Supporting information for spatial representation of migration routes of White-fronted Goose (*Anser albifrons)*

Introduction:

Observations of White-fronted Goose 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 White-fronted Geese migrating through the Baltic Sea Region comprises the N Siberian tundra. Migration to and from the winter quarters (N Germany to S Britain and NW France) takes place at daytime and at night. Migration seasons are from March to April and from September to November. The flyway population "NW Siberia & NE Europe/NW Europe" is estimated at 1,000,000 to 1,200,000 birds (Wetlands International 2019), only a small (but unknown) proportion of it crosses the Baltic Sea in spring and autumn (the majority of birds migrates over land south of the Baltic Sea, e.g. van Wijk et al. 2012).The flight behaviour at offshore wind farms has not been observed extensively and is thus poorly known. It is known from Pink-footed Geese that they strongly avoid close proximity to turbines by circumvent them horizontally or vertically (Plonczkier & Simms 2012).

Conservation status

As a migrating species, White-fronted Goose is protected under EU Birds Directive and under the Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS). IUCN (2016) is listing the species as being of least concern (LC).

Data type and sources

Satellite telemetry:

1. Tracks presented at www.blessgans.org (visited 5 November 2018).
2. Kruckenberg, H., G. Müskens & B.S. Ebbinge (2007): Satellitentelemetrie von Blässgänsen *Anser albifrons albifrons* auf dem Frühjahrszug 2006 und 2007. Vogelwarte 45: 330-331.

Method used and rational

Tracks of individual White-fronted Geese equipped with satellite transmitters 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).

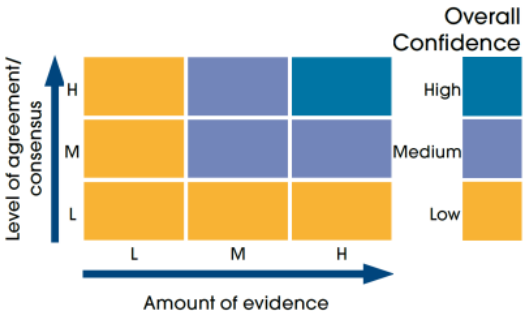


Figure 1.

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 the maps are based on many tracked birds and the tracks are thought to represent the routes taken by population.

Knowledge gaps and resource priorities

It is currently not known which proportion of the flyway population is crossing stretches of the Baltic Sea during migration, compared to migration across land.

References

Plonczkier, P. & I.C. Simms (2012): Radar monitoring of migrating pink-footed geese: behavioural responses to offshore windfarm development. Journal of Applied Ecology 49: 1187-1194.

van Wijk, R.E., A. Kölzsch, H. Kruckenberg, B.S. Ebbinge, G.J.D.M. Müskens & B.A. Nolet (2012): Individually tracked geese follow peaks of temperature acceleration during spring migration. Oikos 121: 655-664.

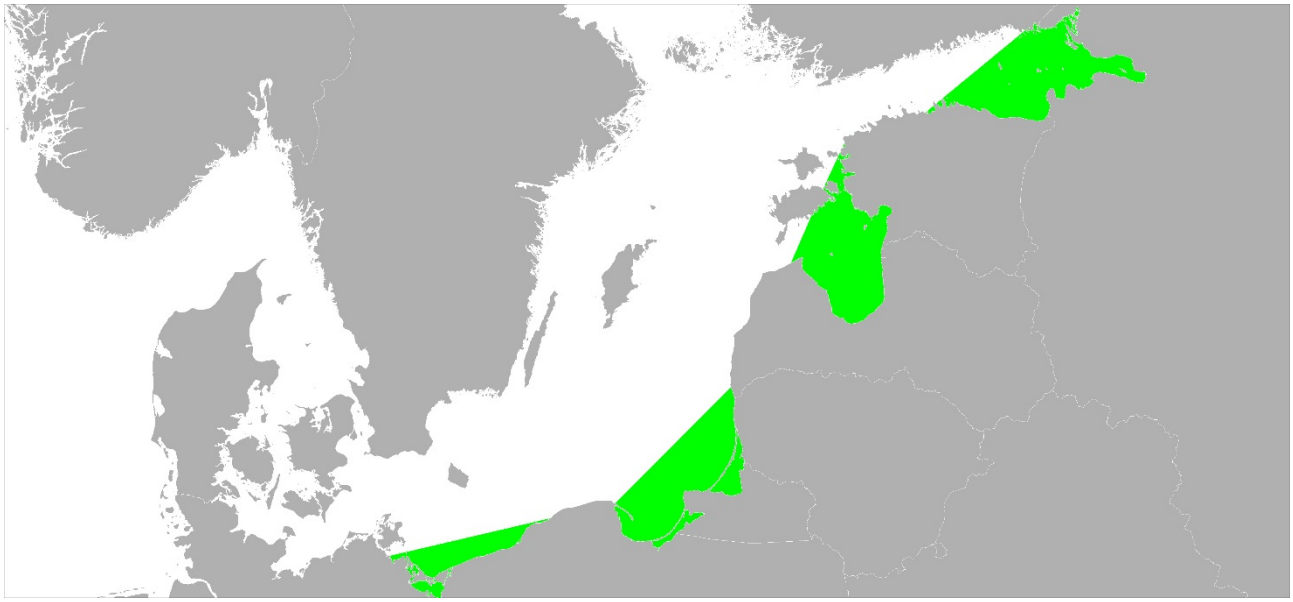
Wetlands International (2019): Waterbird Population Estimates. Retrieved from wpe.wetlands.org on Monday 25 Feb 2019.

