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Status of the harbour seal *Phoca vitulina* populations in the Danish waters, 1976-1989, and short-term effects of the epidemic in 1988

by
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Med et dansk resumé:
Udviklingen i de danske bestande af
spættet sæl *Phoca vitulina* i 1976-1989 og
korttidseffekten af epidemien i 1988

Резюме на русском языке:
Развитие датских популяций пятнистого тюленя (Phoca vitulina) в 1976-1989 г. и краткосрочный эффект эпидемии 1988 года.

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Abstract

Bøgebjerg,[1] E., Tougaard,[2] S., Madsen,[1] J. and Nørgaard[2], N., 1991: Status of the harbour seal *Phoca vitulina* populations in the Danish waters, 1976-1989, and short-term effects of the epidemic in 1988. - Dan. Rev. Game Biol. 14(4).

After the full protection of harbour seal in Denmark in 1977 there was an increase in most local seal populations, and the total number of seals in the Danish waters increased from 2,400-3,500 in 1976 to 6,700-7,500 in 1985-87. The highest average growth rates were found in the Anholt, Rødsand and East Samsø populations, and the lowest rates in the Læsø, Wadden Sea and Hesselø populations. In the second half of the period the growth rate tended to decrease in the populations of East and West Samsø, Anholt, Limfjorden and Hesselø ; however, the only significant decrease was found in the Anholt population. The decrease in growth rate might be due to the fact that the populations were reaching carrying capacity. The only populations with a continuous growth throughout the period were those of the Wadden Sea and Rødsand. During the epidemic in 1988, at least 3,471 seals died in the Danish waters. There was a high correlation between population size prior to the disease and the number of dead seals found in the areas, whereas no correlation was found between population size and the proportion of the population that died. The disease raged in the Danish waters from early April 1988 until January 1989. Within the different areas the epidemic lasted 7-40 weeks; the shortest time lapse was seen in the Rødsand population, where the epidemic started in late July, which is the time when the peak number of seals haul out to moult and mate. In areas such as Limfjorden and the Wadden Sea, which have more than one haul-out site, the disease lasted longer. The seal epidemic was first registered in central Kattegat and in the Wadden Sea. From central Kattegat it spread to southern Kattegat, Limfjorden and the Baltic. Compared to the numbers registered for the local populations in 1987, 48-110% were counted in August 1989; in most areas the populations decreased. With an estimated population size of 5,000 individuals in the Danish waters in 1989 and a rate of increase (0.13) equal to pre-disease, it can be foreseen that the 1987 population level will be reached again in 1992.

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INTRODUCTION

The Danish populations of harbour seal *Phoca vitulina* have been monitored on a regular basis since the late 1960s. However, until 1974 the evaluation of the population status was based on information from highly diverse and heterogeneous sources which lead to rather arbitrary population estimates (Søndergård et al. 1976). From 1976 counts were intensified and Bøgebjerg (1986) reported on distributional and population changes in Danish harbour seal populations during 1976-1984, with special reference to effects of the introduction of full protection from 1976/77 onwards. It was demonstrated that almost all local populations in the Danish waters had increased from an estimated grand total of about 2,000 in 1975 (Søndergård et al. 1976, Joensen et al. 1976) to 4,000 in 1984 (Bøgebjerg 1986).

In 1988 more than 18,000 harbour seals died along the North European coasts (Dietz et al. 1989), following an epizootic caused by a Phocine Distemper Virus (Osterhaus and Vedder 1988, Osterhaus 1988). In this paper the results of the harbour seal monitoring in the Danish waters from 1976 to 1989 are summarized and an evaluation of the short-term consequences of the epidemic for the Danish populations is presented.

ACKNOWLEDGEMENTS

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The National Forest and Nature Agency contributed with data on seal numbers from Hesselø, Anholt and Læsø.

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MATERIAL AND METHODS

Monitoring

After two years with limitations on seal hunting a total ban was introduced in 1977. In the following five years nine seal sanctuaries were established to provide disturbance-free resting areas (Fig. 1). In 1976 a monitoring programme was initiated to follow the development of the populations (Bøgebjerg 1986).

In most areas aerial counts were employed, supplemented by land or boat counts in some localities.

Using aerial counts, population indexes were based on photographs of hauled-out seals. The plane passed the hauled-out seals once or twice at a ground speed of 50-80 knots. The seals were approached from the deep water side at an altitude of 1000 to 300 feet and photographed with either a Rolleiflex 6006 camera with a Sonnar 250 mm lens or a Nikon 801 camera with a Nikkor 80-200 mm lens (Kodak Ektachrome 100 or 200 ASA film). Single seals or assemblages of a few individuals were usually not photographed. When possible, all observed seals were visually counted during a second passage, and the results were tape-recorded.

When counting at sea a 16-18 feet boat was positioned within a distance of 200-300 metres from the hauled-out seals and the number present was assessed by use of binoculars (10 x).

