Guidelines for coordinated cost-effective future monitoring of marine wintering birds

Recommendations and guidelines for bird monitoring in the Baltic

The Guidelines were discussed in a Baltic marine bird experts meeting that took place in 28 – 29 January, 2015 in Jurmala, Latvia. The following experts attended in the meeting: Markus Ahola (FI), Lena Avellan (HELCOM), Mindaugas Dagys (LT), Volker Dierschke (DE), Johanna Karhu (HELCOM), Antti Lappalainen (FI), Leho Luigujoe (EE), Wlodimierz Meissner (PL), Ian Mitchell (UK), Leif Nilsson (SE), Ib Krag Petersen (DK), Jukka Rintala (FI), Antra Stipniece (LV). Nele Markones (DE) submitted written suggestions and comments to the draft Guidelines.

Introduction

The waterbirds are an integral part of the Baltic marine ecosystem. They are predators of fish, macroinvertebrates and other bird species, scavengers of carcasses and fishery discards and herbivores of littoral vegetation.

This document describes recommendations and guidelines for bird monitoring in the Baltic Sea, which were developed within the BALSAM project Work Package 3 “Regional coordination of monitoring of marine mammals and seabirds”. The work will be discussed with marine bird experts in all HELCOM Contracting Parties.

All the Baltic Sea countries (the HELCOM contracting parties) are carrying out marine bird monitoring. However, currently these efforts are not coordinated.

During the non-breeding seasons the distribution areas of marine bird species can cover large parts of the Baltic Sea and the individuals belong to the same population. Mobility of marine birds during non-breeding period allows them to adjust their territorial distribution according to changing accessibility of the suitable feeding sites. Thus counting birds in different parts of the Baltic Sea in different years may cause difficulties to carry out Baltic Sea wide scale assessments. To avoid the risk of missing or double-counting the birds during nationally restricted counting sessions, the coordination of data collection schemes among the Baltic Sea countries is required.

Sufficiently wide assessment units and monitoring approaches could enable the production of high-quality assessments for the MSFD and BSAP. The sharing of tasks and international optimization of monitoring activities could reduce the total costs of assessment.

Therefore, it is important that the Baltic Sea countries coordinate all the wide scale counting activities during the non-breeding seasons (e.g. performing large scale counts in the same winter) and establish a data interchange and sharing system that facilitates carrying out Baltic Sea wide scale assessments.

These monitoring guidelines are limited to abundance and distribution of marine birds during the non-breeding seasons only. It was not intended to duplicate the existing more detailed monitoring guidelines and monitoring manuals or give precise field protocols (e.g. Camphuysen et al., 2004; Wetlands International, 2010). The intention rather was to set common standards for bird monitoring in the Baltic Sea to facilitate data exchange, development of a common database and use for Baltic Sea wide assessments.

Abbreviations used for the names of the Contracting Parties:

DK	Denmark
EE	Estonia
FI	Finland
DE	Germany
LV	Latvia
LT	Lithuania
PL	Poland

RU	Russia
SE	Sweden

Policy relevance

Monitoring of birds is required by several international policy documents binding to all or most of the Baltic Sea countries. All but one HELCOM Contracting Party (RU) are the EU member states and thus they have to comply with the requirements of EU Directives. This sets overall standards regarding biodiversity monitoring in the Baltic Sea.

HELCOM Baltic Sea Action Plan (BSAP) is a programme to restore the good ecological status of the Baltic marine environment by 2021. The strategy, adopted by all the coastal states and the EU in 2007, is a crucial stepping stone for wider and more efficient actions to combat the continuing deterioration of the marine environment resulting from human activities. The HELCOM ecological objective "Viable populations of species" is part of the biodiversity goal "Favourable conservation status of Baltic biodiversity" (Helsinki Comission, 2007). The following bird related CORESET indicators have been developed to achieve this goal:

- Abundance of waterbirds in the wintering season
- Abundance of waterbirds in the breeding season
- Number of drowned mammals and waterbirds in fishing gear
- Marine bird health (White-tail eagle productivity)

Article 11 of the **Marine Strategy Framework Directive** (European Parliament, 2008) provides legally-binding requirements for Member States to establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of marine waters. The Directive provides no particular guidance on the design and content of the monitoring programmes, the setting of environmental targets or determination of GES. However, criteria and methodological standards on good environmental status of marine waters (European Commission, 2010) have been defined to harmonise approach between the countries.

