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Aerial surveys of seals at Rødsand seal sanctuary and adjacent haul-out sites

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Data sheet

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Abstract: This report describes preliminary results of aerial surveys at Rødsand seal sanctuary, Southeast Denmark and adjacent seal haul-out sites in southwestern Baltic. The work was carried out in connection with studies of potential effects of the Nysted offshore wind farm. Monthly aerial counts of harbour and grey seals in southwestern Baltic (Management area 4) were conducted from March 2002 to March 2003 except for a pause from October 2002 - January 2003. The surveys provide information on the use of the different seal haul-out sites, which is believed to have some level of exchange of animals. Furthermore, aerial surveys from late August from 1990-2000 are available as part of the baseline data. Based on the aerial surveys an estimated stock of about 200 harbour seals used the Rødsand area during the moult in late August 2002.

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National Environmental Research Institute

Summary

Introduction

This report describes the preliminary results of aerial surveys at Rødsand seal sanctuary, southeast Denmark and adjacent seal haul-out sites in southwestern Baltic. The work was carried out in connection with studies of potential effects of the Nysted offshore wind farm. Rødsand seal sanctuary is a part of seal management area 4, and the area is believed to hold a more or less closed population with little exchange to other areas. Although the harbour seal is relatively stationary there may be movements between the haul-out sites in the area. A possible reaction to disturbance from the construction and operation of the wind farm may be that the seals use other haul-out sites to a higher extend.

Method

Monthly aerial counts of harbour and grey seals in southwestern Baltic (management area 4) were conducted from March 2002 to March 2003 except for a pause from October 2002 to January 2003. The surveys provide information on the use of the different seal haul-out sites, which are believed to have some level of exchange of animals. Furthermore, aerial surveys from late August carried out in 1990 - 2000 are available as part of the baseline data.

Conclusions

Based on the aerial surveys an estimated stock of about 200 harbour seals used the Rødsand area during the moult in late August 2002.

Because of a seal epidemic in 2002 it has so far not been possible to evaluate the effect of the construction work. However, this will be carried out after the construction work ends in fall 2003.

Rødsand seal sanctuary is the most important haul-out site in southwestern Baltic during summer while it is less important to the harbour seals during February - March. However, two live grey seal pups were observed in late February - early March, which indicate that the sanctuary is very important to grey seals during spring.

Resumé

Introduktion

Denne rapport præsenterer de foreløbige resultater af månedlige flytællinger af sæler ved Rødsand sælreservat syd for Lolland samt tilstødende lokaliteter i den sydvestlige del af Østersøen. Flytællingerne indgår som en del af grundlaget for en vurdering af mulige effekter fra Nysted Havmøllepark syd for Nysted på Lolland. Rødsand sælreservat er en del af delområde 4, som menes at have en mere eller mindre lukket bestand af spættet sæl med begrænset udveksling med andre områder. Selv om spættet sæl er relativ stationær, kan der forekomme bevægelser mellem rastepladserne. En mulig reaktion på eventuelle forstyrrelser i forbindelse med konstruktionen og driften af havmølleparken kunne være, at sælerne benytter andre rastepladser i større udstrækning.

Månedlige flytællinger af sæler i den sydvestlige Østersø (delområde 4) blev udført fra marts 2002 til marts 2003 med undtagelse af en pause fra oktober 2002 til januar 2003. Optællingerne gav information om årstidsfordelingen mellem de forskellige yngle- og rastepladser. Endvidere indgår flytællinger foretaget i årene fra 1990 til 2000 som en del af baseline data.

Metode og konklusion

På grund af sælepidemien i 2002 har det endnu ikke været muligt at vurdere sælernes reaktioner på den første del af konstruktionsarbejdet. En sådan vurdering vil blive foretaget, efter at havmølleparken er bygget færdig i slutningen af 2003.

Om sommeren er Rødsand sælreservat den vigtigste rasteplads i den sydvestlige Østersø, mens Rødsand har mindre betydning for den spættet sæl fra februar til starten af marts. Der blev dog observeret to levende gråsælunger i slutningen af februar til starten af marts 2003, hvilket viser reservatets betydning for gråsælen i vinter- og forårsmånederne.

1 Introduction

1.1 Background and purpose

The Danish government has introduced several action plans with the goal of reducing the annual emissions of CO_2 to half of 1998 levels by 2030. In order to facilitate this, the amount of energy produced from renewable energy sources, including offshore wind farms is to be increased. The Ministry of the Environment and Energy has issued the energy companies Energi E2 and SEAS a commission to construct a wind farm, "Nysted Offshore Wind Farm", close to Rødsand (south of Lolland). The wind farm will consist of 72 2,2 MW turbines. The initial construction work on the foundations started in the end of June 2002, and the wind farm is planned to be in operation in the fall 2003.

An Environmental Impact Sssessment (EIA) study was carried out in 2000 following the guidelines jointly drawn up by the Danish Energy Agency and the National Forest and Nature Agency (Dietz et al. 2000). Part of the guidelines is to assess the extent to which the construction of the wind farm in this area will cause measurable, temporarily or permanent changes in the local population of harbour seals (*Phoca vitulina)* and grey seals (*Halichoerus grypus*).

