Final Report

FEHMARNBELT FIXED LINK
BIRD SERVICES (FEBI)

Bird Investigations in Fehmarnbelt - Baseline

Baseline Investigations and Evaluations

E3TR0011 Volume I

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Please cite as:
FEBI (2013). Fehmarnbelt Fixed Link EIA.
Bird Investigations in Fehmarnbelt – Baseline.
Volume I. Baseline Investigations and Evaluations.
Report No. E3TR0011

Report: 90 pages

May 2013

ISBN 978-87-92416-50-6

Maps:
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Geodatastyrelsen (formerly Kort- og Matrikelstyrelsen), Kort10 and 25 Matrikelkort
GEUS (De Nationale Geologiske Undersøgelser for Danmark og Grønland)
HELCOM (Helsinki Commission – Baltic Marine Environment Protection Commission)
Landesamt für Vermessung und Geoinformation Schleswig-Holstein (formerly Landesvermessungsamt Schleswig-Holstein) GeoBasis-DE/LVermGeo SH

Photos:
Paul Vinke (Cover page)

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

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Note to the reader:
In this report the time for start of construction is artificially set to 1 October 2014 for the tunnel and 1 January 2015 for the bridge alternative. In the Danish EIA (VVM) and the German EIA (UVS/LBP) absolute year references are not used. Instead the time references are relative to start of construction works. In the VVM the same time reference is used for tunnel and bridge, i.e. year 0 corresponds to 2014/start of tunnel construction; year 1 corresponds to 2015/start of bridge construction etc. In the UVS/LBP individual time references are used for tunnel and bridge, i.e. for tunnel construction year 1 is equivalent to 2014 (construction starts 1 October in year 1) and for bridge construction year 1 is equivalent to 2015 (construction starts 1st January).

1 SUMMARY

In order to describe the seasonal abundance of birds in the Fehmarnbelt, their distribution within the area and to analyse the relationships of their abundance to available habitats and existing pressures, FEBI has developed a baseline programme using different methods from visual surveys over radar studies to individual tracking. The survey programme has been described in the scoping report (Femern A/S and LBV 2010). This report presents the data of the baseline studies for the marine and coastal habitats conducted from October 2008 to November 2010.

Preceding the impact assessment, a baseline pressure analysis has been undertaken attempting to outline existing major human activities in the Fehmarnbelt that could lead to pressures on birds in the Fehmarnbelt and which may interact with pressures likely to appear as a result of a fixed link. The two offshore wind farms Nysted I and Rødsand II both affect migratory and staging birds in the Fehmarnbelt area (barrier effects and habitat displacement). Intensive shipping in the Fehmarnbelt is likely to affect waterbird distribution in some areas. Intensive fishing with gillnets and trawls takes place in the Fehmarnbelt causing local disturbance and mortality to waterbirds due to drowning. Another important source of anthropogenic mortality on waterbirds is hunting. Pollution with contaminants including toxic substances is apparent in the Fehmarnbelt originating from a range of different sources through the past decades. This release of pollutants bound in sediment constitutes a decreasing but still measurable source. Oil pollution is a recurrent problem with small-scale spills playing a major role. While stricter regulations and improved navigation technology seek to minimise accidents, increasing shipping intensity may still increase the risk of spills. Eutrophication persists as a key pressure to the ecosystem in Fehmarnbelt, though loads of nitrogen and phosphorus have been decreasing over the last 15 years. Contrary to the situation for herbivorous species of birds, widespread declines in eutrophication loads may result in decrease of benthic productivity, which might subsequently change food availability for benthic carnivorous waterbird species.