During ground counts seals were

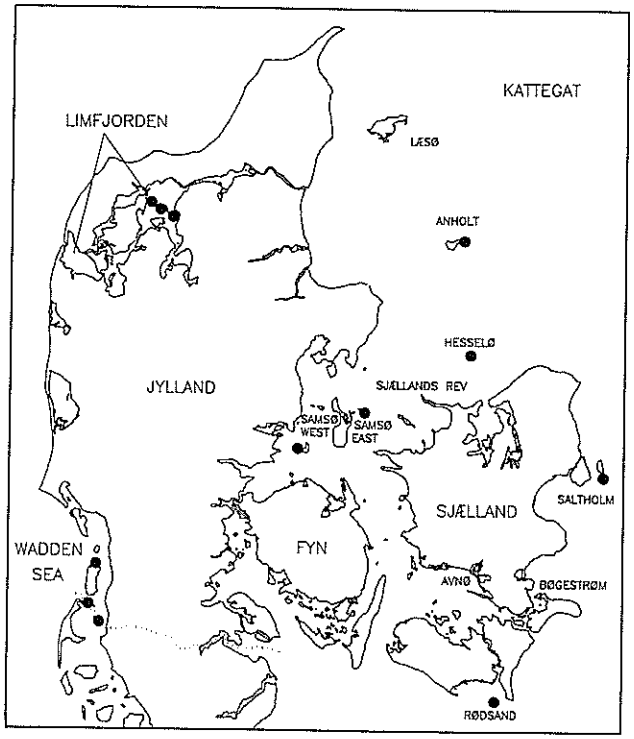

Fig. 1. Major haul-out sites for harbour seals in the Danish waters. Dots indicate seal sanctuaries.

counted by means of a telescope (20-60 x) from distances of 100-800 metres depending on local conditions.

As the abundance of seals on haul-out sites varies in relation to season, time of day, tidal cycle and weather conditions (Godsell 1988, Thompson 1989, Thompson and Harwood 1990, Bøgebjerg 1986), population indexes were based on counts made at peak haul-out times, i.e., during the moulting period in August/September and, preferably, in sunny, calm weather and at low tide.

Each year most areas were counted 2-5 times on different days during late summer (some areas much more frequently), and the day with peak numbers recorded in a site was taken to represent the annual population index (minimum stock).

Seal counts on Hesselø, Anholt and in some years Læsø were performed by the National Forest and Nature Agency. Counts on Saltholm were made on an irregular basis by local observers (A. Jensen and E. Meyer Petersen pers. comm.).

Rate of population change has been expressed by growth rates (r) calculated on the basis of time-series of abundances (N): $r\ (\text{at year } t) = \ln(N(t+1)/N(t))$.

Growth rate over the period was expressed by the exponential growth rate, measured as the slope of the linear regression between $\log_e$ of population size on time (Caughley and Birch 1971). To illustrate changes in patterns of growth population curves have been plotted on logaritmic scales.

To test whether growth rates changed during the period an optimal splitting routine was run (L. Witting unpubl.): If means of the growth rates before and after a particular year differed, a Student-t test splits the growth rate time-series accordingly. This was accomplished for all years and the year representing the lowest probability was chosen as the splitting year. All possible splitting combinations were tested (the smallest number of growth rates in a time-series group was three, which was compared to all possible combinations of time-series groups before and/or after).

Seal death

At the start of the seal epidemic in April 1988 the Ministry of Environment and the Ministry of Agriculture decided that seal carcasses from the central Kattegat, Limfjorden and the Wadden Sea should be systematically collected for examination. This material has made up the basis for a series of studies (Dietz et al. 1989, Tougaard 1989, Härkönen et al. 1990, Heide-Jørgensen et al. 1991, Nørgaard and Larsen 1991).

In the remaining part of the Danish waters collection was more extensive. Dead seals were registered by local contacts, and in most cases information about body length and sex was given.

To express the timing and duration of the epidemic in the different populations, the period in which dead seals were found has been divided into sub-periods when fractiles (0-5%, 5-25%, 25-75%, 75-95% and 95-100%, respectively) of the seals were found. By this procedure time effects of winds and currents causing mass stranding of carcasses of seals which might have died over a longer period is reduced.

RESULTS

Population development 1976-1987

In most local populations as well as in the total population an increasing trend was observed throughout the period albeit a large year-to-year variation in population indexes is observed (Table 1 and 2, Fig. 2). For the total population the average growth rate over the period was 0.13; for the period as a whole the highest average growth rates were found in the Anholt, Rødsand and East Samsø populations, and the lowest rates in the Læsø, Wadden Sea and Hesselø populations. The small and isolated Avnø Fjord and Bøgestrømmen populations were not counted regularly until 1985, but seemingly they increased only slightly (Table 1).

