Document title	Methods for seal abundance monitoring in the HELCOM area 2014
Code	4-1
Category	DEC
Agenda Item	4 – Monitoring of seals
Submission date	3.10.2014
Submitted by	Secretariat
Reference	

Background

Within the BALSAM project (Pilot Project for enhancing the capacity of the Baltic Sea member states to develop their monitoring programmes, co-funded by the EU DG Environment) the seal experts of the Work Package 3 "Seals and seabirds" have produced methods for seal abundance monitoring in the HELCOM area, as contained in this document.

Action required

The Meeting is invited to discuss and endorse the methods for seal abundance monitoring.

Methods for seal abundance monitoring in the HELCOM area 2014

by: Anders Galatius, Markus Ahola, Tero Härkönen, Ivar Jüssi, Mart Jüssi, Olle Karlsson and Mikhail Verevkin

1 Introduction

The three regularly occurring seal species in the Baltic Sea, harbour seal (*Phoca vitulina*), ringed seal (*Pusa hispida*) and grey seal (*Halichoerus grypus*) are monitored at their haul-outs on land during their annual moulting and pupping seasons, with the aim of estimating the abundance and abundance trends (moulting counts) and pup production (pupping counts). Where possible, the monitoring is performed using aerial surveys, where the seal haul-outs are photographed during the relevant periods in areas where there is a significant occurrence of seals.

Harbour seals

Methods

In the Baltic (HELCOM area), harbour seals are distributed in four units, which are monitored separately, namely the Limfjord, Kattegat, southwestern Baltic and Kalmar Sound. The Limfjord and southwestern Baltic are monitored by scientists from the Department of Bioscience, Aarhus University, Kalmar Sound is monitored by scientists from the Swedish Museum of Natural History. Monitoring of the seals in Kattegat is coordinated between these institutions with synchronized surveys in the Swedish and Danish parts of the area.

2.1 Time, place and period

1. 2 aerial surveys of breeding harbour seals in June in the Danish part of the Kattegat area.
2. 3 aerial surveys of moulting harbour seals at all significant haul-outs in all areas during the peak moulting season in August (Teilmann et al 2010). In Kattegat, these surveys are coordinated and synchronized between Denmark and Sweden.

2.2 Equipment

- High-wing fixed wing aircraft with opening windows
- 2 digital cameras with zoom lenses including 200mm in their range and image stabiliser
- GPS-log
- Binoculars
- Intercom headsets
- Immersion suits and life vests

2.3 Procedure

Aerial surveys follow a standard protocol, which has been in use since 1979. There are two observers on each survey. As seals tend to have a higher haul out rate in dry weather, surveys are not carried out if there has been rain at a haul-out within 6 hours prior to the survey. To ensure photographic quality, surveys are only carried out at wind velocities below 10 m/s. The haul-outs are photographed from and altitude of 500-700 feet. Each observer takes a series of overlapping photographs of seal groups at the haul-out through the open window. Occurrence of seals outside the photographs is noted. At a few localities, seals haul out on individual rocks covering a large area. At these sites, overlapping photographs are not possible and the

seals are counted independently by each observer and the mean of these counts is used. Counting from photographs is performed by examination of the series using a computer. Two persons perform individual counts of each locality. In cases of discrepancies exceeding 5% of the two counts, a third independent count is performed. The mean of two counts within 5% of each other constitutes the count for a locality/haul-out.

2.4 Maintenance of equipment

Cameras and binoculars are tested before every survey. Fully charged batteries and empty memory cards as well as spares, must be available for each camera. In case of malfunction or suboptimal function, the equipment is sent for repair or is replaced.

3 Data analysis

All data are secured in databases the National Center for Environment and Energy, Aarhus University (DCE), the Danish Nature Agency or the Swedish Museum of Natural History in Gothenburg. Raw data are partially treated before being entered into the databases. After initial processing, all data are publicly available.

3.1 Calculations

Aerial surveys are used to give an index of the seals observed on land, as described by Teilmann et al. (2010).

4 Quality control

4.1 Quality control of methods

All employed methods have been tested and published by the National Center for Environment and Energy, Aarhus University (DCE). The development of methods has been done in cooperation between the Danish and Swedish partners and represents state of the art in seal monitoring.

5 References

Teilmann, J., Riget, F. & Härkönen, T. (2010). Optimising survey design for Scandinavian harbour seals: Population trend as an ecological quality element. ICES Journal of Marine Science, 67: 952-958.

Ringed seals

Methods

In the Baltic (HELCOM area), ringed seals are distributed in four units, which are monitored separately, namely the Bay of Bothnia, the Archipelago Sea, the Gulf of Finland and the Gulf of Riga. The Archipelago Sea is monitored by Finnish Game and Fisheries Research Institute, the Bay of Bothnia by the Swedish Natural History Museum, the Gulf of Finland by the Finnish Game and Fisheries Research Institute, the Estonian Environmental Board and the St. Petersburg State University/BFN in coordination. The Gulf of Riga is monitored by the Estonian Environmental Board.