While the importance of Fehmarnbelt to waterbirds is primarily related to the non-breeding season, the region also offers a variety of habitats on Lolland, Fehmarn and along the mainland coast of Germany, which are suitable as breeding areas for different waterbird species. The coastal area has been transformed by coastal protection and land reclamation. Today, many coastal stretches serve important functions, e.g. as recreational areas restricting their suitability as breeding areas due to human disturbance. On the other hand, large Special Protection Areas (SPAs) have been established which partly provide undisturbed areas and protect the breeding of important colonial breeding waterbirds. Breeding bird data from four NATURA 2000 areas situated close to the planned fixed link (Eastern Kiel Bight, Baltic Sea east of Wagrien, Hyllekrog-Rødsand, Maribo Lakes) have been examined. The data were provided from NATURA 2000 monitoring programmes in Germany and Denmark. As breeding bird monitoring is not conducted every year, the most recent data from different years have been used: Hyllekrog-Rødsand from 2009, the two German SPAs from 2008 and Maribo Lakes from 2005. In total, 87 species of breeding birds were recorded within the four investigated SPAs with a total estimate of 16,608 breeding pairs. Nineteen of these species are listed in the Annex I of the EC Birds Directive.

The Fehmarnbelt area is of very high importance for staging waterbirds during the winter months, and the offshore shallows east and west of Fehmarn and Albue Bank as well as Rødsand Lagoon are classified as being of international importance to waterbirds. This status is reflected in the protected area networks in both Germany and Denmark, which together cover 30% of the marine area in the Fehmarnbelt. In total 19 species occur in more than 1% of their biogeographical population in the study area. Common Eider *Somateria mollissima* wintering in the Fehmarnbelt comprised up to 43% of the Baltic-Wadden Sea population. This is the highest proportion for any species occurring in the area and highlights the importance of Fehmarnbelt to this species. Common Eider will consequently have special focus in the coming impact assessment. Of the other seaducks, 3.4% of the NW European winter population of Common Scoter were estimated for the study area. Supplementary data showed Greater Scaup occurring in internationally important numbers in the coastal areas of the SPA Eastern Kiel Bight (up to 3.7% of the biogeographic population). In the SPA Rødsand-Hyllekrog three species were found to occur in internationally important numbers. According to supplementary data the Great Cormorant reached up to 6,500 individuals in this SPA with highest numbers in autumn. During summer, the number of Mute Swans increases for moult in this SPA with aggregations of up to 6.5% of the NW-European winter population. Internationally important numbers of Whooper Swan were reported for the inland areas of this SPA. The Tufted Duck has not been recorded in substantial numbers by the FEBI day-time surveys as the species mainly roosts inland during the day, but supplementary data indicate that the area is of international importance to the species. FEBI surveys show that numbers of Red-necked Grebes and Smew exceed the level of international importance. Numbers of wintering Red-breasted Mergansers were also very close to 1% of the biogeographic population. During migration, Little Gulls reach high numbers in the SPA Eastern Kiel Bight which exceed the 1% level of international importance. However, Little Gulls only use the Fehmarnbelt for a relatively short period of time. This has been confirmed by supplementary data. The Little Gull is the only species listed in Annex I of the EC Bird Directive occurring in numbers of international importance in the Fehmarnbelt area. Additionally, internationally important numbers are reported to occur mainly in inland parts of the SPA Eastern Kiel Bight for the Greylag Goose, Barnacle Goose, Gadwall and Shoveler.

The FEBI baseline investigations of bird migration have highlighted importance of Fehmarnbelt to migrating waterbirds. During spring, large numbers of especially seaducks were observed at the Lolland coast, whereas during autumn migration intensities at both coasts were medium to high. Fehmarnbelt represents a very important migration route used by high proportions of the biogeographic populations of species like Common Eider and Common Scoter. The waterbird species which such as geese and Arctic breeding waders show less dependence on water during migration when conducting non-stop flights over distances of more than 1,000 km lasting several days. Therefore, geese and Arctic breeding waders do not concentrate in the Fehmarnbelt area to the same degree as Common Eider and Common Scoter. For some of the species, such as Barnacle and Brent Goose, Red Knot, Dunlin, Bar-tailed Godwit and Eurasian Curlew, high migration intensities were registered during the baseline years 2009 and 2010. With respect to landbird migration, large numbers of daytime migrants are seen at both coasts, yet numbers are much higher at the departing coasts at Rødbyhavn in autumn and Puttgarden in spring, respectively. Soaring species like birds of prey have been registered using updrafts over land areas, and cross the Fehmarnbelt gliding when departing land and in active flight over water. The investigations documented that these landbird species are likely to cross the Fehmarnbelt in the corridor between Rødbyhavn and Puttgarden, and both Rødbyhavn and Puttgarden serve as culmination and as transit points depending on the migration conditions. For some species of birds of prey like Red Kite and Honey Buzzard relatively large proportions of the bio-

geographic populations use the Fehmarnbelt corridor. Landbirds migrating during night-time cross over the Fehmarnbelt region in a broad front, thus only a fraction of the large populations will cross the Fehmarnbelt in close vicinity of the proposed link

