Supporting information for spatial representation of migration routes of Caspian Tern *Hydroprogne caspia*

Introduction:

Observations of Caspian Tern 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

E.g.   species-specific behavior e.g. flying altitudes of the species, temporal aspects (seasonality, monthly and time of day), the numbers of birds using the routes, information on staging areas, behavior when facing barriers or obstacles (e.g. windfarms), as well as more specific information on density and timing of migration, as well as behavior under varying weather conditions etc.

In the Baltic Sea Region, Caspian Terns are breeding mainly in Sweden, Finland and Estonia, while very few pairs do so in Denmark and Germany. The wintering area ranges from W Africa to E Africa in the Sahel Zone and at the Arabian Peninsula along the Red Sea coast. Spring migration takes place in April and May, post-breeding migration is from July to September. Caspian Terns migrate both at night and at daytime and mostly take off just after midnight. Migration is often done solitarily or with their offspring. Caspian Terns migrate over land as well as over open water and sometimes follow coastlines, but they don't hesitate to cross open water to take the shortest route. Observations of the flight behaviour at offshore wind farms are lacking.

Other species of terns do not strictly avoid wind farms, but some circumventing does occur (Gill et al. 2008, Hill et al. 2014, Leopold et al. 2011, Perrow et al. 2015, Petersen et al. 2006). On migration, the altitude while passing over open water areas varies from 90 to 600 meters, which brings the species to some collision risk in wind farms.

Conservation status

Caspian Tern is a specially protected species under EU Birds Directive (Annex I) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS). IUCN (2018) is listing the species as being of least concern (LC). The HELCOM Red List status for breeding birds in the Baltic Sea is vulnerable (VU).

Data type and sources

Satellite telemetry:

1. unpublished data: BirdLife Swedens project for conservation of Caspians Terns
2. unpublished data: BirdLife Swedens project for conservation of threatened costal birds
3. unpublished data: Centre for Animal movements, Professor Susanne Åkesson, Lund University
4. Lötberg, Isaksson, Åkesson. BirdLife Sverige samarbetar för att öka kunskapen om våra kustfåglar. Skräntärnan Astrids öden och äventyr under 2017. Vår Fågelvärld no 1 2018. page 43–43.
5. Shiomi, K., Lötberg, U., and Åkesson, S. 2015. Seasonal distributions of Caspian Terns *Hydroprogne caspia* from Swedish populations, revealed by recoveries and resightings of ringed birds. Ring. & Migr. 30, 22-36.

Method used and rational

Tracks of individual Caspian Terns equipped with GPS-loggers which communicate either through base stations or through GSM network 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 X).
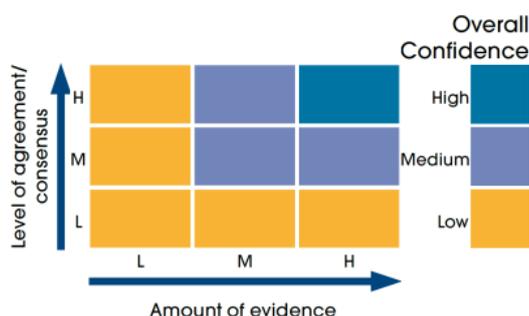

Figure X.

Confidence in the presented information:

Medium.

Justification for confidence level:

Whenever possible please provide traceable accounts describing your evaluations of evidence and agreement (e.g. references).

Experts agreed in high quality information concerning the main migration route (H). The amount of evidence is medium (M), because migration routes of birds breeding in Finland and Estonia are not considered.

Knowledge gaps and resource priorities

The tracking data that is the base fundament in this analysis only from birds in the Swedish population. Satellite telemetry should be applied to other parts of the Baltic breeding population, notably in Finland. By including more of the birds in the Finnish population in a study there will most likely be more birds taking a more eastern route than there is with only the Swedish population.

References

Gill, J. P., D. Sales, S. Pinder, R. Salazar, J. Ford & I. Harding (2008): Kentish Flats Wind Farm fifth ornithological monitoring report. Report to Kentish Flats Ltd. Environmentally Sustainable Systems, Edinburgh.

Hill, R., K. Hill, R. Aumüller, K. Boos & S. Freienstein (2014): „Testfeldforschung zum Vogelzug am Offshore-Pilotpark alpha ventus" und „Auswertung der kontinuierlich auf FINO1 erhobenen Daten zum Vogelzug der Jahre 2008 bis 2012". StUKplus Final Report (FKZ 0327689A/Avitec1 and Avitec2). Avitec Research, Osterholz-Scharmbeck.

