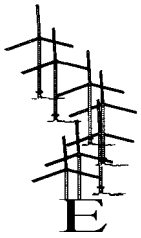
Influence of offshore windmills on migration birds

- in southeast coast of Sweden.

This presentation concerns a programme for following-up the influence of windmills on bird life with reference to two offshore wind farms, at Utgrunden and at Yttre Stengrund in southern Kalmarsund in the Baltic Sea.

GE Wind Energy

Jan Pettersson and Thomas Stalin



Summary

Up to 1,000,000 sea birds meets two offshore wind parks at Utgrunden and at Yttre Stengrund during their migration along the Swedish southeast coast. The sea birds reaction on these wind turbines are studied during spring and autumn migration since autumn 2000. The performed study shows that the sea birds recognise the wind turbines and change their flight route to either side of the wind park. Radar studies show that the sea birds have similar behaviour during night. In wintertime food-searching sea birds continue to be in the area with wind turbines. The results are promising and so far has no collision occurred during the observation of 800,000 sea birds.

Background

Around 600,000 to 1,000,000 Eider **Somateria mollissima** migrate up and down the Swedish coast each season and pass through Kalmarsund there two offshore wind parks are built

The wind power companies GE Wind Energy and Vindkompaniet **AB** received permission to build and run one group of windmills each at Utgrunden respectively Yttre Stengrund in the southern Kalmarsund. The permission terms for these wind farms included a control programme for following-up the effect of the windmills on migrating birds. The wind power companies have made a joint programme for the two wind farms. To document the potential effects on the environment by Offshore Wind parks has a strategic importance for project developer's ability to submit EIA with scientific reference material for offshore projects all over Europe. The program includes studies during several seasons and is divided into different stages. The first stage started in year **2000** and the fourth stage is running under year **2003.** The programme belongs to the research program set up for Utgrunden Offshore Wind Park and is sponsored by the Swedish National Energy Authority, project no. **11518-2.**

During autumn 2000 GE Wind Energy built seven windmills at Utgrunden. After six weeks of installation on 18 October all the windmills were in place. On 21 of December they were fully commissioned to the grid and has since that time been successfully in operation. During the period of May to July 2001 Vindkompaniet built five windmills at Yttre Stengrund and in September 2001 they were fully commissioned to the grid.

Objektive

The objective is to study the effects from Utgrunden and Yttre Stengrund Offshore Wind Park on 1 million seabirds migrating through Kalmarsund.

-How large is the risk for bird collisions during good visibility, day and night?

-How will the wind farms influence the route of bird migration?

-To what extent and how migrate birds during mistfog?

-Will the wind farms influence resting and food searching by Long Tailed Duck during the winter season.

Accomplished bird studies

The study is done through visual field studies from three observation points by the field research ornithologist Jan Pettersson and his team. There were at the beginning and there still are some uncertainty about what are the best technique and the best means for executing this type of study. The programme is divided in stages in order that the developed knowledge and experience can be used for adjustments and changes of the following stage. There is a Research Reference group connected to the field researchers. This group is responsible for evaluation and for setting the program for the next stage of the program.

The study of migrating and resting birds at Utgrunden started in spring 1998 and continued during spring 1999. These two studies are shown in the two reports Pettersson & Lindell 1998 and Pettersson & Lindell 1999. These studies were done before any wind turbines were built.

In connection with the environmental permit for the planned wind farm at Yttre Stengrund a co-ordinated migrant bird study was carried out during 2000 for the two areas. Stage one of the program started in year 2000 and a report was presented with the results of field- and radar-studies, Pettersson 2001. In the presentation of stage two, the migrating birds observed in spring 2001 and autumn 2001 were compared with conditions before the offshore wind farms were built, Pettersson 2002. The study has continued during spring 2002 and autumn 2002 with a new additional topic on observing the flying altitude of Eiders approaching the wind farms. In the report from stage three the observations from 2002 have been compared with the material from 2000 and 2001, Pettersson 2003. The study is continuing during 2003 and a final report from all four stages will be presented during 2004.