One pillar in FEBI's baseline investigations has been the estimation of numbers and distribution of non-breeding waterbirds. Aerial surveys were used to map the distribution of staging and wintering waterbirds with the focus on seaducks, and to calculate their numbers. Aerial surveys were conducted by standard line transect methods sampling densities at a relatively high resolution required for the subsequent analyses and modelling of habitat utilisation. Additionally, ship-based line transect surveys focused on the alignment of the fixed link and the coastal areas were conducted to map the distribution of species which are more difficult to survey from airplane, i.e. grebes *Podicepedidae* and auks *Alcidae*. The estimation of total species abundance was carried out using Distance analyses, while local species distribution and abundance were estimated using distribution modelling, describing the spatial and temporal distribution of species while accounting for the spatial heterogeneity in observation conditions and physical and biological characteristics. Distance analysis provided estimates of total numbers of species in the entire study area, whereas the distribution models took the form of density surfaces (n/km^2) for each species and season. Generalised Additive Models (GAMs) were used to develop the specific distribution models.

Another pillar in FEBI baseline investigations are the studies carried out on the feeding ecology of waterbirds, and assessments of the carrying capacity of their habitats. The diet composition of benthivorous seaducks was evaluated by examining stomach contents of ducks collected from fishermen, sport hunters and dedicated hunting in the Fehmarnbelt area. Additionally, stable isotope composition in seaduck blood and main prey types was measured aiming to characterise bird diet composition over longer term. The diet of Great Cormorants has been studied by analysing contents of pellets that birds regurgitate while on roosting sites, and diet composition of Mute Swans, moulting in Rødsand Lagoon in July and August, was studied by analysing samples of swan droppings collected from shoreline or emerged rocks in shallow parts of the lagoon. Molluscs dominated the diet of Common Eiders during both study seasons, Blue Mussel *Mytilus edulis* being the most common prey amounting to at least 80% of diet composition of dissected birds. In terms of wet weight and energetic value of consumed prey, Blue Mussels remained the most important prey type, but crabs and gastropods also appeared as being important. Common Scoters almost exclusively fed on bivalves, mostly small clams (particularly *Cerastoderma* and *Astarte*) and Blue Mussels. Diet composition of Long-tailed Ducks was highly variable with Blue Mussels being numerically the most common prey species, and fish being the second most important prey type. Stomach examination and results of stable isotope analysis suggested that Common Eiders and Long-tailed Ducks had slightly different diet composition between the two studied winter seasons, with bivalves constituting lower proportion of the diet during the first winter of 2008/2009. Thus, the results regarding these three most abundant seaduck species wintering in the Fehmarnbelt indicated that each species has plasticity to adapt to changing foraging conditions and shift to alternative prey if needed. Qualitative analysis of the Mute Swan diet composition revealed that they rely on four species of submerged vegetation in Rødsand Lagoon during the summer moulting period. The amount of plant epidermis cells identified in swan droppings indicated *Zostera* and *Potamogeton* as the most important food items, each with equal shares of 37% in averaged samples from the two study seasons. A total of 1,015 otoliths were found in a subsample from Great Cormorants food. Thirteen fish species of 7 families were identified, which represented marine fish species only with Cod and other species of Gadidae family being the most common prey. The frequency distribution of prey species taken by

cormorants generally matched composition of fish community as reported by Dietrich et al. (2010), indicating that Great Cormorants are generalists feeders.