Rødsand seal sanctuary is a part of seal management area 4 (Teilmann & Heide-Jørgensen 2001). This area is believed to hold a more or less closed population with little exchange to other areas. Although the harbour seal is relatively stationary there may be movements between the haul-out sites in area 4. A possible reaction to disturbance from the construction of the wind farm may be that the seals will use other haul-out sites to a higher extend. It was therefore decided to conduct monthly aerial surveys of all seal localities in area 4.

The aerial survey data collected during the present study before 1 July 2002 as well as data from previous years (in August) will serve as the baseline situation before the construction of the wind farm started. In summer 2002 all seal colonies in Denmark was hit by a seal epidemic, which killed about 44% of the seals in area 4 (Dietz et al. 2003a). It has not been possible to separate the possible effect from the construction work from the effect of the seal epidemic on the seal population. The construction will continue until fall 2003, and an evaluation of the effect of the wind farm will therefore be possible after the construction has ended.

1.2 Possible effects on seals from the establishment and operation of offshore wind farms

It is possible that some of the activities involved in the construction and operation of the wind farm will have a negative impact on the seals in and near the wind farm area. The most significant sources of disturbances may be the physical presence of the wind turbines and the noise from ships and construction work. These disturbances can potentially lead to temporary or even permanent loss of habitats near the wind farm. This may lead to a migration of seals out of the area to other foraging areas and to use of other haul-out sites.

In order to study the possible effects from the construction and operation of the wind farm on the seal population a number of investigations was initiated. Besides the aerial surveys described here, a web-cam placed close to a seal haul-out site monitors the diurnal activity and the use of the Rødsand seal sanctuary, while satellite telemetry describes the movements, habitat selection and use of the actual wind farm area.

2 Description of the Nysted Offshore Wind Farm area and the seal sites at Rødsand

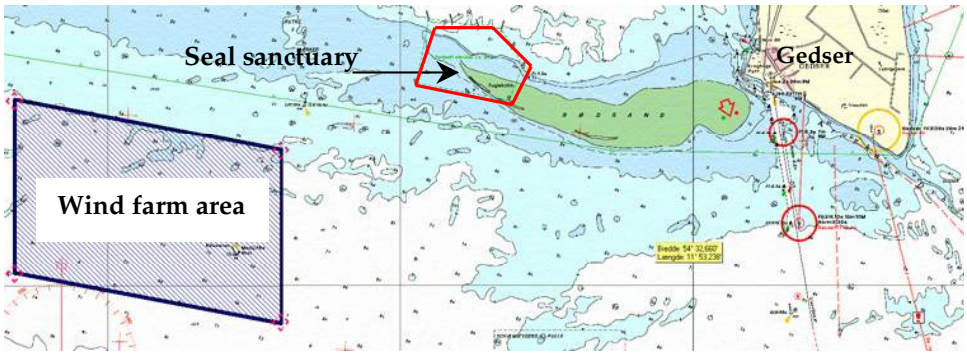

Figure 1 Map of the wind farm area and the seal sanctuary.

Nysted Offshore Wind Farm will be placed in Fehmarn Belt about 10 km south of the city Nysted (Lolland). The water depth in the wind farm area is between 5.5 m and 9.5 m. A large part of the area consists of sand bottom with larger and smaller ridges. In places there are pebbles, gravel or shells. Although there are outcrops of stones larger than 10 cm, no reef-like aggregations are known.

About 2 km north of the wind farm there is a shallow (less than 4 m deep) lagoon-like area between Southeast Falster and Southwest Lolland. This area is used by a large number of fishermen mainly using fish traps (fyke nets) and pound nets. The area also constitutes an ideal habitat for harbour and grey seals, where they go ashore on remote sand banks (Rødsand seal sanctuary) or stone reefs (Vitten, Skrollen and Flintehorne Odde) away from human disturbance. The wind farm will be placed 4 km south-west of the seal sanctuary (Fig. 1).

2.1 Seal sites at Rødsand

At the western tip of the Rødsand sandbank (54°35'N, 11°49'E), a seal sanctuary was established in 1978 (Bøgebjerg 1986). The seal sanctuary is protected from public access from 1 March – 30 September in a distance of about 500 m around the western tip of the sand bank (Ministry of the Environment and Energy 1993). The seals prefer the western most tip of the sandbank because the water currents creates a deep water channel very close to the bank, through which they can rapidly escape. This is the most important haul-out and breeding site for harbour seals in the southwestern Baltic Sea (Teilmann & Heide-Jørgensen 2001). Haul-out sites are important for breeding, moulting and resting seals.

From the satellite tagging data it has been shown that both seal species use several haulout sites besides the seal sanctuary, e.g. Vitten (about 10 km west of the seal sanctuary) and Flintehorne Odde (about 5 km north of the sanctuary). The grey seals have also visited known

seal localities in Bøgestrømmen, Saltholm, and Falsterbo in Sweden as well as several sites along the Swedish East Coast and Estonia in the Baltic. This suggests that harbour seals are more resident in the area while grey seals are utilising a much greater area in certain periods of the year (Dietz et al. 2003b).

From aerial surveys, land counts and satellite taggings we know that both seal species are found in the Rødsand area. Only few observations of grey seals have been reported elsewhere in Denmark, why we consider Rødsand to be the most important haulout site for this species.

