

## Population size and breeding success of Bewick's Swans wintering in Europe in 1983-4

JAN H. BEEKMAN, SJOERD DIRKSEN and TEUS H. SLAGBOOM

### Introduction

The breeding grounds of the Bewick's Swan *Cygnus columbianus bewickii* are distributed over the arctic tundras of northern U.S.S.R. The total number of birds has been put at about 30,000 (Timmerman 1977). There are two separate populations. Birds breeding west of the Taymyr Peninsula winter in Europe, while those breeding further east migrate to south-east Asia (China, Japan, and Korea). The latter number about 20,000 birds. Furthermore there is an isolated winter haunt in Iran, where normally only small numbers occur. (Cramp & Simmons 1977; Timmerman 1977.)

The migration to the wintering quarters in Europe begins in September and takes place via a narrow front route along the arctic coasts of Russia, the White Sea, then overland via Lake Onega and Lake Ladoga, the Gulf of Finland, north Estonia, the Baltic, Gotland, and southernmost Sweden. First arrivals in the wintering quarters in Denmark, the German Democratic Republic, the Federal Republic of Germany, and the Netherlands may occur as early as the end of September or the beginning of October. Most birds, however, reach these places between mid-October and mid-November. First arrivals in Britain normally occur around mid-October, but the major influx of birds is in November and December. This shift from the continent to Britain and Ireland, is partly a response to cold spells. Peak numbers in Britain and Ireland occur in mid-winter. (Cramp & Simmons 1977; Evans 1979; Salmon 1980, 1981, 1982, 1983; Sheppard 1982.) Depending mainly on the weather situation, movements may occur between Britain and the continent and between Britain and Ireland in either direction throughout the winter (Evans 1982).

The winter distribution of Bewick's Swans in west Europe is concentrated in the Netherlands, England and Ireland, Denmark, and East and West Germany, with only small numbers in France (mainly Camargue), Belgium, Poland, and Sweden

(Cramp & Simmons 1977; Górski & Jesionowski 1983). A few birds may winter on ice-free spots in the Courlandic Haff near Klaipeda, Lithuania (M. Valuis, pers. com.).

The size of the population of Bewick's Swans wintering in Europe has been estimated several times during the last fifteen years. Before that time, an estimate of 5000-10,000 birds was available for the beginning of this century (Bauer & Glutz 1968), and one of 6500-7500 birds for the mid-1950s (Nisbet 1959). In 1958, however, the maximum number of Bewick's Swans counted in the Netherlands was over 10,000 (Timmerman 1977). For the period of 1967-1973 a new estimate of 6000-7000 Bewick's Swans was given for the European population, based upon the results of the International Waterfowl Censuses organized by the International Waterfowl Research Bureau (I.W.R.B.) (Atkinson-Willes 1975). Over the period of 1967-1976 the same author mentions about 10,000 birds (Atkinson-Willes 1981). Mullié and Poorter (1977) organized Bewick's Swan censuses in the Netherlands from 1975 to 1977 and combined the results with the International Waterfowl Census results from abroad. Their preliminary conclusion was that the population held at least 9000-10,000 birds. Poorter (1981) mentions 13,000 Bewick's Swans. These were counted in both January 1976 and January 1977, but the figure for January 1977 is still too low since the data from Ireland and Denmark were incomplete (Poorter, pers. com.). Finally, Scott (1980) assessed the population at 12,000 birds, based on previous publications, to establish the 1% criterium for application of the Ramsar Convention.

Our conclusion from this review is that these figures should be treated with care, since they might either reflect a strong increase in numbers or an uncertainty as to the real population size.

There were three reasons to make a new attempt to assess the population size. In the first place, we had organized the Dutch Bewick's Swan Project 1982-1984 which

aimed, among other things, to assess the importance of Dutch winter haunts for the total population. Secondly, the possible uncertainty about the accuracy of previous estimates justified a new census, particularly to enable application of the 1% criterium, laid down in the Ramsar Convention for conservation purposes.

Finally, an accurate figure for the proportion of cygnets in the population was needed, which could be used as an index for breeding success. Such a figure is useful for the Dutch project, in which we want to compare the distribution of successful breeders with their cygnets versus non-successful birds over areas with different types of food in the Netherlands. The breeding success of the whole population is necessary as a reference. Successful breeders tend to reach the winter quarters somewhat later than non-successful birds (Beekman *et al.* 1981), and the distribution of cygnets over the winter range is uneven (Mullié & Poorter 1977). Therefore, the proportion of cygnets in the population should be established from as large a sample as possible over the whole winter range.

