

Experimental wildlife reserves in Denmark: a summary of results

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INTRODUCTION

What are the disturbing effects of shooting, angling, rambling and other recreational activities on migratory waterfowl? Can future reserves be organised according to the needs of the birds, at the same time as a sustainable use of the areas takes place?

These were the questions asked by the Danish Wildlife Administration Board's committee for reserves, which initiated the project with the experimental reserves at Nibe-Gjøøl Bredning in Limfjorden and at Ulvshale-Nyord on the island of Møn in 1985 (Figure 1). Background research work during the shooting seasons from 1985/86 to 1988/89 registered bird and human exploitation of the two areas. Subsequently, experiments were carried out in the shooting seasons from 1989/90 to 1991/92 including limited human admittance to the areas. The objects of the experiments were (1) to test if human activity, prior to the testing period, had kept the number of birds below the natural basis of the area, and (2) to develop empirically refuge models, allowing sustainable use of the areas (see Madsen in press). The National Environmental Research Institute has recently finished the registration work (Madsen *et al.* 1992 a, b, c, d), allowing the following summary of the results and conclusions.

NIBE-GJØL BREDNING

One of the largest eelgrass *Zostera marina* beds in northern Europe (approximately 45 km²) is found at Nibe and Gjøøl Bredning. The eelgrass is the food of large populations of herbivorous waterfowl during their time migration periods. The area has been declared a Ramsar and EC Birds Directive Special Protection Area. During the autumn months of the years 1985-88, up to 2,000 Mute Swans *Cygnus olor*, 1,000 Whooper Swans *Cygnus cygnus*, 5,600 Wigeon *Anas penelope* and 10,000 Coot *Fulica atra* were registered in the area.

On the fiord, human activities take place. During the summer period, there is intense fishing using traps and nets, sailing on the deeper parts of the fiord, and windsurfing off the harbours. During the shooting season, the waterfowl are hunted from shooting punts in the eelgrass beds as well as from adjoining reedbeds and islets.

With the purpose of examining whether human activities disturb the behaviour of the waterfowl the activity of flocks of swans and Wigeon were observed in Nibe and

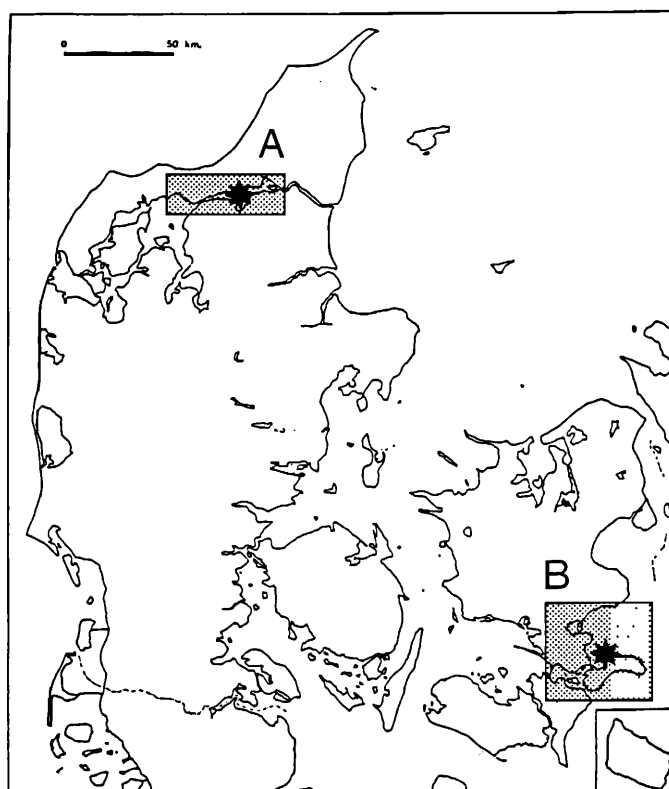


Figure 1. Location of study areas. A: Nibe-Gjøøl Bredning in the Limfjorden; B: Ulvshale-Nyord on Møn. Stars indicate the areas where experiments were carried out; shaded areas show surveillance areas