3 Objectives

The objectives of the present study are:

Determine the occurrence of seals at haul-out sites especially in the Rødsand area by season.

To study the effect of the construction of the wind farm on the use of the seal sanctuary.

4 Materials and methods

4.1 Aerial surveys

Since 1990, aerial surveys have been conducted in the Danish Baltic (management area 4, Fig. 2) every year, or every second year, during the moult in late August. The region consists of the seal sites at Rødsand, Vitten, Aunø Fjord, Dyrefod, Bøgestrømmen, Saltholm, and the Swedish site, Falsterbo (Fig. 2). These sites are considered to host parts of the same stock of harbour seals, which means that there may be regular movements between these sites. The surveys are part of the Danish monitoring program of seals. In 1999, a supplementary survey was conducted in late August during the EIA preparations for the Rødsand wind farm.

The methodology in the present study follows that used since 1990 (Teilmann et al. 2001). The same flight type (Cessna 172), pilot and observers were used. As the seals may spread on single stones over a large area it was necessary that two observers participated: one counted the seals by vision, another photographed flock for subsequent examination.

Two types of error may occur in these surveys:

1) The seals may move between sites.

2) The number of seals hauling out may vary during the day, due to the weather, or because of disturbances.

3) Hauled-out seals may be overlooked (especially single individuals).

Surveying all sites within short time (app. 3 hrs) may eliminate the first error. The second type of error may be reduced by conducting the surveys at the same time of day and during similar weather conditions (e.g. by avoiding rain).

Figure 2 Map of Management area 4 (Southwestern Baltic) with area names and seal sites. Seal haulout sites are indicated with arrows.

The aerial surveys were started in March 2002 and continued until August 2002. From September 2002 through January 2003 the aerial surveys were interrupted due to lack of funding and contracts. The surveys were resumed in February 2003 and the most recent data available for this report was obtained in March 2003.

4.2 Calculation of the population size

During any survey a part of the seals will always be in the water. To estimate the actual population size from aerial counts a correction factor must be applied. Land observations of freeze branded harbour seals along the Swedish Kattegat coast during 1985 - 97 showed large variations in the number of seals on land during the summer months. In the beginning of June only about 25% of the seals are on land on average. This figure increases linearly until the first half of August when the largest part of seals is found on land (56%). Thereafter it decreases to 36% in the beginning of September. During the annual aerial surveys conducted in late August 45% of the seals are found on land (Härkönen et al. 1999). As this is the best available correction factor, we multiply the counts in late August with 2.22 to get absolute abundance in the southwestern Baltic.

4.3 Statistical analysis of data

To estimate the amount of data necessary for testing the possible shift in use of haulout sites, power analyses, to calculate the probability of detecting a certain change (Green 1989), was made from the baseline data collected in late August between 1990 and 2000.

Count data are generally Poisson distributed, however, if the mean intensity of the distribution is large the Poisson distribution can be approximated by the normal distribution. A special characteristic of the Poisson distribution is that the variance is equal to the mean intensity.

We have analysed the aerial surveys from the 6 locations in Management area 4 (see Fig. 2). For each of these locations the mean number of seals from 1990 - 2000 and the standard deviation around the yearly means have been calculated. The last row in the table below gives the average number of seals counted in the 5 control areas (all except Rødsand).

Table 1 Mean number of harbour seals from the 6 monitored period from late August 1990 - 2000.

Location	Period	N	Mean of period	Std. of obs.	Var. of obs.
Saltholm	1990 - 2000	23	17.0	4.9	23.7
Bøgestrømmen	1990 - 2000	23	20.3	5.8	34.1
Aunø-Fjord	1990 - 2000	23	33.3	11.7	137.8
Rødsand	1990 - 2000	22	73.0	14.1	198.2
Vitten/Skrollen	2000	3	31.3	5.7	32.3
Falsterbo	1990 - 2000	23	69.3	15.9	253.2
Control (5 areas)	1990 - 2000	95	34.2	4.4	19.2

The means of the different locations are all above 10 seals, which is a basic requirement if the normal distribution approximation is to be used. It should also be observed that data reflect the basic property of the Poisson distribution, i.e. that the variance is approximately proportional to the mean. In fact, the variance is larger than the mean, which means that data are generally overdispersed, which is a commonly observed phenomenon in environmental data. Thus, observations between different locations cannot be compared unless the variation in variance between locations is taken into account. We propose to use a normal approximation for data and weighting the observations according to the standard deviations in data around yearly mean values.

The 6 locations provide a classical "beyond BACI" (Underwood 1994) design with 1 impact area and 5 control areas where BACI (before-after-control-impact) is a traditional statistical monitoring design for detecting environmental change of a potentially impacted site. The model for this design becomes:

$X_{ijklm}=\mu+area_i+location_j(area_i)+intervention_k+year_l(intervention_k)+area_i*intervention_k+location_j(area_i)*intervention_k + e_{ijklm}$

where

$area_i$ describes the spatial variation between the control and impact areas.$location_j(area_i)$ describes the spatial variation between the 5 control areas.

$intervention_k$ describes the overall change from before to after$year_l$ ($intervention_k$) describes the interannual variation within the before and after periods, if surveys are made for several years in the monitoring period.