In some of the local populations (East and West Samsø, Anholt, Limfjorden, Hesselø) the growth rate tended to decrease during the second half of the period (Fig. 2); however, the only significant decrease in growth rate was found in the Anholt population (Table 1). In the Wadden Sea and Rødsand populations a continuous growth was observed throughout the period.

Seal death in 1988

In 1988 a total of 3,471 dead harbour seals were registered in Denmark (Table 2), which is a minimum estimate of the deaths caused by the epidemic.

There was a high correlation between population size prior to the disease and the number of dead seals found in the areas (data from Table 2 and 3; $r = 0.937$, $n = 10$, $P < 0.001$), but no correlation between population size and the proportion of the population that died ($r = 0.151$, $n = 10$, $P > 0.05$). The estimated population size was used for this comparison (lower esti-

*Table 1. Results of censuses of harbour seals in Denmark 1977-1989, excluding 1988 (no total count possible due to the epidemic). Exponential growth rates and analysis of splits in growth rates are given. NS: no significant split in growth rate; *: split significant at 5% level.*

	76	77	78	79	80	81	82	83	84	85	86	87	89	Growth rate 76-87	Change in mean rate
Wadden Sea	389	410	332	421	671	656	789	924	853	958	1261	1477	868	0.13	NS
Limfjorden	90	200	330	326	300	440	420	588	639	657	710	682	652	0.15	NS
Læsø	292	271	415	200	474	365	282	388	257	379	656	690	642	0.06	NS
Anholt[1]	88	29	64	176	341	320	417	525	450	477	530	525	393	0.23	*
Hesselø	380	205	130	443	602	591	649	777	679	950	1000	531	582	0.12	NS
Sjællands Rev	7	25	4	70	104	45	0	0	1	2	0	109	31	-	-
West Samsø	-	150	200	250	245	330	410	370	490	663	587	549	264	0.14	NS
East Samsø	-	8	18	3	36	24	79	25	111	190	197	192	96	0.18	NS
Avnø Fjord[2]	20	20	20	20	20	20	20	20	20	30	22	32	32	-	-
Rødsand	20	5	28	9	40	11	50	55	60	81	80	94	50	0.22	NS
Bøgestrømmen[2]	20	20	20	20	20	20	20	20	28	3	3	24	31	-	-
Total	1306	1343	1561	1938	2853	2822	3136	3692	3588	4390	5046	4905	3639	0.13	NS

Note 1: mean growth rate before split (1976-1981): 0.43; after split (1982-1987): 0.04.
Note 2: annual indexes for 1976-1983 only based on estimates.