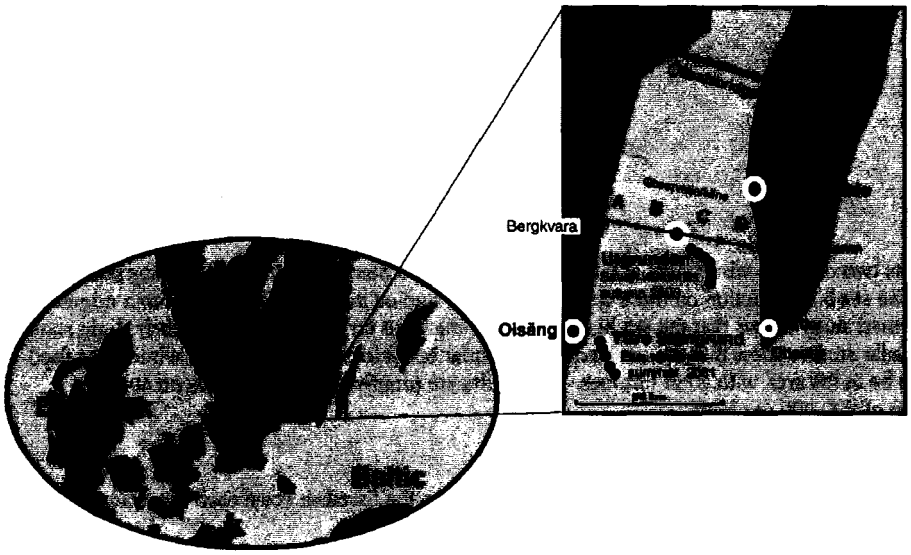


Figure 1 Observation points, Olsäng, Utgrunden and Eckelsudde.

Results
Spring migration at Utgrunden

The spring migration are very strong in Kalmarsund, around 450 000 sea birds mainly Eiders have been counted in the three spring studies 1999,2001 and 2002. The migrating Eiders fly on either of the sides of the seven wind turbines at Utgrunden. In 1999 around 40 % of 125 058 migrating Eiders flew in the five km wide sector (C) there Utgrunden wind turbines later was built, figure 2. When the seven windmills were in full operation, spring 2001 respective spring 2002, only 6 % of 192 751 and 7% of 211 239 Eiders flew in sector C. Instead most of them flew in sector D, figure 2. With a closer look Eiders avoids the area there the wind turbines are built as seen in figure 3, there sector C is divided in five sub sectors of 1 km width. The migration of the other sea birds in the area under the same time show nearly the same picture for how they do when they face the wind turbines at Utgrunden and at Yttre Stengrund. They fly on one of the sides and not over or through the wind park.

Autumn migration at Yttre Stengrund.

The autumn migration are strong in Kalmarsund, between 200 000 to 300 000 seabirds have been registered in the three autumn studies 2000,2001 and 2002. These studies show that in the period of late October the migrating route in southern Kalmarsund is near the Mainland. Only 1-2 % of the Eider migrate in area C there Utgrunden offshore wind park is situated. This means that the fly route is concentrated to sector A and that the migrating birds turn west after passing Yttre Stengrund.

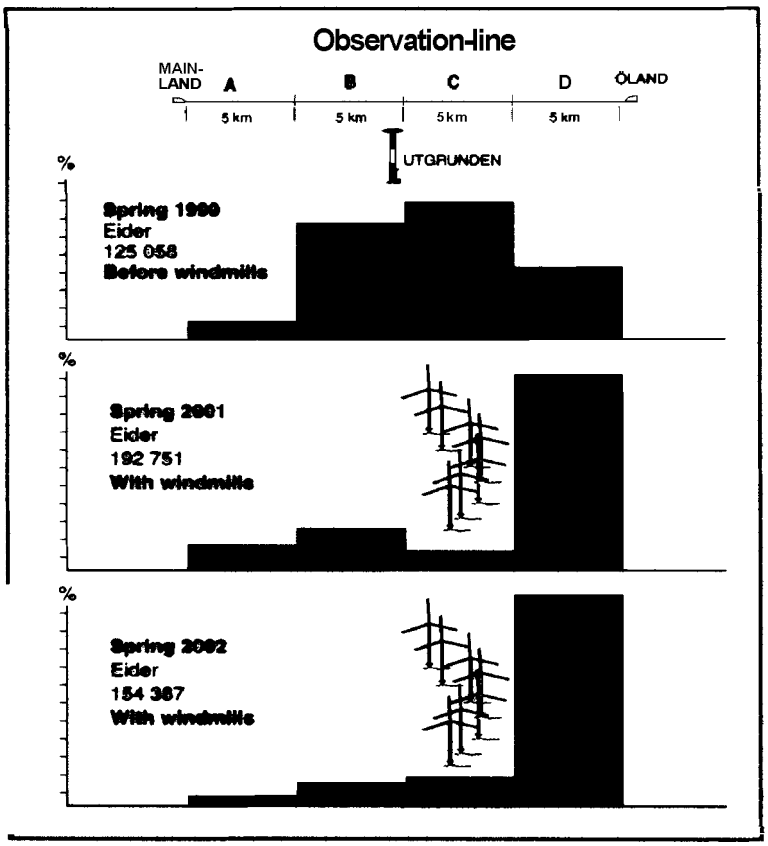


Figure **2.** Distributions of Eider during spring **1999,** spring **2001** and spring **2002.**

