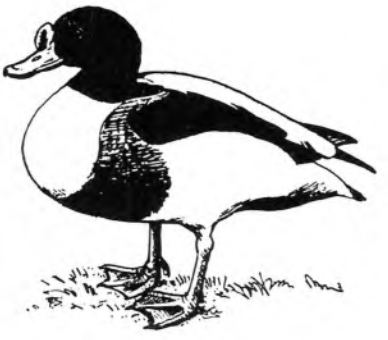
Non-breeding Shelduck *Tadorna tadorna* in the southwest Netherlands: effects of habitat changes on distribution, numbers, moulting sites and food



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In the Delta area of southwest Netherlands, several sea-arms were recently (partially) changed into fresh or saltwater lakes. In the Oosterschelde a storm-surge barrier was built. All these activities resulted in a total reduction of intertidal area from 31,950 ha in 1960 to 19,615 ha in 1990.

Shelduck are present in the Delta area throughout the year, with 8000-10,000 in January. After estuarine areas were changed into freshwater lakes, the peak in Shelduck numbers showed a shift from winter to spring and summer. This is probably related to a change in food resources exploited by Shelduck: from predominantly marine invertebrates in the tidal situation to predominantly Chironomid larvae and their pupae in the freshwater situation. The latter food source shows peak populations in late spring.

In the most important wintering area, the Oosterschelde, the percentual decreases in winter numbers in the periods 1979-83 and 1988-90, in both the entire estuary (including areas turned into freshwater lakes; -52%) and in the areas that remained tidal -40%), were considerably higher than 22% of tidal Shelduck habitat lost. In addition to habitat loss, the most likely explanation for this decrease is the considerable recent decline in Hydrobia *populations in this area.* Hydrobia *was shown to be the most important food item in saline tidal areas. The relatively high mortality among Shelduck in the Oosterschelde during the winters of 1985-87 may have been another cause of the decrease in the local winter population in 1988-90.*

Based on ringing recovery data, it is presumed that birds moulting in the Delta area mainly originate from northwest France, Belgium and the Delta area. A part of the Delta population moves to the German Wadden Sea instead of moulting locally. Shelduck present in winter concern local breeding birds, birds from northerly breeding areas, and birds breeding in France, Belgium and England.

Concentrations of moulting Shelduck in the Delta area are found in two areas, Westerschelde (several thousands annually) and Haringvliet (up to 2000 on freshwater), and not in the most important wintering area, the Oosterschelde. The presence of safe and undisturbed areas during moult could well be more important than the availability of food.

The northwest European wintering population of Shelduck *Tadorna tadorna* is estimated at 250,000 birds, with numbers stable or slightly increasing during the past three decades (Monval & Pirot 1989). The average total count in January in the Netherlands in 1977-86 was 41,000 (Monval & Pirot 1989). After the Dutch part of the Wadden Sea (mean 33,000 in January, Smit & Wolff 1980), the most important wintering area for Shelduck in the Netherlands is the Delta area in the southwest (Fig. 1), with about 8000-10,000 birds in January (approximately 4% of the northwest European population). The Delta area is not only visited by large numbers of non-breeding Shelduck throughout the year, it is also an important breeding area (tentative estimate 2000-3000 pairs) and there are at least two moulting sites.

The deltas of the rivers Rhine, Meuse and Scheldt have, however, incurred drastic