$area_i*intervention_k$ describes the general difference in change (before/after) between control and impact area, which we shall refer to as the general BACI effect.

$location_j(area_i)*intervention_k$ describes the difference in change (before/after) between the impact area and the 5 specific control locations.

e_{ijklm} is a normal distributed error term, NIID(0,σ^2_{area}) with a variance that is dependent on location and eventually year of monitoring.

If the flight observations are carried out over the 6 areas on the same day and the specific climatic conditions on the day of observation have an influence on the observations then a term should be added ($DAY_n(year_l(intervention_k))$) that describes the variation between days of observation. We will consider the variation between observation days as a stochastic effect.

Power analyses based on the statistics of the different locations and the mean of the 5 control areas are carried out by calculating the standard error of the BACI effect. Using this calculated standard error and a significance level of 5%, we can calculate the magnitude of the BACI effect that is detectable with a power of 80% for a given sample sizes.

Table 2 Power analysis for aerial surveys conducted in late August (1990 - 2000) prior to the construction work.

		Number of flights in baseline							
Control area	Impact area	n=3	n=6	n=9	n=12	n=15	n=18	n=21	n=24
Saltholm	Rødsand	50.6	32.3	25.8	22.1	19.6	17.8	16.5	15.4
Bøgestrøm	Rødsand	51.6	33.0	26.3	22.5	20.0	18.2	16.8	15.7
Aunø-Fjord	Rødsand	62.1	39.7	31.6	27.1	24.1	21.9	20.2	18.9
Vitten/Skrollen	Rødsand	51.5	32.9	26.2	22.5	20.0	18.2	16.8	15.7
Falsterbo	Rødsand	72.0	46.0	36.7	31.4	27.9	25.4	23.5	21.9
All 5 areas	Rødsand	50.0	32.0	25.5	21.8	19.4	17.7	16.3	15.2

This implies that if we have 12 flights in baseline and 12 flights after start of construction then we can detect an absolute change of 22.1 seals in BACI effect between Saltholm and Rødsand. For example if the mean number of seals at Saltholm increases with 10 seals from

before to after and the mean number of seals at Rødsand decreases with 12.1 seals then the BACI effect will become significant with a probability of 80% given 12 flights in baseline and 12 flights after construction. Alternatively, if the mean number of seals at Rødsand increases by 35 and the mean number of seals at Saltholm only increases by 12.9 then the BACI effect will become significant with a probability of 80% given 12 flights in baseline and 12 flights after construction. The BACI effect that can be detected is slightly smaller when all control areas are considered together (see table above).

The counts in late August from 1990 to 2000 will serve as part of the baseline data. However, it is important to emphasise that only surveys conducted during the same time of year both before and after the construction of the wind farm can be included in the statistical test.

Observation flights should not be carried out on consecutive days as this may provide serial correlation in data. This will reduce the information obtained relative to conducting flights on days with sufficient time in-between such that the observations can be assumed independent.

It is crucial that the number of seals that died due to the seal epidemic in 2002 as well as seals shot by hunters at all locations is recorded and accounted for such that a significant BACI effect is not attributed to the epidemic or hunting of seals.

5 Results

5.1 Monthly surveys

On Rødsand no seals were observed in March 2002 and February and March 2003 (see appendix and Fig. 4). This is in accordance with the camera observations which show that very few seals occur at Rødsand during early spring (Edrén et al. 2003). The number of seals peak in August - September. The same general pattern is seen at Falsterbo, Avnø, and Bøgestrømmen while Saltholm and Vitten show a more variable pattern with relatively more seals during spring. This indicates that seals are moving between sites at certain times of the year perhaps in order to utilise better food resources or more pleasant haul-out sites.

