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Use of neckbands in studying the movements and ecology of the Bean Goose Anser fabalis

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The paper presents methodological experiences of an internordic study based on neckbanding of 365 Bean Geese, also having been marked with aluminium leg rings. Altogether more than 800 reading observations have been received, and of the 191 Finnish marked individuals 63.4 % have been identified after marking. The neckbands, made of doublelayered, UV-protected PVC plastic, have been proved very durable, as well as the visibility of the engraved codes being readable in the field with spotting scopes. No disturbance to birds have been reported from the field, nor observed in cage experiments. The rare cases where the neckbands have been lost do not lower the value of marking as the mortality calculations are based on the leg ring recoveries. The observation work must be specially organized when starting such a study and the marking should be done at the breeding places if birds with known origin are desired. The observation efficiency varies from year to year and in different areas dependent on concentration tendency of birds, the escape distances and the length of periods they stay in areas most intensively studied.

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1. Introduction

Neckbanding is a method much used in North America, especially for studying geese (summarized, e.g., by Day et al. 1980). In Europe its probable disadvantages have been discussed on a more or less theoretical basis, but practical experiences of its real effects and advantages have seldom been presented as, e.g., concerning the Mute Swan (Matthiasson 1976). Plainly, if the opposition on the ethical basis is taken into account, the ways of obtaining as much information of as small amount of marked individuals as possible should be known when such a study is started.

The present study was started in 1976 as an internordic project partly funded by the Nordic Council for Wildlife Research (NKV). The work was co-ordinated by Dr. Mette Fog, Denmark, and the marks were originally developed at Kalö Game Biology Station. The filing and gathering of observations and recoveries from different countries has been managed by Dr. Leif Nilsson, Lund, as well as the organized monitoring in Sweden. Mr. Geir Tveit, Oslo, has managed the marking trials and monitoring excursions in Northern Norway. The authors have developed catching and marking methods and managed the monitoring in Finland, both in the breeding area and in resting places. As the neckbanded individuals have been marked also with normal leg rings, many recoveries have been obtained through the ringing centres. — Since 1980 the neckbanding study has been continued as national projects in Sweden and Finland. The study teams of both countries work in continuous co-operation with each other.

Preliminary reports' on the results of these studies have been published by Nilsson (1984), Nilsson & Persson (1984) and Pirkola & Kalinainen (1984). The aim of this paper is to present methodological experiences, many of which are applicable also to the use of individually coded plastic leg rings.

2. Preparation and material of neckbands

The neckbands used have been made of a double-layered UV-protected PVC plastic (an engraving material for making

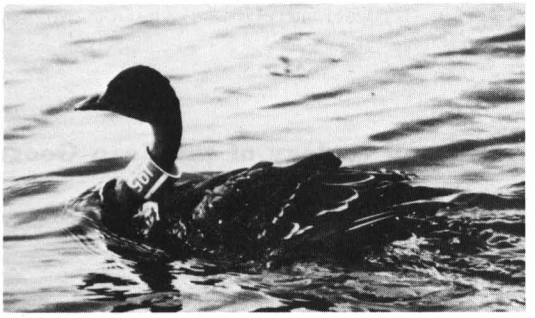

Fig. 1. The neckbands used in Fennoscandia are orange in colour except the code figures and the vertical stripes (white on the birds marked at Finnish breeding places, black in the Norwegian moulting concentrations; no stripes at the Scanian wintering places). Foto: Sauli Moilanen.

signs for outdoors use). The code symbols are engraved with a pantograph; thus they are formed by the underlaying black or white layer, exposed along the 2 mm broad groove and contrasting to the orange colour of the upper layer. The engraved pieces, when softened in hot air (120°-180°) are wound around a wooden tube. When cooled the plastic keeps as a ring, elastic enough to be opened by fingers but, when allowed, immediately returning to the form of spiral with the right diameter. The dimensions (diameter 43 mm, height first 40 mm, later 45 mm) have been determined by experiments on caged birds. The different coloured vertical stripes across the band between the code rows (for the marking area indication) have been made by attaching pieces of adhesive plastic on the surface of the neckband and covering it twice with a polyurethane lacqeur. The neckband is closed around the neck by glueing together the shortly overlapping ends. The thickness of the engraving material is 1.9 mm and the weight of a neckband is 14 grams. The price for one neckband in 1983 was ca. 23 Swedish crowns (mainly labour costs).