Spatial data product (map) metadata:

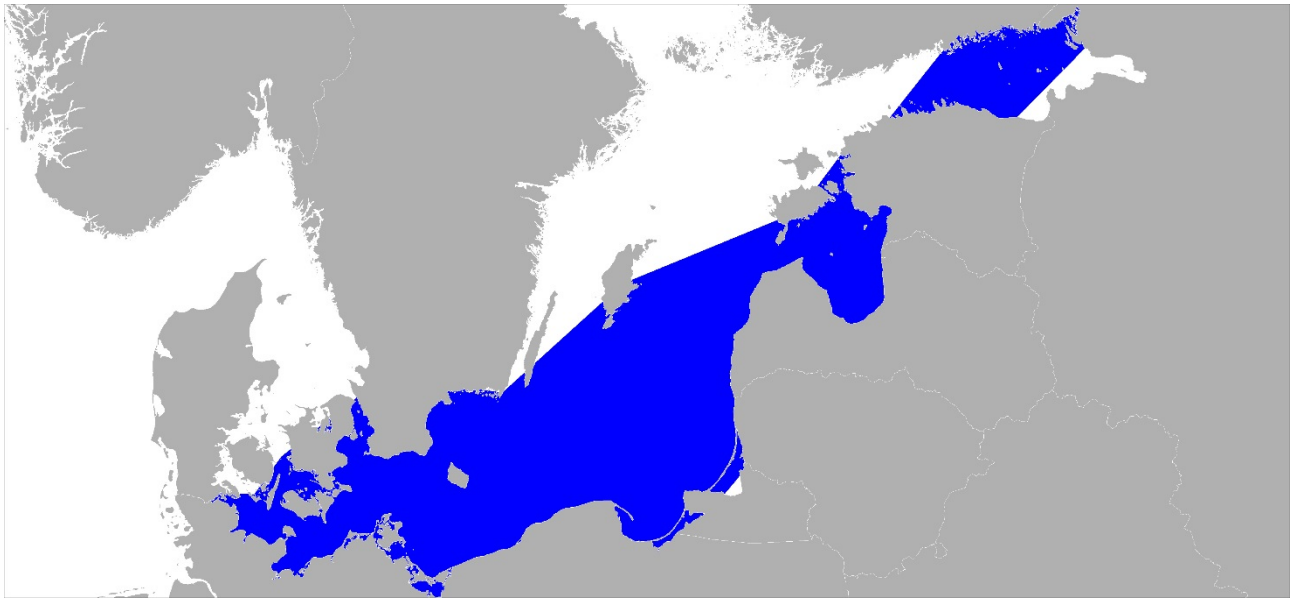
Categories	Filled in by Secretariat
Keywords	Filled in by Secretariat e.g. *marine birds *migration *environment
Language	English
Resource identifier (System generated ID)	Filled in by Secretariat
Legal constraints	Data product can be used, given that the source (HELCOM) and underlying data used for creating the data product (the references listed in lineage section) must be referred as original sources.
Resource Constraints	Map based on aggregated data from data presented in the internet and on scientific publication.
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 **White-fronted Goose** according to the HELCOM migratory sea birds workshop (MIGRATORY BIRD WS 1-2018) based on the following data sources: 1. Tracks presented at www.blessgans.org (visited 5 November 2018). 2. Kruckenberg, H., G. Müskens & B.S. Ebbinge (2007): Satellitentelemetrie von Blässgänsen *Anser albifrons albifrons* auf dem Frühjahrszug 2006 und 2007. Vogelwarte 45: 330-331.Russian Barnacle Geese *Branta leucopsis* tracked by resightings and geolocation. Ardea 94: 667-678.



White-fronted Goose spring



White-fronted Goose autumn

P*lease note that the maps presented here are example maps and not yet ready to be used in spatial planning*