Foraging behaviour of Common Eider, Tufted Duck and Long-tailed Duck have been studied using VHF radio telemetry. During the two winter seasons (2008/2009 and 2009/2010) 75 individuals were equipped with external radio transmitters on both the Danish and German sides of the Fehmarnbelt. Recorded foraging activities of ducks were used to calculate bird energy budgets for different periods of the wintering season. Radio-tagged Common Eiders and Long-tailed Ducks were found foraging at deeper waters compared to Tufted Ducks: Common Eiders at an average depth of 7.4±2.7 m, Long-tailed Ducks at 6.3±3.2 m and Tufted Ducks at 3.4±2.0 m. Common Eiders and Long-tailed Ducks were almost exclusively diurnal foragers, whereas Tufted Ducks foraged either exclusively at night, when birds were resting during daytime on freshwater ponds during mild winter periods, or during both day and night, when staying in marine waters all the time during cold winter periods. Foraging intensity varied during winter period for Common Eiders and Long-tailed Ducks, indicating that birds had to spend a higher proportion of the daylight time feeding in mid-winter. Foraging intensity also differed between species: Common Eiders spent up to 60% of daylight hours diving, whereas Long-tailed Ducks were engaged with foraging activities for up to 90% of daylight hours during winter months. Energy budgets calculated based on recorded Common Eider foraging intensity, diet composition and literature data were balanced and indicate that the Fehmarnbelt area is a favourable wintering area to the species.

Satellite telemetry was used to assess (a) local movements of ducks in the Fehmarnbelt, specifically connectivity among discrete wintering sites and wintering site fidelity, and (b) identify bird breeding sites (populations of origin), migration routes and schedules of the annual cycle. Additionally, Global Positioning System (GPS) telemetry was used to track local movements of Common Eiders and assess habitat choice in Mute Swans. In addition to home range analysis, a calculation was applied to assess site fidelity of wintering Common Eiders. A modified Kaplan-Meier procedure was used to calculate the probability that individual eiders would remain site faithful during the winter period. The movements of nineteen Common Eiders equipped with satellite transmitters indicated that the birds are relatively sedentary during their winter staging period. Distances between Common Eider weekly location recordings were rather small, and each bird used only one or two discrete wintering sites. Cumulative site fidelity declined early and late during the wintering period indicating that about half of the tracked individuals stayed at the same wintering site through the entire winter. Tracking of 13 Common Eiders tagged with satellite transmitters extended over the two winters, and all these birds returned to the greater Fehmarnbelt area (as identified by the extent of FEBI surveys) the following winter. Four out of six satellite-tracked Long-tailed Ducks stayed within relatively small areas in the Fehmarnbelt during January – March, whereas two individuals moved over extensive areas. Both tagged Common Scoters used two discrete wintering sites during January – March 2010. Satellite telemetry indicated, that Tufted Ducks moving between daily roosting site and marine coastal waters prefer to use the shortest distance between those. GPS telemetry of swans in Rødsand Lagoon revealed that tagged birds moved extensively within the lagoon, but were always restricted to the *Zostera* beds in its western parts.

The third pillar in FEBI's baseline programme has been the study on bird migration. Bird migration in the Fehmarnbelt has been investigated mainly at two onshore stations, one on each side of the link and one ship-based, offshore in the Central Belt. Besides, the area south-southwest of Hyllekrog was covered by ship during autumn 2009. Visual observations were conducted during daytime and acoustic observations during night-time. In addition, surveillance radar devices were used at these stations. In horizontal mode they register flight directions and spatial

distribution and in vertical mode migration intensities at different altitude bands; an additional vertical surveillance radar was placed at Westermarkelsdorf as a reference station. A tracking radar (Superfledermaus) has been used to provide three-dimensional flight paths including species information during daytime and species type information during night-time; this tracking radar has been placed at Rødbyhavn during 2009 and at Puttgarden during 2010.