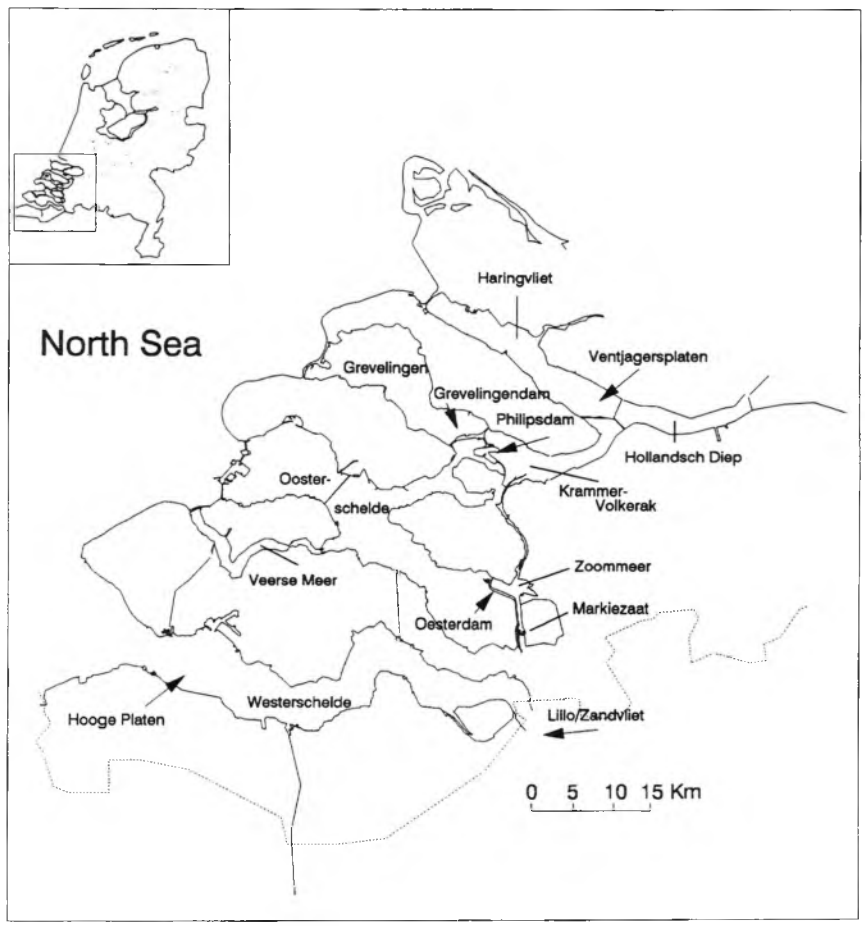

Figure 1. Geographical position of the Delta area of the southwest Netherlands and some localities mentioned in the text.

recent changes in habitat as a result of large scale engineering works. Sea-arms were (partially) closed off from the tide and turned into freshwater lakes (Haringvliet, Hollandsch Diep, Markiezaat, Zoommeer, Krammer-Volkerak) or saltwater lakes (Veerse Meer, Grevelingen). In 1986-87 the completion of a storm-surge barrier in the mouth of the Oosterschelde, and the construction of secondary dams, resulted in a loss of 30% of the intertidal flats in the Oosterschelde/Krammer-Volkerak Estuary and a reduction of the tidal amplitude from 3.7 m to 3.2 m in the remaining sea-arm. Only the Westerschelde Estuary maintained its original free connection with the North Sea. All these activities resulted in a reduction of intertidal area in the (former) estuarine areas from 31,950 ha in 1960 to 19,615 ha in 1990, a decline of 39% (Table 1).

This paper summarizes the current knowledge of non-breeding Shelduck in the Delta area. It particularly tries to answer whether the recent habitat changes have influenced changes in numbers and distribution of Shelduck, and their food availability.

Methods

Counts. Various sources of Shelduck counts in the Delta area have been used in this paper. Complete counts in January were available from 1967, 1973 and 1975 (Saeijs & Baptist 1977). Since 1975, monthly bird counts have been carried out in the tidal waters and saline lakes of the Delta area. Up

Table 1. Changes in habitat types and intertidal area of the (former) estuarine areas in the Delta area, southwest Netherlands between 1960 and 1990.

Area	1960 Habitat type	1960 Intertidal area (ha)	Closed	1990 Habitat type	1990 Intertidal area (ha)
Haringvliet-					
Hollandsch Diep	brackish tidal	500	Nov 1971	fresh stagnant	50
Krammer-Volkerak	salt tidal	2350	Apr 1987	fresh stagnant	0
Grevelingen	salt tidal	5500	May 1971	salt stagnant	0
Oosterschelde	salt tidal **	12000	Oct 1986*	salt tidal	11365
Markiezaat	salt tidal **	1500	Mar 1982	fresh stagnant	0
Zoommeer	salt tidal **	550	Oct 1986	fresh stagnant	0
Veerse Meer	salt tidal	1350	Apr 1961	brackish stagnant	0
Westerschelde	salt tidal	8200	-	salt tidal	8200
	Total	31950		Total	19615

* Completion of storm-surge barrier.
**Formed single unit before 1982.

to and including the non-breeding season 1977-78 these counts were restricted to each of the months September-April, but since the 1978-79 season (seasons running from July through June) counts have been carried out during each month (Meininger *et al.* 1984, 1985, Meininger & van Haperen 1988, and unpublished data). All counts in tidal areas were carried out during high tide, when Shelduck roost in flocks on the slope of dikes, on sand-bars, or swimming along the edges of saltmarshes; counts in lakes were performed from the shore and from boats.

Processing of count data. For each area only complete monthly counts have been used. Bird-days have been calculated by multiplying by 30 the sum of single day monthly Shelduck totals during the period considered.

Food choice. In August 1988 and winter 1990-91, faecal samples (n = 45) were collected in various areas in the Oosterschelde and Westerschelde. Samples were collected during low tide at sites where concentrations of Shelduck were actively foraging. In addition, stomach contents of 65 frost victims collected during the cold spells in January 1987 (n = 14) and February 1991 (n = 51) were examined for food remains. Both faeces and stomach contents were examined using a binocular microscope, using a magnification of 10-50x for larger organisms and 100-1000x for algae. The occurrence of food items was classified as "not present", "few" and "many".