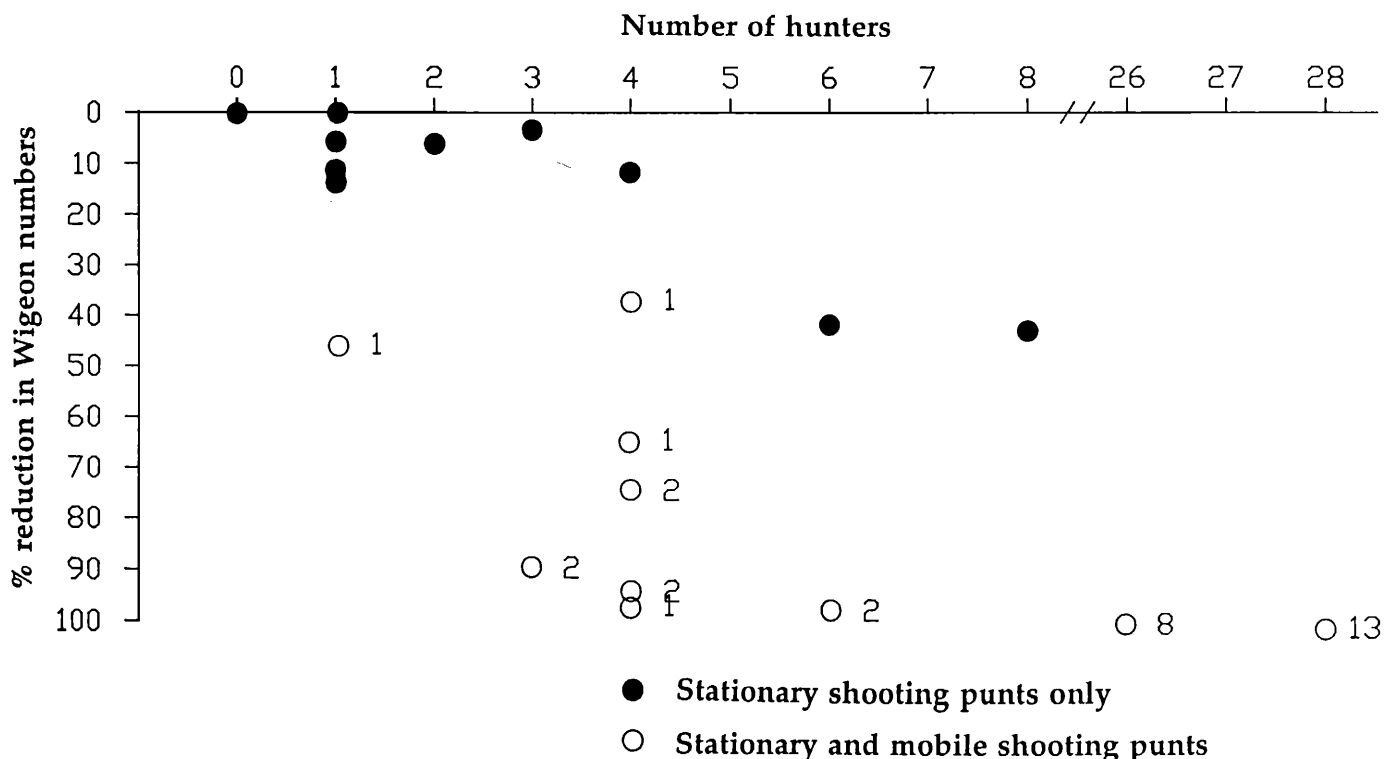


Figure 2. Presence of Wigeon in the *Zostera* bed in Nibe Bredning in relationship to intensity of shooting from two types of shooting punts. The relative decrease in wigeon numbers is expressed as the difference between the numbers observed early in the morning and the numbers at noon (most shooting takes place during the intervening period). Figures adjacent to circles show the number of mobile punts out of the total number of hunters present.

Gjøl Bredning over a number of days. When Mute Swans and Wigeons were undisturbed, they spent 65% and 78%, respectively, of the daylight hours feeding. When dinghies, shooting punts or windsurfers approached a flock, the birds abandoned feeding and moved to an undisturbed place where they rested for a while before resuming feeding. When the birds were disturbed repeatedly, they prolonged the period of rest. The longest period of rest after being disturbed was caused by mobile shooting punts. The Wigeon then rested on average 46 minutes after a first disturbance, 168 minutes after a second disturbance. The resting period was shorter when the disturbance was caused by a fishing boat, on average 20 minutes after a first disturbance. The shortest resting period followed a shot being fired from a stationary shooting punt, on average 8 minutes. The distance of escape flight depended on the source of disturbance. The longest distance was taken from windsurfers (Wigeon 400-600 m) and the shortest distance from mobile shooting punts (20-200 m).

