

Evolution, foraging behaviour and reproductive output of coastal breeders at Zeebrugge

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Seabird populations in Zeebrugge

The creation of new land in the outer harbour of Zeebrugge in 1985 attracted large number of coastal breeding birds. Each species shows its own specific evolution in breeding numbers since the creation of new suitable nesting habitat. As a pioneer species the population of Little Tern initially increased up to a maximum of 425 pairs in 1997. Because of habitat loss and succession of the vegetation numbers decreased afterwards. The Common Tern population shows a gradual increase up to 2510 pairs in 2003, while the number of Sandwich Terns strongly fluctuated. The latter species shows peaks in occurrence in 1993 and 2000. The reasons for these strong fluctuations are not clear. All three species of gulls (Black-headed Gull, Herring Gull and Lesser Black-backed Gull) show a strong increase up to 2001. The Lesser Black-backed Gull and Herring Gull further increased in 2003. For all species the outer harbour of Zeebrugge is by far the most important site within Flanders. Also at the international level, the numbers of Little Tern, Common Tern, Sandwich Tern and Lesser Black-backed Gull are extremely important (2.4% - 4.0% of the total geographical population!). European law protects all the three tern species because their populations are vulnerable for extinction. In 2004 measures will be taken to further protect the unique and internationally important ornithological value of the outer harbour of Zeebrugge.

Reproductive parameters

Being highly specialised piscivorous birds, terns are often used as bio-indicators for example to predict the abundance of specific species of fish or the presence of toxicants in the coastal marine environment. To serve as bio-indicator one must, however, know precisely how fluctuations in the marine environment translate into changes in the biology of the investigated species. This requires the monitoring of a range of parameters for several years. For this reason, the reproductive output of Common Terns at Zeebrugge is monitored since 1997 by enclosing a part of the colony with chicken wire to prevent the chicks to walk away from the study site (Table 1). Up to and including 2001 clutch size (i.e. the average number of eggs per nest), hatching success (i.e. the proportion of eggs that actually hatched) and fledging success (i.e. the proportion of hatched eggs that actually fledged) of the Zeebrugge Common Terns was high. This resulted in a high reproductive output averaging 1.2 fledglings/pair during the period 1997-2001. Such output is by far sufficient to maintain a stable population and is high when compared to foreign colonies. The high reproductive success suggests a high availability of food at Zeebrugge. Surprisingly in 2002 none of the parents were able to fledge a chick. Clutch size and hatching success in 2002 were comparable to those in earlier years, but chick

mortality was exceptional high. Data on food composition, food intake rate and growth of the chicks were gathered, but were not yet analysed. We got the impression that a combination of food shortage during the chick rearing period and high predation rates by Herring and Lesser Black-backed Gull caused the failure of the 2002-breeding season. Poor breeding success was also recorded in nearby colonies in the Dutch Delta area, suggesting a lack of clupeids in the entire southern North Sea. After all, clupeids are the major food source for Common Tern chicks. Apparently the food situation greatly improved in 2003 when fledging success and breeding success was amongst the highest measured since the onset of the monitoring programme.

Table 1 Reproductive parameters of Common Terns in Zeebrugge compared to colonies in The Netherlands (Griend) and Germany (Baltrum, Minsener Oldeoog and Trischen). Source: Becker *et al.* 1997.

Colony	Year	N pairs	Clutch size (N eggs)	Hatching success (%)	Fledging success (%)	Breeding success (N fledged young/pair)
Griend	1993	25	2.5 (62)	87	24	0.5
	1994	21	2.6 (55)	80	39	0.8
	1995	23	2.6 (60)	82	31	0.7
Baltrum	1993	18	2.9 (53)	87	37	0.9
	1994	22	2.9 (64)	92	68	1.8
	1995	16	2.9 (47)	83	9	0.3
Minsener Oldeoog	1993	21	2.7 (56)	88	0	0.0
	1994	25	2.9 (73)	96	47	1.3
	1995	18	2.9 (52)	96	48	1.3
Trischen	1993	35	1.5 (50)	0	0	0.0
	1994	33	2.4 (79)	0	0	0.0
	1995	35	1.1 (39)	0	0	0.0
Zeebrugge	1997	78	2.4 (185)	78	50	1.2
	1998	185	2.5 (466)	77	61	1.2
	1999	90	2.5 (230)	78	67	1.3
	2000	52	2.3 (121)	91	37	0.8
	2001	35	2.3 (82)	80	74	1.4
	2002	34	2.2 (75)	81	0	0.0
	2003	36	2.6 (94)	87	74	1.7

Food availability

Earlier research on terns in The Netherlands suggests that foraging trip duration (i.e. the time it takes a parent from leaving the colony until it returns with a fish) is a good indicator for the amount food available to the terns. In 2001 and 2002 (and also in 2003 but these results were not yet analysed) foraging trip duration was measured at the Zeebrugge Sandwich Tern colony. The time a parent is

absent from the nest is positively related to the size of the prey it brings back to colony (Fig. 1). Compared to Europe's largest colony, which is established at the isle of Griend in The Netherlands, it took parents at Zeebrugge less time to return with a fish. At Zeebrugge in particular small clupeids were brought to nest in a relatively short time. Even compared to a colony at Hirsholm (Denmark) where the availability of clupeids appeared to be very high, foraging trip duration of small clupeids was even shorter at Zeebrugge. In other words: at Zeebrugge there seems to be a superabundance of small clupeids. There were no large differences in foraging trip duration between 2001 and 2002, suggesting that the availability of clupeids did not decline in 2002. This seems to be in contradiction with our above conclusions that for Common Terns the availability of clupeids has drastically decreased in 2002. There is, however, a major difference in the timing of breeding season between Common and Sandwich Terns, which can explain this seemingly contrast. The latter species hatches most chicks during the last week of May, while most Common Tern chicks hatch around the second half of June.

