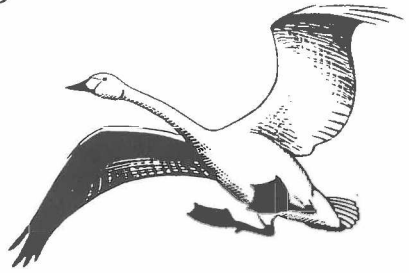


# Habitat use by Whooper Swans *Cygnus cygnus* and Bewick's Swans *Cygnus columbianus bewickii* wintering in Denmark: Increasing agricultural conflicts.



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*Coordinated counts of Whooper and Bewick's Swans were carried out in Denmark during the winter seasons 1991-92, 1992-93 and in January 1992-94. Average numbers in the January counts were 1,130 Bewick's Swans (c.8% of the flyway population) and 15,800 Whooper Swans (c.63% of the flyway population). Habitat use in Denmark has changed during the past few decades for both species. Previously Whooper and Bewick's Swans fed mainly in natural habitats, whereas both species in this study (c.80%) fed mainly on farmland. Whooper Swans, in particular, fed on wintergreen crops causing agricultural conflict. Numbers of complaints about swans causing crop damage have increased rapidly since the mid 1980s, a development closely connected to the increase in Danish farming areas with wintergreen crops.*

**Keywords:** *Whooper Swan, Bewick's Swan, Wintering Grounds, Habitat Use, Agricultural Conflicts*

Whooper Swans *Cygnus cygnus* wintering in the continental part of Europe belong mainly to the Scandinavian and Western Siberian population (e.g. Cramp & Simmons 1977, Mathiasson 1991). Since the late 1960s, the shallow Danish coast has been known to hold large numbers of wintering Whooper Swans (Joensen 1974). Present estimates (Monval & Pirot 1989) suggest that Denmark holds about one third of the Whooper Swans wintering in continental Europe.

Although Denmark is more important as a staging area than as a wintering ground, Bewick's Swans are known to winter along the Danish west coast in varying numbers depending on the severity of the weather (Joensen 1974, Monval & Pirot 1989).

As a large number of Whooper Swans winter regularly in Denmark, and as no effective national surveys have been made specifically on Whooper or Bewick's Swans, a national coordinated census was carried out in Denmark, 1992-94. The aim was to describe present occurrence of migratory swans by assessing seasonal variation in numbers, site and habitat use.

As the study progressed, it became obvious that swans were feeding on farmland habitats causing conflict with agriculture. As the problem appears to be relatively new and hitherto undescribed, information on its historical development was also collected.

## Methods

The surveys were organised by the National Environmental Research Institute (NERI), Kalø, and the fieldwork was undertaken by volunteers and staff of the field stations of the Ministry of Environment. Counting sites were selected based on information from Joensen (1974), Pihl (1992) and the knowledge of local volunteers. Additional material was supplied by faunistical surveys of the Danish Ornithological Society and aerial waterfowl censuses undertaken by NERI as part of the IWRB waterfowl counts (IWC). Coordinated counts were conducted on a monthly basis in the period October to April 1991-1993, November 1993 and January and March 1994. For a

detailed description of the count organisation, see Laubek (1995). Counters were asked to count on Saturdays in an attempt to avoid double registration. Counts made plus or minus one week from the counting weekend were accepted for analysis.

The following information was recorded on a site basis: numbers of Whooper and Bewick's Swans, numbers of juveniles and adults, brood size, flock size and choice of habitat. Locations of flocks were drawn on maps 1:100,000 or 1:25,000. Material on the development of agricultural conflicts was collected using a questionnaire sent to the Danish national network of Game Consultants of the Ministry of Environment in the spring of 1993. The consultants were asked how many complaints they had received annually during 1975-1992. They were asked also about the swan species and crops involved in each complaint.