The 21 mm high and 5-12 mm broad symbols, engraved in vertical rows of one letter and two numbers, can be read with a tripod-mounted 25 × power spotting scope from a distance of 220 m, and with 40 × power from 280 m. In ideal conditions without wind and air vibration, the distances may be ca. 20 % longer. With 10 × 50 power binoculars the code can be read from a maximal distance of 55 m and thus in practice only from a hide. With bare eyes the neckband can be seen from ca. 250 m or with binoculars from 400-500 meters.

The neckbands sit loosely on the neck feathers and are easily moved by birds when preening. No damage to feathers, nor excessive preening or ice accumulation have been observed on caged birds, nor reported from the field. No changes in behaviour have been observed either in the marked individuals or their species companions. The neckbands have completely maintained their colour and visibility of codes, even after 5 years' exposure. The material cannot be broken in any natural situations. The cases where a hunter has shot an originally neckbanded goose, without finding a trace of neckband on the fallen bird, may be explained by the possibility that the shot pellets have broken the band and it has dropped separately from the bird. Some neckbands obtained from shot birds have indeed been pierced by several pellets with only narrow ridges of plastic holding the halves together. The case where two young, when recaught, were observed to have lost their neckbands may be due to failure in glueing when closing the neckbands. After liberation the birds may have been able to open the neckband sufficiently with a foot to pull it off over the head. Such cases can be avoided by doing the glueing carefully (the nitrile glues Bostik A 3 or 1782 used, demand a vulcanization time of ca. 5 minutes).

The neckbands have been prepared and used in accordance with recommendations of the International Waterfowl Research Bureau (IWRB) from 1979. According to the new co-ordinative system from 1981, the present study uses orange neckbands up to 1985. Beyond 1985, all colour marks used for grey geese in Fennoscandia must be blue. — The orange colour selected for Fennoscandian use in 1977 unfortunately resembles the yellow used for bean goose in the DDR too closely. Confusions have been caused especially by the very yellowish orange (Vynaplast 205) used in Norway 1979. Both groups of the birds migrate partly through Finland and may occur in the same habitat also in the Netherlands, at least in severe winters.

3. Factors affecting the chances of observation

Up to 31st July 1983, 807 observations with the codes read have been obtained of the 365 individuals marked in Fennoscandia between 1976-82 (the recoveries included). In addition, 961 observations have been reported of marked birds in which the code has not been read. The marking area has, however, been recognized in many of them on basis of the vertical stripes. — Of the 191 Finnish marked individuals, 63.4 % have been met with, many of them several times.

Of the total of code read observations, more than 90 % have been made in Southern Sweden, including the surroundings of Lake Tåkern. This is only partly due to the 156 individuals marked in the midst of the most intensively monitored area, Scania. E.g. of the 288 code read observations on Finnish marked birds, 78 % have been made in Southern Sweden, 18 % in Finland, and only 4 % in such countries as Denmark, FRG and the Netherlands. From the DDR, Poland or USSR there are no reported observations, although there are indications that the Fennoscandian Bean Geese at least in some cases may visit these countries (Nilsson 1984).

The high number of observations made in Southern Sweden is partly due to the intensive monitoring there (cf. Nilsson & Persson 1984), and partly to the fact that very large numbers of geese stay there long periods (6 weeks - 6 months yearly) in autumn and winter, feeding daily on the fields. Many thousands of individuals can be checked for the possible existence of neckbands and there are chances to make several attempts to read the codes. On the northern resting areas — even in the peak period of the spring migra-

tion — the chances to get observations are much smaller, as the same individuals usually stay in a locality only 1-3 days. The same holds true for the countries of Northwestern Europe (Denmark, FRG, the Netherlands), where the Fennoscandian Bean Geese do not seem to visit at all in mild winters and where they stay usually only a couple of weeks even in the most severe winters. Total lack of observations from the DDR, Poland and USSR might be explained by the short and perhaps occasional visits by geese, and a low ornithological activity in the areas concerned.