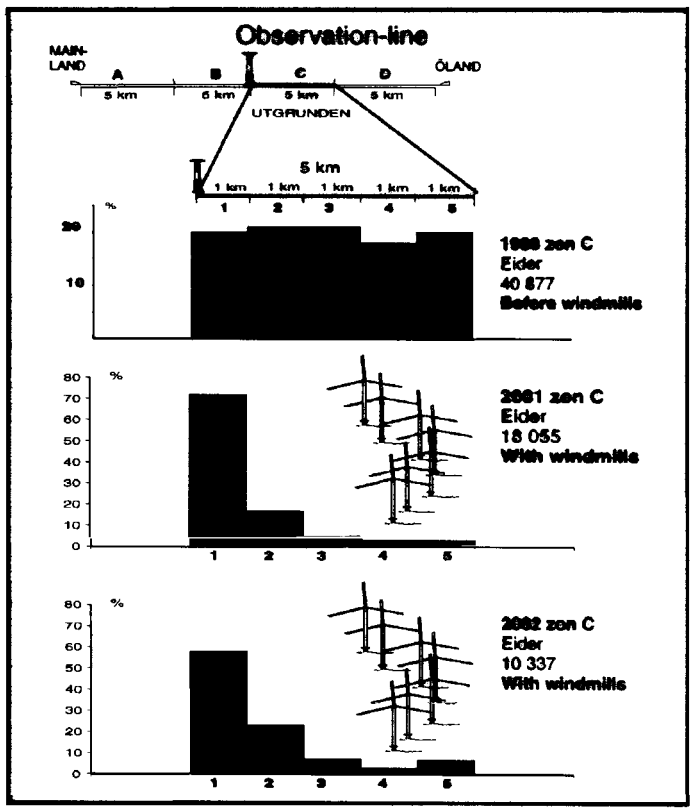


Figure **3.** Migration in Sector C.

In autumn **2000** before the wind turbines at Yttre **Stengrund** were built, **32** % of the Eider flocks flew through the 1,5 km wide area there the five wind turbines now are built. In autumn **2001** and autumn **2002** less then **2** % of the sea birds migrate through the same area. In autumn **2001** with the wind turbines installed **82** % of the Eider flocks choose to fly west of the five

windmills and 72 % of the flocks flew east of the windmills in autumn 2002. The prevailing wind direction influences, which side the Eiders, choose to fly.

The height of the birds approaching the turbines has been studied in autumn 2002 with a optical distance instrument, WILD, 80 cm, 12X. The Eiders normally fly below 10 meters altitude. At Yttre Stengmnd 39 Eider flocks have been registered at three positions, before turbines, passing by the first turbine and reaching the fifth turbine. Those Eiders that come close to the turbines increase their height from 10 m to about 40 m at first turbine increasing to 50 m at the fifth turbine. Most of the Eiders flew at a distance of 500 to 1000 m from the turbines. The height were decreasing with the distance to the turbine, figure 4. There were other bird species that moved unimpeded in-between the turbines at the same flight altitude like Common/Arctic Tern *Sterna hirundo/paradiaea* at 50 m height Widgeons *Anaspenelope* flying on the west side of the turbines did not change their flying altitude at 50 m.

