Wigeon *Anas penelope* numbers and bags during two hunting regulation schemes at Skallingen, Denmark

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A comparison of Wigeon numbers was made during two different temporal hunting regulation schemes at Skallingen in the Danish Wadden Sea. The hunting was conducted on a saltmarsh on which Wigeon fed at night. During 1979-86, a period of three days of hunting alternated with five days without hunting, between 7 September and 30 December. Hunting was allowed in both the morning and evening. During 1987-93, hunting was allowed every day, between 1 October and 20 December, but restricted to evenings only. Coincident with this change in hunting regulations, the October peak in Wigeon numbers failed to appear, and the overall number of bird-days decreased. Flooding frequency could not explain this change in patterns of occurrence. Furthermore, the decrease in Wigeon numbers at Skallingen was in contrast to the trends in the flyway and regional populations. With the change in hunting regulations the overall hunting intensity increased, and an indication was found that the number of Wigeon shot increased as well. The cessation of hunting in September and the increased number of hunting days in November had no apparent effect on Wigeon numbers. Possible reasons for this are discussed. It is concluded that the change in hunting regulations was counter productive to the most important quarry species.

Keywords: Wigeon, Numbers, Hunting Regulation, Hunting Bags, Disturbance

It is well documented that hunting can cause disturbance to waterfowl (Bell & Owen 1990; Madsen & Fox 1995). This has led to hunting regulations at many important waterfowl staging areas. Typically, the regulations have been spatial, i.e. hunting is prohibited in a part of an area. Several studies (e.g. Owen & Thomas 1979; Jepsen 1983; Madsen 1995) have reported on the effect of this management strategy on waterfowl numbers. Alternatively, hunting can be regulated temporally. This can take place, for instance, by reducing the length of the hunting season or introducing non-hunting periods. However, few studies have reported on the possible effects of this type of hunting management (Ziegler & Hanke 1988; Townshend & O'Connor 1993).

On Skallingen; a natural saltmarsh in the Danish part of the Wadden Sea, attempts have been made to reduce hunting disturbance through temporal regulations. In 1979, a hunting scheme was introduced in which three days of hunting alternated with five days without hunting. The hunting season was between September and December, with hunting being allowed in the morning and evening. However, general concern grew that this hunting scheme had undesirable effects on waterfowl populations. This led to the introduction of a new hunting scheme in 1987, hunting being allowed every day, but with the start of the hunting season delayed to October. Furthermore, hunting was restricted to the evening only.

The aim of this study was to compare these two regulation schemes with

respect to, firstly, the occurrence of the Wigeon *Anas penelope* and, secondly, hunting intensity, the number of Wigeon shot and hunting success.

Study area (see **Figure 1**)

The peninsula of Skallingen (55°30'N, 8°16'E) is situated in the northern part of the Danish Wadden Sea. Together with the island of Langli, Skallingen borders the Hobo Dyb tidal area. Skallingen is dominated by a large naturally formed saltmarsh of 1300 ha, with a well developed creek system. The major part of the saltmarsh is grazed by cattle and sheep. Since 1983 (the start of systematic counts in the area - see methods), the stock density has been about 0.4 cows and 0.3 sheep per ha (National Forest and Nature Agency, unpubl. data). The grazed area consists of about 200 ha of lower saltmarsh dominated by *Puccinellia maritima*, and about 800 ha of upper saltmarsh dominated by *Festuca rubra*. A zone parallel to the coast is ungrazed, and dominated by dense *Halimione portulacoides* growth. In the Hobo Dyb area, human activities have been prohibited since 1983.

The hunting on Skallingen is regulated by the Forest and Nature Agency of the Ministry of Environment. During 1979-86, the hunting season started on 7 September and ended on 30 December. Three days of hunting alternated with five days without hunting. Hunting was restricted to 1½ h before to 2 h after sunrise and 2 h before to 1½ h (1 h in November and December) after sunset. During 1987-93, the hunting season started on 1 October and ended on 20 December, with hunting being allowed every day. Hunting was restricted to 2 h before to 1½ h (1 h in November and December) after sunset. Under both schemes, hunting was allowed on all of the Skallingen saltmarsh except for a 300 m zone parallel to the coast. The number of hunting licences was constant (93), as was approximately the maximum number of hunters allowed per day (1979-86: 25 and 1987-93: 28). The number of hunters present was regulated by each licence specifying the days on which the hunter could hunt.