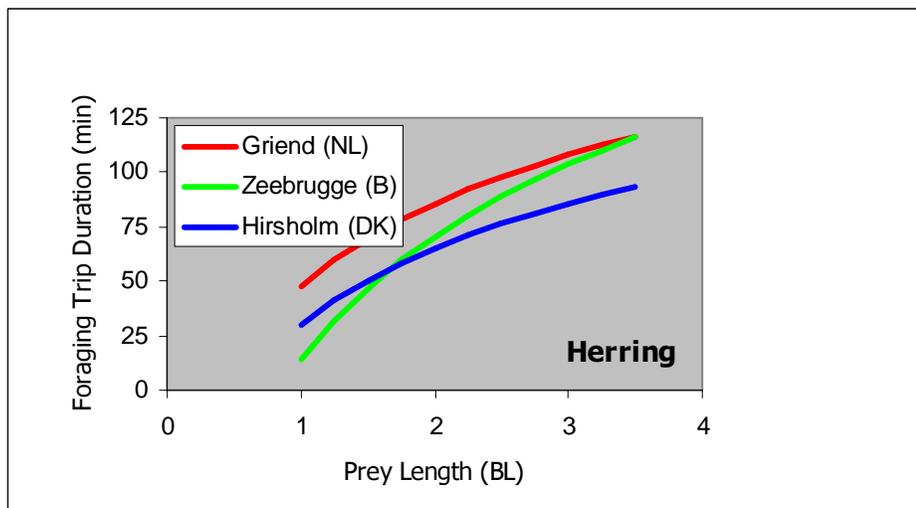


Figure 1 Foraging trip duration in relation to the length of the clupeids brought to Sandwich Tern chicks at Griend, Hirsholm and Zeebrugge

Diet composition

Food requirements of seabirds are mainly known from observations at the breeding site. In many cases it is very difficult to obtain knowledge on the food preferences of adult seabirds. Therefore, it is often assumed that the composition of food supplied to the chicks also reflects the diet composition of adults. For this reason Sandwich Terns are characterised as being highly specialised fish-eaters that almost exclusively feed on Clupeidae and Ammodytidae. In this study samples of faeces were taken around the nests of Sandwich Terns. The faeces were sampled just before hatching of the eggs to be sure that they only contained adult food remains. The samples were carefully washed and bony structures, otoliths and remains of invertebrates were sorted out under a microscope. Otoliths were specified and the length of the prey fish was back-calculated using allometric relationships described in literature. It

appears that there are major difference in species composition between adult Sandwich Terns and their offspring. Observations from a hide placed at a few meters from a colony in 2001 and 2002, showed that chicks at Zeebrugge were mainly fed with Clupeidae. Ammodytidae and other species (mainly Gonidae) were less common prey items. In contrast, the diet of adult Sandwich Terns predominantly consisted of Ammodytidae, whereas Clupeids (*Sprattus sprattus*) were rarely found in the faeces. Surprisingly the faeces of the adults contained relatively high proportions of Nereis jaws. Judged from the size of these jaws it can be excluded that they stem from the stomach of the fish that was eaten by the birds. In other words the polychaete might be an important food item for adult for Sandwich Terns during the incubation period, which certainly is unexpected for a strictly piscivorous seabird.

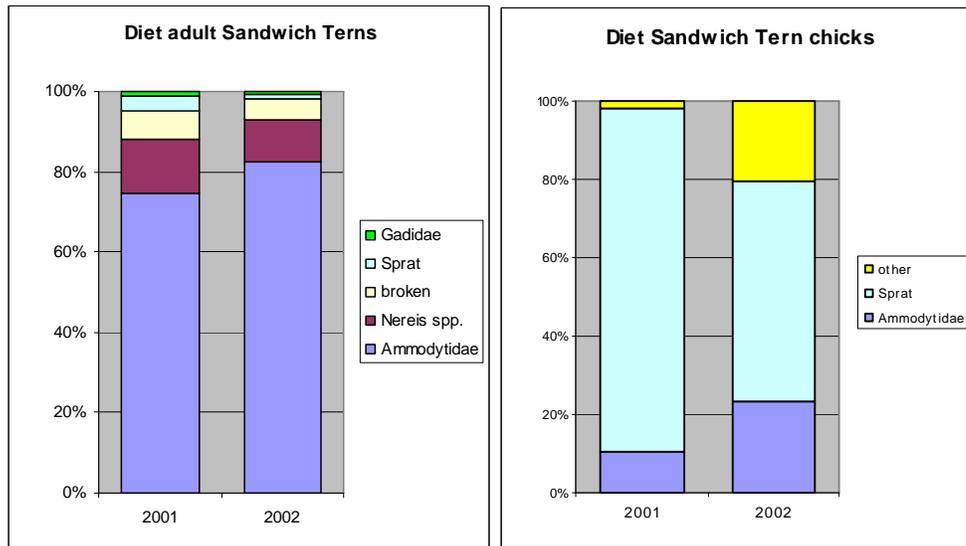


Figure 2 Diet composition of adult Sandwich Terns (based on numbers of otoliths and Nereis jaws found in faeces) compared to that of chicks in the outer harbour of Zeebrugge in 2001 and 2002.