## Results

### Numbers and distribution

The Whooper Swan is the most numer-

ous (Table 1) and widespread (Figure 1A) of the two species. Birds arrive from early October and depart in March or early April. In both winters, 1991-92 and 1992-93, numbers peaked in January (Figure 2A). With a counted midwinter population of c.16,000 Whooper Swans, more than half (c.63%) of the Scandinavian-Russian flyway population winters in Denmark. The current population estimate is 25,000 (Rose & Scott 1994). Although this is a widespread species, almost two thirds of the birds were found within three areas: Limfjorden (57°04'N, 09°40'E), Mariager Fjord (56°43'N, 10°10'E) in North Jutland, and the fjords and coasts of South Sealand and Storstrøm (55°03'N, 12°13'E).

Table 1. Numbers of migratory swans counted in Denmark, January 1992-1994.

	1992	1993	1994
Bewick's Swan	1159	954	1279
Whooper Swan	16,128	15,501	15,821

On the basis of knowledge about numbers of birds at the different sites in previous years, it is estimated that 90-95% of all Whooper Swans were counted (Laubek 1995).

Bewick's Swans were found mainly in north and west Jutland (Figure 1B).

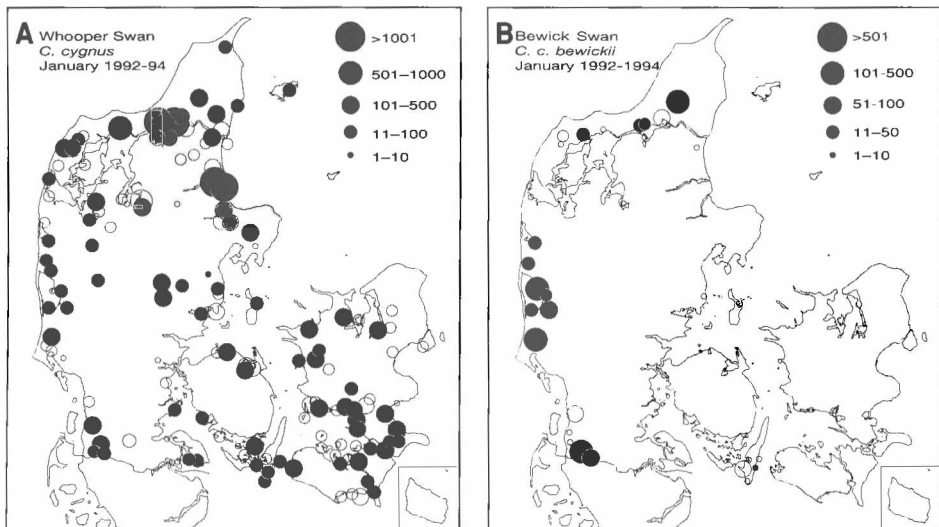
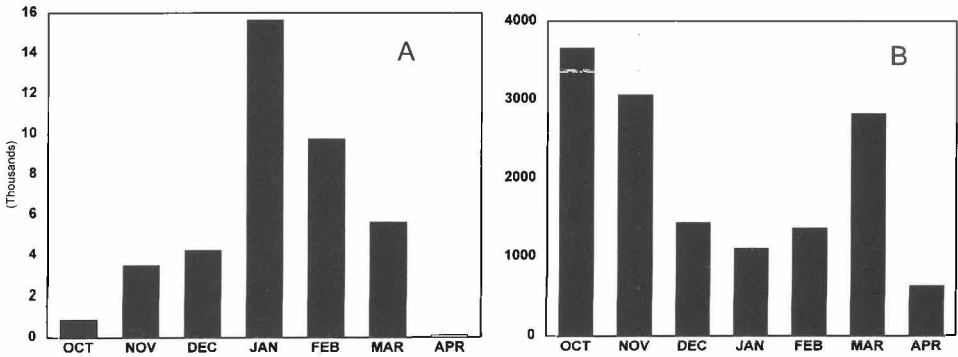


Figure 1. Distribution of Whooper Swans (A) and Bewick's Swans (B) in Denmark, January 1992-94. Sites with observations from more than one year are shown as filled circles, referring to the average number. Sites with observations from one year are shown as open circles.