## Methods

There were two possible moments for a census, each having advantages and disadvantages. One possibility was mid-November, immediately after all Bewick's Swans are supposed to have arrived in Europe. By then they feed mainly on submerged water plants (e.g. *Potamogeton* sp.) or waste crops (beets, potatoes, and spilled grain in stubble fields) (Beekman *et al.* 1981; Sheppard 1982). When doing so they are concentrated in relatively few areas, which facilitates counting, since the chance of overlooking significant numbers is small. However, migration, both on the continent itself and from the continent to Britain and Ireland, is at its peak during that period, which might lead to biased results.

Another possible moment to do a census was mid-January, simultaneously with the I.W.R.B. International Waterfowl Census. In order to minimize counting bias, the census had to be carried out in one weekend instead of in a two-week period, as is the usual procedure for the International Waterfowl Census. The advantage of counting in mid-January is that migration hardly occurs in this particular period, pro-

vided that the weather conditions are stable. Disadvantageous is the fact that by then a significant part of the population feeds on wet pastures, dispersed over many sites. The Bewick's Swans are not very "traditional" in selecting such sites, which makes proper counting more difficult since sites not previously used could easily be missed.

To draw conclusions about the best moment to do an eventual follow-up in later years, we decided to organise two censuses and to compare the results afterwards. The weekends (Friday to Sunday) of 11–13 November 1983 and 13–15 January 1984 were chosen. Care was taken to let the November census also coincide with other waterfowl counts.

The national coordinators of the waterfowl censuses in all the countries where Bewick's Swans were to be expected, i.e. the United Kingdom, Ireland, Denmark, East and West Germany, Sweden, Poland, Belgium and France, were contacted. They were asked to set up the Bewick's Swan censuses in their countries and pursue full coverage. Unfortunately, in West Germany the weekend of 21–22 January 1984 was already fixed for the International Waterfowl Census, and this could not be changed. West Jutland (Denmark), with all its inland "fjords", was covered by aeroplane combined with ground counts, since the flocks are difficult to locate in that area and consist of mixed Bewick's Swans and Whooper Swans *C. cygnus*.

Observers were requested to collect data on total numbers of birds, numbers of cygnets and brood size. They were also asked to count on the Saturday of the census weekend.

## Results

### *Census 11–13 November 1983*

#### Weather conditions

5–10 November: calm and mild weather, weak to moderate winds mainly from southerly directions. Maximum temperatures between 10° and 15°C. Mostly dry weather.

11–14 November: dry and cold weather with moderate easterly winds. At night, light to moderate frost; during the day, temperatures between 0° and 5°C on the continent and 5° to 9°C in Britain and Ireland.

Results of the census (Table 1)  
In most countries the national organizers achieved a complete or almost complete coverage of areas where Bewick's Swans occur. Only in Ireland was it impossible to organize a complete count, but overall numbers are usually low there around mid-November (O. J. Merne, pers. com.). In spite of the good coverage the census was not a success. As a result of the weather conditions a lot of birds moved further westwards during the census period. Migrating birds were reported from many places. In Britain, many swans arrived on 12 and 13 November. Data from areas counted on two successive days showed numbers differing considerably from one day to the other. For this reason the data should be interpreted with some care.

In total, 11,536 Bewick's Swans were counted, 11.3% of which were cygnets. The total for each country is presented in Table 1. Around 80% were observed on the continent, the Netherlands accounting for almost half of the total. Areas which held over 500 Bewick's Swans were: in Denmark, Vest Stadil Fjord/Vedersø Klit (1169); in West Germany, the Lower Elbe (503); in the Netherlands, the Lauwersmeer (808), the Noordoostpolder (582), the Border Lakes of the Ysselmeer Polders (1082), and the polders south and north of

the Border Lakes (1371); and in England, the Ouse Washes (1041).

#### Census 13–15 January 1984

##### Weather conditions

11–18 January: very turbulent weather with severe gales from between south-west and north-west on 13, 14, and 16/17 January. At most places daily precipitation 5–10 mm, sometimes 10–20 mm. Temperatures fluctuating between 0° and 9°C.

19–22 January: initially calmer weather with little precipitation, falling temperatures, and winds shifting to easterly directions. Minimum temperatures falling to -2° to -5°C, maximum temperatures in Germany -2°C, and in Britain 3°C. On 21/22 January, there were heavy snowstorms in Scotland, on 22 January also snow in England, Belgium, the Netherlands, and West Germany.