Ringing recoveries. To gain insight into origin and movements of Shelduck using the Delta area, all recoveries up to 1991 relating to this area were obtained from the files of the Dutch ringing centre.

Numbers, distribution and seasonal pattern

Large numbers of Shelduck were present in the Delta area during the whole year. The seasonal pattern varied greatly between the different sub-areas (Fig. 2). The freshwater areas Haringvliet, Hollandsch Diep and Biesbosch held relatively small numbers in winter (January mean 350). Numbers in the Haringvliet peaked during late summer, probably related to the moulting site in this area (see below). Little is known about Shelduck numbers in the Grevelingen before its enclosure in 1971. The only complete counts available are 157 birds in August 1966 and 261 in January 1967 (Saeijs & Baptist 1977). In the saline Lake Grevelingen considerably larger numbers are present nowadays. The peak numbers in March in the saline Lake Grevelingen (mean 1400) and the brackish Veerse Meer (mean 500) may have been related to prebreeding gatherings of birds which later distribute over nearby polder areas to breed.

The various tidal areas showed remarkable differences. The Oosterschelde (including Zoommeer and Markiezaat before enclosure) is a typical wintering area, with the largest numbers (up to 10,500 birds) in December-March and only small numbers in May-September. The Krammer-Volkerak before enclosure also showed a peak in winter, but a larger peak in May-July. The latter peak probably concerned birds which concentrated in the tidal area of the northern part of the Krammer-Volkerak, before moving to the adjacent moulting area in the Haringvliet. After

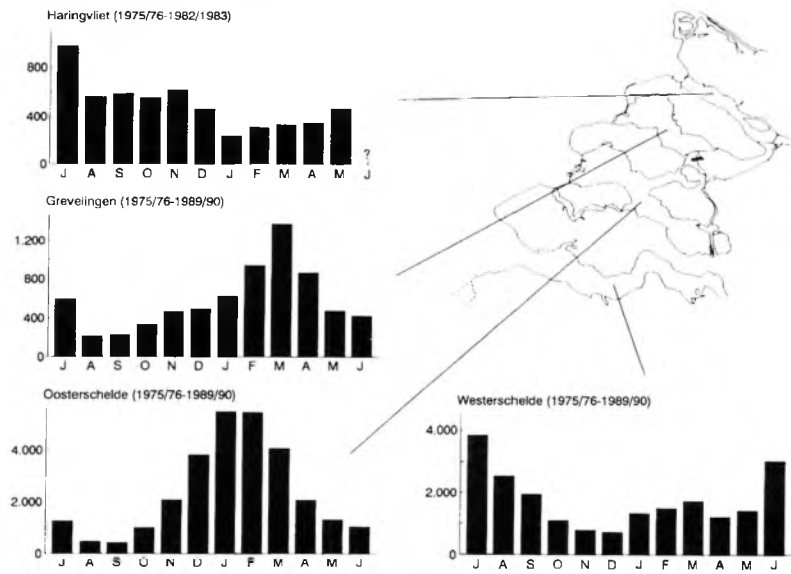

Figure 2. Mean monthly numbers of Shelduck counted in four regions of the Delta area, southwest Netherlands: Haringvliet (1975-76/1982-83), Grevelingen, Oosterschelde and Westerschelde (1975-76/1989-90).

the Oosterschelde, the Westerschelde is the second most important wintering area of Shelduck (up to 3600). However, in contrast to the Oosterschelde, peak numbers in the Westerschelde were observed in June and July (July mean 4000, maximum 7000). This phenomenon is partly related to the moulting sites in this estuary. However, since in most years the numbers present in July greatly exceeded the numbers on the moulting sites, the Westerschelde also functions as a pre-moulting area, from which birds move on to moulting areas elsewhere, probably in the German Wadden Sea.

The differences in seasonal pattern between the areas also resulted in differences in geographical distribution in various seasons. In August concentrations of (adult) Shelduck were virtually restricted to the moulting areas. In the other areas only small numbers, almost exclusively juvenile birds, were present. In January the species was widely distributed over the Delta area, with the largest concentrations in the eastern part of the Oosterschelde (Fig. 3).