The Article 12 of the **Birds Directive** (European Parliament, 2010) requires that the EU member states every three years report on the implementation of the national provisions taken under this Directive. Until 2013 the reporting under Article 12 primarily reflected the legal transposition and technical implementation of the directive on the national level. In 2008 it was agreed to start exploring a new system of bird reporting, which would deliver data on the actual state and trends of bird populations, similar to the reporting under Article 17 of the Habitats Directive, as well as a change from a 3-year to 6-year reporting cycle. The 1st reporting according to the new format took place in 2013. The Birds Directive applies to all species of naturally occurring birds in the wild state in the European territory of the Member States, as defined in Article 1. Thus detailed report has to be completed for all regularly occurring species in the relevant seasons. For marine bird species wintering and passage are among the reporting seasons.

Several marine bird species can be considered as the "typical species" of the **Habitats Directive** Annex I habitat types such as 1110 Sandbanks which are slightly covered by sea water all the time and 1170 Reefs (Council of the European Communities, 1992). Article 17 of this directive requires detailed reporting on each of the listed habitat types and the requested information includes information on the status of typical species of the habitat.

The same data collection schemes can provide data that serve the data needs for the indicators under BSAP as well as MSFD, BD and HD reporting.

Recommendations for monitoring abundance and distribution of waterbirds during non-breeding seasons

Seasons

The Baltic Sea is used by waterbirds outside the breeding season as a moulting, feeding and wintering areas, and also as migration staging place.

Wintering is the most suitable period for waterbird monitoring as they aggregate in certain feeding grounds and are less mobile than in other non-breeding seasons. Thus coordinated counts within this period allows collecting the least biased data and the winter season is top priority for waterbird monitoring during the non-breeding period.

The moult is a critical period in the life cycle of seaducks when most species are flightless or near-flightless. Although the flightless moulting ducks appear to establish a relatively regular diurnal pattern of local movement and habitat use, they have limited opportunity to move if conditions change following the onset of moult. Thus populations during this period can be considered as closed. Besides the need to monitor important moulting grounds (site monitoring), carrying out full scale surveys provides an opportunity to collect reliable data on total population size moulting in the Baltic Sea and to discover new sites. Although currently there is no HELCOM CORESET indicator developed for the moulting birds due to lack of suitable data, collection of appropriate data should be promoted.

It has been shown recently that the counts of arctic breeding seaducks such as Long-tailed Duck at the key bottle-neck sites in Finland and Estonia during the spring migration period can well reflect population changes and status of the populations of these species wintering in the Baltic Sea. Continuation of this type of monitoring is highly desirable.

EU member states have designated Marine SPAs to protect sites where marine bird species are regularly aggregating in large numbers for wintering, moulting or staging during the migrations. Monitoring of these sites in different seasons is needed to fulfil the obligations arising from Birds Directive and regular updating of the Natura 2000 database. Although monitoring of these sites in the wintering and moulting periods might be covered with the generic large scale marine bird monitoring surveys, there is a need for a dedicated monitoring for some of these sites during the migration periods. There might be also a need to have different sampling design or counting platform to obtain more precise site specific data which might be difficult using the one intended for large scale surveys.

To be able to specify to which extent the Marine SPAs grasp the amount of birds present in the national waters, the monitoring of the marine SPAs should not be limited to the sites only. They should cover also the general marine areas.

Current situation

All Baltic Sea countries are currently monitoring wintering birds and collecting data on species numbers and distribution; however, counting methods, timeframe and type of financing varies greatly among the countries.