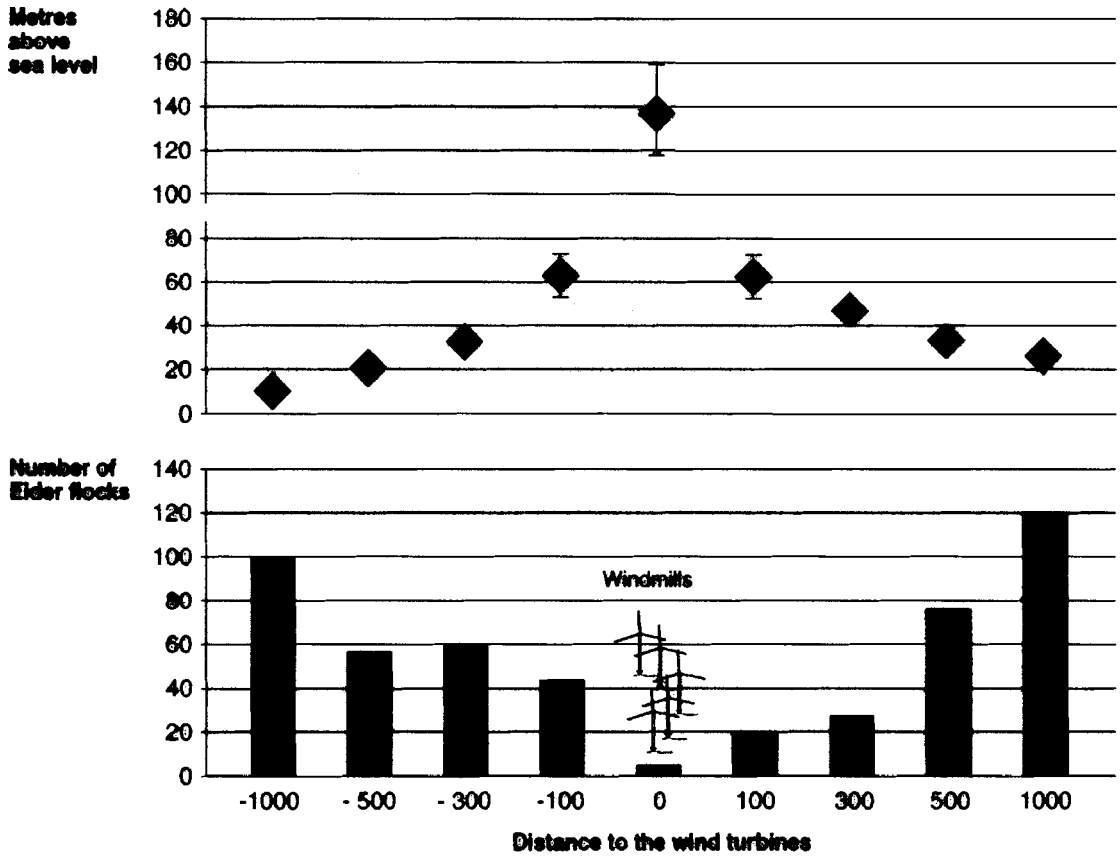


Figure 4, Flying altitude and number of Eider flocks depending on distance to the wind turbines at Yttre Stengmnd, 500 flocks registered, Autumn 2002.

Radar study

The possibility to analyse recorded radar echoes from migration days with high activity is a useful way to learn how the birds fly. This is done in cooperation with the Swedish Armed Forces. The military Surveillance radar that has been used is situated in the south of Oland at Ottenby and digital data are afterwards transferred to VHS-bands. The radar material is not covering all manually observed hours during the studied periods. This assistance has been of great help to the study. During daytime the radar pictures are compared with the manuall observations and each flock is identified. The radar detects 32% of the bird flocks representing 70% of the migrating birds. The bird flocks fly way during day time in the Kalmarsund show that that they seems to fly on either side of the wind turbine row and that they don't fly over or through the wind farms, figure 5.

