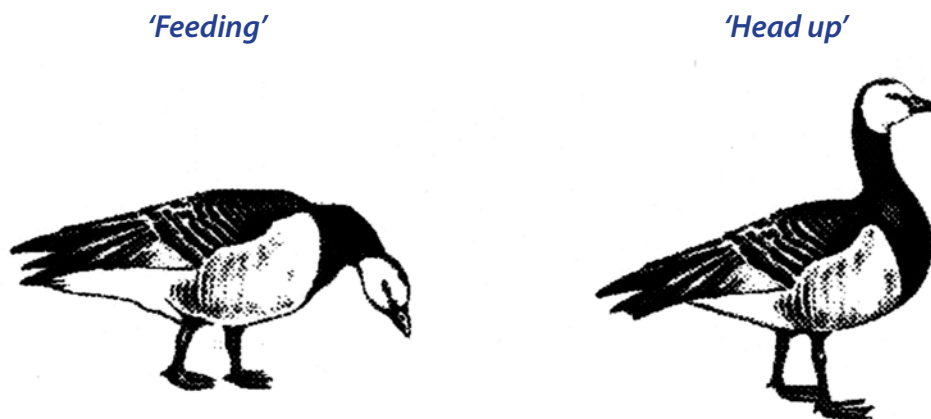
Feeding and vigilance

Barnacle geese come to the UK in the winter to feed on rich grasslands and estuaries along our coastline. A staggering 70 % (18 000 birds) of Greenland's barnacle geese overwinter on the RSPB Loch Gruinart reserve. The rest overwinter on other Hebridean islands or in Ireland. Up to 10 000 geese can arrive at Loch Gruinart in a single day and immediately begin to feed on the salt marshes and adjacent farmland. In early spring they spread out over the rest of the island to find new fields. Barnacle geese forage in large flocks often made up of many family units. Throughout the winter the younger geese learn where best to feed and how to survive by foraging with their family groups.

When an individual is foraging it has to balance the risk of feeding with the risk of possible predation. Gathering in flocks to feed gives an earlier warning of the approach of a suspected predator. At Loch Gruinart this may be anything from a human to a hen harrier and barnacle geese remain vigilant to reduce the risk of possible capture. Early on in the season even a passing car can set a whole field of geese into the air.

Geese are excellent subjects for a study of vigilance. In winter there are large variations in flock size and the open habitat used for grazing makes observation of individuals relatively easy. They also have classic feeding and vigilant postures.

Figure 2 The feeding and vigilance postures of a barnacle goose



The video you are about to watch will involve you in a study of the vigilance behaviour of barnacle geese grazing in winter. You will observe twenty one sequences of the behaviour of geese in flocks, which range in size from 1 20 birds.

Objectives

After the exercise you will:

1. understand the importance of defined categories of behaviour and obtain experience in recording the frequency and duration of defined behaviours;
3. understand the trade-off between feeding and vigilance;
4. understand the advantage of group feeding in reducing vigilance costs.

Demonstration notes

1. Does vigilance change as a function of flock size?

To answer this question the student should be able to interpret the results using two scatter diagrams (Figures 3 and 4), which are plotted from data shown in Table A, and some basic statistics (Pearson correlation coefficient). The results of the practical are that the amount of time individual birds spend being vigilant declines significantly as flock size increases (Figure 3) but the surveillance rate (i.e. the number of 'head ups') does not (Figure 4). Therefore, the overall conclusion from this practical is that if an animal feeds in a group, then the individual's risk of capture by a predator is reduced and so the time spent being vigilant will decline as flock size increases. The underlying reasons for this is that as a group gets larger it becomes increasingly likely that other birds will provide the early warnings necessary of any danger, and the overall risk of capture is reduced. The underlying mechanism here is thought to be that individuals estimate the size of their flock and regulate their time budget accordingly. Surveillance rate is not a significant predictor of vigilance in this study and some reasons for this are outlined below.

2. What other factors are likely to influence the behaviour of an individual?

The answer to the second question should bring in some relevant reviews of the literature which link to three ideas: social status, foraging efficiency, and peripheral predation.

1. Social status

One effect of social status is that parental birds spend more time vigilant than their young (Black & Owen, 1989). This individual variation in vigilance has to be taken into account in most field studies and for a further discussion see Black et al., 1992.

2. Foraging efficiency

The second influence, foraging efficiency, is controversial and has only been demonstrated in a few species of birds. The basic premise is that individuals who assume a head up posture may not be looking out for predators but may be scanning for new food patches or monitoring their neighbours as they feed. This has yet to be shown in barnacle geese.

3. Peripheral predation

The third possible influence relates to peripheral predation, which means that individuals on the outside of a flock are at a greater risk of capture since they will be encountered first by a predator (Black *et al.*, 1992; Inglis & Lazarus, 1981). Peripheral predation also means that the shape of the flock is important and the underlying mechanism may be that different individuals may be estimating the distance to the flock periphery and not the size of the flock.

Background to the investigation

This study was carried out in the winter of 1994 at Loch Gruinart's RSPB reserve on the island of Islay in Scotland. The birds were observed using a remote camera set up on the principal grazing field.