Inshore surveys. Ground count based coastal surveys are carried out in all countries. In the countries with larger inshore areas that cannot be counted from coast, the ground counts are usually accompanied by plane counts. Unlike the ground based coastal counts, the inshore plane surveys are not carried out annually and in most countries, where they take place, the regularity is not strictly set. These plane surveys most usually are carried out as total counts or strip counts because using line transects in the complex inshore environment is difficult.

In the winter season the inshore counts are internationally coordinated by Wetlands International as a part of the International Waterbird Census (IWC). The ground counts are carried out annually and mostly are done by volunteers. They are well synchronised in time among the European countries as the weekend closest to the 15th of January is the central dates for the IWC. However, there is no international coordination in timing of the inshore plane surveys and they may take place in different years in different countries.

Inshore surveys in the duck moulting period and during the passage have been carried out only in part of the Baltic Sea countries. Where they are, they often were carried out on project basis. Thus they also lack the coordination among countries.

Offshore surveys by plane and ship have been carried out in all countries, however, usually they have occurred as one-off surveys on project basis and rarely covering entire waters of the countries. Years of the

large scale counting are not synchronised between countries and the choice of the counting platform mostly depends on the tradition. There is an increasing use of line transects, however strip transects are also used.

Offshore monitoring, especially in the winter time, lacks coordination and is geographically not representative. Because of the spatially and temporally uneven survey coverage across the Baltic region, assessments of offshore seaducks or auks are not possible with the current monitoring. There is also a need for revising the winter population monitoring in the northern part of the Baltic Sea, as it is expected that due to general climate warming, iceless winters in the Northern Baltic will become more frequent in the future. Thus, to monitor Baltic populations of marine birds, spatial scale in the marine bird censuses need to be increased.

Wide scale monitoring of offshore moulting waterbirds takes place on regular basis only in Denmark. There is a need to carry out baseline surveys of moulting seaducks in the rest of the countries and to establish national monitoring programmes with appropriate sampling design where needed. Baltic wide coordination of such surveys will be the next step.

Coordination should be enhanced by building a platform for marine bird monitoring in the Baltic. Adopting common monitoring guidelines and establishing common monitoring database are the first steps to take. Wide scale survey activities should be coordinated between Baltic Sea counties to collect more reliable data for the Baltic Sea wide assessments.

Choice of methods

There are 3 conventional monitoring methods to record population numbers and distribution. Each of them has its strengths and weaknesses which, in short, are given below. The novel methods are discussed after the conventional methods.

Ground based survey is the oldest of the methods and is the least demanding regarding the personnel and costs. There are many volunteers, especially in the western part of the Baltic Sea available that are able to carry out waterbird counts using this methodology. Due to the International Waterbird Census established decades ago and currently organised by Wetlands International, all Baltic Sea countries have and existing monitoring network, covering significant portion of the Baltic coastline as well as established field survey protocols and procedure (Wetlands International, 2010). However, the method can be used to monitor the very coastal areas only. Usually the effective counting belt reaches up to a distance of 1km from coast, however, the actual distance depends on the species and visibility during the count. While this might be sufficient for species with very coastal distribution such as dabbling ducks or mergansers, it is not able to cover significant populations occurring further from coast such as Long-tailed Duck or scoters. In addition, it is difficult to use distance sampling during ground based surveys as the counting routes are not randomly positioned against the existing habitats and environmental gradients. Thus it is not possible to account for birds not detected.

Shipboard and **aerial** line transect surveys are widely used for estimating the abundance of marine birds in offshore areas (Camphuysen et al., 2004) as they do not have limitations of the ground based surveys regarding the geographic coverage. They allow accounting for birds present but not detected using the distance sampling (Thomas et al., 2002). On aerial or ship based surveys it is impractical to record individual distance to every observation, so the observations are grouped within distance belts and detection functions are calculated using these distance belts. In marine bird surveys the unit of observation is a flock of birds and for each flock also the flock size is recorded. For single birds the flock size is 1. If a flock spreads over several distance belts, number of birds is recorded for each belt separately.