The Wigeon was chosen as the focal species for this study, since it is both the most numerous waterfowl species in the area and the species most exposed to hunting, locally being restricted to saltmarsh feeding. Furthermore, Wigeon may be particularly sensitive to disturbance on account of their requirements for long feeding periods (Mayhew 1988). Wigeon generally spend the daytime roosting in the Hobo Dyb, flying into the saltmarsh at dusk to feed during the night (B. Jakobsen pers. comm., pers. obs.).

Methods

Since 1983, the total number of Wigeon in the Skallingen area (including Skallingen, Hobo Dyb and Langli, **Figure 1**), has been counted at high tide. Counts were made at five day intervals from September to November, by the staff of the Langli Field Station. December counts were excluded from the analysis owing to low numbers, depending highly on the weather. From these counts, annual maximum numbers and monthly numbers of bird-days were determined. The number of bird-days could not be calculated for October 1987, because of several missing counts. The timing of the counts during 1983-86 is considered to give an unbiased indication of Wigeon populations through the season, because no bias was found towards hunting or non-hunting days either for the whole autumn (X^2_1 = 0.076, df=1, P>0.75) or for the different months (X^2_1 = 0.000-0.303, df=1, P>0.50).

To evaluate the effect of hunting regulations on Wigeon numbers, it was necessary to account for the frequency of flooding of the saltmarsh during both periods. It is well known that Wigeon prefer feeding in or close to water (Känel 1981; Rijnsdorp 1986; Mayhew & Houston 1989; Loonen & van Eerden 1989; Jacobsen & Ugelvik 1994). At Skallingen, water is in scarce supply on the saltmarsh, except during and after floods. The dates on which the saltmarsh was flooded during the