With almost 50% of the days covered by the land stations during the migration periods February to May and August to mid-November, and some days during the moulting period June / July, concentrating on days with favourable weather and migration conditions, a good temporal resolution of the spring, moult and autumn migration in the Fehmarnbelt has been achieved. The species composition as well as phenologies of migration intensity showed that the most important and the numerous species were sufficiently covered. Large waterbirds have been reliably covered visually up to distances of 3-5 km during good weather conditions, while migrating passerines were covered within a radius of a few 100 m. The coverage of other species like birds of prey, waders and pigeons depended on visibility conditions, too, with flight heights hardly covered visually beyond an altitude of 100-200 m. While visual observations were invaluable to assess the species composition and individual flight tracks at the observation locations, additional methods were used to cover times of bad visibility (fog, night) and large ranges. Acoustic recordings (onshore) and direct acoustic observations (offshore) provided additional data for the night-time. To gain data on more species not covered by visual and acoustic methods, migrating bird census during the mornings added some species which e.g. do not call during migration, fly at day or night but are hard to detect by visual observations.

During the baseline study, data on 230 bird species migrating through the Fehmarnbelt have been collected and additional data have been screened for species which could not be detected with available methods but are assumed to migrate through the area. It is not possible to describe each species in detail and the scope of the baseline has rather been to highlight important features and general aspects and go into species specific details at later stages when more details are needed for the impact assessment. During spring, high migration intensities of waterbirds (seaducks) were observed at the Lolland coast migrating in easterly directions, lower intensities at the Fehmarn coast and even lower offshore, with main migration directions towards east and low flying altitudes. During autumn migration intensities at both coasts were medium to high, however, higher at the Fehmarn coast, and again low offshore in the central Fehmarnbelt.

Overview and insight of bird migration at the Fehmarn link – also with a view on potential impacts - is best described by separating different bird species groups according to their migration behaviour. For this, four main types of migration behaviour of the associated species groups have been addressed: 1) waterbirds preferentially migrating over water (type 1 species); 2) waterbird species less dependent to migrate over water (type 2 species); 3) landbirds migrating during daytime (type 3 species) and 4) landbirds migrating broad-front during night-time (type 4 species).

Waterbirds preferentially migrating over water (type 1 species): Typical representatives for this migration strategy in the Fehmarnbelt are seaduck species (Common Eider, Common Scoter, Long-tailed Duck), divers (*Gavia spp.*), grebes, mergansers, auks and terns. Divers, Common Eider and auks have in common to be heavy species with high wingloads and imperfect flight abilities and will migrate over sea, as there they feel save. Other species like terns combine foraging and migration which would not be possible on land. While most of these species are daytime migrants, some species are known to migrate at night as well. For

example, from the baseline investigations in Fehmarnbelt it appeared that Common Scoters almost exclusively fly over water during the day, whereas their calls were frequently recorded over land during the night.

For type 1 species the Fehmarnbelt simply by way of its geographic position represents a very important migration corridor. During daylight, the waterbirds flying parallel to the coast are the most abundant migratory bird species group. For several species Fehmarnbelt represents a very important migration route used by high proportions of their biogeographic populations. Of these species, most likely auks have the highest dependency of migration over water. Divers and seaducks are mostly confined to migrate over sea; during daytime at the Fehmarnbelt these species have not been observed to migrate over land. However, both Divers and seaducks breed at inland locations and regularly cross land, e.g. Red-throated Divers and Common Scoters over Skåne, Sweden and Common Eider over Schleswig-Holstein, Germany towards the Wadden Sea. In addition Common Scoters are known to migrate over land during night-time, which has also been recorded in the Fehmarnbelt region. Therefore, crossing over land is a regular event during these species' migration. Other species, like gulls and terns, have also been registered to migrate over land during the baseline years 2009 and 2010.

Low flight altitudes are very common for the type 1 species, in particular over water, which is even more prominent during headwind situations. Flight directions of supposedly migrating individuals and flocks were as expected, but seaducks in particular, migrated close to the coast in spring at Lolland and in autumn at Fehmarn. While a leading-line effect of the coasts exists for these species, the actual distance to the coast is also influenced by the wind. The pelagic species, with overall lower numbers, did not show a leading line effect to the same extent and were more evenly distributed.

For the type 1 species, a potential barrier effect of e.g. bridge structures exists.

Of the Common Eider and Common Scoter, both during autumn and spring large proportions of the biogeographic flyway populations cross the Fehmarnbelt flying at low altitudes near-coast and coast-parallel. An unknown proportion may choose different flyways. Of the Common Scoter, large proportions migrate during dusk and dawn and at night-time, also with large numbers over land. The baseline studies confirmed both daytime and night-time migration, with methods applied (night-time acoustics and telemetry).