To a certain extent, the Mute Swans were able to compensate for the loss of feeding time by feeding more intensively after the disturbance, while the Wigeon were unable, within the same day, to compensate for the disturbances.

The eelgrass beds at Nibe Bredning held 4 or 5 sportsmen in stationary shooting punts before the

number of Wigeon was affected seriously; more punts made the Wigeon leave. In the case of shooting both from stationary and mobile punts, the number of birds was reduced considerably by the presence of 3 or 4 punts (Figure 2). Thus, shooting from mobile punts was much more disturbing than from stationary punts, in spite of the fact that the bag of Wigeon in general was better from stationary than from mobile shooting punts. Mute Swans accepted a higher level of hunting intensity than Wigeon and did not desert the area, but rested in a peaceful area within Nibe Bredning.

It was concluded the baseline research that fishing did not seriously influence the presence and activity of the waterfowl, partly because they reacted only slightly to fishing boats, partly because the fishing season had stopped before the huge influx of waterfowl in October. Windsurfing had a certain disturbing effect because the birds flew a long distance away. However, windsurfing mostly took place in areas not used by the birds; only during time of high tide was it possible to windsurf through the eelgrass beds.

Shooting, and in particular, mobile punt shooting were the worst sources of disturbance. This was partly because they took place where the birds were feeding, and partly because they provoked a strong reaction in the birds.

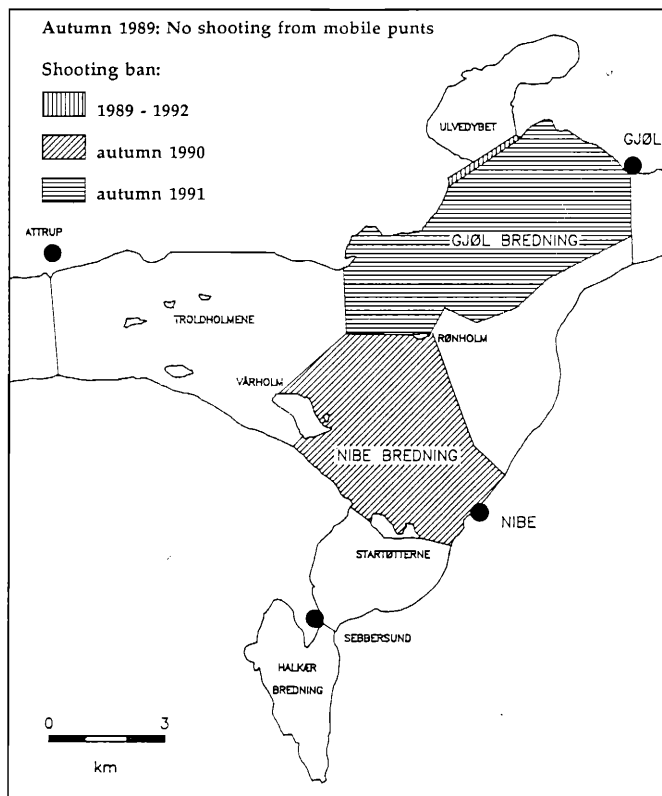


Figure 3. Experimental set-up of wildlife reserves in Nibe-Gjøl Bredning during the autumn seasons 1989-1991.

Using the conclusions of the baseline studies, the three years of experiments were concentrated on the disturbing effects of shooting. Regulations were put into force via an order under the Wildlife Administration Act. The disturbing effect of mobile punt shooting was tested by prohibiting that particular activity in the whole of Nibe and Gjøl Bredning during the first season. To test the disturbing effect of punt shooting in general, Nibe Bredning was laid out as a reserve with prohibition of shooting in the second season; and in the third season, Gjøl Bredning was laid out under the same conditions (Figure 3). By switching between the two areas, the conclusions were reinforced. It was predicted that if the shooting previous to the experiments were a disturbing and limiting factor to the waterfowl in the area, the restrictions of the shooting would result in an increase in the number of especially quarry species (Wigeon primarily) and the birds would concentrate in the refuge areas.