Aerial or **plane based surveys** allow covering large areas in a relatively short time. This is particularly important during the winter season when the light time of day is very short and days with weather conditions appropriate for bird counting at sea are infrequent. The aerial surveys would allow efficient use of the short periods of available light and suitable weather which is not possible for the ship-based surveys. For countries having large areas that need to be surveyed the aerial counts are the only viable choice for full scale surveys. However, aerial surveys are more expensive and demanding regarding the weather conditions during the surveys, which can be rarely available. This can become a major obstacle if the survey has to be carried out

in a specified and narrow time period. Especially during the period when birds are very mobile (e.g. migration) this can lead to surveys that are very fragmented in time and thus not able to deliver a representative picture of bird occurrence.

Several disadvantages of observer based aerial surveys have been reported: larger flocks tend to get underestimated during aerial surveys (e.g. Bellebaum et al., 2014), identification of birds is considerably harder and there are groups that usually can be identified up to the genus level only and aerial surveys are not suitable for small, inconspicuous species (such as grebes or auks), in particular in concentration areas. However, the aerial surveys cause less disturbance reactions for some of the species groups (e.g. divers). Field experts for the aerial surveys need additional training on species recognition, bird detection and estimation of flock size.

Ship based surveys outperform the aerial surveys regarding bird detection and species identification and are preferred if faunistic precision or precise counts of rarer species are important. Species identification skills obtained in ground counts are usually sufficient for carrying out ship based surveys, however observers need additional training on estimation of distances and flock size. On the negative side, surveying speed of ships do not allow covering large areas. For countries with large territories to be surveyed, the amount of ship time needed might be prohibiting due to availability of days with suitable weather. During the winter when days are short, ratio of counting and waiting time is cost inefficient. However, as being less demanding than aerial surveys regarding the weather conditions, there might be situations where the ship surveys are the only option to carry out surveys at all. Additional disadvantage is that most of the ships suitable as a platform for bird counting may not be able to cross very shallow banks and approach coastline. Zigzag line transect designs (Strindberg and Buckland, 2004) are needed for ship surveys as the classical parallel line sampling design is not cost effective for ships.

Line transects vs strip transects. The two sampling techniques are relevant for both plane and ship based counting platforms. Using strip transects the objects of interest outside the strip are not counted. Width of the strip should not be larger than area where detectability of the objects is 100%. In practice, this assumption rarely is true even for narrow strips thus resulting in underestimation of the population size (Ronconi and Burger, 2009). The proportion of undetected birds varies between the species. Distance sampling allows using all observations collected during the counts and is not restricting them to one particular counting belt. The method takes into account the well-known fact that detectability of objects decreases with increased distance from observer. Species and observer specific detection curves allow more robust population estimates than those obtained in the strip transects. Within the aerial transect surveys there is a difference from the classical line transects. The belt that is nearest to the transect line is not used as it falls in the zone below the aircraft that cannot be observed.

Aerial imaging. Current developments in object based image analysis techniques allow listing the aerial imaging as a possible alternative to the conventional counting platforms (Gordon et al., 2013; Groom et al., 2013, 2007; Thaxter and Burton, 2009). The studies comparing visual counts and aerial imaging often show considerable differences in the results of both types of surveys (Kulemeyer et al., 2011). Aerial imaging can provide more precise estimates, by improving bird detection and reducing biases due to imperfect detectability of birds in conventional methods. It establishes a traceable sampling method which allows storing of collected samples for later reuse. Nevertheless, presently the method is considerably more expensive than the conventional methods. It requires considerable investments and steep learning curve to establish the workflow, especially the developing an automated rule-set based recognition of candidate image segments for birds; it does not reduce the overall man-time needed. Due to the current cost-effectiveness, presently it is not recommended to fully replace the visual counts with aerial imaging in the national monitoring programs.

Recommendations for the choice of sampling platform and method. To harmonise the monitoring methods across the Baltic sea, a combination of ground based counts and plane based visual counts using line transects are recommended if new large-scale national monitoring schemes for waterbird populations in the Baltic Sea during the non-breeding period are designed. It is recommended to use line transects with distance sampling instead of strip transects.