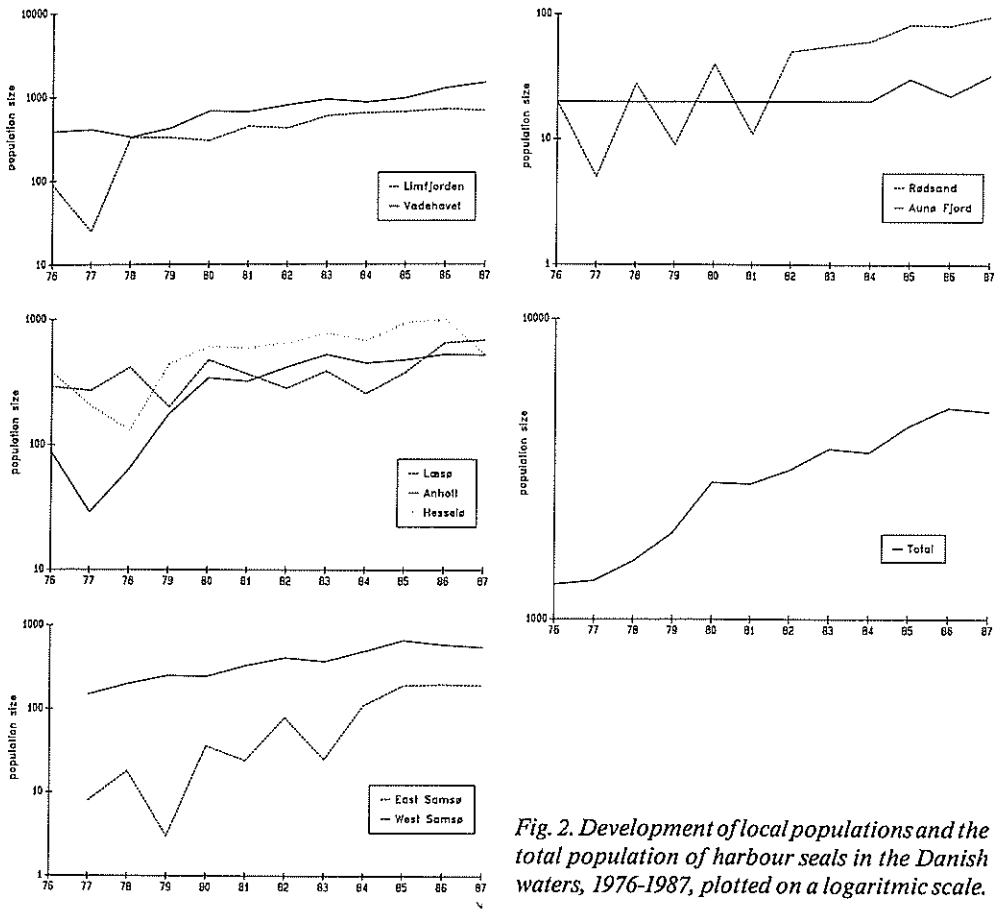

Fig. 2. Development of local populations and the total population of harbour seals in the Danish waters, 1976-1987, plotted on a logaritmic scale.

mate in Table 3), as it provides a more realistic figure than does the 1987 population index. The highest number of dead seals was found in the Wadden Sea, followed by the area west of Samsø, Hesselø, Limfjorden, and Anholt. In the small populations of Avnø Fjord and Bøgestrømmen no population decline was observed throughout the summer and only a few dead seals were found. In the Rødsand area 68 seals were found dead within the seal sanctuary, whereas no dead seals were found in a haul-out site 12 kilometres to the west of the sanctuary.

In the Wadden Sea pups were observed throughout the summer of 1988 (e.g., 155 on 5 July). In contrast, in the inner Danish waters virtually no pups were observed in late summer, indicating that most of the 1988 cohort there died as a consequence of the disease.

Duration and dispersal of the disease in the Danish waters

The disease raged in Danish waters from early April till the end of the year (in the Wadden Sea until mid January 1989). Within the different populations the time lapse between the data of the first and last finding of dead seals varied between seven and 40 weeks (Table 2 and Fig. 3). The

shortest time lapse of seven weeks was seen at Rødsand, where the epidemic started in late July, coinciding with the time when the peak number of seals haul out to moult and mate. In other populations, where the disease started earlier and at a time when generally fewer seals haul out, the time lapse was 11-12 weeks and the peak in severity (25-75% of the carcasses found) was also longer.

In areas with more than one haul-out, e.g., Limfjorden and the Wadden Sea, the disease lasted longer (Table 2, Fig. 3). Thus, for the Wadden Sea as a whole the disease lasted 37-40 weeks, but within single haul-outs the period was shorter. Within the Wadden Sea area the disease tended to start in the west, dispersing towards east (Figs 3 and 4).

The dead seals found along the coasts of Skagerrak and northern Kattegat probably drifted from populations outside the area.

