Supporting information for spatial representation of migration routes of Bewick's Swan (*Cygnus columbianus bewickii).*

Introduction:

Observations of Bewick's Swan were collected from the Baltic Sea area for the HELCOM Migratory Sea Birds Workshop (MIGRATORY BIRD WS 1-2018).

HELCOM Recommendation 34E/1 "Safeguarding important bird habitats and migration routes in the Baltic Sea from negative effects of wind and wave energy production at sea" covers both planning and ecology/conservation aspects. It was identified by the State and Conservation Working Group that one of the first steps in the process to implement the Recommendation is to spatially identify migration routes and sensitivity of a given area with regards to migration.

A workshop on migration routes of birds over the Baltic Sea was convened on 20-22 November 2018 at the premises of HELCOM Secretariat, in cooperation with the ICES/OSPAR/HELCOM Joint Working Group on Seabirds (JWG BIRD). The workshop was organized in order to support the implementation of HELCOM Recommendation 34E/1 by producing maps with migration routes of waterbird species covering the entire Baltic Sea Region. The workshop brought together data from:

   i)   coastal migration counts,
   ii)   waterbird counts at staging/stopover sites,
   iii)   tracking data (satellite telemetry, GPS data loggers)
   iv)   radar observations.

The workshop agreed to produce a written accounts, e.g. relevant information to be included with the maps as part of the metadata information, and seasonal migration maps for selected example species for which reliable information is available and to include the confidence of the expert judgement or data to these maps.

Please note that in their current form the maps are not ready to be used for planning, but that they represent examples of what can be produced with significantly higher quality, given more time and resources. The maps produced in the workshop represent the initial steps in the process to map migration and represent the available information and the most common routes for the respective birds, but they do not mean that there are no birds migrating outside of the delineated areas. Due to lack of time, no buffers, sensitivity scores nor weighting has been added to the layers.

Migration season represented

Pre-breeding (spring) migration and post-breeding (autumn) migration.

Ecology and behavior of species

The breeding area of Bewick's Swans comprises the N Siberian tundra. Migration to and from the winter quarters (N Germany to Great Britain) takes place at daytime and nocturnally. Migration seasons are from February to May and from October to November. The flyway population of W Siberian birds migrating to NW Europe is estimated at 21,000 birds (Wetlands International 2019). Though some birds are migrating across N Germany and Poland, most birds cross the Baltic Sea at some stage of their journey. A study using GPS data loggers has shown that the great majority of sea crossings (93% out of 201 flights recorded) occurs at heights below 150 m (Griffin et al. 2016). The flight behaviour at offshore wind farms has not been observed extensively and is thus poorly known.

Conservation status

As a migrating bird, Bewick's Swan is protected under EU Birds Directive, the Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS). IUCN (2015) is listing the Eurasian subspecies *Cygnus columbianus bewickii* as endangered (EN).

Data type and sources

Satellite telemetry (GPS data loggers):

1. Griffin, L.R., E.C. Rees & B. Hughes (2016): Satellite-tracking of Bewick's Swan migration in relation to offshore and onshore wind farm sites: final report. The Wildfowl & Wetlands Trust, Slimbridge.

Method used and rational

Tracks of individual Bewick's Swans equipped with GPS data loggers were generalized and geo-referenced.

Level of confidence in presented results

For communicating the degree of certainty in key findings, confidence in the validity of a finding is presented, and is expressed qualitatively.

Each contributing scientist has rated their confidence in the evidence presented. An overall confidence rating of high, medium or low is derived by qualitatively assessing both the amount and consistency of the available information (e.g. the type, amount, quality, and consistency of evidence (e.g., mechanistic understanding, theory, data, models, expert judgement) and the degree of agreement, or conflicting evidence or differing opinions). Where both are high there is high confidence about what is happening. But if either are insufficient there is a high degree of uncertainty and an overall confidence rating of low (figure 1).
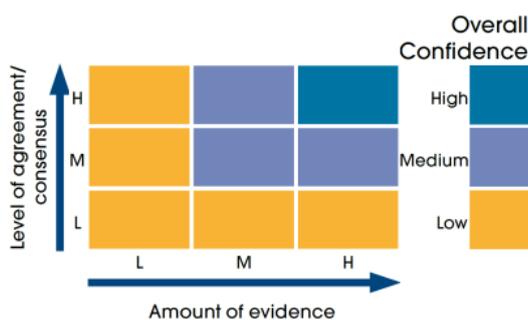

Figure 1.

Confidence in the presented information:

High.

Justification for confidence level:

Experts agreed in high quality information concerning the main migration route (H). The amount of evidence is high (H), because it is thought that the birds tracked represent all migration routes occurring in the Baltic Sea region.

Knowledge gaps and resource priorities

References

Griffin, L.R., E.C. Rees & B. Hughes (2016): Satellite-tracking of Bewick's Swan migration in relation to offshore and onshore wind farm sites: final report. The Wildfowl & Wetlands Trust, Slimbridge.

Wetlands International (2019): Waterbird Population Estimates. Retrieved from wpe.wetlands.org on Monday 25 Feb 2019.