However, it is not recommended to change the currently running monitoring schemes if the counting platform for offshore birds is the only difference from the recommended setup (e.g. ship-based line transects instead of plane based line transects). It is recommended to use ship based surveys for fine scale monitoring of offshore sites if the topography of the site allows it. Ship-based surveys qualify also for high concentration-areas as they generally provide more precise estimates for big flocks –especially when consisting of different species as well as for small, inconspicuous species mixed with big seaduck flocks (such as auks and grebes).

Recommended standards for aerial surveys. Aerial survey techniques described in Camphuysen et al. (2004) and Petersen et al. (2006) can be regarded as a standard for offshore bird monitoring in the Baltic Sea. Flights have to be performed at an altitude of 250 feet (76 m) with a speed that does not exceed 100 knots (185 km/h). Flying higher and faster negatively affects recognising the species. Moreover, the view angles for distance belts that are given below are calculated for the altitude of 250 feet and changes in altitude render the given angles unusable.

The observed flocks or individual birds have to be assigned to the transect belts. The recommended parameters of the distance belts are given in the Table 1. These parameters are valid only if the recommended flight altitude is kept.

Table 1. Parameters of distance belts for aerial surveys – the band boundaries (distances from transect lines) and angles from horizon if aircraft flies at altitude of 250 feet.

Band		Band boundaries (perpendicular to transects)	Angle from horizon
A*	A1	44 – 91	60 - 40
	A2	92 – 163	40 – 25
B		164 – 432	25 – 10
C		433 – 1000	10 – 4
(D)**		(1000 – 1500)	(3– 4)

* in some survey protocols currently in use (e.g. Research and Technology Centre (FTZ), University of Kiel) the band A is split into A1 and A2 as it has been shown that the detection decreases within the band A and detection is lower in A2 than in A1.
** although usually discarded from the data analysis due to very low detection in band D, it is recommended to keep this band in the survey protocol to avoid observers attributiong these distant flocks to band C.

Recommended standards for ship surveys. Ship survey techniques described in Camphuysen et al. (2004) can be regarded as a standard for ship based offshore bird monitoring in the Baltic Sea. Preferred ship type is a stable motor vessel with forward viewing possibilities at least 5m above sea level (higher viewing platform preferred). It should be able to keep a constant speed during the surveys. The preferred ship cruising speed is 10 knots (18.52 km/h).

The observed flocks or individual birds have to be assigned to the transect belts. The recommended parameters of the distance belts are given in the Table 2. To avoid an overestimate of bird numbers in flight, a regular snapshot of flying birds over the transect and within 300m distance ahead of the ship is performed.

Table 2. Parameters of distance belts for ship surveys – the band boundaries (distances from transect lines).

Band	Band boundaries (perpendicular to transects)
A	0 – 50
B	50 – 100
C	100 – 200
D	200 – 300

E	> 300

Territorial coverage of monitoring programmes

The HELCOM agreement covers the whole territory of the Baltic Sea. The "marine waters under the sovereignty and jurisdiction of Member States of the European Union" are in scope of the MSFD and thus its reporting obligations cover both its territorial and EEZ waters. Thus it is recommended that the territorial scope of the national marine bird monitoring programmes for the Baltic Sea are not limited to territorial waters and cover EEZ waters too, especially if they include sand banks, reefs or other sites holding significant waterbird populations. The Birds Directive applies to all species of naturally occurring birds in the wild state in the European territory of the Member States. While there are no doubts regarding the territorial waters, the directive does not explicitly state whether EEZ waters need to be included for reporting.

Timing and regularity (temporal sampling)

Coordinating efforts. All countries, except RU, have reported that they are aiming for large scale surveys of wintering populations at least once in 6 years in their monitoring programmes. Many countries even have reported such surveys every 3rd or 2nd year. For Baltic Sea wide population estimations and assessments, an effort should be taken that the surveys at least once during the MSFD reporting cycle (6 years) are coordinated. The national institutions responsible for marine bird monitoring are invited to harmonize financing plans of the national monitoring programmes to allow carrying out large scale surveys during the same winter. The winter 2015/2016 is recommended for carrying out the first coordinated Baltic Sea wide marine bird counts for monitoring. If the weather does not allow performing Baltic wide survey in the suggested winter, it should be carried out in the next suitable winter.