##### Results of the census (Table 2)

During the census an almost complete coverage was achieved, and nearly all the areas were counted between 13 and 15 January. For Ireland the period was somewhat longer, but the organizer successfully obtained a complete figure for the country. Northern Ireland was not covered completely. West Germany was counted one

**Table 1. Observed numbers of Bewick's Swans and proportion of cygnets in Europe, 11–13 November 1983.**

	Total	% cygnets	Number sampled
Sweden	65	16.9	59
Denmark	2045 <sup>2</sup>	11.2	1744
Poland	120	14.0	57
East Germany	733	13.9	490
West Germany	900	15.9	800
The Netherlands	5468 <sup>3</sup>	10.1	5302
Belgium	50		
France	28	22.2	18
England	1969	11.3	355
Northern Ireland	42	9.5	42
Ireland	116 <sup>4</sup>	14.3	28
Total	11536 <sup>5</sup>	11.3 <sup>1</sup>	

##### Notes

<sup>1</sup> The percentage of cygnets in the entire count is the weighted mean of the country means.

<sup>2</sup> Range 2045–2225

<sup>3</sup> Range 5247–5687

<sup>4</sup> Cover incomplete

<sup>5</sup> Range 11,315–11,935

**Table 2. Observed numbers of Bewick's Swans and proportion of cygnets in Europe, 13–15 January 1984.**

	Total	% cygnets	Number sampled
Sweden	0		
Denmark	427	15.8	368
Poland	5	0.0	5
East Germany	135	16.7	48
West Germany	543 <sup>3</sup>		
The Netherlands	8801 <sup>1</sup>	12.5	7444
Belgium	43	18.6	43
France	88	0.0	8
England	4995	9.5	4187
Northern Ireland	130 <sup>4</sup>	3.4	29
Ireland	1114 <sup>5</sup>	8.5	878
Total	16243 <sup>6</sup>	11.3 <sup>1</sup>	

##### Notes

<sup>1</sup> The percentage of cygnets in the entire count is the weighted mean of the country means.

<sup>2</sup> The West German count was on 21–22 January.

<sup>3</sup> Range 8716–8885

<sup>4</sup> Cover probably incomplete

<sup>5</sup> Range 1114–1314

<sup>6</sup> Range 16,196–16,565

week later (see Methods). Fortunately double counts are unlikely as the weather conditions in that week were not favourable for eastward migration. Indeed no movements were reported during the census period which indicates a stable distribution.

The total for the census is 16,281 Bewick's Swans, 11.3% of which were cygnets. Again the totals for each country are listed (Table 2). In addition the spatial distribution of the observed birds is shown in Figure 1. Because of the scale of the map areas with large concentrations are not indicated separately. Therefore areas with more than 500 swans are mentioned here: in the Netherlands, NW-Overijssel/S-Friesland (966), the Noordoostpolder (768), the forelands along the northern part of the River Yssel (1344), the polders south of the Border Lakes (2254) and Zeeland (756); in England, the Ouse Washes (3364); and in Ireland, the Slob/Tacumshin Lake/Killag, Co. Wexford (525).

#### Population size in 1983-4

In January in all countries a complete or almost complete coverage of areas where the species might be found was achieved. Furthermore, as already mentioned, no observations of migration or other large-scale movements were received. So there are good reasons to believe that the January census is a close representation of the number of Bewick's Swans in the population at that time. Therefore it is concluded that the European Bewick's Swan population had at least 16,000-16,500 individuals in the winter of 1983-4.

In comparison with the numbers counted in January 1984, over 4500 swans were missing in November 1983. A few hundred of those will probably have been in Ireland. It is improbable, however, that because of migratory movements more than 4000 Bewick's Swans were overlooked in the counted areas. For that reason it must be



**Figure 1.** Distribution of Bewick's Swans during the census of 13-15 January 1984. One dot represents one site or a cluster of nearby sites. Small dot = 1-160 swans (<1% of total); large dot = >160 swans (>1% of total). Sites which held over 500 swans are mentioned in the text.

supposed that some thousands of birds were still north-east of Poland at the time of the census. Arrival dates in the autumn of 1983 support this suggestion; compared to previous years, arrivals in the Lauwersmeer area (where the first significant numbers arrive in the Netherlands in autumn) were 2-3 weeks delayed.

The total established population size is high compared to the totals published so far. For reasons of comparison and as an extra argument data are presented from January 1983, obtained from various sources (Table 3). In comparison with January 1984 (Table 2), the 1983 totals are higher in Denmark, and in East and West Germany, and lower in England. Because of this difference in the distribution (more eastward!), it seems probable that the January 1983 total of Ireland was lower than that of January 1984. If we use an estimate of 500-1000 for the whole of Ireland, the European total for January 1983 becomes at least 15,250-15,750. Remembering that no special effort was made to visit all areas possibly holding Bewick's Swans during this count, this total is close to the population size established for 1983-4.