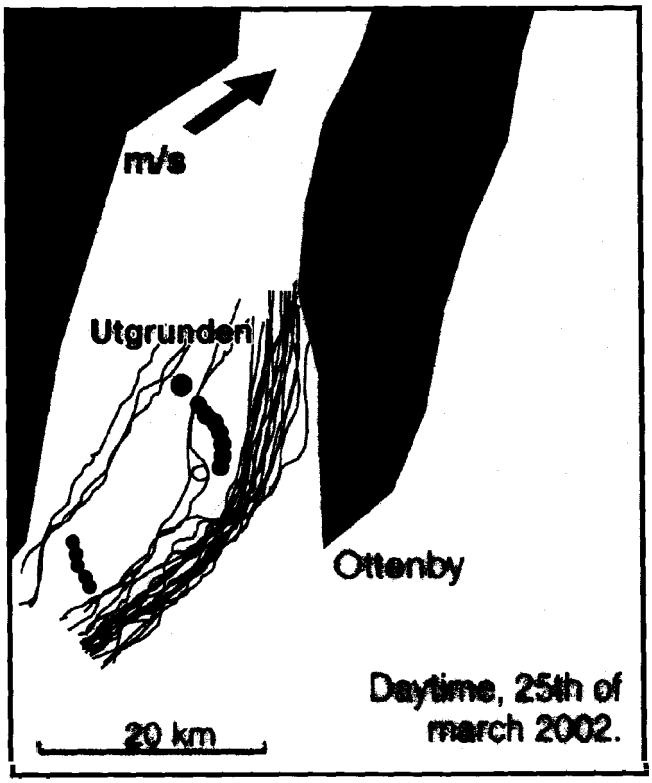


Figure 5. Radar trajectories of Eider flocks during daytime.

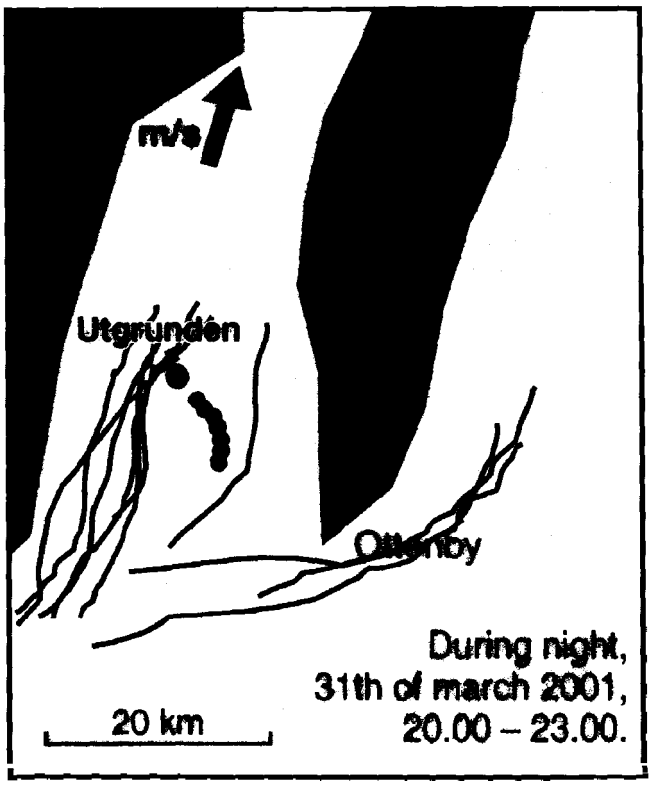


Figure 6. Radar trajectories of sea birds in the night.

Radar is the only possibility to study migrating birds during nights or in mist. Radar studies are available from 407 hours, studies 2000,2001 and 2002. Out of these 407 hours migration was occurring under 74 hours. The results show that the flocks during night seems to recognise the wind turbines and that they fly on either side of the wind turbines with good marginal at both Utgrunden and at Yttre Stengrund, figure 6. The sea birds show the same pattern as during daytime.

During the studies from 2000,2001 and 2002 the radar material with mist during daytime is 82 hours. Out of these 82 hours migration was occurring under 19 hours. The intensity of migration was low. One problem with these studies is that the radar has less coverage during heavy mist and that migrating flocks of bird probably have been missed. The material from two seasons of radar study during mist is still to small to base an analyse on. However the material indicate that the migration behaviour is different as compared to daytime migration. the birds migrate on a wider front, figure 7. There is no material on migration during both night and mist as the phenomena is rare.