At breeding places even checking geese for the possible occurrence of neckbanded individuals is difficult. Also reading codes is only seldom possible because of factors such as the long escape distances of geese, the varying topography and vegetation, commonly occurring air vibration and often even difficulties in finding an adequate place for the tripod of a spotting scope. Hides are rarely useful except at man-made feeding places, which are mainly visited by non-breeding birds. — 150-500 breeding and non-breeding individuals have been checked yearly, but only a few marked birds have been observed per year. The chances of getting observations are best in the localities of marking in the initial as well as in subsequent years, due to the attachment of adult geese to their earlier breeding localities. Thus, of the 45 code readings made in the Finnish breeding area, all except 5 are controls or recoveries obtained close to the original marking places. — The few checks in the moulting areas of the non-breeders have resulted in only one observation (the code being not read).

The important resting areas of geese — both in Southern Sweden and elsewhere — are frequently visited by amateur ornithologists who, rather commonly have spotting scopes. Despite of it, the observations with the code read have been done for the most part (in Sweden 90 %, in Finland ca. 75 %) by the relatively few persons involved in the study teams equipped with similar optical instrumentation. This must be due to the difficulties in reading the codes of a shy and relatively small species. E.g. on the migratory Whooper Swans *Cygnus cygnus* code readings have been made by Finnish ornithologists more often than on Bean Geese, although the number of marked swans is much smaller (112 individuals, marked in Denmark and Sweden 1978-79). — In some cases an ornithologist has found a neckbanded goose from his photo, although he did not observe it in the field when taking the photo. Also, almost all hunters who have shot a neckbanded goose, have said that they did not see the neckband until retrieving the fallen bird. This indicates that neckbanded geese may escape the attention of people despite being present and visible.

The annual variation in the observability has been large even in the areas of regular monitoring, depending first of all on the length of period which the geese spend in those areas. This is well illustrated by the proportions of geese observed in autumn and winter in Southern Sweden, from those which were marked in the preceding summer and had not been reported dead before the autumn migration. In the mild winter 1982/83, when large numbers of geese spent ca. 2 months even in the Tåkern area and overwintered in Scania, this proportion was 67 %. In the colder seasons 1980/81 and 1981/82 it was ca. 35 % and 25 % respectively. The same holds true also for the spring migration. In 1981 the migration stopped for 1-2 weeks due to a cold spell in April, and the geese remained an exceptionally long time at the resting places of Southern and Western Finland. 15 individuals were identified then but this number has been 6 or less in other years.

The recovery percentage among the Finnish marked geese has been rather high, 22 %, if compared e.g. with the 11.7 % obtained from the leg ring material of 600 bean geese marked in Norway 1969-72 (Tveit 1984). This is, however, mainly due to the rather heavy hunting pressure at the Finnish breeding localities and the intensive campaign among the hunters to activate reporting of recoveries. Also the intensive field studies in the marking localities have made it possible to find more corpses of both marked and non-marked birds, killed by predators, than is normally the case in connection with ringing.

4. The informational value of different groups of individuals marked

The Fennoscandian catching operations and characters of marked birds and observations obtained have been listed in Table 1. In all catching operations, most of the birds can be aged as to be either less than 1 1/2 years old (the exact year of birth is thus known) or older (minimum age is known). Also the individuals which have not been aged with certainty (mainly non-breeders in spring or in moulting concentrations) belong to the group of birds known as to their minimum age. — The catching of flightless birds at breeding places results in more young

Table 1. The marking operations, population characters known and the number of code read observations of Bean Geese neckbanded in Fennoscandia 1976-82. The observations up to 31.VII.1983 have been included. For descriptions of catching methods, see referred literature.

Status of geese caught, catching method	Geographical area, main performers	Total marked	% individuals with known: exact age	birth place	breeding place	Observations
Resting (migrating or wintering) geese, with cannon nets from roosting lakes (See Litzbarski 1979)	Scania (Sweden); B. Jönsson, P. Haartman, A. St. Joseph	156	46	-	2	443
Non-breeding flightless adults in moulting concentrations, by hands or drive nets (See Tveit 1984)	Finmark (Norway); G. Tveit B. Jönsson	18	(10)	-	-	76
Flightless youngs and adults at the breeding places, by hands or with hoops or small fishing nets (See Pirkola & Kalinainen 1984)	Lapland-Ostrobothnia (Finland); the authors, A. Karlin, J. Ruuskanen, S. Saari S. Siirtola, E. Väyrynen	185	78	78	22	288
Non-breeding adults or immatures in the breeding localities, with cannon nets from fields, feeding floats etc.	Ostrobothnia, Northern Karelia (Finland); E. Väyrynen R. Komu, B. Jönsson	3	(33)	-	-	1
Migrating adults and immatures at spring resting places, with cannon nets from fields	Ostrobothnia (Finland); R. Komu	3	(33)	-	-	6
Totals		365				807

(easier to catch) than adults, and thus yields relatively more exactly aged individuals than the other catching operations which are non-selective.