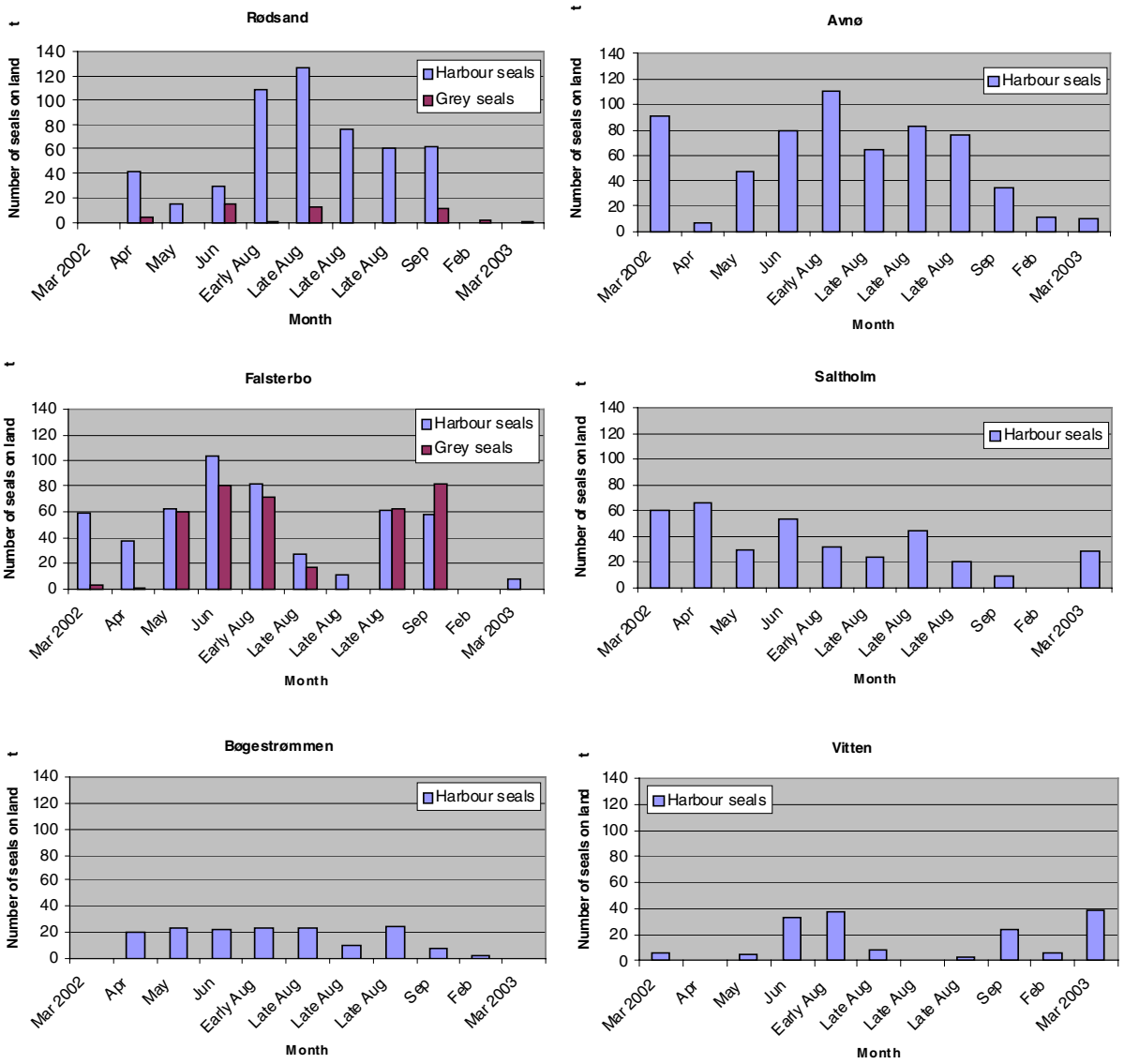

Figure 4 Survey results for monthly surveys in southwestern Baltic (Management area 4) from March 2002 to March 2003. Note that no surveys were conducted from October – January due to a pause in the environment studies for Nysted Offshore Wind Farm. In addition to the monthly surveys, the areas were surveyed three times in late August as a part of the national seal-monitoring program (Edrén et al. in prep). Abundance and trend in southwestern Baltic seal stock

5.2 Abundance and trend in southwestern Baltic seal stock

The combined annual growth rate in area 4 between 1988 and 2000 was 11.2% (95% CI: 7.8 - 14.6%, P=0.00008, Edrén et al. in press). No survey was conducted in 2001, however, if we project the same growth rate to 2001 and use the correction factor (x 2.22), the population size was 895 in 2001 and would have been 995 in 2002. Due to the seal epidemic the stock decreased by about 44% from the expected 2002 level. This means that the absolute abundance of harbour seals in southwestern Baltic may be about 550 individuals. An increase in the seal stock may be expected in the coming years.

Rødsand has the largest stock of harbour seals in management area 4 with about 200 harbour seals remaining after the seal epidemic. Aunø Fjord was probably not hit by the epidemic and a continuos growth was observed with a stock of about 160 individuals. The remaining seal stock at Falsterbo, Saltholm, Bøgestrømmen and Vitten are approx. 70, 60, 40, and 10, respectively (Fig. 3).