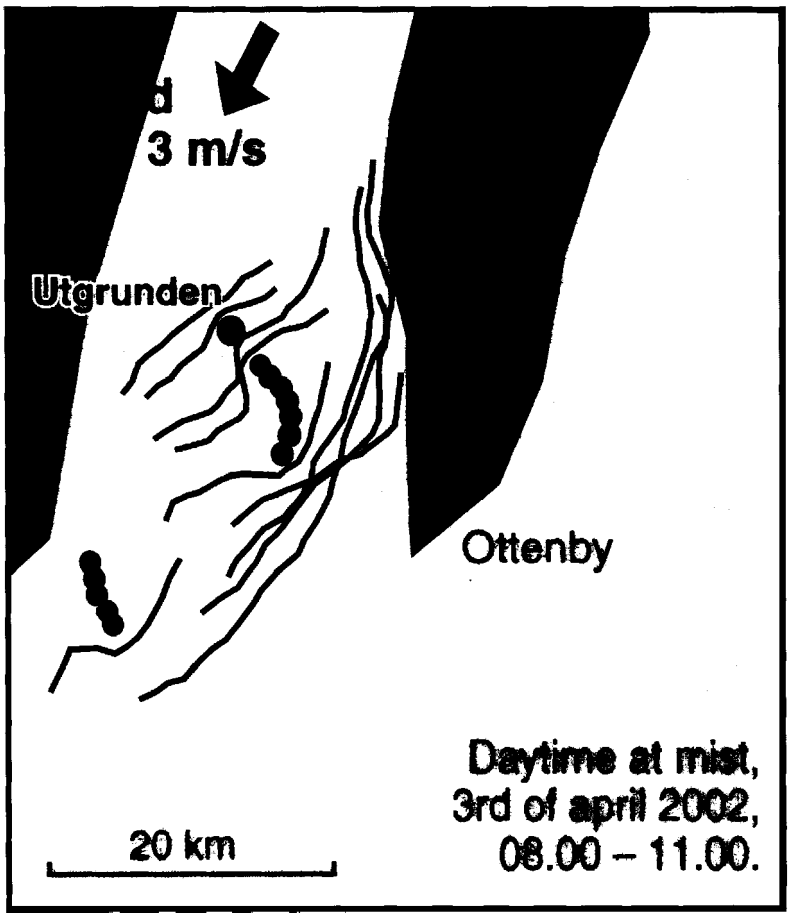


Figure 7. Radar trajectories of Seabirds during mist

Resting of Long-tailed Ducks

During autumn, winter and spring a flock of around 1.000-2.000 Long-tailed Duck ***Clangula hyemalis*** are resting and feeding on the banks of Utgrunden where the windmills have been build. This ducks have been studied before and after the building of the windmills. The flock of this ducks continue to feed in the area around the windmills after the windmills have been built. See figure 8.

The ducks are seen some ten meters from the wind turbines and fly frequently back and forth in-between the wind turbines. The ducks are actively seeking food near the active wind turbines. The **same** picture is valid for a smaller amount of Eiders in the same area.

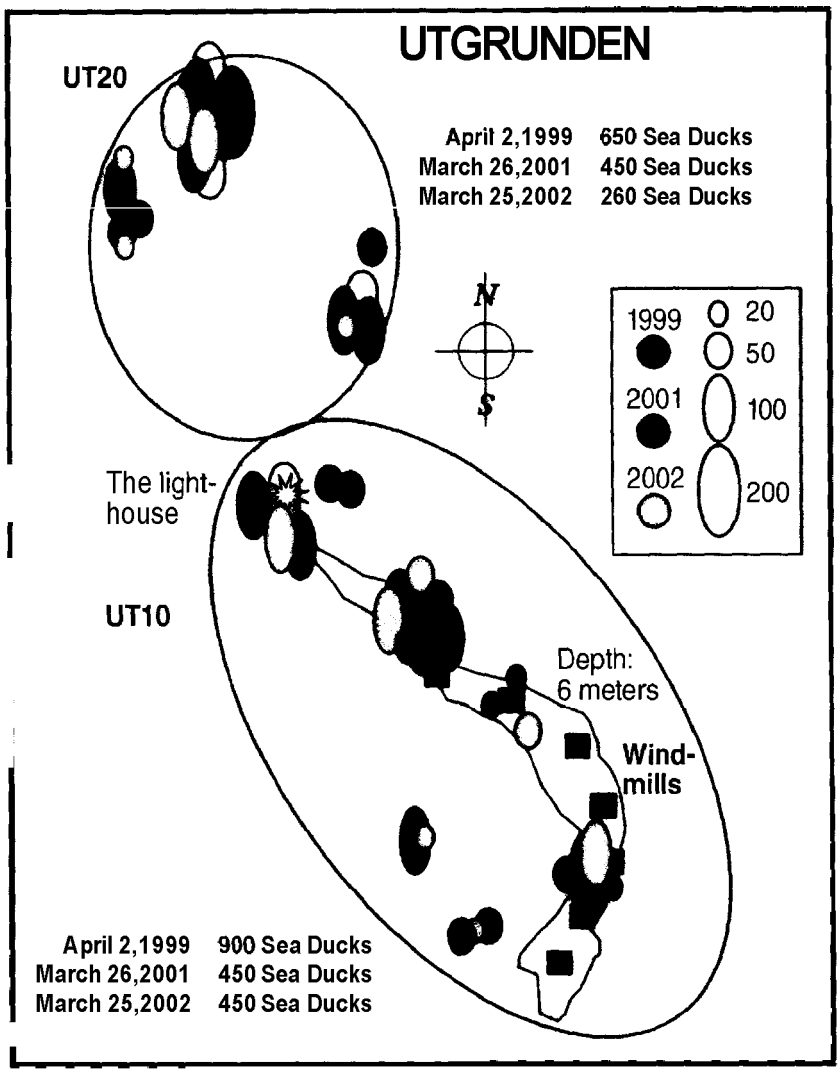


Figure 8. Resting Sea Ducks.