Moulting sites

Most Shelduck from northwest Europe undertake a moult migration to the German Wadden Sea in late summer, where up to 180,000 birds shed their flight feathers (Hoogerheide & Kraak 1942, Goethe 1961a, 1961b, Oelke 1969, Nehls *et al.* 1992). Besides this major moulting site, there are several areas in northwest Europe where relatively small numbers moult; Bridgwater Bay in southwest England (*c.*3000 birds, Eltringham & Boyd 1960), the Wash in eastern England (1000-1500, Bryant 1981), the Forth Estuary in Scotland (800-2500, Bryant 1978, 1981), the Wadden Sea near Vlieland, the Netherlands (several hundreds, Smit & Wolff 1980), Lauwersmeer, the Netherlands (*c.*500, Meeuwsen & van Scharenburg 1988) and Haringvliet and Westerschelde in southwest Netherlands. At least since around 1900 Shelduck have been known to moult on sand-banks in the mouth of the Westerschelde Estuary (Maebe & Van der Vloet 1952). The first quantitative data from this area, the Hooge Platen, are from Maebe & Van der Vloet (1952) who found 750 moulting birds on 15 August 1951, and from Lebret (1956) who counted 4100-4900 moulting birds on 16 August 1955. Data from later years are relatively scanty, and the numbers noted in 1955 have been attained again only exceptionally. In 1968 hundreds of moulting birds were observed (Ouweneel 1976). Between 1978 and 1990 the number of adult birds present on the Westerschelde

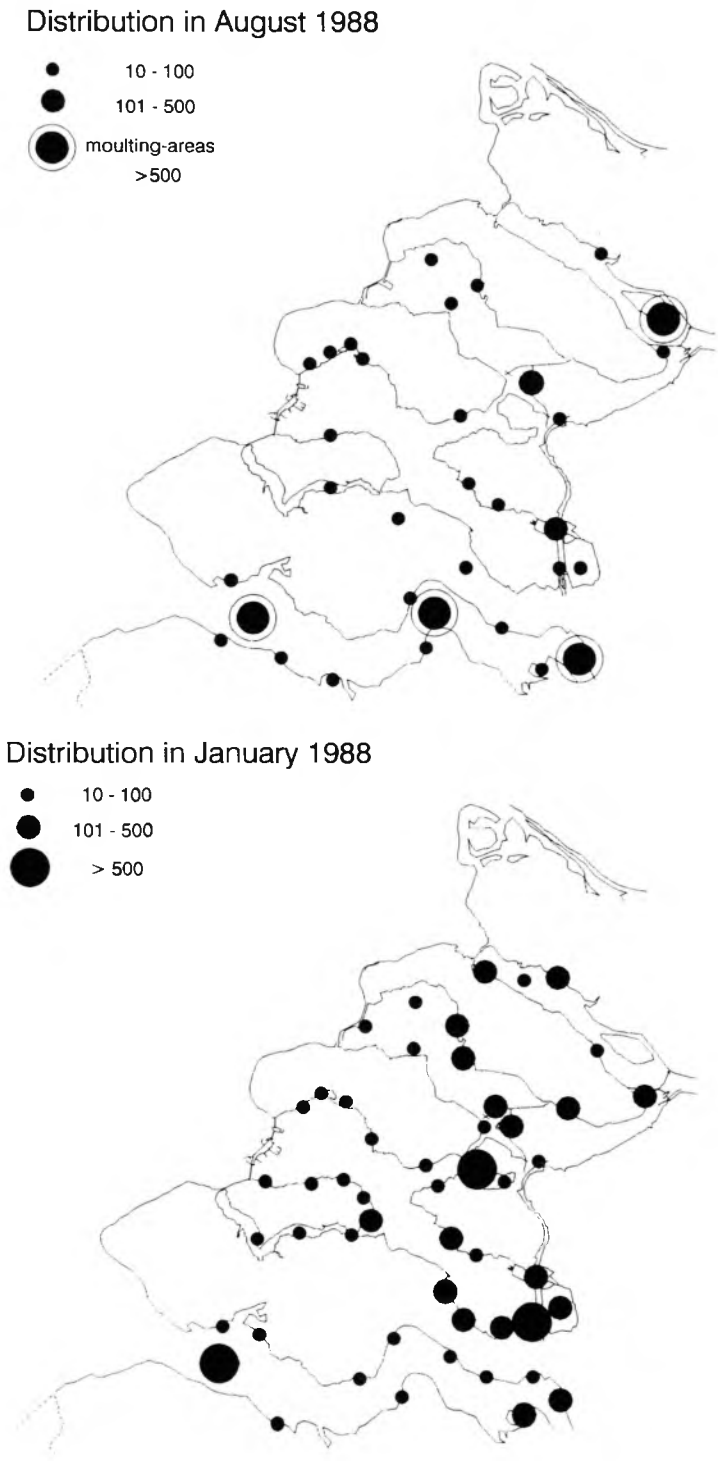

Figure 3. Distribution of Shelduck in the Delta area, southwest Netherlands, in August and January 1988.

in mid-August (generally in tight flocks and behaving like moulting birds) generally varied between 2000 and 3000, with over 4500 in 1987. In recent years concentrations of moulting birds have not only been found on the Hooge Platen (which remains the most important site), but also in the central and eastern parts of the estuary (Table 2).