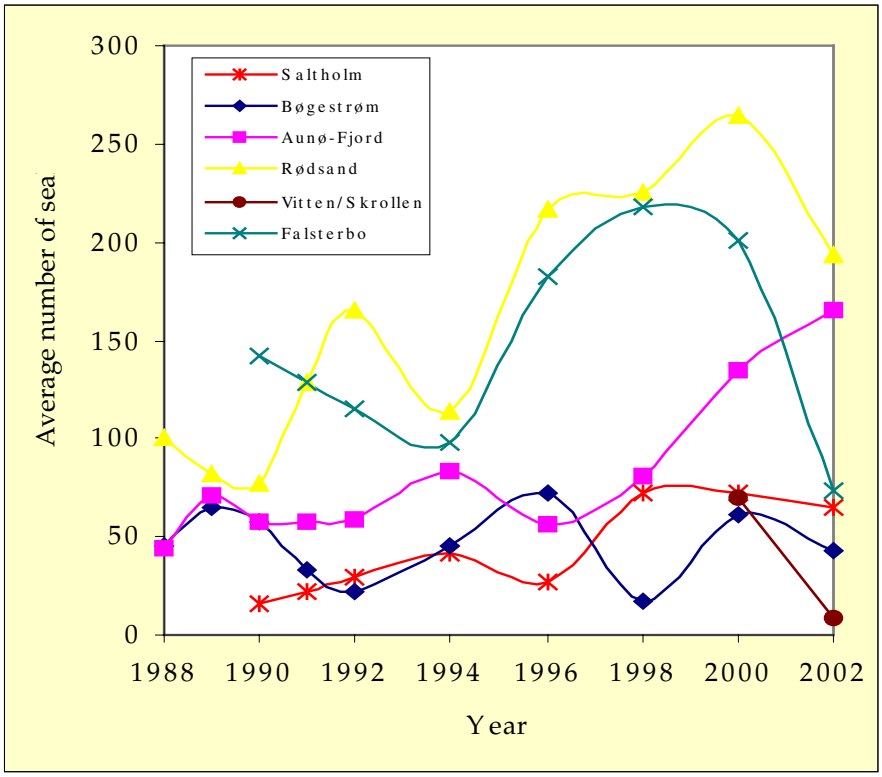

Figure 3 Trend in stock size on the 6 most important localities in southwestern Baltic. Each point is an average of the three counts made in late August each year.

5.3 Seal epidemic

From May to November 2002 a seal epidemic (Phocine Distemper Virus, PDV) stroke the Danish harbour seal (*Phoca vitulina*) populations again. This was exactly the same virus that killed about 18,000 harbour seals in 1988 (Dietz et al. 1989, Heide-Jørgensen et al. 1992). The combined number of seals that died in Northern Europe in 2002 is probably above 20.000 individuals (Dietz et al. 2003a).

Aerial surveys in the southwestern Baltic conducted in August 2002, revealed that about 44% of the expected number of seals were missing, corresponding to a mortality of 440 individuals (Dietz et al. 2003a). Only 109 dead seals were found on the beach. The true effect of the epidemic on the seal population will be estimated after the aerial surveys in August 2003.

One dead grey seal (*Halichoerus grypus*) was found on Rødsand, but it is unknown, whether it died from the virus.

6 Conclusion

Monthly aerial counts of harbour and grey seals in southwestern Baltic (Management area 4) were conducted from March 2002 to March 2003 except for a break from October 2002 - January 2003. The surveys provide information on the use of the different seal haulout sites, which are believed to have some level of exchange of animals.

Because of the seal epidemic it has not been possible to evaluate the effect of the construction work so far. However, this will be done after the construction work ends in fall 2003.

Based on the aerial surveys an estimated stock of about 200 harbour seals used the Rødsand area during the moult in late August 2002.

Rødsand seal sanctuary is the most important haulout site in southwestern Baltic during summer while it less important to the harbour seals during February - March. However, two live grey seal pups were observed in late February - early March, which indicate that the sanctuary is very important to grey seals during spring (for more details on the grey seals pups see Edrén et al. 2003).

7 Acknowledgements

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9 Appendix 1

All details on surveys conducted in Management area 4 / South-western Baltic from March 2002 to March 2003 is shown below.

Aerial survey of seals in western Baltic

Date: 13 March 2002
Take off: 08:15 **Landed:** 11:10

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Rune Dietz
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	2 -4	**Cloud cover:**	8/8
Wind direction:	W	**Temperatur C^0:**	2 - 7
VandWaterlevel at Gedser during survey compared to average:			+ 60 cm

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:45	0			88 Rune 91 Jonas	90 / 0
Dyrefod						
Lolland NØ						
Flintehorne Odde	09:06	0			6 grey seals + 1 in water	0 / 6
	09:12	0	-	-	1 on stone	1
Vitten/Skrollen	09:20	0			7 on stones	7 / 0
Rødsand	09:30		0	0	Sanctuary buoys were layed out during survey	0
Bøgestrømmen	10:05		0	0	The usual stones were not visible	0
Jungshoved N						-
Falsterbo	10:25	0			36 HS (group 1), 7 HS (group 2) 3 GS (group 3), 16 HS in water	59 / 3
Saltholm	18:45	0	-	-	11 E of saltholm on stones 50 S of Satholm on stones	61
Amager SØ	10:50					0

Total area 4:

Western Baltic harbours seals total:	218	**Western Baltic grey seals total:**	9
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon D1	**Film:**	Digital
Camera 2 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 9 April 2002
Take off: 08:18 **Landed:** 11:10

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Rune Dietz
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	<5	**Cloud cover:**	0/8
Wind direction:	E	**Temperatur C^0:**	1 - 5
VandWaterlevel at Gedser during survey compared to average:			+ 20 cm

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:44	0	-	-	7 on stones	7 / 0
Dyrefod						-
Lolland NØ	08:50					0
Flintehorne Odde	09:05	0				0
Vitten/Skrollen	09:20					0
Rødsand	09:24	2	41/5	46?	Ca. 40 seals on outer most tip 4 grey?	41/5
Bøgestrømmen	09:55	50	-	-	20 harbour seals	20 / 0
Jungshoved N						
Falsterbo	10:20	50	25	25	25 on land + 8 in water, southern tip 6 HS+1GS in the middle	38 / 1
Saltholm	10:45	0	-	Video	10 at Sønder Flint, 2 in bay 2 westcoast, 52 southcoast	66
Amager SØ	10:55	0	-	-		0 / 1

Total area 4:

Western Baltic harbours seals total:	172	**Western Baltic grey seals total:**	7
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 17 May 2002
Take off: 08:18 **Landed:** 11:00