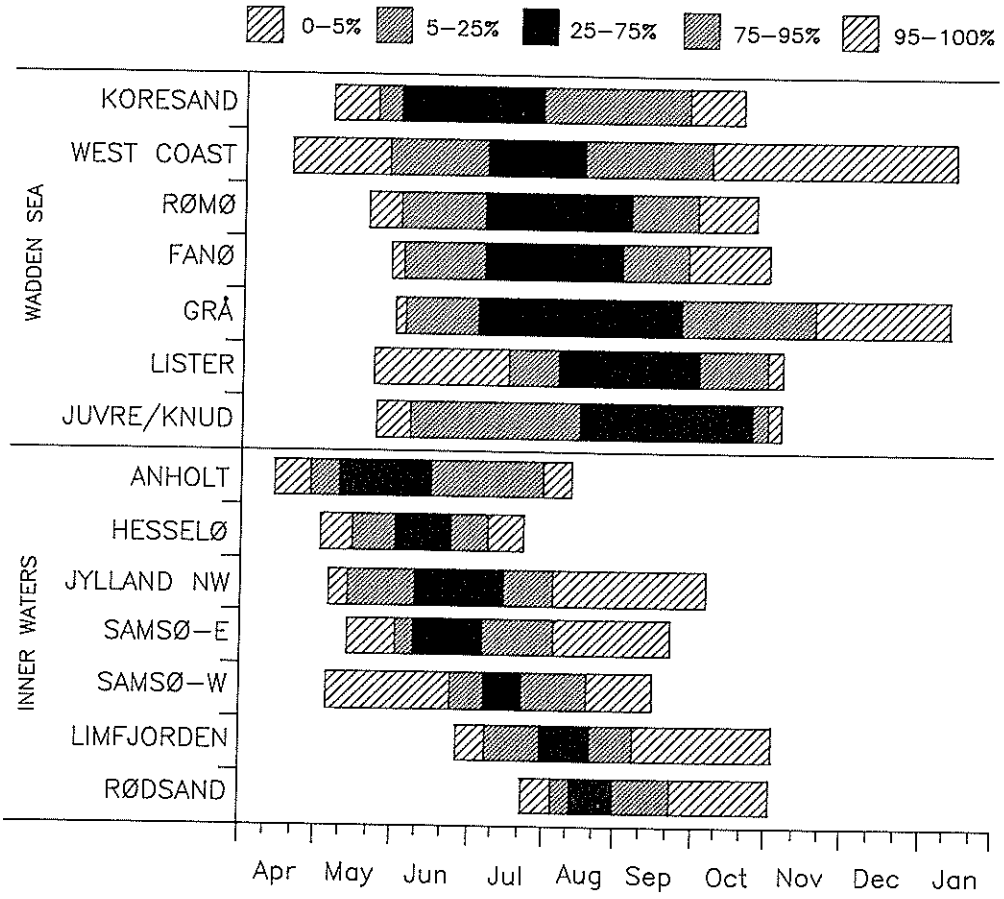

Fig. 3. Duration of the epidemic in haul-out sites in the Wadden Sea and the inner Danish waters from April 1988 to January 1989, expressed by fractiles of the number of seals found dead. Site names for the inner waters are given in Fig. 1 and for the Wadden Sea in Fig. 4. Data from Anholt and Hesselø are modified from Dietz et al. (1989).

Table 2. Duration of the seal epidemic in 1988 and the number of dead seals found in the Danish waters (areas shown in Fig. 1). Information from Anholt and Hesselø from Dietz et al. (1989).

Area	Date of first and last findings	Estimated disease weeks	No of dead seales
Wadden Sea	17.04.-13.01.-89.	15 - 02, 89.	1238
Limfjorden	27.06.-07.10.	26 - 40	391
NW Kattegat	09.05.-26.08.	19 - 34	172[a]
Læsø	09.05.-29.07.	19 - 30	85
Anholt	11.04.-24.06.	15 -(25)	277
Hesselø	11.04.-24.06.	15 -(25)	460
West Samsø	13.06.-26.08.	24 - 34	635
East Samsø	23.05.-05.08.	20 - 31	114
Lillebælt	a	-	4
Storebælt	a	-	15
Avnø Fjord	c	-	2
Saltholm	b	-	6
Rødsand	31.07.-01.11.	30 - 36	68
Bøgestrømmen	c	-	4
Total	11.04.-13.01.-89.	15 - 02, 89.	3471

Note a: seals probably drifted to the area from adjacent sites with haul-outs.
Note b: little information available.
Note c: area apparently not affected by the disease.

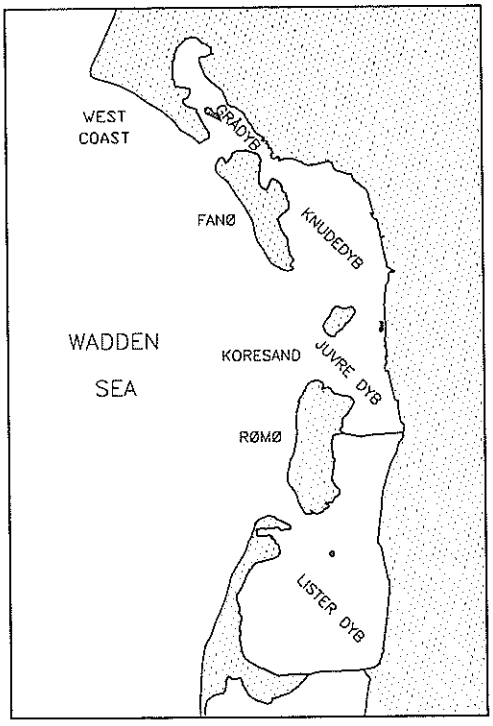

Fig. 4. Sites in the Wadden Sea from where dead seals were collected during the epidemic in 1988/89.

Population status in 1989

In August 1989, one year after the epidemic, a grand total of 3,639 harbour seals were counted in the Danish waters, representing 74% of the 1987 population (Table 1). Compared to the 1987 population indexes, 48-110% were counted in the different areas (Table 1). In most areas the population declined. In one area, Hesselø, where an increase was recorded, the 1987 population index was low and probably underestimated (see Table 1).

Pups were not counted systematically in all areas, but in the Kattegat and Limfjorden populations the proportion of pups varied between 6 and 16% in the first half of August (average 10.0% for 10 haul-outs), and in the Wadden Sea as a whole the proportion of pups was 20%.

DISCUSSION

Population development 1976-1987

Despite large year-to-year variations in the local population indexes, which may result from either methodological shortcomings or exchange between adjacent populations, the trend was generally increasing for all populations. The fact that the increase was general excludes the possibility that exchange of individuals between the Danish populations explains the increase in the local populations.

In some populations a decreasing growth rate was observed. This might indicate that after an initial period of rapid growth following the full protection in 1976, some Danish seal populations were approaching carrying capacity in 1987. Exceptions to the general pattern were the Wadden Sea and Rødsand, where no decline in the growth rate was observed.

However, the processes that may limit the size of populations are not clear.