Since 1975, but not annually, up to 300 moulting Shelduck have been noted in the eastern part of the Westerschelde, just across the border in Belgium (Table 2). In most years the moulting flocks moved downstream to the adjacent Dutch part of the Westerschelde (Van Impe 1981, Voet 1982).

At least since 1967 a concentration of moulting Shelduck has been present almost annually on the Ventjagersplaten in the Haringvliet (Ouweneel 1976, Zwarts 1974). In the late 1960s some tens of birds were moulting (Zwarts 1974), in most later years up to 500-1100 birds were present, in 1982 up to 2050 and in 1983 up to 1500 (Ouweneel 1988, Table 2). The Ventjagersplaten and the Lauwersmeer are the only known European Shelduck moulting sites in freshwater areas.

Table 2. Numbers of moulting Shelduck in the southwest Netherlands, 1975-1990.

	HARINGVLIET		WESTERSCHELDE		
	Ventjagersplaten *1	Lillo/ Zandvliet (Belgium)	East *4	Central *4	West (Hooge Platen) *4
1975	?	160 *2	?	?	?
1976	600	- *2	?	?	?
1977	450	255 *2	?	?	?
1978	1100	200 *3	?	-	1600
1979	900	140 *3	?	?	?
1980	750	300 *2	960	-	1000
1981	750	- *2	280	-	500
1982	2050	?	260	-	2000
1983	1500	?	106	370	2060
1984	?	?	100	40	1600
1985	-	?	220	410	2000
1986	500	?	340	870	500
1987	650	?	415	1100	3000
1988	?	?	25	150	3000
1989	170 *5	?	-	450	2150
1990	?	?	140	660	1300

*1 Ouweneel (1988), *2 Voet (1982), *3 Van Impe (1981), *4 Files Rijkswaterstaat Tidal Waters Division, *5 B.L. de Bruin in Van Nes & Marteijn (1990).

Changes in numbers and distribution caused by habitat changes

The dramatic changes in habitat which occurred in the Delta area during the past decades had a considerable effect on numbers and distribution of Shelduck visiting this area.

The change of the Haringvliet from a (brackish) tidal area into a freshwater lake has had little effect on its function as a wintering area (e.g. Saeijs & Baptist 1977). Before the closure Shelduck were only moulting in very small numbers in this area (Zwarts 1974).

After their enclosure and subsequent change into freshwater lakes, the Zoommeer and Markiezaat lost much of their function as a wintering area, while numbers now reach a larger peak in spring (Fig. 4). After the enclosure of the Krammer-Volkerak this area maintained its relatively small wintering numbers (300-400), while the pre-moulting concentration in May-July increased from an average 600 to 2000 (Fig. 4).

January numbers in the combined Krammer-Volkerak/Oosterschelde area (including Zoommeer and Markiezaat) showed an increasing trend between 1967 and 1982 (Fig. 5). The drop in January numbers and bird-days in the tidal areas after 1982 can be attributed partly to the loss of important winter feeding areas in the Markiezaat (March 1982), Zoommeer (October 1986) and Krammer-Volkerak (April 1987).

A comparison between mean winter numbers (Dec., Jan., Feb.) in the period 1979-83 and 1988-90 in the entire Oosterschelde (excluding Krammer-Volkerak) showed a decrease from 7600 to 3600 birds (52%;

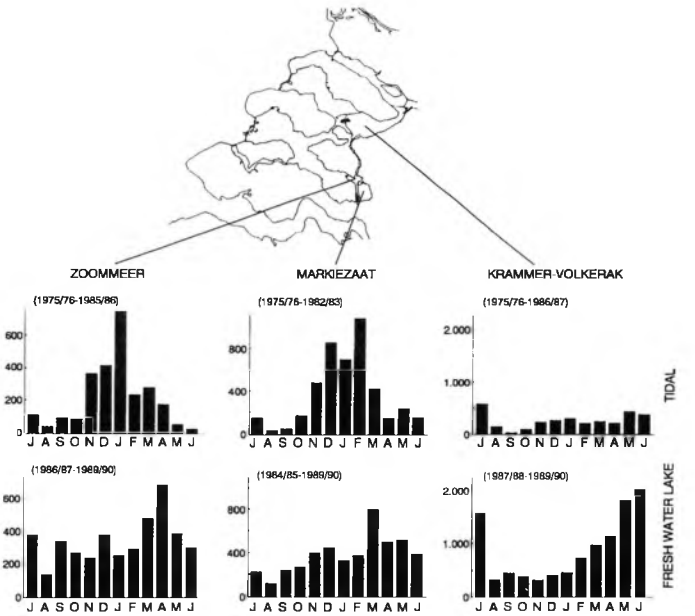

Figure 4. Mean monthly numbers of Shelduck counted in three parts of the Oosterschelde/Krammer-Volkerak Estuary, Delta area, southwest Netherlands, before and after their change from tidal areas to freshwater lakes.