**Figure 2. Phenology of Whooper Swan (A) and Bewick's Swan (B) in Denmark, October–April 1991–93, expressed as the average number of birds per month during the two seasons.**

Apart from having a restricted geographical distribution, the majority of birds were found in only ten sites. Maximum numbers of birds were found during migration in October–November and in March (**Figure 2B**). Peak numbers of about 5,000 birds were counted outside census weekends. During autumn migration, swans were found evenly distributed on sites in north and west Jutland while, during spring migration, birds were concentrated at sites in the north of Jutland. The midwinter population numbered about 1,000 birds (**Table 1**).

From the known staging areas used by Bewick's Swans, it is assumed that more than 95% of those present in Denmark

were counted (Laubek 1995).

*Habitat use*

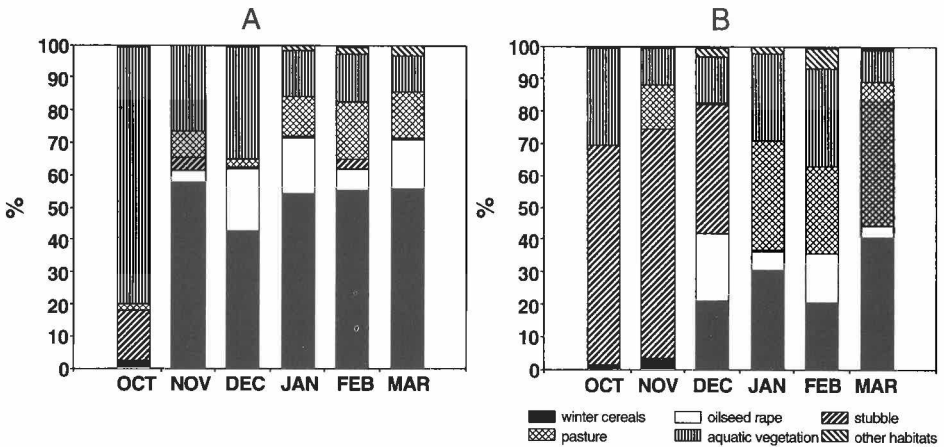
Whooper Swan: The choice of habitat is shown in **Table 2**. The relative proportion of Whooper Swans on different habitats was roughly the same during the 1991–92 and 1992–93 seasons. The relative importance of the various habitats changed during both seasons (**Figure 3A**).

On arrival in October, almost 80% of the Whooper Swans foraged on water, mainly shallow marsh areas and fjords where they fed on submerged vegetation such as *Zostera*, *Ruppia*, *Chara* and *Zannichellia palustris*. During November

**Table 2. Habitat use by Whooper and Bewick's Swans in Denmark, October to March 1991–92 and 1992–93, expressed by the seasonal number of calculated swan-days per habitat.**

	winter wheat	oilseed rape	stubble	pasture	aquatic vegetation	waste potato	ploughed	other <sup>1</sup>	n <sup>2</sup>
<u>Whooper Swan</u>									
1991–92									
Swan-days	570,698	87,497	13,019	109,326	155,564	2,458	0	8,971	39,909
%	(60.3)	(9.2)	(1.4)	(11.5)	(16.4)	(0.3)	(0)	(0.9)	
1992–93									
Swan-days	668,844	217,766	36,163	193,679	267,834	17,869	0	11,608	42,898
%	(47.3)	(15.4)	(2.6)	(13.7)	(18.9)	(1.3)	(0)	(0.8)	
<u>Bewick's Swan</u>									
1991–92									
Swan-days	78,765	32,044	68,842	128,070	22,082	70	0	139	6,548
%	(23.9)	(9.7)	(20.9)	(38.8)	(6.7)	(0)	(0)	(0)	
1992–93									
Swan-days	57,421	12,322	166,299	43,522	87,887	4,218	50	3,418	19,653
%	(15.3)	(3.3)	(44.4)	(11.6)	(23.4)	(1.1)	(0)	(0.9)	

NOTES: <sup>1</sup> Other habitats include peas, carrots, sugar-beet and fallow.  
<sup>2</sup> n is the actual number of swans counted on habitats.