On Hesselø, holding one of the densest populations with a relatively low growth rate, a hitherto not recorded high pup mortality was noted in the 1980s, probably caused by an infectious disease (an unidentified *Streptococcus* infection, B. Clausen pers. comm.). This may suggest that density dependent processes, viz. increased pup mortality induced by high density of seals, had come into play. On the other hand, from the ringed seal *Phoca hispida* populations in the Bothnian Bay, northern Baltic, it has been reported that PCB has reached critical levels, affecting the fertility of female seals and thereby possibly the growth of populations (Helle et al. 1976, Olsson et al. 1975, Helle 1980). Similarly, in the Wadden Sea high PCB levels are suspected to affect pup production in harbour seals (Reijnders 1980, 1986). No information is available about heavy metal intoxication in Danish seals; however, no signs of reduced fertility were recorded in female Danish harbour seals examined during the disease in 1988 (B. Heje Larsen pers. comm.).

During the seal epidemic in 1988 it became clear that not all seals were covered by the annual counts. Individual identification of seals making use of a haul-out site in the Wadden Sea recently demonstrated that, on average, seals within this area are hauled out approximately 30% of the day and night during the pupping period (Nørgaard and Tougaard in prep). On this basis, combined with the evidental discrepancy between the expected and observed impact of the seal death on the subsequent population size, it has been concluded that the countings from the Wadden Sea may be multiplied with a correction factor of 1.8 to obtain a realistic population estimate (Tougaard 1989).

For the remaining Danish populations no evaluation of the ratio between the real and the counted population exists. Due to less tidal influence it is suggested generally to be lower than for the Wadden Sea, and a conservative (arbitrary) correction factor of 1.2 has been applied to derive population estimates. Owing to the large year-to-year variation in annual indexes, only one population estimate has been computed for the three-year period 1985-87, using the peak index reached in the period. As the magnitude of the correction factor is not known precisely, the population estimates are presented by a range between the peak index and the peak index multiplied by 1.2 (Table 3). However, comparing the pre- and postdisease populations' size with the number of seals that died in Limfjorden, it is clear that the population estimates

Table 3. Estimated size of harbour seal populations in the Danish waters 1976-1987. For 1985-1989 the estimate for the Wadden Sea is the population index multiplied by 1.8; for the remaining areas the range between the peak index and the peak index multiplied by 1.2 is shown (see Discussion).

	1976	1984	1985-87	1989
Wadden Sea	900 - 1080	1620 - 1800	2650	1890
Limfjorden	200	650 - 700	710 - 850	660 - 780
Læsø	400 - 500	400	690 - 830	650 - 780
Anholt	150	500 - 600	530 - 640	400 - 480
Hesselø	500 - 600	800 - 900	1000 - 1200	590 - 700
Sjællands Rev	45	100 - 150	110 - 130	30 - 40
West Samsø	150 - 200	500 - 550	670 - 800	270 - 320
East Samsø	20	120 - 150	200 - 240	100 - 120
Avnø Fjord	20	20 - 30	30 - 40	30 - 40
Saltholm	15	15 - 20	20 - 30	20 - 30
Rødsand	20	60 - 70	100 - 120	50 - 60
Bøgestrømmen	20	50	30 - 40	30 - 40
Total	2440 - 3570	4835 - 5515	6740 - 7570	4720 - 5280

prior to the disease are far too low and that the correction factor of 1.2 is probably too low for this area. Evidently, further studies are needed to evaluate the relationship between the counted and real population sizes.

With the recent knowledge about the seal presence at haul-outs in the Wadden Sea, the previously published estimates from 1976 and 1984 (Bøgebjerg 1986) have been revised accordingly. Hence, from 1976 to 1984 the total estimated population of harbour seals in the Danish waters increased from 2,440-3,570 to 4,835-5,515 and from 1984 to 1985-87 to 6,740-7,570 (Table 3).

Dispersal pattern of the epidemic

The first international recordings of the 1988 epidemic were made in harbour seal populations in northern Kattegat and the international Wadden Sea, from where it dispersed northwards to the Norwegian west coast populations and westwards to the English populations (Dietz et al. 1989). Accordingly, within the Danish waters the epidemic was first noted in central Kattegat and the Wadden Sea (April-May 1988). Later, it propagated into southern Kattegat (June-July), Limfjorden (July-August) and the Baltic (August-September).

Very little is known about the exchange of individual seals between haul-out sites in the Danish waters but the dispersal pattern of the epidemic indicates that disease carrying seals were the main agents.