Conclusion

After having observed about 800 000 sea birds at Utgrunden and Yttre Stengrunden it is clear that the sea birds recognize the turbines well in advance, 2 km and that they avoid the turbines during daytime and normal visibility. The birds change their route 500 - 1000 meter parallel to the park and fly on either the west or the east side. The Eider flocks don't seem to fly near the windmills in any numbers at Utgrunden when their route continues straight forward. In daytime most of the sea birds fly at a distance of 1 000 meters and few birds fly nearer than 500 meters. At Yttre Stengrund there the birds take a sharp turn after passing the wind turbines they fly closer even up to 100 meters distance to the turbines. It is very seldom that they fly over the windmills. During this whole study no single collision have been seen. During daytime the risk for collision is very little.

Radar studies during the night show that the sea birds recognise the wind turbines and fly parallel to the wind parks similar to the daytime behaviour. About 20 % of the migration is done during the night. Proportional more birds fly in the middle of the Kalmarsund during the night than during daytime. The occasion of mist and migration is rather uncommon and the number of migrating birds that has the risk of collision under these circumstances are low. The phenomenon of mist during night with migration is so uncommon that no material is available.

Food searching and resting sea birds mainly Long-tailed Duck continue to be in the area around the wind turbines during the winter season. These birds are seen some ten meters from the active wind turbines and they fly frequently back and forth in-between the wind turbines. The wind turbines seem to have no large effect on these stationary birds possibility to make their food search in the area.

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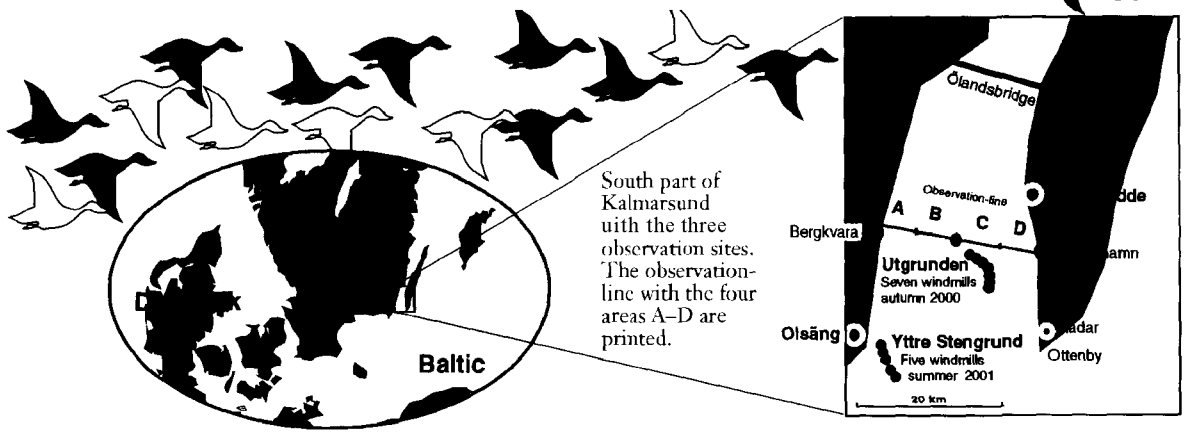
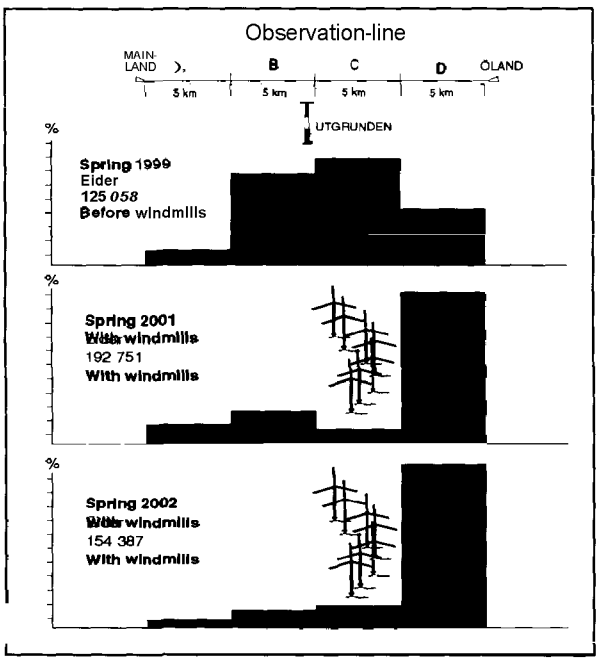
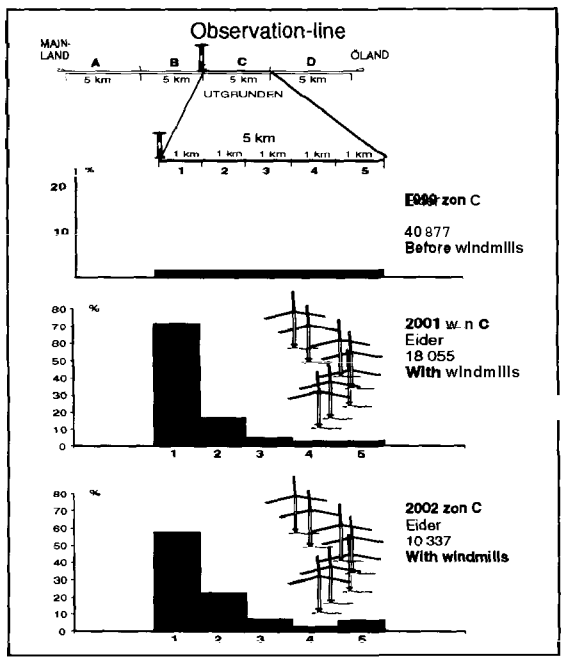
Influence of offshore windmills on migration birds in southeast of Sweden