The breeding population is known a) of the individuals, which have been marked as breeding adults, and b) of the individuals which have been marked in other situations but observed later breeding somewhere. E.g. of the individuals marked as flightless young, the birth population is known, but not the breeding population (there are no cases where any of the 46 individuals marked as young in 1979-80 had been observed breeding in the marking locality, in contrast to the 5 of 40 marked adults which have been found breeding at the same places in later years). When starting the study it was thought that the breeding population of many individuals would be detected by later observations at the breeding places. It has proved, however, that such observations are very occasional due to the difficulties in obtaining observations in the breeding localities. The breeding population has been hitherto made clear only for 3 of the 156 Scanian marked individuals (less than 2 %), but none of the 46 possible individuals marked as young, none of 18 individuals marked as moulting non-breeders, and none of those 3 individuals which were marked during spring migration. The chances may perhaps be better among the individuals marked as non-breeders at their early summer stay area, provided that this has some relation to their future breeding locality.

The observation efficiency varies too much from year to year to calculate survival rates from them, due to the effect of the varying length of the birds' stay in even the most important resting areas. E.g. of the 41 individuals marked in Finland 1981, 9 were observed in Southern Sweden in the cold winter 1981/82 (including the observations from autumn months). In the mild winter 1982/83, 6 of these 9 individuals were observed again, but in addition 4 individuals were observed which had not been recognized in the preceding winter.

5. General remarks

The rare cases where the neckband has been lost do not lower the value of marking, because for any mortality studies only recoveries can be used, and the neckbanded individuals are marked also with normal leg rings. In contrast to

observations made sometimes elsewhere (e.g. Litzbarski 1979), no cases of ice accumulation on neckbands have been reported from the field or observed in experiments on caged birds. No changes in behaviour of the neckbanded individuals or their species companions have been observed.

Even if the bean goose is one of the shyest waterfowl species and the neckbands are relatively small, the observation efficiency is surprisingly high. In larger and less shy species the observation percentage may, of course, be still higher as e.g. in Swedish Mute Swan, *Cygnus olor* (85 %, Mathiasson 1976). In some large species, as e.g. the Canada Goose *Branta canadensis*, or large raptors, the technique might well be applied by using individually coded plastic leg rings. In such a shy species as the Bean Goose, it is reasonable to start a neckbanding study only if the observation work can be specially organized.

An international co-ordination for colour-marking should be established for several groups of birds, as has been done for waterfowl by the International Waterfowl Research Bureau (Stronach 1981). The co-ordinative system for geese and swans has been demonstrated to the national ringing organizations, and includes a division of the palearctic area into regions in which only one colour is used. In each colour region the use of codes is co-ordinated separately. — Such colour pairs as orange and yellow should never be used for populations which in some phase of the species' life can intermingle. Concerning the codes, confusions caused by very similar symbols (as e.g. K and X) or combinations (e.g. those which can be read from different directions to being same, as 09N and N60) must be avoided.

In the Bean Goose it has proved that it is very difficult to unravel the breeding population of birds marked on the overwintering areas, in moulting concentrations or during migration. This is mainly due to its habit of breeding dispersed in remote areas. In such species, the only possibility to establish sufficient material of birds with known origin is to mark them at their breeding places. Even if no mass catching is possible, the high re-observation percentage may compensate a relatively low number of marked individuals. It also greatly compensates the disadvantage that mortality among birds marked at breeding places is somewhat higher than among those marked elsewhere, due to the predation on young and the heavy hunting pressure before autumn migration. The birds marked as breeding adults tend to return to their breeding localities in later years and give more chances to get breeding site observations than any other group of birds marked.

Neckbanding is a particularly useful method in studying local movements, especially in the area of marking. It may be used e.g. to check the adequacy of population counts and for investigations of home ranges or the relations of the local population to autumn flocks and hunting. Much information can also be obtained about the social behaviour such as the duration of pair bonds or the permanence of family ties.

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