The question is whether the high population levels affected the extent of the disease and the speed of dispersal. The correlation between population size and number of dead seals, and the lack of correlation between population size and proportion of dead seals, indicate that the disease made a comparable inroad on most populations (on average 45% of the estimated pre-disease population sizes in 10 areas). In Limfjorden a very high proportion of the pre-disease population apparently died (95%); this is probably an artefact explained by too low population estimates (see above). The lowest proportions of dead seals were found in Avnø Fjord, Bøgestrømmen and Læsø (7, 13 and 12%, respectively). For Læsø, however, the number of dead seals was probably underestimated, as dead seals probably drifted away from the island, e.g., to the mainland coast where many carcasses were found. For Bøgestrømmen and Avnø the proportion

of dead seals is probably correct and close to the natural annual mortality rate (cp Reijnders 1978); thus, most likely these areas were not affected by the disease at all.

It is characteristic that the affected populations all haul out on sand banks or reefs with dense rocks, where the seals haul out closely together. This is in contrast to the populations in Bøgestrømmen and Avnø Fjord where the seals haul out on solitary rocks. This difference suggests that the infection was mainly transferred on land. Furthermore, on sand banks the seals will apparently crowd irrespective of numbers (Bøgebjerg unpubl.); therefore, the extent and dispersal of the disease was probably not directly related to population size.

Short-term population effects of the epidemic

With an estimated grand Danish population of 6.740-7,570 individuals in 1985-87 and approximately 3,500 dead seals in 1988, the post-epidemic population was expected to be approximately 3,240-4,070 individuals. Assuming low mortality in the winter of 1988/89 and a production of 10-20% pups in spring 1989 the estimate for August 1989 was expected to be 3,570-4,880. The actual population, as estimated on the basis of population indexes and multiplication by correction factors, was 4,720-5,280 (Table 3).

The discrepancy may partly be explained by the employed method of population counts, which may be subject to some uncertainty, and by the application of correction factors which are undocumented for all areas but the Wadden Sea. For some areas, in particular Limfjorden, the estimates for the populations before 1988 seem to have been too low. Alternatively, the number of seals which died from the disease may have been overestimated, e.g., due to drifting dead seals originating from foreign populations. This factor is, however, regarded as negligible, especially for Limfjorden, as the majority of dead seals were found close to known haul-out sites.

After the epidemic disease in northwest Europe there was a general concern about the long-term effects on the populations (e.g., Dietz et al. 1989, Harwood et al. 1989, Simmonds 1991). There is still a risk of a return of the disease, which may affect individuals which have not developed antibody response against the PDV virus, or seals born after 1988. In the autumn of 1989 sick and dead seals infected with the PDV-virus were reported from the northern coast of Norway (Krogsrud et al. 1990), and, in 1990, from the German Wadden Sea (Heidemann pers. comm.), indicating that the virus may still be active in the marine environment.

With an estimated population size of 5,000 individuals in the Danish waters in 1989 and a rate of increase (0.13) equal to pre-disease, it can be foreseen that the 1987 population level will be reached again in 1992.

DANSK RESUMÉ

Udviklingen i de danske bestande af spættet sæl *Phoca vitulina* i 1976-1989 og korttidseffekten af epidemien i 1988.

Efter totalfredningen af spættet sæl i Danmark i 1977 steg de fleste lokale bestande af sæler, og det totale antal sæler i de danske farvande steg fra 2.400-3.500 i 1976 til 6.700-7.500 i 1985-1987. Den største gennemsnitlige vækst blev fundet i delbestandene ved Anholt, Rødsand og Østsamsø, og den laveste registreredes i Læsø-, Vadehavs- og Hesseløbestandene. De små, isolerede bestande i Avnø fjord og Bøgestrømmen steg øjensynligt kun ganske lidt (Tab.1).

Der var en tendens til aftagende vækst i antallene for de lokale delbestande ved Øst- og Vestsamsø, Anholt, Limfjorden og Hesselø igennem den sidste halvdel af perioden, mens bestanden ved Anholt udviste en signifikant aftagende vækst i det samme tidsrum. Denne aftagende vækst kan muligvis have været foranlediget af, at sælbestandene var ved at nå områdernes bæreevne. Kun i Vadehavs- og Rødsandbestandene var der en vedvarende vækst igennem hele perioden.

I forbindelse med sældøden i 1988 omkom mindst 3.471 sæler i de danske farvande. Der var en klar sammenhæng mellem bestandsstørrelse forud for sygdommen og det antal døde sæler, der fandtes i områderne, men der var ingen sammenhæng mellem bestandsstørrelse og den andel af bestanden, som døde. Det største antal døde sæler fandtes i Vadehavet, vest for Samsø og ved Hesselø, Limfjorden og Anholt.

I de indre danske farvande syntes de fleste unger, der var født i 1988, at være gået til som følge af sygdommen, der rasede fra tidligt i april og frem til januar 1989. I de enkelte områder varede sygdommen 7-40 uger; kortest i Rødsandbestanden, hvor epidemien startede sidst i juli, mens størstedelen af sælerne var »på land« for at parre sig og skifte pels. I områder som Limfjorden og Vadehavet, der har mere end én hvileplads varede sygdommen længere tid (Tabel 2, Fig. 3).