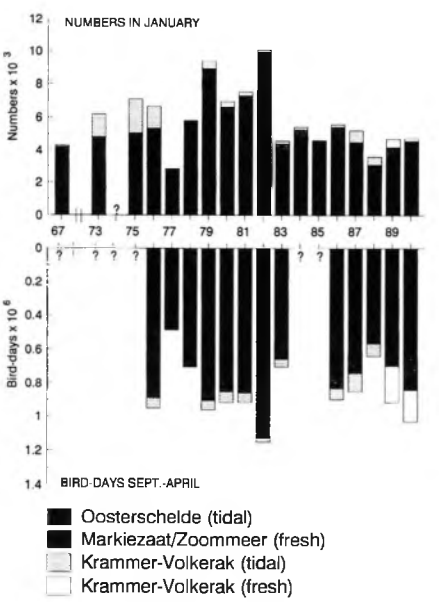

Figure 5. Numbers of Shelduck counted in January and bird-days per season (September-April) in the Oosterschelde and Krammer-Volkerak area.

Student's t-test: t6 = 3.22, n.s., see Schekkerman *et al.* in press), while numbers in those parts of the Oosterschelde *not* affected by enclosures showed a decrease of 40% (Student's t-test: t6 = 2.64, $P<0.05$). Taking into account the distribution over the Oosterschelde Estuary, Shelduck faced a "distribution-corrected habitat loss" of 22% in winter (Schekkerman *et al.* in press). The percentual decreases in winter numbers in both the entire estuary (including areas turned into freshwater lakes; -52%) and in the areas that remained tidal (-40%) are considerably higher.

January numbers in the Westerschelde appear to have been more or less stable during the last 15 years, while the increase in bird-days may at least in part be explained by an increasing number of moulting birds (Fig. 6, also see Table 2).

Origin of Shelduck in the southwest Netherlands

Figure 7 shows the ringing and (corpse) recovery sites of Shelduck visiting the Delta area.

There are only two foreign recoveries of Shelduck ringed as chicks in the Delta area: one in February near Southampton (southern England) in its fourth winter and one at the Cote d'Azur (southern France) in its first winter. It is striking that both recoveries were during cold spells in the winters 1962-63 and 1978-79 respectively.

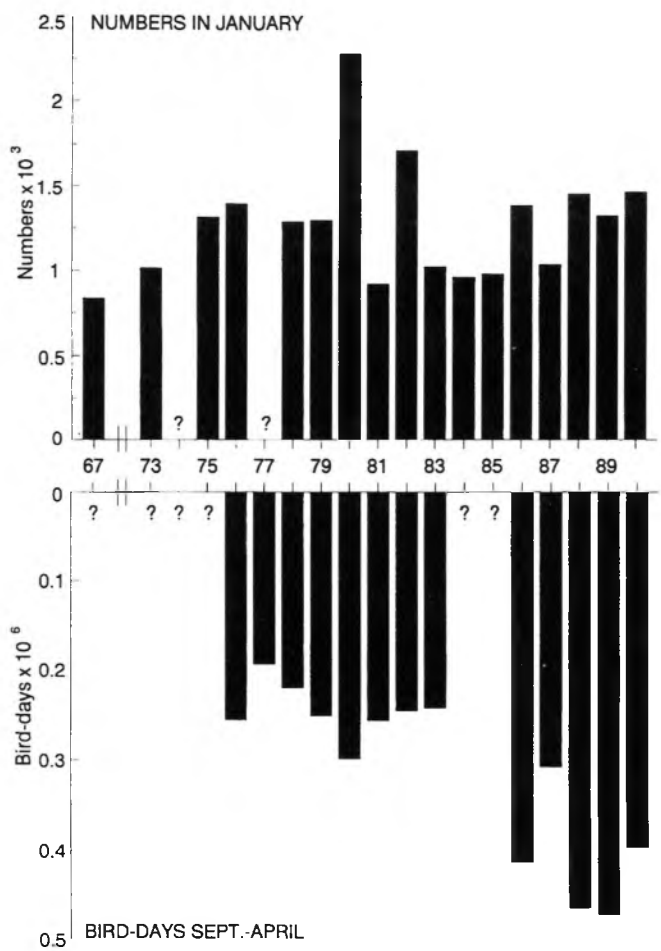

Figure 6. Numbers of Shelduck counted in January and bird-days per season (September-April) in the Westerschelde.

Figure 7. Ringing and recovery sites of Shelduck visiting the Delta area, southwest Netherlands.