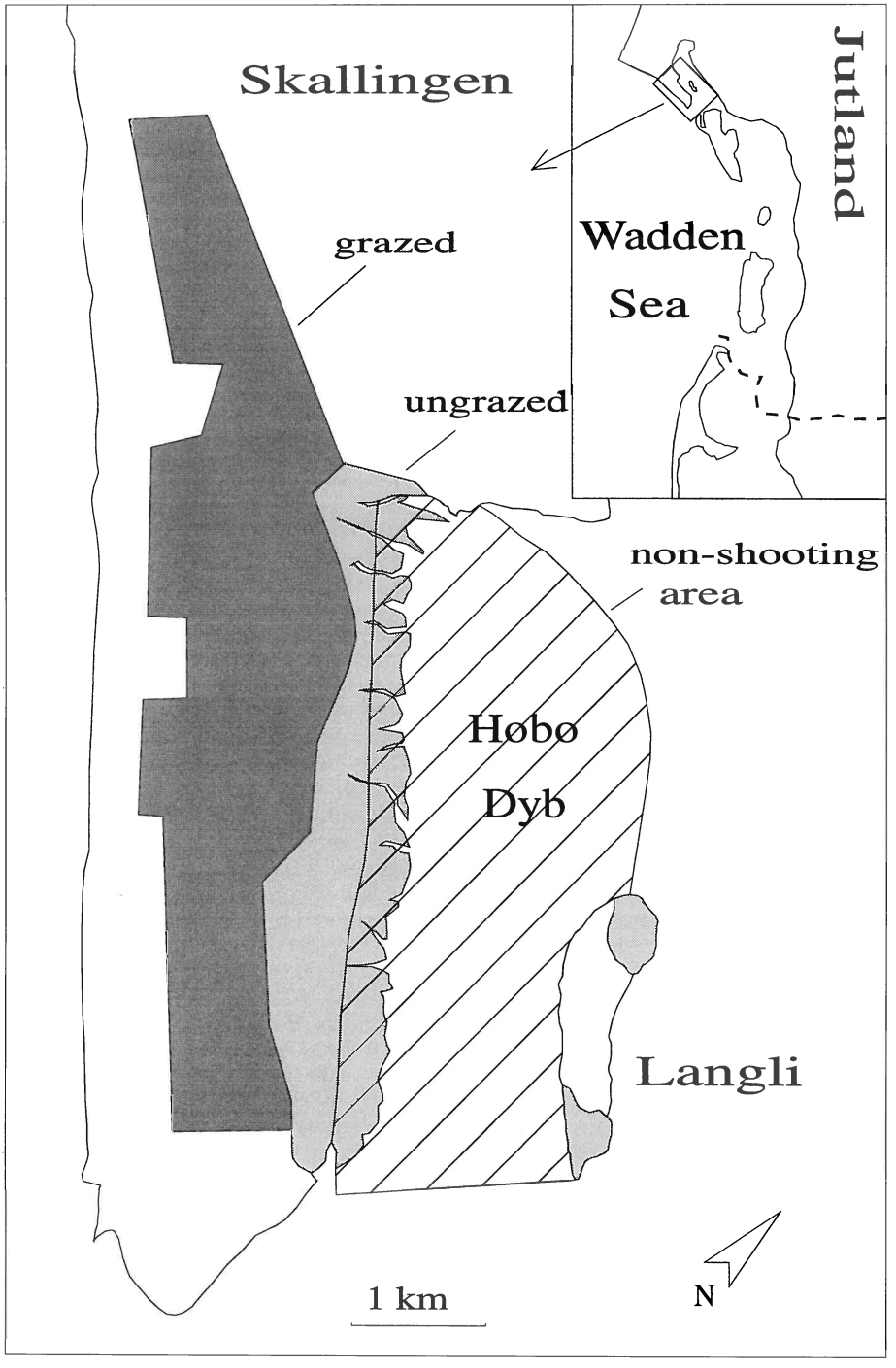

Figure 1. The Skallingen area with the saltmarshes and the non-shooting zone.

autumns from 1983 to 1993 were extracted by comparing the floodwater level at Skallingen (i.e. 150 cm above "Danish Ordnance Datum") with the daily maximum Wadden Sea water level measured at Esbjerg (10 km to the east of Skallingen) by The Coast Authority and the National Meteorological Institute. A flood event was defined as at least the major part of the lower saltmarsh being covered with water.

Hunters buying licences to hunt on Skallingen were obliged to report to the Forest and Nature Agency on the total number of visits and the species and numbers shot per season. The results presented here are based on the summarised information for each hunting season during 1983-93. A few hunters failed to report every year. However, the overall results are based on an equal number of bag reports from both hunting schemes (81.7 (SE = 1.2) *v* 81.8 (SE = 0.8) reports per year, for 1983-86 and 1987-93 respectively, $t = 0.076$, $df = 9$, $P>0.75$).

To compare hunting success between the two hunting schemes it is necessary to account for the proportion of juveniles in the population, because juveniles appear to be more vulnerable to hunting (Owen & Black 1990). As an index of relative annual productivity during 1983-93, wing survey data from the Danish hunting bag was used (calculated from Clausager 1987-89; 1990-94 and unpubl.).

Results

*Wigeon numbers and bird-days (see **Table 1**)*

Overall for the autumn (September-November), the mean number of bird-days declined by more than one third between the periods 1983-86 and 1987-93. At the same time there was an indication of a reduction in mean maximum numbers, although this change was not statistically significant.

During 1983-86, a marked peak in mean Wigeon numbers occurred from mid to late October (**Figure 2**). This peak did not occur during 1987-93, mean numbers being almost constant from late September to early November. The mean number of bird-days in October almost halved from 1983-86 to 1987-93, while there were no changes in September and November.

Flooding frequency

Overall for the period 1983-93, the number of Wigeon bird-days was significantly correlated with flooding frequency for the autumn (Spearman's rank correlation: $r_s=0.720$, $n=10$, $P<0.05$), and for the different months except for October (September: $r_s=0.702$, $n=11$, $P<0.05$; October: $r_s=0.548$, $n=10$, $P>0.10$; November: $r_s=0.789$, $n=11$, $P<0.01$). However, the mean number of days with flooding of the saltmarsh did not differ between 1983-86 and 1987-93, either for the autumn as a whole or for the different months (**Table 2**).

*Hunting intensity, bags and success (see **Table 3**)*

Overall the mean hunting intensity (hunter-days per year, i.e. summed number of visits of all hunters) increased by about 20% between 1983-86 and 1987-93, as a result of an increased number of hunting days per hunter.

Table 1. Wigeon bird-days and maximum numbers (mean ± SE) during 1983-86 and 1987-93. Significance indicated by *: $P<0,05$. 1987 has been omitted from the calculations of total bird-days, as has October 1987 from calculations of October bird-days (see Methods).