Compared with the autumn seasons prior to the experiments (1985-88), three out of five studied populations of waterfowl in the area increased during the autumns of 1989-91. Swans (Mute Swans plus Whooper Swans), light-bellied Brent Goose *Branta bernicla hrota* and Wigeon (Figure 4). In the case of the Wigeon, the increase was most pronounced in the refuge areas, whereas the swans and Brent Geese

showed a distinct increase in the refuge areas in one of the years and not in the other. Additionally, the length of stay of Wigeon in the area was prolonged. Before the experiments, the number of birds peaked during the months of October and November. During the years of experiments, large numbers of birds stayed for the rest of the year. The question is, where did the many Wigeon of Nibe-Gjøl Bredning come from? No decrease of importance could be traced in the large resting places close by. This may suggest that the concentration did not happen by 'draining' the neighbouring areas for birds. It is more likely that birds which previously bypassed or made short stops, prolonged their period of rest in the area; in the past they would have been found farther south along the flyway.

The flyway populations of swans and Wigeon probably also increased in the years 1985-91. But in the case of the Wigeon, the local increase (from 5,000-6,000 before the experiments to 12,000-21,600 during the years of experiments) was significantly higher than for the population as a whole. Variation in the weather conditions (especially ice formations) and food resources (eelgrass) had no important influence. The eelgrass beds did show an increase in horizontal and vertical distribution, but the growth took place primarily at water depths beyond the reach of ducks and swans.

ULVSHALE-NYORD

The salt marshes at Nyord and Ulvshale, in connection with the surrounding shallow water areas with extensive growth of submerged vegetation, are important breeding and resting areas for waterfowl. During the autumns of the baseline research, up to 3,100 Mute Swans, 1,300 Greylag Geese *Anser anser*, 1,000 Canada Geese *Branta canadensis*, 4,000 Mallard *Anas platyrhynchos*, 800 Wigeon and a few hundreds of Teal *Anas crecca* and Shovelers *Anas clypeata* were observed. By virtue of the geographical situation close to the Baltic, a large influx of birds comes from the north. Many flocks fly straight across the area, while other flocks settle for a time. Judging from the baseline research, the area appeared to be primarily a transit station between the northern breeding areas and the southern autumn staging and wintering areas. Certain species, did use the area as a wintering place: Canada Goose and Mallard.

During summer, the area is used for a number of human activities: fishing, rambling, swimming, sailing and wildfowling. During the migration of the waterfowl, the activities consist almost exclusively of shooting and fishing. Shooting takes place on the salt marshes, from punts (in the reedbeds, in the open shallow areas, on sand bars) or from motorised punts. In the mornings