Notes: The Gulf of Riga is also surveyed in the Latvian part if the ice cover extends across the national border. As the Gulf of Riga area is on the southern limit of formation of sea ice in average ice winters, the monitoring success is extremely sensitive to severity of winter. In past two decades (since 1994, when the systematic surveys were introduced) only the 2005/2006 winter was severe enough to form stable sea ice during the ringed seal moulting period in mid-April. In other years aerial, ship-based or land-based surveys have been carried out to explore haul out distribution and abundance of seals and get point estimates of the seal population in various ice conditions.

2.1 Time, place and period

1. Archipelago Sea: 2 aerial line transect surveys of moulting ringed seals in mid-April in the Archipelago Sea and on the Finnish side of the Gulf of Finland east of Helsinki (the main series of transect lines located east of the Kotka longitude.
2. Bay of Bothnia: 2 aerial line transect surveys between the 20th of April to the 1st of May.
3. Gulf of Riga: aerial line transect survey 15th of April and 1st of May
4. Gulf of Finland: aerial line transect survey between 15th of April and 1st of May

2.2 Equipment

- High-wing fixed wing aircraft with opening windows
- 2 digital cameras with zoom lenses including 200mm in their range and image stabiliser
- GPS-log
- Binoculars
- Intercom headsets
- Immersion suits and life vests
- Inclinometer to mark width of transect strip
- Dictaphones

2.3 Procedure

Line transect methodology (Härkönen & Lunneryd 1992, Härkönen et al. 1998) is employed since ringed seals haul out on the ice to moult. Surveys are flown at an altitude of 90m and the surveyed strips are 800 m wide. The transects are evenly spaced over the ice area in a manner so that a minimum of 13% of the entire ice covered sea area is surveyed. A greater survey fraction only marginally reduces variances of survey results (Härkönen & Lunneryd 1992).

Notes: In the Gulf of Riga, poor ice conditions in most years have suggested that seal distribution on ice has not resembled that of a "normal" winter, the observation results can then only be used to describe distribution rather than calculate or compare abundance estimates.

2.4 Maintenance of equipment

Cameras and binoculars are tested before every survey. Fully charged batteries and empty memory cards as well as spares, must be available for each camera. In case of malfunction or suboptimal function, the equipment is sent for repair or is replaced.

3 Data analysis

The location data of observations are retrieved from EXIF of aerial photographs, the photos are visually scanned for all seals, and overlapping areas of series of photographs are visually excluded. The data is tabulated, flight transects are segmented into smaller units (5 km segments of observation strip or specially defined spatial grid, e.g. squares of 5 sq.km each) using data treatment software (R-package or GIS tools). Seal densities per square kilometer in each unit, abundance estimate, based on the mean densities and coverage of the ice area together with 95% confidence interval of the estimate are calculated using the standard statistical procedures (Härkönen and Lunneryd 1992).

All data are secured in databases at the Swedish Museum of Natural History in Gothenburg, the Finnish Game and Fisheries Research Institute and Estonian Environment Agency. Raw data are partially treated before being entered into the databases. After initial processing, reports are are publicly available.

3.1 Calculations

Seal abundance estimates are produced using the methods described by (Härkönen and Lunneryd 1992). Aerial surveys are used to give an index of the seals observed on land, as described by Teilmann et al. (2010).

4 Quality control

4.1 Quality control of methods

The development of methods has been done in cooperation between the international partners and represents state of the art in seal monitoring.

5 References

Härkönen, T and S. G. Lunneryd 1992. Estimating abundance of ringed seals in the Bothnian Bay. *Ambio* 21:497-510

Härkönen, T., O. Stenman, M. Jüssi, I. Jüssi, R. Sagitov, M. Verevkin. 1998. Population size and distribution of the Baltic ringed seal (*Phoca hispida botnica*). In: Ringed Seals (*Phoca hispida*) in the North Atlantic. Edited by C.Lydersen and M.P. Heide-Jørgensen. *NAMMCO Scientific Publications*, Vol. 1, 167-180.

Teilmann, J., F. Riget, T. Harkonen. 2010. Optimising survey design in Scandinavian harbour seals: Population trend as an ecological quality element. ICES Journal of Marine Science, 67: 952–958

Grey seals

2 Methods

In the Baltic Sea, grey seals are surveyed as one unit, the distribution of which covers most of the Baltic Sea area (see HELCOM Red List entry: http://helcom.fi/Red%20List%20Species%20Information%20Sheet/HELCOM%20Red%20List%20Halichoerus%20grypus.pdf). Moulting counts take place during the peak moulting season over two weeks in late May – early June, which is agreed and scheduled among the international partners: Finnish Game and Fisheries Research Institute, the Swedish Natural History Museum, Estonian Environmental Board, the St. Petersburg State University/BFN and Department of Bioscience, Aarhus University. Grey seals are hauling out in herds on small islets and skerries. All the locations where grey seals have been observed to haul out during previous years (>270 + a few new sites per year found from the observed area in Finland, 7 sites in Denmark, 30 sites in Sweden, 15 sites in Estonia and 8 + few new sites in Russia) are surveyed two to three times during the agreed two-week period

Note: In Denmark, localities are only surveyed once in the period.