Leopold, M. F., E. M. Dijkman, L. Teal & the OWEZ-Team (2011): Local birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ) (T0 & T1, 2002-2010). Noordzeewind Rapport OWEZ R 221 T1 20111220. Imares, Wageningen.

Perrow, M.R., A.J.P. Harwood, R. Berridge & E.R. Skeate (2015): Avoidance of an offshore wind farm by a breeding seabird has implications for the offshore renewables industry. In: Köppel, J. & E. Schuster (eds.): Book of Abstracts: Conference on Wind energy and Wildlife impacts: 52. Berlin Institute of Technology, Berlin.

Petersen, I. K., T. K. Christensen, J. Kahlert, M. Desholm & A. D. Fox (2006): Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. National environmental Research Institute, Kalø.
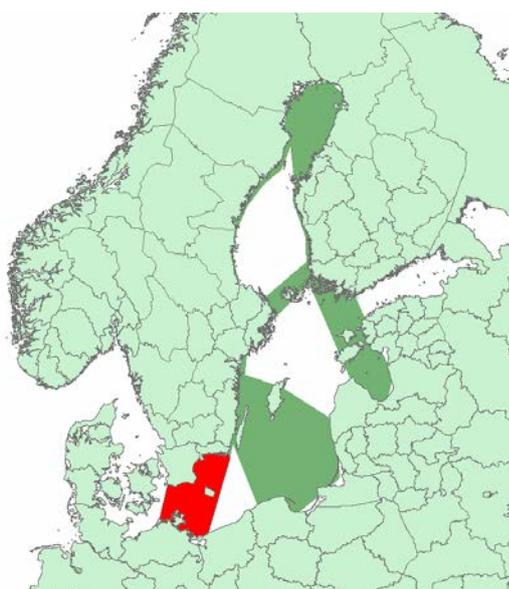
Spatial data product (map) metadata:

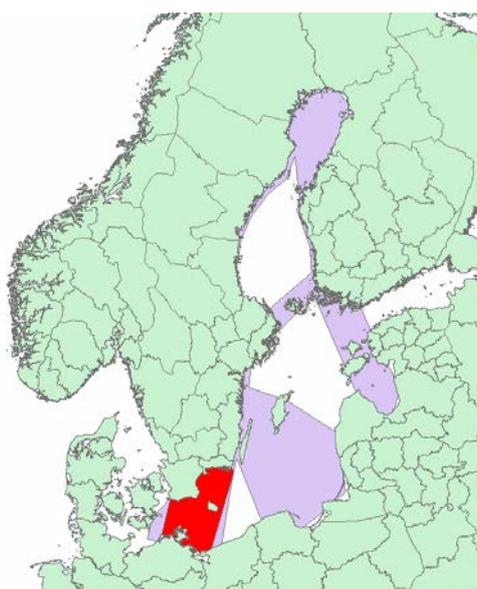| Categories	Filled in by Secretariat
Keywords	Filled in by Secretariat e.g. *marine birds *migration *environment
Language	English
Resource identifier (System generated ID)	Filled in by Secretariat
Legal constraints	Data product can be used, given that the source (HELCOM) and underlying data used for creating the data product (the references listed in lineage section) must be referred as original sources.
Resource Constraints	Map based on aggregated data from various sources.
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))	Origin of the dataset, e.g. This dataset displays spatial representation of the migration routes of **Caspian Tern** according to the HELCOM migratory sea birds workshop (MIGRATORY BIRD WS 1-2018) based on the following data sources: Satellite telemetry: 1. unpublished data: BirdLife Swedens project for conservation of Caspians Terns 2. unpublished data: BirdLife Swedens project for conservation of threatened costal birds 3. unpublished data: Centre for Animal movements, Professor Susanne Åkesson, Lund University 4. Lötberg, Isaksson, Åkesson. BirdLife Sverige samarbetar för att öka kunskapen om våra kustfåglar. Skräntärnan Astrids öden och äventyr under 2017. Vår Fågelvärld no 1 2018. page 43–43. 5.Shiomi, K., Lötberg, U., and Åkesson, S. 2015. Seasonal distributions of Caspian Terns *Hydroprogne caspia* from Swedish populations, revealed by recoveries and resightings of ringed birds. Ring. & Migr. 30, 22-36.

Caspian tern spring

Caspian Tern autumn