*Proportion of cygnets and brood size*

During both censuses in 1983-4 the proportion of cygnets was 11.3%. This means a relatively low breeding success for 1983 (Evans 1979; see also Discussion). The conclusion that the relative mortality of cygnets was similar to that of adults in the period between the two censuses, based upon the identical proportion of cygnets, is not justified, because the proportion of cygnets in the section of the population missing in November is unknown.

Within the part of the population which had already arrived in November, the cygnets were almost evenly distributed

(Table 4). In January, the relative distribution is different. From east to west there seems to be a steady decline in the proportion of young (Table 4). It is clear that proportionally more adults without cygnets migrated to Britain and Ireland in the meantime.

Data on brood size were not collected in all countries. Especially in Denmark and the Netherlands, where special projects concerning the species were being carried out, many data were collected (Table 5). The mean brood size in the population was rather small: 1.79 in November and 1.67 in January. Remembering the low proportion of young, this is in accordance with the correlation between brood size and proportion of young found by Evans (1979) for the birds wintering at Slimbridge, England.

**Table 3. Numbers of Bewick's Swans in Europe during the I.W.R.B. mid-winter census, January 1983.**

	Total	Source
Sweden	0	I.W.R.B.
Denmark	1077	I.W.R.B.
Poland	5	I.W.R.B.
East Germany	295	I.W.R.B.
West Germany	891	G. Dahms/I.W.R.B.
The Netherlands	8734	Bergh (1985) <sup>2</sup>
Belgium	?	
France	90	Ph. Dubois (L.P.O.)
England	3690	Salmon (1983)
Northern Ireland	12 <sup>1</sup>	I.W.R.B.; no more data available
Ireland	86 <sup>1</sup>	O. J. Merne (For. & Wildl. Serv.)/ I.W.R.B.; no more data available
<b>Total</b>	<b>14880</b>	

Note

<sup>1</sup> Incomplete.

<sup>2</sup> Also data from Dutch Bewick's Swan Project 1982-1984.

**Table 4. Proportions of cygnets in different (groups of) countries during both censuses.** All figures are weighted means, derived from Tables 1 and 2.

	11-13 November 1983	13-15 January 1984
Sweden, Denmark, Poland, GDR, FRG	13.0	15.9
The Netherlands Britain, Ireland	10.1	12.5
	11.4	9.2
	11.3	12.6

Note

<sup>1</sup> Belgium and France inclusive.

### Discussion

The population size established in this study is high compared to those previously published. As explained above, it is felt that the estimate is an accurate one. To explain the differences, the number of Bewick's Swans must have been under-estimated in former years, or the population must have increased.

Under-estimation of the population size in former surveys (Nisbet 1959; Atkinson-Willes 1975, 1981; Timmerman 1977; Poorter 1981) cannot be excluded. Different publications contradict each other. For instance, Atkinson-Willes (1981) and Poorter (1981) mention 10,000 and 13,000 birds respectively for overlapping periods. The completeness of a census depends totally on full coverage of the distribution range of the species. Since the beginning of the International Waterfowl Censuses more and more areas are being counted. Bergh (1985) stresses the importance of full coverage during these censuses and shows that the numbers of waterfowl counted in the Netherlands have increased during 1973-1983 due to an increase of counted areas. By the same token, this effect will hold for the whole of Europe. Furthermore, comparison of the results from International Waterfowl Censuses (Atkinson-Willes 1975, 1981; this paper, see Table 3) and those from censuses focussing on Bewick's Swans (Poorter 1981; this study) shows that the latter result in consistently higher totals counted. Besides that, the estimate of Poorter (1981) can be considered as a good minimum figure for 1976 and 1977, but the data were still incomplete (Poorter, pers. com.). Therefore, it can be concluded that the population size has been underestimated so far.

An actual increase in numbers in a popu-

lation can either be caused by growth, as a result of recruitment being higher than mortality, or by an influx of birds into the population, coming from another population. In this particular case, the latter could be caused by birds shifting from the eastern population to the western one. This is only a theoretical possibility, and there are no data to support this. Of the few birds neck-banded in the eastern population by Russian and Japanese researchers (Yoshii 1981), none were resighted in Europe. Furthermore, in geese from different breeding populations having overlapping or nearby winter quarters, very little exchange between the populations occurs (e.g. Barnacle Geese *Branta leucopsis*, Ogilvie & Owen 1984).