The barnacle geese spent a large part of the day grazing in this field and from time to time stood or walked with a 'head up' posture. Whilst grazing the eyes were very close to the ground and the probability of detecting an approaching predator was very low. Only undisturbed stable flocks were selected for study and in each sample the size of the flock was noted by two observers. Twenty one flocks ranging in size from 1 - 20 birds were monitored in this way.

Each student needs a stop clock (stop watch) and completes Table 1 as she/he watches the DVD or video.

The DVD or video

After a brief introduction to the migration of barnacle geese, the film shows twenty one sequences of one minute duration in which you must score the frequency and duration of 'head-up' (vigilant) postures in a target goose. At the beginning of each sequence the number of geese in the flock being filmed is indicated on screen for you to record also. Your observations are to be entered on Table 1.

After writing up a report of the exercise you should then examine and discuss the data shown in Figures 3 and 4 and answer questions 1 and 2.

- 1. How does vigilance change as a function of flock size?**
- 2. What other factors are likely to influence the vigilance behaviour of an individual?**

References

Black, J. M., Carbone, C., Wells, R. L. and Owen, M. 1992.

Foraging dynamics in goose flocks: the cost of living on the edge. *Animal Behaviour*, 44, 41-50.

Black, J. M. & Owen, M. 1989. Antagonistic behaviour in barnacle goose flocks: assessment, investment and reproductive success. *Animal Behaviour*, 37, 199-209.

Inglis, I. R. & Lazarus, J. 1981. Vigilance and flock size in brent geese: the edge effect. *Z. Tierpsychologie*, 57, 193-200.

Table 1 A check sheet for recording the behaviour of the target animal in the flocks of barnacle geese

Flock number	Flock size	Number of head ups	Time of each head up (s)	Total time vigilant (s)	Total time feeding (s)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
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Figure 3 Relationship between Group size and Vigilance

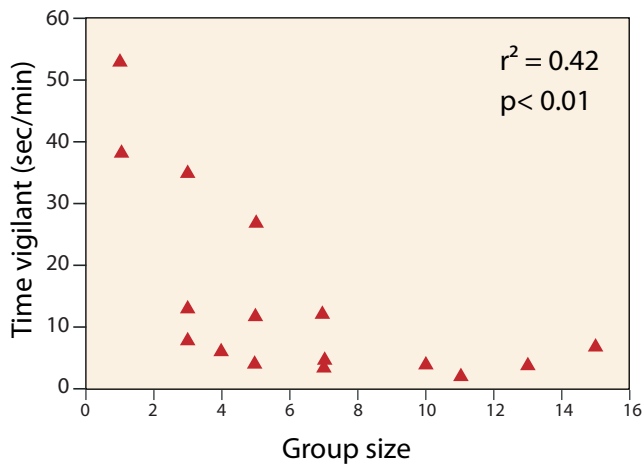
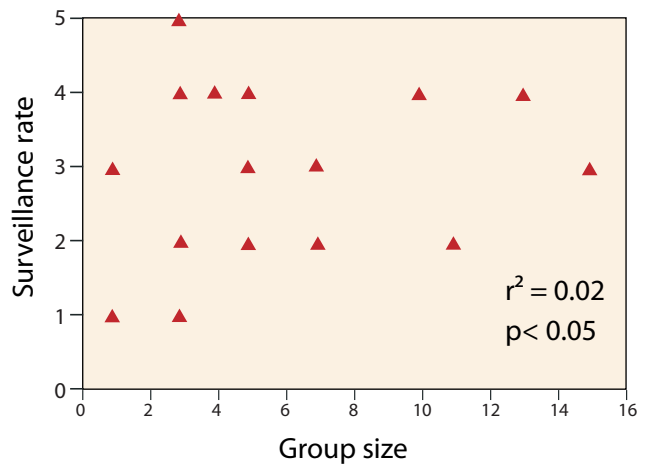


Figure 4 Relationship between Group size and Surveillance Rate



The two figures quoted inside the graphs are for r^2 values. The r^2 values are for the coefficient of determination which indicates to what extent other factors are influencing the two variables being investigated. So if group size and time spent being vigilant are correlated and the coefficient was 0.8 then $r^2 = 0.64$ or 64 %, so group size would explain 64 % of the variation in time spent being vigilant but other factors would explain the remaining 36 %.

The coefficient of determination is used in undergraduate courses for which the DVD/video was originally devised. Teachers of AS/A2/Advanced Higher Biology or Psychology may feel that students could just calculate the correlation coefficient for the data given in Table A: if so, the two values for the Spearman rank correlation coefficients (selected in preference to the Pearson coefficient as the data don't appear linear) for Figures 3 and 4 are $r = 0.78$ (coefficient is significant at the 0.01 level – 2 tailed) and $r = 0.14$ (not significant, $p = 0.602$) respectively.

Table A

Time spent being vigilant and surveillance rate

Group size	Time vigilant (sec/min)	Surveillance rate
5	4	4
15	7	3
5	12	3
11	2	2
3	35	4
3	35	1
13	4	4
10	4	4
7	3.5	2
1	53	1
7	4	3
3	8	2
1	38	3
7	12	2
5	27	2
4	6	4
3	13	5