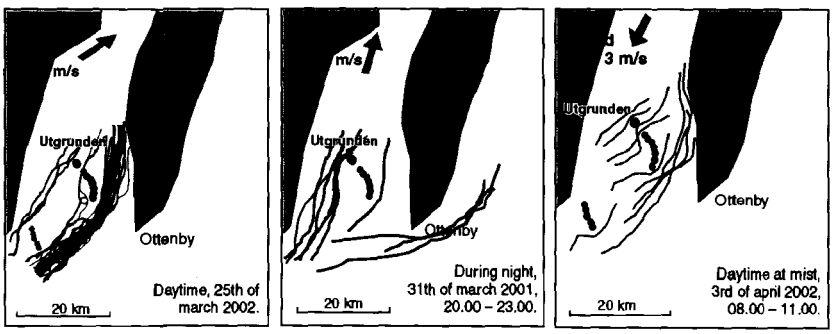
South part of Kalmarsund with the three observation sites. The observation-line with the four areas A–D are printed.



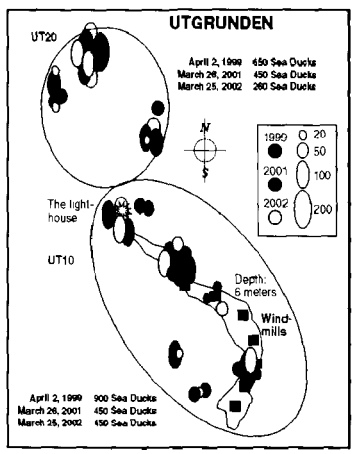
The spring migration of Eider counted in four different sectors in Kalmarsund. Less Eiders fly in the wind turbine area (sector C) with windmills than before.



The spring migration of Eider in sector C with wind turbines, divided in 1 km wide subsector, compared with the situation before the windmills 1999.



Radar echoes from Eider flocks identified by manual observer during daytime. The birds recognize and adjust their flight route to either side of the wind park. During night the radar echoes show that the sea birds recognize the wind turbines and change their route similar to day time. Few hours with radar echoes in mist indicates that the birds move on a wider front then during the day.



Food searching Long Tailed ucks studied before and after the windpark was built at Utgrunden.
The ducks continue to be in the area around the wind turbines and they are seen some ten meters from the active wind turbines and fly frequently back and forth in-between the wind turbines.

GE imagination at work