● 1
● ≥ 5 Ringing and recovery sites of Shelduck, ringed as full-grown visiting the Delta area.

■ Ringing sites of Shelduck, ringed as chicks, recovered in the Delta area.

▲ Recovery sites of Shelduck, ringed as chicks in the Delta area.

Shelduck ringed as chicks recovered in the Delta area in their first winter (Oct.-Feb.) include single birds from the Camargue (southern France), Blackwater Bay, the Medway Estuary (eastern England), the Sont (eastern Denmark) and the North Sea coast of Zuid-Holland (the Netherlands).

Birds ringed as chicks and recovered in the Delta area during Nov.-Feb. after their first winter originate from the Camargue (2), Poole Harbour, southern England (1), the northern Netherlands (2), Belgium (2) and the Baltic coast of Sweden (1). The birds from southern France (e.g. Walmsley 1981a, 1981b), England and Belgium were probably on their way from their moulting areas in the Wadden Sea to their breeding areas, using the Delta area as a stop-over site. The birds from Denmark and Sweden probably wintered in the Delta area (cf. Salomonsen 1968).

Recovery data of Shelduck ringed as full-grown birds, visiting the Delta area, have been summarized in Table 3. It is striking that the only recoveries during August (the moulting period) in the Delta area are of birds ringed in northwest France in winter. These birds may be local French breeders or wintering birds from more northern breeding areas. The origin of birds moulting in the Delta area is therefore still largely unknown. It is presumed that they mainly originate from northwest France, Belgium and the Delta area. The presence in the Delta during the breeding season of birds ringed at the moulting area in the German Wadden Sea, indicate that a part of the Delta breeding population moves to the German Wadden Sea instead of moulting locally.

Shelduck present during winter in the Delta area concern local breeding birds, birds from northerly breeding areas wintering in

Table 3. Ringing localities, ringing periods, and month of recovery in the Delta area of Shelduck ringed as full-grown birds.

Ringed or recovered		Month of presence in the Delta area											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
BALTIC SEA	Mar-Jul	-	-	1	-	-	-	-	-	-	-	-	-
(Sweden,	Aug-Sep	1	1	-	2	-	-	-	-	-	-	-	1
Denmark, Germ.)	Oct-Feb	-	-	-	-	-	-	-	-	-	-	-	-
WADDEN SEA	Mar-Jul	-	-	-	-	-	-	-	-	-	-	-	-
(Denmark,	Aug-Sep	6	8	1	3	3	4	1	-	3	1	-	4
Germany)	Oct-Feb	-	2	-	-	-	1	-	-	-	-	-	-
NETHERLANDS	Mar-Jul	-	2	-	-	-	-	-	-	-	-	-	-
(excl. Delta)	Aug-Sep	1	1	-	-	-	-	-	-	-	1	-	-
	Oct-Feb	-	-	1	-	-	-	-	-	-	-	2	-
NETHERLANDS	Mar-Jul	2	-	-	-	-	-	-	-	-	-	1	-
(Delta area)	Aug-Sep	1	1	-	-	-	-	-	-	-	-	-	-
	Oct-Feb	1	1	-	2	-	-	1	-	-	1	-	-
BELGIUM	Mar-Jul	-	-	-	-	-	-	-	-	-	-	-	-
	Aug-Sep	1	2	-	-	-	-	-	-	1	-	-	-
	Oct-Feb	-	-	-	-	-	-	-	-	-	-	-	-
NW-FRANCE	Mar-Jul	-	1	1	-	-	-	-	-	1	-	-	1
	Aug-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	Oct-Feb	1	3	4	4	-	2	1	3	1	-	-	1
GREAT BRITAIN	Mar-Jul	-	2	-	-	-	-	-	-	-	-	-	-
	Aug-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	Oct-Feb	-	2	-	-	-	-	-	-	-	-	-	-

the Delta, and birds breeding in France, Belgium and England moving into the direction of their breeding areas after moulting.

Food

Feeding studies of the Shelduck in British estuaries showed the small gastropod mollusc *Hydrobia ulvae* to be one of the most important food sources; in addition a variety of bivalves, small worms (e.g. *Tubifex costatus*, *Nereis* sp.) and crustaceans (e.g. *Corophium volutator*) (Olney 1965, Bryant & Leng 1975, Thompson 1982, Thompson *et al.* 1986). Birds wintering in non-tidal hyper-saline lagoons along the Mediterranean coast of France mainly feed on algal bioderm, the brine shrimp *Artemia* and aquatic Coleoptera adults (Walmsley & Moser 1981).