Peak Wigeon numbers

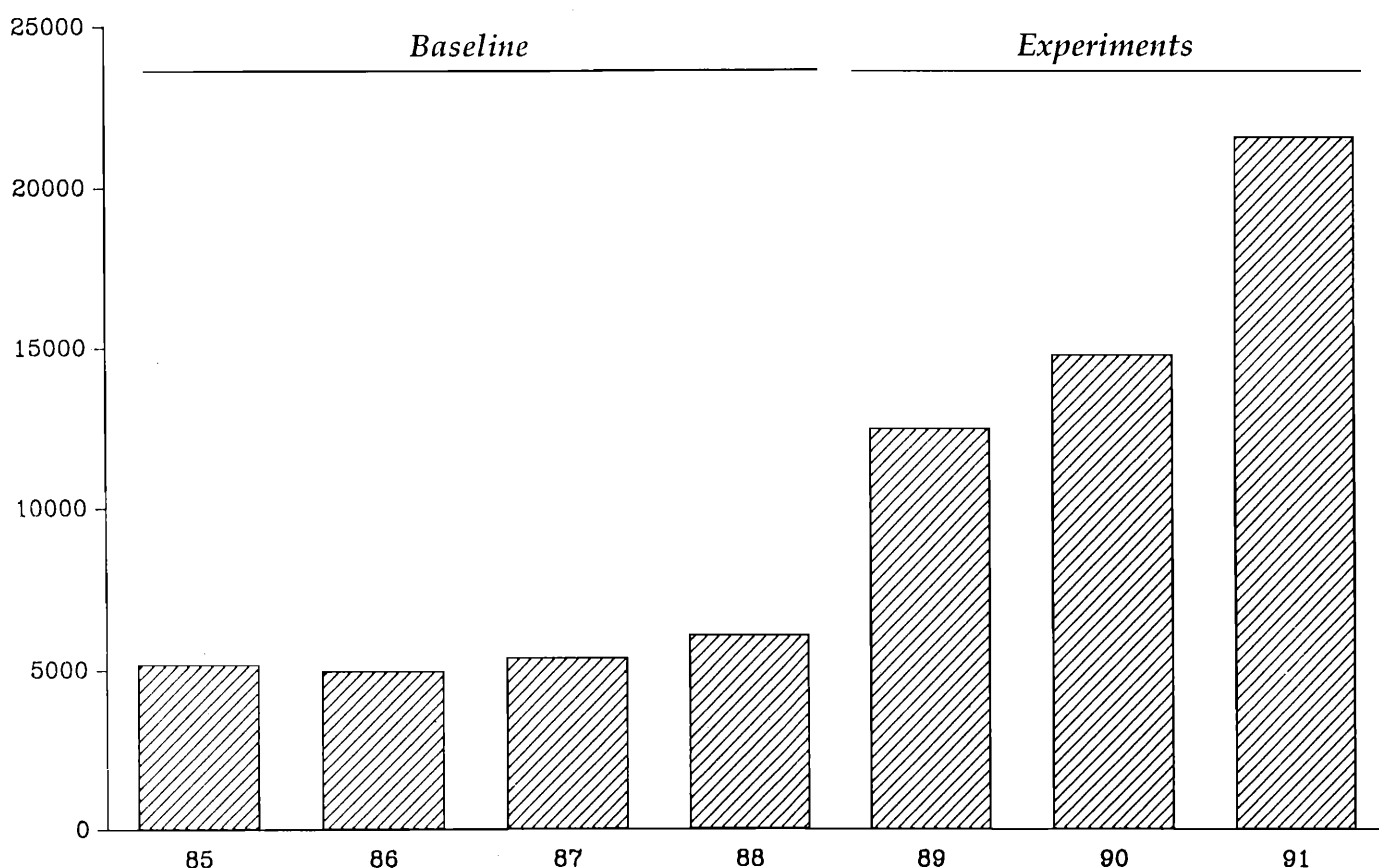


Figure 4. Development of the peak numbers of Wigeon recorded during the autumn, before and during experiments in Nibe-Gjøel Bredning.

the shooting takes place primarily from punts, whereas at dusk the shooting takes place chiefly in the tidal channels and at deeper parts of the bay.

From the baseline research it was evident that shooting was the most important disturbing factor for the waterfowl. In August, ramblers crossing the meadows and beach walkers constituted an important factor of disturbance, which resulted in a local re-distribution of the birds.

During the three years of experiments at Ulvshale-Nyord, there were different reserve systems in force, regarding shooting: During the first year, the reserve consisted of shallow water, the second year it consisted of shallow water and a salt marsh area (apart from a zone of 100 m along the coasts). In the third year the reserve consisted of the salt marsh and the adjacent shallow water (with no 100-metre shooting zone). Shooting from motor-driven boats and mobile punts was prohibited during the whole period.

During the experiments, 11 out of 16 studied species showed an increase in number compared with the baseline period. The huntable species in particular showed a higher increase than could be explained

by increases in the flyway populations. Thus, birds were attracted to the area, with peak numbers of: 1,900 Greylag Geese, 4,500 Canada Geese, 9,900 Mallard, 2,500 Teal, 4,700 Wigeon and 1,100 Shoveler.

Most of the huntable species were found in the shooting-free areas. The number of dabbling ducks and geese reached their peak numbers during the third year of experiments. It appeared, as well, that the best refuge consisted of the combination of salt marshes and adjacent shallow waters, a perfect ecological unit for the dabbling ducks, allowing them to choose to rest or feed in the marshes and in the shallow area, depending on the water level. Most of the Canada Geese and many of the Mallard were still to be found outside the actual shooting-free area, but in areas undisturbed by the motorised and mobile punts. This shows that the birds accepted the usual level of shooting from stationary punts, and that numbers earlier probably had been kept down due to shooting from motorised and mobile punts.