	1983-86	1987-93	df	t
Bird-days				
Total	102,029 ± 12,838	65,079 ± 9,769	8	2.323*
September	15,901 ± 4,204	14,646 ± 4,058	9	0.182
October	58,426 ± 3,892	31,529 ± 6,835	8	3.003*
November	27,702 ± 9,454	22,987 ± 4,061	9	0.527
Maximum	4,701 ± 856	2,660 ± 594	8	1.898

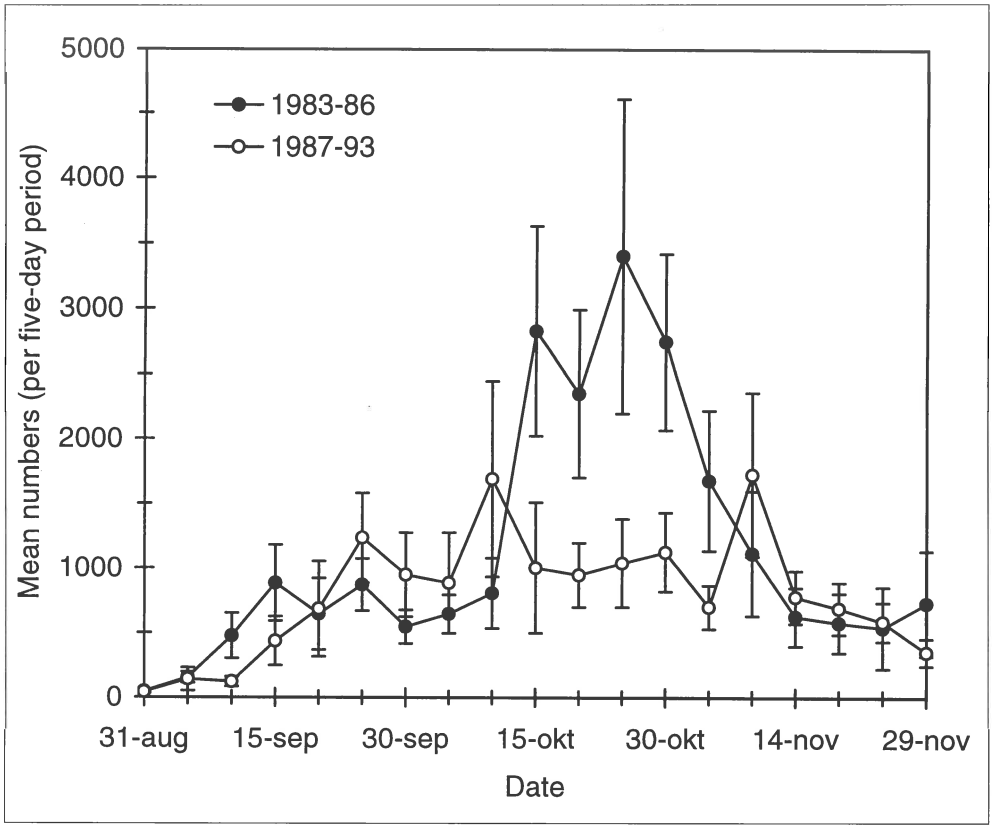

Figure 2. The autumn phenology of Wigeon (mean ± SE) in the Skallingen area during the two hunting regulation schemes.

Table 2. Flooding frequencies (mean ± SE) on the Skallingen saltmarsh during 1983-86 and 1987-93. Degrees of freedom is 9 in each case. None of the differences were significant ($P<0.05$).

	1983-86	1987-93	t
Total	15.0 ± 2.8	12.1 ± 2.1	0.745
September	3.0 ± 1.3	2.9 ± 0.8	0.092
October	7.2 ± 2.3	4.9 ± 1.3	0.901
November	4.7 ± 1.4	4.4 ± 1.6	0.121

Table 3. Hunting statistics (mean ± SE) during 1983-86 and 1987-93. Degrees of freedom is 9 in each case. Significance indicated by *: $P<0.05$.