**Figure 3.** Habitat use of Whooper Swan (A) and Bewick's Swan (B) October–March 1991–93, expressed as the relative monthly average distribution on six habitat types during the two seasons. Whooper Swan ( $n=82,807$ ), Bewick's Swan ( $n=26,201$ ).

and December, 30% of the birds were found on water. During the rest of the season, less than 15% of the birds were seen on water. Swans switched quickly to arable land from early November when 50–55% of them fed on winter wheat *Triticum aestivum*, winter barley *Hordeum vulgare* and winter rye *Secale cereale*. From late November, Whooper Swans started foraging on winter Oilseed Rape *Brassica napus*; during December and January, about 20% of the birds did so, dropping to about 10% during the rest of the season.

The spring of 1994 was very different from the previous two springs because frost and snow in February had devastated the green plants of Oilseed Rape, grass and winter cereals making these unattractive as food sources. Instead, Whooper Swans fed on flooded fields of stubble and grassland (70%) and potato (10%). In total, approximately 80% of all Whooper Swans were observed feeding on farmland.

**Bewick's Swan:** Habitat utilisation summed for each of the two winter seasons is shown in **Table 2**. The relative importance of the different habitats varied considerably between the two winter seasons but also within each season (**Figure 3B**).

On arrival in October and during November, more than 65% of the

Bewick's Swans were seen on stubble fields, and the remainder were observed on water, pasture and artificial grassland. During late November and December, the relative importance of stubble fields decreased. The birds then shifted to wintergreen fields. From late December until departure in March or April, about 40% of the birds were feeding on winter wheat and winter Oilseed Rape. The rest of the birds mainly foraged on flooded pastures and cultivated grassland (c. 40%) or on aquatic vegetation in the fjords (c. 15%). An increase in the proportion of birds foraging on water in January and February was caused by short periods of frost and snow which forced the birds off the fields onto the unfrozen fjords and large lakes of west Jutland. Since most swans also sleep in the feeding habitat during daytime, observers were not asked to distinguish between feeding and sleeping birds, but merely to count the number of birds on the habitat. The importance of aquatic vegetation as a food resource is, therefore, probably overestimated because many swan flocks observed on water during the daytime consisted of birds which had remained at the roosting site and were not foraging but just preening and sleeping. Especially on cold days, when swans left the roost late, many birds were counted on water.

As for Whooper Swans, the spring of 1994 was somewhat different. About 57% of the Bewick's Swans fed on potato fields and the majority of the rest (24%) fed on flooded pastures and stubble fields where they dug up roots.

### Agricultural conflict

The first swan damage was reported to the Game Consultants in 1974, and the numbers of complaints, as well as the area with wintergreen crops, were fairly stable until about 1982. Since then the number of reported cases of swan damage gradually increased during the mid 1980s with a short break only in 1986–87 due to a very cold winter. The birds were partly forced off the fields in mid-winter 1986–88 due to snow cover. Furthermore, a cold spell in January 1987 destroyed many wintergreen fields, which led to low yields of winter crops that season. Many farmers therefore, did not grow winter crops the following year, thus explaining the drop in 1987–88.