To realize growth in a population, the breeding success must exceed the annual mortality rate. Evans (1979) gives 12.9% annual mortality for adult birds (i.e. birds of breeding age). Owen and Cadbury (1975) found twice as high a mortality for cygnets as for adult birds during winter. Mortality in cygnets of Mute Swans *C. olor* is at least three times that of adult birds (Andersen-Harild 1981). We therefore consider 12.9% as a minimum figure for annual mortality rate in Bewick's Swans.

We calculated average yearly growth rate for the population and average yearly breeding success (i.e. mortality plus calculated growth) needed to reach 16,250 birds in 1984, from different population sizes previously published. For the moment, we assume 6500 Bewick's Swans in 1970 (Atkinson-Willes 1975), 10,000 in 1972 (Atkinson-Willes 1981), and 13,000 in 1977 (Poorter 1981), to be true. The calculations are shown in Table 6.

The calculated figures for average yearly breeding success should be compared with observed figures. Since the distribution of

Table 5. Data collected on brood size during both censuses.

	11-13 November 1983							13-15 January 1984								
	No. cygnets					No. fam.		No. Brood	No. cygnets					No. fam.		No. Brood
	1	2	3	4	5	fam.	cyg.	size	1	2	3	4	5	fam.	cyg.	size
Denmark	41	34	15	3	-	93	166	1.78	13	15	5	-	-	33	58	1.76
East Germany	3	4	3	-	-	10	20	2.00								
West Germany	19	22	13	3	-	57	114	2.00								
The Netherlands	135	66	39	11	4	255	448	1.76	200	132	51	6	1	390	646	1.66
England	11	6	1	-	-	18	26	1.44	13	8	2	-	-	23	35	1.52
Ireland									6	10	3	1	-	20	39	1.95
Totals						433	774	1.79						466	778	1.67

**Table 6. Previous estimates of population size and calculated required growth and breeding success leading to a population of 16,250 Bewick's Swans in 1984. A constant mortality rate of 12.9% (Evans 1979) is assumed as a minimum figure (see text).**

Year	Population size	Annual growth (average)	Annual breeding success (average)
1970	6,500 (Atkinson-Willes 1975)	6.3%	19.2%
1972	10,000 (Atkinson-Willes 1981)	3.8%	16.7%
1977	13,000 (Poorter 1981)	3.2%	16.1%

cygnets over the population is uneven (see Table 4) and because there are no data on breeding success available measured over the whole population, a problem arises here. The best series of breeding success over a longer period of years and based on data throughout the winter, are probably those given by Evans (1979) for Slimbridge and the Ouse Washes in England (updated by E. C. Rees (pers. com.)). Over the period 1970–1984, average yearly proportion of cygnets observed there are 16.2% and 13.2% respectively. In the Onnerpolder in the Netherlands, average yearly proportion of cygnets observed over 1976–1984 was 15.8%, also based on data throughout the winter (Beekman & Dirksen, unpubl. data). In Ireland, over 9 years during 1970–1981 the average yearly proportion of cygnets was 12.7% (Sheppard 1982). These figures are somewhat lower than those calculated in Table 6. Considering that mortality is probably somewhat higher, the conclusion is justified that actual growth of the population must occur at a lower rate than calculated in Table 6, or that growth does not occur at all.

Although figures on population size, which have been published through the years, suggest an increase in numbers of Bewick's Swans wintering in Europe, the results from former surveys should be interpreted with care. Coverage of areas during censuses has improved a lot, and an increase in numbers at a rate implied by the results of these surveys is not plausible. From a conservation point of view care should be taken before drawing this kind of conclusions. To do so, one needs reliable estimates of population size and accurate figures of yearly recruitment and mortality.

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#### Summary

In the 1983–4 winter, two international censuses of the Bewick's Swan *Cygnus columbianus bewickii* were organized in Europe. The population size was assessed at not less than 16,000–16,500 birds, which is more than ever counted before. The distribution of the Bewick's Swans over the winter quarters in Europe is given. Breeding success in 1983 was 11.3%, brood size was about 1.7. Previous estimates of the population size were too low and growth of the population is questionable.

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**Jan H. Beekman**, Pluimerstraat 33A, 9711 SV Groningen, the Netherlands.

**Sjoerd Dirksen**, van Heemskerkstraat 16A, 9726 GK Groningen, the Netherlands.

**Teus H. Slagboom**, Benedictijnenhove 10, 3834 ZA Leusden-C, the Netherlands.