Hitherto relatively little was known about the food choice of the species in various areas of the Delta. Analysis of faeces and the examination of stomach contents of winter victims revealed Mud Snail *Hydrobia ulvae* to be the most important food item in saline tidal areas: 35 out of 40 faeces collected at two sites in the Oosterschelde in November and December 1990 contained *Hydrobia*, five contained fragments of crustaceans (probably amphipods) and five small quantities of both diatoms and green algae. Out of 65 stomachs of winter corpses, collected in the eastern part of the Oosterschelde, 18 were empty or only contained sand; all other stomachs (n = 47) contained variable amounts of *Hydrobia*, one also fragments of jaws of the worm *Nereis*.

In the brackish eastern part of the Westerschelde bivalves and *Hydrobia* are virtually absent. Analysis of faeces collected in August (n = 14) showed that Shelduck (including moulting birds) mainly feed here on diatoms (mainly *Pleurosigma*, a large benthic species), which occur in extensive thickets on the tidal mud-flats, copepods, and to a lesser extent on the small crustacean *Corophium volutator*. Faeces collected in this area in December (n = 10) contained only green algae. Faeces collected in August (n = 20) on the Hooge Platen in the mouth of the Westerschelde mainly contained fragments of small specimens of the bivalves *Macoma balthica* and *Cerastoderma edule* and some also of *Corophium volutator*.

The food choice in the fresh Haringvliet is unknown. Before the Krammer-Volkerak was transformed into a freshwater lake, large numbers of Shelduck used to feed on

tidal mud-flats adjacent to the Haringvliet moulting area, before moving to the actual moulting site. Zwarts (1974) presumed that Shelduck here were mainly feeding on oligochaete worms, of which the biomass peaked in May and June.

Nothing is known about the food choice in the Grevelingen and Veerse Meer.

In Zoommeer and Markiezaat there was a shift from peak numbers in winter before enclosure to a peak in spring after these areas became freshwater lakes. In these two areas, and in the Krammer-Volkerak after enclosure, potential food items for Shelduck are benthic (green) algae, benthic diatoms and larvae of Chironomidae. It is striking that the numbers of chironomid larvae and their pupae in these areas also show a peak in late spring (Van Nes & Smit 1990).

Discussion

The most important explanations for the changes in distribution and numbers of Shelduck in the Delta area are the changes in habitat and, as a consequence, the presence and availability of potential food items.

In the most important wintering area, the Oosterschelde, the percentual decrease in winter numbers in the periods 1979-83 and 1988-90 in both the entire estuary (including areas turned into freshwater lakes; –52%) and in the areas that remained tidal (–40%) were considerably higher than the "distribution corrected habitat loss" of 22%. This strongly suggests that in this area other factors than just habitat loss played a role in the decrease noted. An additional explanation for the decrease in Shelduck numbers in the Oosterschelde could be the considerable recent decline in *Hydrobia* populations, as noted since the early 1980s in several parts of the Oosterschelde; it is not yet certain what caused this decline (Coosen *et al.* in press). *Hydrobia* was shown to be the most important food item for Shelduck in saline tidal areas. During cold spells in the three successive winters 1985-87 a total of 1,114 Shelduck corpses were found in the Delta area, of which 538 were in the Oosterschelde (Meininger *et al.* 1991). This relatively high mortality may have been another cause of the decrease in local winter population in 1988-90.

The shift in peak numbers from winter to spring and summer in the former tidal areas, now turned into freshwater lakes, is probably related to a change in food resources exploited by Shelduck: from predominantly marine invertebrates in the tidal situation to predominantly Chironomid larvae and their pupae in the non-tidal, freshwater situation. The latter food source shows peak populations in late spring.

Concentrations of moulting Shelduck in the Delta area are only found in two areas, Haringvliet and Westerschelde, and not in the most important wintering area, the Oosterschelde. The moulting areas are situated in places with relatively little human disturbance, in contrast to the Oosterschelde, where there are a lot of recreational (boating) and fishery (e.g. mussel culture) activities. This suggests that the presence of safe and undisturbed areas during moult could be more important than the availability of food. This is in accordance with the situation as noted in the German Wadden Sea (Nehls *et al.* 1992).

We are grateful to the hundreds of people who participated in the bird counts in the Delta area, organised jointly by Rijkswaterstaat and Staatsbosbeheer (State Forestry Service). Recent counts from the Krammer-Volkerak and Zoommeer were kindly made available by the Rijkswaterstaat Institute of Inland Water Management (RIZA, Henk Smit and Egbert van Nes). The Netherlands Ringing Centre (Vogeltrekstation Arnhem) provided us with recovery data of Shelduck. Ed Stikvoort kindly assisted in identifying food remains in Shelduck faeces and stomachs. Cor Berrevoets prepared figures. Arteunis Bos and Johan Schefferlie collected data on the food of Shelduck in 1988. Franciscus Colijn, Eric C.L. Marteijn and Hans Schekkerman commented on an earlier version of the manuscript. We thank an anonymous referee for reviewing the manuscript critically.

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