Aircraft type:	Cessna 172	**Pilot:**	Vlads (Ikaros)
Speed over localities (knots):	80	**Observer front seat:**	Helena Homes
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	4 - 8	**Cloud cover:**	6/8
Wind direction:	NW	**Temperatur C^0:**	15

VandWaterlevel at Gedser during survey compared to average: + 10 cm

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:48	0		-	47 on scattered stones	47
Dyrefod						-
Lolland NØ	08:55				0	0
Flintehorne Odde						-
Vitten/Skrollen	09:05	0	-	-	4 on large stones	4
Rødsand	09:20	0	-	-	5 on stones	5
Bøgestrømmen	09:27	-	-	-	16 in water	16
Jungshoved N	09:58	0	-	-	23 on stones	23
Falsterbo						-
Saltholm	10:20	5	56 / 60	-	100 - 150 on land + 7 in water	63 / 60
Amager SØ	10:40	0	-	-	30 on stones	30
Total area 4:	10:48		-	-	0	0

Western Baltic harbours seals total:	188	**Western Baltic grey seals total:**	60
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon D1	**Film:**	Digital
Camera 2 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 17 June 2002
Take off: 08:26 **Landed:** 11:14

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Rune Dietz
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	<5	**Cloud cover:**	8/8
Wind direction:	W	**Temperatur C^0:**	17
VandWaterlevel at Gedser during survey compared to average:	+ 0 cm		

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:50	0	-	-	80 on stones	80/0
Dyrefod	09:00	0	-	-	7 on stones	7/0
Lolland NØ	09:10	10	-	-	7 on stones	7/0
Flintehorne Odde	09:21	0	-	-	9 on stones, 1 in water	10
Vitten/Skrollen	09:33	50	-	-	29 Vitten 4 Skrollen	33
Rødsand	09:40	100	30 / 16	30 / 16	2 groups. Outer group GS Inner group HS, no pups	30 / 16
Bøgestrømmen	10:07	10	-	-	20 on stones, 2 in water	22
Jungshoved N						
Falsterbo	10:28	0	97 / 70	97 / 75	3 HS groups, 1 GS group 10 GS, 6 HS in water	103 / 80
Saltholm	10:50	5	-	-	50 on stones 3 in water	53
Amager SØ	11:00		-	-		0
Total area 4:	10:48		-	-	0	0

Western Baltic harbours seals total:	345	**Western Baltic grey seals total:**	96
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon D1	**Film:**	Digital
Camera 2 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 7 August 2002
Take off: 08:15 **Landed:** 11:00

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Oluf Damsgaard
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	2-5	**Cloud cover:**	7/8
Wind direction:	E	**Temperatur C^0:**	20

VandWaterlevel at Gedser during survey compared to average:

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:40	0	113	109	ca. 82	111/0
Dyrefod	08:53	10	-	-	13 on stones (SE of the island)	13/0
Lolland NØ	08:50				0	0
Flintehorne Odde	09:08		-	-	0	0
Vitten/Skrollen	09:20	10	-	-	32 on stones 5 in the water	37
Rødsand	09:28	30	107	110	Ca. 100, at least 1 greyseal	109/1
Bøgestrømmen	09:57	0	-	-	24 on stones	24/0
Jungshoved N	10:00	0	-	-		0
Falsterbo	10:25	0	79/15	82/16	1 group HS+ 2 in water (1 dead) 1 group GS+55 in water	82/71
Saltholm	10:44	0			32 on stones	32/0
Amager SØ						0

Total area 4:

Western Baltic harbours seals total:	426	**Western Baltic grey seals total:**	84
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 27 August 2002
Take off: 08:43 **Landed:** 11:25

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Susi Edrén
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	5	**Cloud cover:**	0 / 8 very hazy
Wind direction:	E	**Temperatur C^0:**	20
VandWaterlevel at Gedser during survey compared to average:			

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	09:05	0	-	-	64 on stones	64
Dyrefod	09:13					0
Lolland NØ	09:20					0
Flintehorne Odde	09:33					0
Vitten/Skrollen	09:44	0	-	-	7 on stones 2 in water	9
Rødsand	09:52	50	128/13	126/13	1 group GS to the North, 1 group HS	127 / 13
Bøgestrømmen	10:21	0	-	-	23 on stones	23
Jungshoved N	10:24		-	-		0
Falsterbo	10:48	0	-	-	16 GS in water 10 HS on land, 17 in water	27 / 16
Saltholm	11:00				24 on stones	24
Amager SØ	11:15					0

Total area 4:

Western Baltic harbours seals total:	274	**Western Baltic grey seals total:**	29
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 29 August 2002
Take off: 09:15 **Landed:**

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Thomas Rasmussen
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	10	**Cloud cover:**	1/8
Wind direction:		**Temperatur C^0:**	20
VandWaterlevel at Gedser during survey compared to average:			