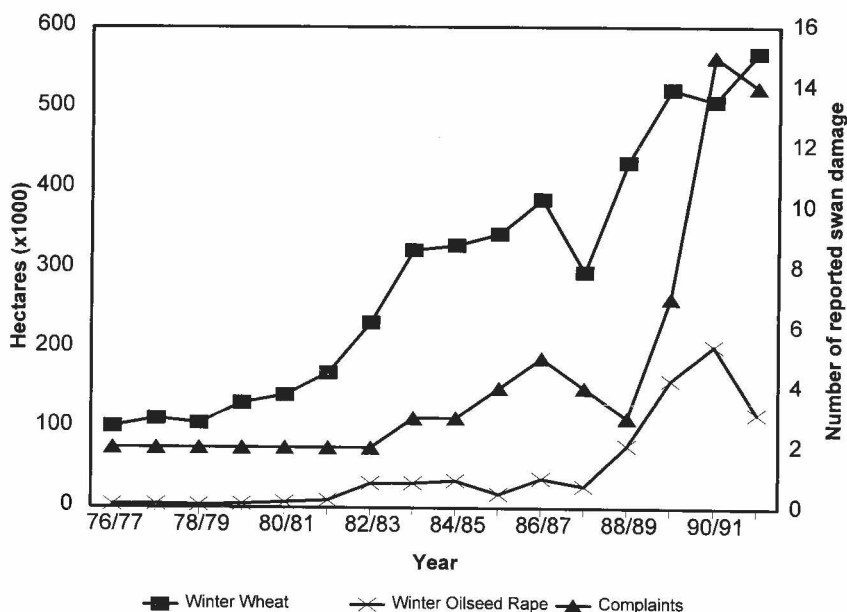
The number of cases of damage reported to the Game Consultants has increased since the early 1980s, the development accelerating since 1988 (Figure

4). In total, 62 incidents were registered in the period 1980–1993 covered by the questionnaire. Out of 17 Game Consultant districts, 11 reported conflicts between farmers and swans; in ten districts, all damage was reported during the period January to April. Nine districts had problems with Whooper Swans and, in two districts, Bewick's were reported to have caused damage. In all 11 districts with swan conflict, damage was reported to Oil-seed Rape and winter wheat, two districts also reported damage to winter barley and finally one district reported damage on winter rye and grassland *Lolium* sp.. The development in farm land areas of winter wheat and Oil-seed Rape, the preferred wintergreen crops exploited by swans, are shown in Figure 4. Coinciding with the increase in agricultural conflict, the total areas sown with these two crops has increased considerably during the 1980s and early 1990s.

### Discussion

#### *Distribution and numbers*

Whooper Swan: Counts from 1965–73, covering the majority of Danish sites



**Figure 4.** Development of Oilseed Rape, winter wheat areas and the number of complaints of swan damage in Denmark, 1976–92. Data on winter wheat and Oilseed Rape areas were compiled from the Danish Statistical Institute.

(Joensen 1974), ranged from 5,700 birds in mild winters to 10,800 in cold winters. Comparing these numbers with the results of the 1991-1994 surveys, which were all in mild winters, there seems to have been a considerable increase in numbers of Whooper Swans wintering in Denmark. This corresponds with an increase in the breeding populations in Sweden and Finland (Arvidsson 1987, Ohtonen 1992), from which at least part of the Danish wintering population originates (Preuss 1981, Mathiasson 1991, Ohtonen in litt.).

Compared to the distribution of birds found by Joensen (1974), there has been a slight decrease in midwinter numbers of Whooper Swans in the fjords of west Jutland, whereas there have been increases in numbers in north and northeast Jutland. The midwinter population in southeast Denmark has not changed much during the period.

**Bewick's Swans:** During January 1969-73, Joensen (1974) counted, on average, 685 birds (range 470-1,113), the average of January counts 1992-94 is 1,093 birds. But, in fact, only the mild winter of 1972-73 could be compared with the three mild winters of 1991-94. In January 1973, 1,113 Bewick's swans were counted. Thus the Danish wintering population seems to have been stable during the past 25 years, despite the fact that population estimates during the past 40 years have been increasing steadily (Rüger *et al.* 1986, Monval & Pirot 1989, Dirksen & Beekman 1991, Rose & Scott 1994).