During the years of experiments, the length of stay of the dabbling ducks was prolonged considerably,

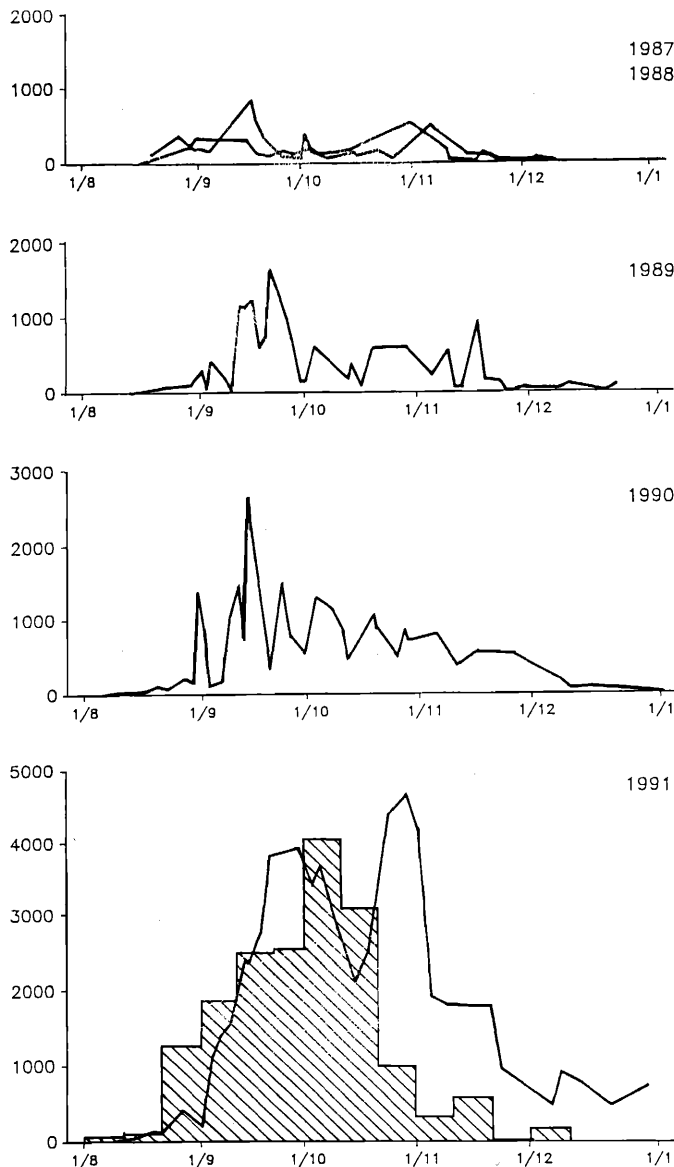


Figure 5. Development of numbers and phenology of Wigeon during autumn, before (1987 and 1988) and during experiments (1989-1991) at Ulvshale-Nyord. Inserted in the bottom graph (shaded) is the phenology (on a relative scale) of Wigeon immigrating from the Baltic to the study area (see text).

compared with the previous years. An example is shown in Figure 5. In the bottom graph the intensity of the influx of Wigeon from the Baltic into the area (registered by standard counts on numerous mornings) is inserted. The influx begins in the end of August and peaks during the months of September and October. The graphs of the numbers actually resting in the area show that not only did the number of Wigeon increase over the years: also their length of stay was considerably prolonged. Before the experiments, most Wigeon disappeared during September, i.e. before the peak of the influx. Gradually, during the experiments, a better accordance was reached between the influx and the number of resting birds; in 1991 a 'tail' in the numbers of resting birds was observed after the cease

of migration, and approx. 1,000 Wigeon even stayed for the winter.

CONCLUSIONS

The conclusions of the experiments in both areas were that shooting prior to the experiments had a disturbing effect, in particular on the huntable species, and that their numbers were kept below the carrying capacity of food resources and resting possibilities. It cannot be ruled out that the increase of some of the populations may be caused by other factors: general increase of population (swans) and change of wintering distribution (Light-bellied Brent Geese).

During the period of experiments, Nibe-Gjøel Bredning developed into the most important single location for Wigeon in Denmark, and Ulvshale-Nyord became one of the most important resting places with the widest spectrum of species in the country. Because of the exchange of birds between the reserve and the surrounding areas, even the number of birds outside the reserves increased. Thus, the decrease in hunting areas was counter balanced by better shooting opportunities outside the refuges.

The introduction of refuge areas allowed that the carrying capacity of food resources was reached, by and large, in both locations. At Nibe-Gjøel Bredning, most of the eelgrass accessible to the birds within the reserve each year was almost depleted by the end of the year. But after the shooting season (closure 31 December), the birds had the opportunity again to disperse to the neighbouring areas. In the shallow water areas around Ulvshale-Nyord the situation was similar.

Based on the results, it was recommended to the Wildlife Administration Board that a permanent reserve system for both areas, including zoning of recreational activities and refuge areas with a shooting ban, should be introduced.

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Brent geese