Synchronisation of large scale surveying of moulting populations is also recommended. However, before establishing coordinated monitoring of moulting populations, baseline surveys and designation of important moulting sites is needed in the majority of the Baltic Sea countries.

Time of the year. Populations of wintering birds have to be monitored during the winter months (mid December – end of February). If the weather allows, the January is preferred. There is a need to coordinate timing of the counts within the winter when coordinated surveys take place to avoid double-counting or undercounting birds due to freezing of suitable areas in the northern part of the Baltic seas and cold-weather movements of birds.

Although it would be preferable if all countries could carry out the surveys in an agreed short period of time, the weather constraints and availability of suitable planes might make it impossible.

For monitoring moulting populations, July and August are preferred.

Time of the day. The light time of day has to be used for counting. The optimal time for counts is from 10:00 till 14:00 when the sun is highest and its reflections on water do not reduce detectability of birds. However, deviations from the optimal time period might be needed to allow for two count sessions per day, especially in spring and summer seasons when the days are long and the sun is high.

Weather conditions. Surveys can be performed only in weather conditions that are suitable for bird counts. The most important is the sea state – during aerial surveys it should not exceed 3 according to Beaufort scale or 5 during ship-based surveys respectively. It is important that there is no fog or any other precipitation during the surveys as they influence detectability of birds negatively. Good light conditions are important, however, it is not mandatory to have a sunny weather. Often slightly overcast weather is even better as there are no sun reflections that reduce detectability of birds.

Sampling design (statistical sampling

There is an existing network of survey sites for the ground based surveys used for the annual International Waterbird Census programme (Wetlands International, 2010). It is recommended to use this network for counts of coastal birds in the national monitoring programmes. However, to avoid incomplete data from the sites that have been counted only partly in some of the years, the survey sites should be organised so that

they consist of smaller “counting units” that are always counted completely if the particular unit has been counted at all in the particular year. The reporting has to be done on the level of counting units.

The sampling design in the offshore areas or inshore areas that are not fully accessible from coast largely depends on the choice of the counting platform. Typically to survey these areas, the survey design comprises a series of parallel lines, either randomly spaced or systematically spaced with a random start. Featureless open water is naturally characterised by a range of physical and environmental factors that are likely to influence the abundance and distribution of the birds, but about which little can be inferred from the surface without taking measurements. The systematic spacing of lines is more practical with a constant and relatively short turning and transit between the ends of successive lines.

The disadvantage of the parallel design is that the ship or aircraft must travel from one line to the next without counting of birds. If counting is carried out on these connecting lines, the random design is compromised, as there is greater effort along the boundaries of the survey region where densities of most species are atypical. Thus design based estimation of abundance is biased. If searching is not carried out on these connecting lines, resources are not used efficiently, especially in the case of shipboard surveys, for which ship time is expensive. This is not an issue for the plane based counts, as the short time intervals spent on the connecting lines give the counting crew a break and allow them to get prepared for the next transect line. Such a design is problematic for ship based surveys where the counting crew does not need breaks as the observers work in shifts. Ships often are either not able to move straight from the transect end point to the beginning of the next transect due to curved coastline or, to avoid this, there is a need to reduce the survey area. Additionally, the loss of search effort decreases the cost efficiency. As a consequence, in ship surveys continuous zigzag designs are preferred, because no time is spent moving from one line to the next.

Thus for the plane based surveys, systematically spaced parallel lines with a random start are preferred. For ship based surveys, an adjusted angle zigzag design is preferred.