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	09:40	0	-	-	0	83 / 0
Dyrefod	09:49	0	-	-	9 (2 pups)	9 / 0
Lolland NØ	09:53					0
Flintehorne Odde	10:08					0
Vitten/Skrollen	10:13					0
Rødsand	10:26	75		Photos (47) + 30 in wate	72 ialt. Many seals in the water	77/0
Bøgestrømmen	10:56	0			10 on stones	10
Jungshoved N	10:00					0
Falsterbo	11:20				11 in water	11/0
Saltholm	11:30	0	-	-	44 on stones	44
Amager SØ	-	-	-	-	-	-

Total area 4:

Western Baltic harbours seals total:	234	**Western Baltic grey seals total:**	0
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 31 August 2002
Take off: 09:45 **Landed:** 12:30

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Susi Edrén
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	3-8	**Cloud cover:**	2/8, very hazy
Wind direction:	SV	**Temperatur C^0:**	20
VandWaterlevel at Gedser during survey compared to average:			

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	10:15	1	-	-	76 on stones	76
Dyrefod	10:20					0
Lolland NØ	-					-
Flintehorne Odde	10:35					0
Vitten/Skrollen	10:46	0	-	-	3 on stones	3
Rødsand	10:52	0			8 HS in water, no grey	61/0
Bøgestrømmen	11:19	2	-	-	25 on stones	25
Jungshoved N	11:22					0
Falsterbo	11:42	2			8 HS in water	61/63
Saltholm	12:03	0	-	-	20 on stones	20
Amager SØ	12:16					0

Total area 4:

Western Baltic harbours seals total:	246	**Western Baltic grey seals total:**	63
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 20 September 2002
Take off: 08:20 **Landed:** 11:10

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Oluf Damsgaard
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	10	**Cloud cover:**	5/8
Wind direction:		**Temperatur C^0:**	15

VandWaterlevel at Gedser during survey compared to average: - 5 cm

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	08:45	0	-	-	34 on stones	34/0
Dyrefod	08:50	0	-	-	9 on stones, 1 in water	10/0
Lolland NØ		0	-	-		0
Flintehorne Odde	09:11	0	-	-	5 on stones	5/0
Vitten/Skrollen	09:22	0	-	-	24 on stones	24
Rødsand	09:42	75			ca. 50	62/12
Bøgestrømmen	09:57	0			8 on stones	8
Jungshoved N	10:00	0			2 on stones	2
Falsterbo	10:35	0			58 HS on land 82 GS in water	58/82
Saltholm	10:50	0			8 on stones, 1 in water	9/0
Amager SØ		0				0

Total area 4:

Western Baltic harbours seals total:	212	**Western Baltic grey seals total:**	94
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 5 February 2003
Take off: 11:45 **Landed:** 14:00

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Rune Dietz
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Jonas Teilmann
Wind m/s:	2-5	**Cloud cover:**	7/8
Wind direction:	N	**Temperatur C^0:**	-2
VandWaterlevel at Gedser during survey compared to average:			

Locality	Time	Disturbance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	12:13	25	-	-	12 on stones	12/0
Dyrefod	12:20		-	-		0
Lolland NØ	12:25		-	-		0
Flintehorne Odde	12:40		-	-		0
Vitten/Skrollen	12:50	0	-	-	6 on stones	6/0
Rødsand	13:00	0			2 grey seals in the water	0/2
Bøgestrømmen	13:25	0			2 on stones	2/0
Jungshoved N	13:30					0
Falsterbo		Not surveyed dur to fog				
Saltholm		Not surveyed dur to fog				
Amager SØ		Not surveyed dur to fog				

Total area 4:

Western Baltic harbours seals total:	20	**Western Baltic grey seals total:**	2
Notes:		**Notes:**	
Camera 1 (front seat):	Nikon F90	**Film:**	Fujichrome Provia 400
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

Aerial survey of seals in western Baltic

Date: 10 March 2003
Take off: 11:45 **Landed:** 14:00

Aircraft type:	Cessna 172	**Pilot:**	Jens Larsen
Speed over localities (knots):	80	**Observer front seat:**	Rune Dietz
Højde over lokaliteterne (fod):	400-500	**Observer back seat:**	Susi Edrén
Wind m/s:	10	**Cloud cover:**	0/8
Wind direction:	W	**Temperatur C^0:**	10
VandWaterlevel at Gedser during survey compared to average:			

Locality	Time	Distur-bance (%)	Camera1 (Harbour/ grey)	Camera2 (Harbour/ grey)	Visuelle observations during survey	Total (harbour/ grey)
Aunø	12:40	0	-	-	11 on stones	11
Dyrefod	12:45		-	-	24 on stones	24
Lolland NØ	12:55		-	-	4 on stones	4
Flintehorne Odde	13:10		-	-		0
Vitten/Skrollen	13:20	0	-	-	2 groups on stones, 39 seals in total Very low tide	39
Rødsand	13:30	0			1 grey seal pup on land	0/1
Bøgestrømmen	13:53	0				0
Jungshoved N						
Falsterbo	14:13	25			8 HS on land	8/0
Saltholm	14:39				28 seals on stones S/SE of Saltholm	28
Amager SØ	14:51					0

Total area 4:

Western Baltic harbours seals total:	114	**Western Baltic grey seals total:**	1
Notes:		**Notes:**	
Camera 1 (front seat):	Sony	**Film:**	Digital video
Camera 2 (front seat):	Nikon D1	**Film:**	Digital

Approved by: Jonas Teilmann

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