In Finland, grey seal pup counts are carried out in a sample area of 44 small islands in the Southern edge of the Archipelago Sea in late February and early March. In Denmark, where the grey seal is currently establishing itself as a breeding species, all localities are surveyed in late February and early March. In Estonia main breeding islands (2-4) are surveyed according to presence of seals. In Sweden and Russia, pup counts are not a part of the monitoring program.

2.1 Time, place and period

Every year, the following aerial and/or land based surveys are performed:

1. Grey seal pups: 2 aerial surveys at selected grey seal pupping areas (Finland: southern edge of the Archipelago Sea; Denmark: all grey seal localities in the Danish HELCOM area; Estonia: major breeding islands (2-4) in Estonian western Archipelago and the Gulf of Riga; Sweden and Russia: no counts is carried out during the pupping season) in the end of February / early March and in mid to late March.

2. Grey seal moult: In Finland, 3 aerial surveys of moulting grey seals at all known haul-outs in SW Archipelago (the core area of moulting distribution) and 2 aerial counts in the Gulf of Bothnia and the Gulf of Finland during late May – early June. In Denmark 1 survey covering the Danish HELCOM area is performed. In Sweden 3 aerial surveys are carried out at haul-outs in the key areas, in other areas 3 surveys are carried out from land our boat. In Estonia Gulf of Finland and Estonian W archipelago with Gulf of Riga are surveyed in separate flights. Minimum two censuses carried out in Gulf of Finland and three on W Archipelago. In Russia Eastern part of the Gulf of Finland is surveyed from ships or boats for 1-2 times depending on weather.

2.2 Equipment

- High-wing fixed wing aircraft with opening windows
- Helicopter with large opening side door (grey seal pup counts in Finland)
- Digital cameras with zoom lenses including 200 - 300mm in their range and image stabiliser. GPS-log (not used in Denmark)
- Binoculars
- Intercom headsets
- Immersion suits and life vests
- Boats (in Russia and some areas in Sweden)

2.3 Procedure

Aerial surveys with fixed wing aircraft or helicopter follow a standard protocol. As seals tend to have a higher haul out rate in dry weather, surveys are not carried out if there has been rain at a haul-out within 6 hours prior to the survey. To ensure photographic quality, and high haul-out rate, surveys are only carried out at wind velocities below 10 m/s. A pilot and one or two observers are required for each survey. The pilot is making sure that the flight route allows the photographing observer to take pictures of all the grey seal herds. The observer at the opening window takes a series of overlapping photographs of seal groups at each haul-out while both the pilot and the other observer, if present, are helping observing seals outside the photographs (in practice those swimming outside of the hauled out group or hauling out separately).

All data are secured in databases at the Swedish Museum of Natural History in Gothenburg, the Finnish Game and Fisheries Research Institute and Estonian Environment Agency. Raw data are partially treated before being entered into the databases. After initial processing, all data are publicly available.

Note: in Denmark, surveys are performed at mean wind velocities up to 10 m/s, in Estonia at wind speeds up to 8 m/s.

Note: in Estonia, only one observer is used.

Note: in Finland, grey seal pups are counted on each of the 44 small islands is flown around with a helicopter at the altitude of 50-100 meters and overlapping photographs covering the entire islands are taken by one observer while the other is keeping notes. From the photographs, numbers of pups (when

possible assigned to two age classes), number of females and males are counted, as well as number of white-tailed sea eagles, which visit the sites for eating the afterbirths as well as pups.

Note: in Russia, the main haul-outs are located in a no-fly zone, and photographs are taken from boats at the distance of 100-400 meters.

2.4 Maintenance of equipment

On each survey flight at least two cameras, several charged batteries and empty memory-cards are brought, ensuring the availability of equipment in case of malfunction.

3 Data analysis

Numbers of grey seals are counted from the pictures. Numbers of observed seals are summed up by sea area and the highest number obtained over the flights or the boat survey in each area is used as the counted population size.

Data are secured in databases at the Swedish Museum of Natural History in Gothenburg, the Finnish Game and Fisheries Research Institute, the Estonian Environment Agency and Department of Bioscience, Aarhus University. Raw data are partially treated before being entered into the databases. After initial processing, all data are publicly available.

3.1 Calculations

Aerial surveys are used to give an index of the seals observed on land, as described by Teilmann et al. (2010).

4 Quality control

4.1 Quality control of methods

The development of methods has been done in cooperation with international partners and represents state of the art in seal monitoring.

4.2 Quality control of data and reporting

Survey results are included in the monitoring databases and reported to the public on an annual basis.

5 References

Teilmann, J., Riget, F. & Härkönen, T. (2010). Optimising survey design for Scandinavian harbour seals: Population trend as an ecological quality element. ICES Journal of Marine Science, 67: 952-958.