Orientation of sampling lines. The most statistically efficient study design is a set of line transects running perpendicular to the major environmental gradient. In the Baltic Sea for most marine bird species the dominant environmental gradient runs perpendicular to the shore (i.e. increasing depth out to sea). For this reason, planning transects to run to and from the coastline out into deeper water might beneficial. However, visibility may be another concern. If the sun is positioned on either side of the aircraft it may considerably decrease the detectability of birds on that side of the aircraft. As bird counting during the winter season usually takes place in the middle of the day when the sun is highest (from ca 10:00 to 14:00 local time), it may be beneficial to position the transect lines in the north-south direction to have sun in front or back of the plane and thus reducing the glare. Often it is not possible to take into account both considerations (environmental gradient and position of sun in the middle of the day) simultaneously. Thus the final decision on orientation of the transect lines have to be taken considering additional practical aspects and either decision is possible. If the sampling design comprises a series of transects where the whole transect line is treated as single sampling unit, the lines should be placed against the main gradient, if the transect lines are divided further into segments and thus allowing to use spatial distribution modelling for calculating the population size, the positioning of the lines against the gradient is less important and north-south orientation of the transect lines might be more beneficial to improve detection.

Distance between the sampling lines. As the counting belt C reaches up to 1km distance from the transect line, placing a transect line every 2 km would fully cover the target area (except the areas below aircraft). Intervals less than this will run a high risk of double counting of birds. While 2km interval is preferable for fine scale studies such as site surveys or EIAs, it might be too expensive for national monitoring, especially for countries with large areas of territorial and EEZ waters. Thus distance of 3 to 10 km is recommended. To avoid large sampling effort over deep waters with very low densities of marine birds, stratification and choosing different line placement interval for either of strata is recommended. Higher density of sampling lines need to be placed in the stratum more suitable for marine birds. Considerations on the minimum sampling effort per each stratum have to be taken into account to generate confident estimates of bird numbers. The maximum recommended distance between sampling lines is 10 km.

Species

All species of waterbirds observed during the counts are recorded regardless the platform. However, only a part of the species have sufficient data to carry out meaningful analyses of populations in the Baltic Sea.

Marine birds function trophically as marine organisms, mostly as important predators (Brown, 1980). In the wintertime, when they aggregate in suitable feeding habitats, their abundance depends on the ecosystem productivity. However, they also have top-down impacts on their prey species. The structure of species communities is driven by the large number of variables that influence species interactions. Depending on use of resources of different structural parts of the ecosystem species can be aggregated in functional groups.

The species assessed for the CORESET indicator "Abundance of waterbirds in the wintering season" form the list of target species for bird monitoring in the Baltic Sea.

Common Data Format for Interchange of Data

The bird monitoring data is currently stored in national or institutional databases with ad hoc data extractions for regional assessment products. Part of the data (mostly coastal and inshore sites) is stored also in the Wetlands International IWC database.

To facilitate future Baltic Sea assessments, a common data interchange format and a database need to be developed to store bird monitoring data from all Baltic Sea countries. For the database to serve the intended purpose, it was agreed that it should be able to contain the data at the highest possible resolution (i.e. as it was collected in the field). European Seabirds At Sea (ESAS) database has been developed and a number of institutes from countries around the North Sea use it to store data in a common format following recommendations of standard recording techniques. The meeting of Baltic marine bird experts in January 28 – 29 in Jurmala, Latvia agreed to take the structure of this database as an initial template for the marine bird database of the Baltic Sea. The database is suitable to store data from both plane and ship surveys.

Since its development in early 1980s the ESAS database has undergone several incremental changes to adjust for advancements in the fieldwork protocols and data analysis methods. Currently several institutions carrying out surveys of seabirds at sea have made modifications and extensions to the ESAS database to facilitate storing of important additional information which cannot be recorded in the current ESAS data format. These modified database versions are still backwards compatible with the ESAS standard.

While acknowledging differences in the national and institutional data standards, it is important to ensure compatibility of them with the data interchange standard agreed by the experts of the Baltic Sea countries. While it is recommended to develop and agree on a special Baltic data interchange standard taking advantage of the best examples of the data standards, it is recommended to currently use the ESAS data standard for the data interchange needs.

It is recommended also to develop a web-based interface to facilitate the data entry or uploading in the database. However, before it has been developed, any spreadsheet (e.g. xls or ods), database (e.g. dbf) or text (e.g. csv or tab) format that can be read in general office spreadsheet software such as Microsoft Excel can be used for data submission.

Written by: Ainars Aunins, LFN, LV

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