Comparing the distribution of the two species, Bewick's Swans are not only restricted to relatively few sites with many birds, but are also more traditional in the use of these areas. Whooper Swans are more widespread, due to their use of a broader spectrum of landscape types, and at least part of the population seems to be much less traditional in its choice of wintering and staging sites. These birds often use temporarily suitable sites in river valleys and farmed bog areas inland. However, the majority of Whooper Swans are found in diked fields near the coast and fjords, or at drained lakes.

#### *Choice of habitat and conflict with farmers*

Only two decades ago, the feeding habits of both species were quite different. The first reports of Danish Bewick's Swans feeding in the fields date to January 1964 (Poorter 1991) and a slow increase in numbers feeding in fields might have taken place during the 1960s. Descriptions from Schiöler (1925), Spärck (1958), Schelde (1961), Salomonsen (1962) and the maps of Joensen (1974) and Christensen (1987) showed that the majority of both species fed on natural habitats until the beginning of the 1980s. Before this, only a smaller fraction of the birds fed on stubble fields and pasture during autumn and spring. The main shift from aquatic to field feeding on the Danish staging and wintering grounds took place during the late 1970s, i.e. five to ten years after Poorter (1991) described a similar shift by Bewick's Swans in The Netherlands.

Compared to Dutch studies (Dirksen *et al.* 1991), the Bewick's Swans on the Danish autumn staging areas seem to have replaced pondweeds with ears and seeds left in stubble fields. Furthermore, the importance of pastures and artificial grassland as foraging habitats during winter and spring is much less significant than in The Netherlands. Finally, the percentage of swans foraging on arable land (27%), is about 10% higher than found in The Netherlands (Dirksen *et al.* 1991).

The studies of habitat use showed a remarkable difference between the two swan species. Although 80% of all observed birds of both species were seen on farmland, the fact that only about 25% of the Bewick's Swans fed on arable land, compared to 75% of the more numerous Whooper Swans, is the major reason why almost all swan damage reported in the questionnaire was caused by Whooper Swans.

The habitat switch from aquatic to field feeding seems to be triggered by a combination of eutrophication of a number of important wintering sites in the late 1970s and early 1980s, forcing the birds to find alternative food sources, and, very conveniently for the swans,

the change in farming practice during the 1980s which offered them attractive foods. Despite the recovery of submerged vegetation in some areas during the late 1980s and early 1990s (cf. Limfjordsovervågningen 1992), the swans preferred to stay in the new field habitats.

However, coinciding with the introduction of the Oil-seed Rape type "OO" in 1988, the number of complaints about swan damage increased dramatically and most complaints since then have concerned rape. The same year, the Danish government decided on a number of regulations to protect the ground water, lakes and the sea against wash-out of pesticides and nitrate. This meant that farmers were obliged to lay down a minimum of 65% of their arable land with wintergreen crops before 1990 and, by 1992, this had increased to 80% of the arable land.

Considering the fact that, for many years ahead, Danish legislation, with the purpose of protecting freshwater

resources, will lead to a high proportion of wintergreen fields, there will probably be no decrease in conflict between farmers and swans. Furthermore, with the set-aside scheme of the European Union, farmers have to put 10–15% of arable land into nonfood production or leave it fallow. In Denmark, these areas have been laid out since 1993, and a considerable part is now used for nonfood production, especially Oil-seed Rape grown for fuel. These fields will most certainly result in future problems for swans and farmers.

The possibilities of using the EU set-aside scheme in the management of swans in Denmark and other European countries where there are conflicts between farmers and swans (e.g. The Netherlands, Germany, United Kingdom and Ireland (Madsen 1992)) is worth examining. This scheme might, as suggested by Patterson & Fuchs (1992), be a potential source of low-cost reserves for a number of grazing waterfowl.

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