Sælepidemien blev først registreret i den centrale del af Kattegat og i Vadehavet. Fra den centrale del af Kattegat spredte den sig til det sydlige Kattegat, Limfjorden og Østersøen (fig.3). Sygdomsramte sæler synes at have været hovedsmittespreder, men måger kan også have bidraget til spredningen af sygdommen.

I 1989 taltes 48-110% af det antal, der var registreret for delbestandene i 1987; i de fleste områder faldt bestanden, men på Hesselø, hvor et forøget antal registreredes, kan det have skyldtes, at 1987-antallet har været vurderet for lavt. F.eks. antyder en nyere dansk undersøgelse for Vadehavsområdet, at optællingsresultater skal ganges med 1,8 for at realistiske tal opnås. For de øvrige danske områder er denne omregningsfaktor imidlertid ukendt, men generelt tyder det på, at de antal der nås ved den anvendte optællingsmetode er for lave (Tab. 3).

Set i lyset af bestandsudviklingen i perioden 1976-1987 vil bestandsniveauet fra før sælepidemiens udbrud i 1988 være genoprettet i 1992, forudsat at vækstraten på 0,13 ikke falder og at det virus, der forårsagede epidemien, ikke blusser op igen.

Резюме на русском языке:

Развитие датских популяций пятнистого тюленя (Phoca vitulina) в 1976-1989 г. и краткосрочный эффект эпидемии 1988 года.

После введения полной охраны пятнистого тюленя в Дании в 1977 г. большинство местных популяций тюленей увеличились, и общее число тюленей на датских водах возросло с 2400 - 3500 в 1976 г. до 6700 - 7500 в 1985 - 1987 г. Наибольшее среднее повышение наблюдалось у отдельных местных популяций у острова Анхольт, Рёдсанд и на востоке острова Самсё, а наименьшее регистрировалось у популяций Лесё, на Западно-Ютландских морских отмелях и у острова Хесселё. Небольшие изолированные популяции в Авнё-Фиорде и проливе Бёгестрёммен очевидно увеличились только незначительно (Табл. 1).

Была тенденция к понижению темпа роста отдельных местных популяций на востоке и западе острова Самсё, у Анхольта, в Лимфиорде и у Хесселё в течение последней половины периода, между тем как популяция у острова Анхольт выказала значительно понижающийся темп роста. Возможно, что это понижение вызвано тем, что численность популяций тюленей приближается к содержащей способности данных районов. Непрерывный рост в течение всего периода наблюдался только у популяций Западно-Ютландских отмелей и Рёдсанда.

В связи с массовой гибелью тюленей в 1988 г. погибли по меньшей мере 3.471 тюлень на датских водах. Была явная связь между численностью популяций до эпидемии и числом найденных в данных районах мертвых тюленей, но не было связи между численностью популяции и погибшей долей данной популяции. Наибольшее число мертвых тюленей было найдено на Западно-Ютландских морских отмелях, к западу от Самсё и у Хесселё, в Лимфиорде и у острова Анхольт.

Кажется, что на внутренних датских водах большинство рожденных в 1988 г. детенышей погибли от болезни, свирепствовавшей с начала апреля до самого января 1989 г. В отдельных районах болезнь длилась от 7 до 40 недель, наиболее кратко у популяции Рёдсанда, где эпидемия началась в конце июля, когда большинство тюленей были на суше для случки и смены меха. В таких районах как Лимфиорд и Западно-Ютландские отмели, где имеется больше одного места отдыха, эпидемия длилась дольше (Табл. 2, Фиг. 3).

Эпидемия тюленей впервые регистрировалась в центральной части Каттегата и на Западно-Ютландских отмелях. Из центральной части Каттегата она распространилась в его южную часть, в Балтийское Море и Лимфиорд (Фиг. 3). Кажется, что главными разносчиками заразы были больные тюлени, но возможно, что распространению болезни также содействовали чайки.

В 1989 г. было подсчитано 48 - 110% числа особей, регистрированного по отдельным популяциям 1987 года; в большинстве районов численность понизилась, но на Хесселё, где было зарегистрировано больше тюленей, причиной этого могла быть слишком низкая оценка численности в 1987 году. Например, новейшее датское исследование района Западно-Ютландских отмелей дает намек о том, что результаты подсчетов для получения реалистичных чисел следует помножить на 1,8. Для остальных датских районов такой поправочный коэффициент еще неизвестен, но в общем кажется, что численности, получаемые принятым способом подсчета, слишком низки (Табл. 3).

На основании развития популяций с 1976 по 1987 г. можно предположить, что численности, состоявшие до начала эпидемии тюленей в 1988 году, будут восстановлены в 1992 году, при условии, что темп роста (0,13) не понизится, и что вызвавший эпидемию вирус не вспыхнет снова

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