	1983-86	1987-93	t
Hunter-days	807.0 ± 28.9	953.4 ± 35.5	2.791*
Hunting days/hunter	9.87 ± 0.33	11.66 ± 0.42	2.898*
Wigeon shot/hunter	7.42 ± 1.03	10.09 ± 1.77	1.059
Wigeon shot/hunter-day	0.75 ± 0.10	0.85 ± 0.14	0.485

The Wigeon was by far the most common bird species shot, making up 50-70% of the yearly bag records during 1983-93. The data suggests that both the mean number of Wigeon shot per hunter within a season and the number of Wigeon shot per hunter-day increased between 1983-86 and 1987-93, although these changes were not statistically significant. The hunting success was highly correlated with the breeding success in the population, as indicated by the Danish hunting bag 1983-93 (r_s=0.709, n=11, P=0.02). The mean percentage of juveniles within the population did not, however, differ between the two periods (1983-86: 67.0 (SE=4.8) and 1987-93: 68.4 (SE=6.3), t=0.140, df=9, P>0.50).

Discussion

The marked peak in Wigeon numbers at Skallingen which occurred in October 1983-86 had disappeared in 1987-93, thereby halving the number of bird-days for this month and causing a general decline in overall bird-days for the autumn. This change in pattern of occurrence could not be attributed to the flooding frequency, which remained constant. Neither could this decrease in Wigeon numbers be attributed to the trends in the regional or the flyway population, which were respectively stable (Laursen *et al.* in prep.) and increased (Monval & Pirot 1989; Madsen 1992; Rose & Taylor 1993) during the study period.

The change in hunting regulations appears to be the likely reason for the decline in Wigeon numbers between 1983-86 and 1987-93. The hunting regulation scheme introduced in 1987 almost tripled the number of days for hunting during the two months of highest Wigeon numbers. The hunting statistics indicate that the hunters did exploit the extra hunting days, giving an overall increase in hunting intensity.

A negative effect on Wigeon numbers of an increased hunting disturbance is in agreement with the general knowledge of the effect of hunting on waterfowl (Bell & Owen 1990; Madsen & Fox 1995). The findings at Skallingen are also in agreement with Townshend & O'Connor (1993), who found a strong negative relationship between the total number of consecutive days of hunting and Wigeon numbers at Lindisfarne, northeast England. Furthermore, Jettka (1986) and Gerhard (1994) found that non-hunting periods had a positive effect on Mallard *Anas platyrhynchos* numbers on two German sites. However, Ziegler & Hanke (1988) found no positive effect on Mallard numbers from the introduction of non-hunting weeks at "Häverner Marsch", northwest Germany. These divergent results might be influenced by both the length of the non-hunting period, and the position of the sites on the flyway of the affected species. Non-hunting periods may be more likely to have a positive effect on waterfowl numbers on staging areas, compared to wintering areas, assuming that staging areas are characterised by a higher arrival rate of new individuals.

Overall, the introduction of the second hunting scheme improved the conditions for hunting. Despite the decrease of Wigeon numbers in the area, there was an indication that the number of Wigeon shot per hunter increased. This was probably due partly to the increased number of hunts per hunter in the two months of highest Wigeon numbers, and partly to improved hunting success; the increased number of hunting days allowing the hunter to be more selective in relation to the hunting conditions. A successful hunt is dependent on both weather conditions and the timing of the tide (local hunters pers. comm.; Frikke & Laursen 1994).

There appeared to be no effect on Wigeon numbers from stopping hunting in September. Similarly, there was found to be no effect from taking out the non-hunting periods in November. This may be influenced by a combination of several factors. The occurrence of Wigeon was highly dependent on flooding of the saltmarsh. Therefore, Wigeon numbers in September may have depended more on floodings, owing to the low frequency, than on the former hunting scheme. The lacking effect of non-hunting periods in

November, could have been influenced by a low rate of arrival of new individuals into the area; Wigeon numbers in the Danish Wadden Sea peaking in October (Laursen *et al.* in prep.). In addition, the lower Wigeon numbers may have made these months in general less sensitive to changes in hunting intensity. It is known that the sensitivity of goose flocks to human disturbance increases with flock size (Owens 1977; Madsen 1985).

To conclude, temporal hunting regulation by non-hunting periods seemed in this case to be a better way of reducing local hunting disturbance than by postponing the start of the hunting season and suspending the morning hunt. The minor significance of the morning hunt is furthermore indicated by the fact that usually few hunters were present and shooting was scarce (Jakobsen 1986). The introduction of the present hunting scheme was intended to improve the conditions for waterfowl at Skallingen. It must be concluded, however, that it was counter productive for the most important quarry species, Wigeon. The local population decreased while the hunting bag tended to increase. The results illustrate the importance of basing the design of temporal hunting regulations on a minimum of knowledge of the phenology, diurnal feeding pattern and feeding grounds of the affected species.

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