Spatial data product (map) metadata:

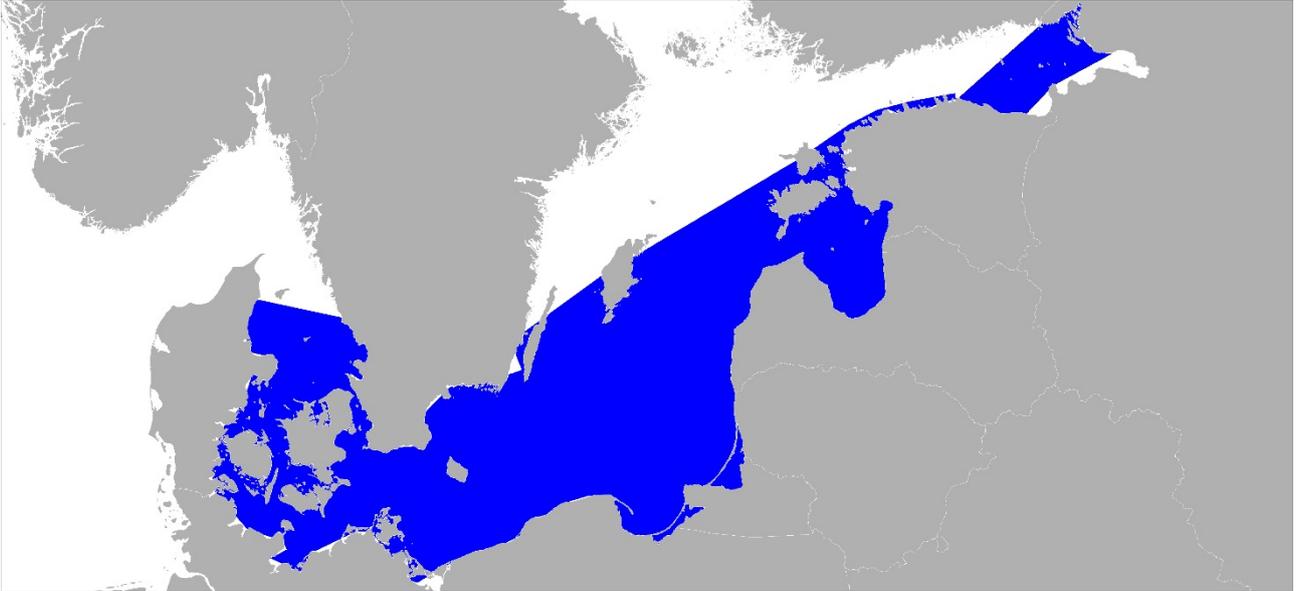| Categories	Filled in by Secretariat
Keywords	Filled in by Secretariat e.g. *marine birds *migration

	*environment
Language	English
Resource identifier (System generated ID)	Filled in by Secretariat
Legal constraints	Data product can be used, given that the source (HELCOM) and underlying data used for creating the data product (the references listed in lineage section) must be referred as original sources.
Resource Constraints	Map based on aggregated data from published report.
Contact for the resource	HELCOM Secretariat

Technical Information

Representation type	Vector/raster
Coordinate reference system	ETRS89LAEA
Format	ESRI Shapefile / TIFF
Lineage (This is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist))	This dataset displays spatial representation of the migration routes of **Bewick's Swan** according to the HELCOM migratory sea birds workshop (MIGRATORY BIRD WS 1-2018) based on the following data sources: 1. Georeferenced tracks from GPS tracking. Source: Griffin LR, Rees EC & Hughes B 2016: Satellite-tracking of Bewick's Swan migration in relation to offshore and onshore wind farm sites: final report. The Wildfowl and Wetlands Trust, Slimbridge.
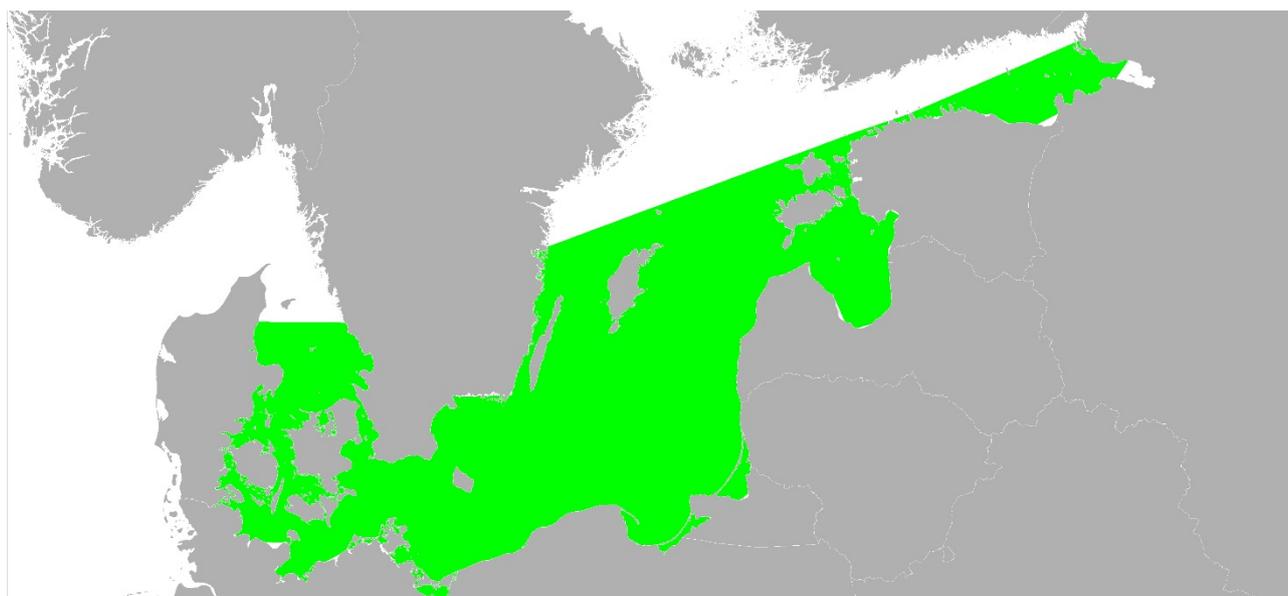
Bewick's Swan spring

Bewick's Swan autumn