Waterbird species less dependent to migrate over water (type 2 species): Migrating over sea may be compromised by the need to minimise the migratory route of a species, especially if migration covers long distances. For example Arctic breeding waterbirds such as swans, geese, dabbling and diving ducks and Arctic breeding waders may conduct non-stop flights over distances of more than 1,000 km and are engaged in flights lasting several days; also, gulls belong to this group. These species will migrate over water as long as it fits to their overall migration route but are prepared for long flights over land. They will also make use of favourable wind conditions and adapt migration timing accordingly. These species may fly large distances during good migration conditions, and are thus less dependent on stop-over sites, and they also fly both day and night. However, their migration routes do show some dependency on weather. In particular wind speed and direction may shift migration routes. Therefore these birds may or may not directly overfly the Fehmarnbelt area.

For some of the species, such as Barnacle and Brent Goose, Red Knot, Dunlin, Bar-tailed Godwit and Eurasian Curlew, high migration intensities were registered during the baseline years 2009 and 2010. It has to be assumed, however, that

many of these observations were only made by chance when large flocks of birds were registered during good observation conditions or picked up by the tracking radar. Consequently, it also has to be assumed, that considerable numbers and most likely some species, in particular wader species, were not registered as they were either not spotted during their fast flight at high altitudes or did not exactly cross one of the field stations. Besides a high heterogeneity with regard to flight directions and paths, flight altitudes of type 2 species are generally higher than those of type 1 species, and results suggest, that in particular *Branta* geese and wader species will wait for favourable winds to start their migration.

In general, type 2 species do not rely particularly on the Fehmarnbelt, nor are they affected by any topography or artificial structures during their migration. However, in some cases, for instance due to strong winds or inclement weather, their migration routes cross the Fehmarnbelt and flying altitude could be within the altitude of a possible bridge structure.

Landbirds migrating during daytime (type 3 species): For landbirds migration over sea is risky as landing and shelter is not an option and the ability to compensate for wind drift is limited. Soaring species like birds of prey and e.g. Common Crane have been registered using updrafts over land areas, and cross the Fehmarnbelt gliding when departing land and in active flight over water and/or at low altitudes. Other species mainly performing active flight such as passerines, swifts and pigeons choose a migration route dependent on wind and topographic features to optimise flight time and energy expenditures. Their migration is steered by topographical features, as they follow coastlines in order to either "find and choose" crossing points or to end up at accumulation points, from which they have to cross. Typical representatives for this migration strategy in the Fehmarnbelt are birds of prey, cranes, storks, crows, jackdaws and pigeons as well as the day-migrating passerine species such as Skylark, wagtails, Meadow and Tree Pipit, finches and Siskin.

It has been proposed, that these landbird species are likely to cross the Fehmarnbelt in the near vicinity of and more or less parallel to the planned fixed link; Puttgarden at the Fehmarn side and Rødbyhavn at the Lolland side had been considered culmination points for these migrating landbirds. High recorded numbers of type 3 species during the two baseline years support this assumption. However, it has to be acknowledged that other locations at the Fehmarn NW coast or the Lolland SW coast may also serve as crossing points, e.g. Hyllekrog. Observations of coasting versus crossing flight behaviour have provided hints, that at least for smaller species departure points may well be located at the NW tip of Fehmarn during spring and at Hyllekrog or near Albuen during autumn.

Birds of prey represent an important group of birds due to their high protection status and due to the fact that considerable proportions of the respective breeding populations do cross the Baltic Sea within the Fehmarnbelt region. Apparently, birds of prey are well able to select the optimal crossing passage when facing large water bodies. The baseline results showed that birds of prey do cross the Fehmarnbelt, even during inclement weather, according to their migration phenology. Common Crane have been registered mainly in spring, at altitudes > 100 m, while during autumn, they prefer to cross the Baltic Sea further east. It can be concluded from the baseline investigations, that these soaring species are indeed using the Fehmarn link to cross the Baltic Sea. Consequently, Rødbyhavn and Puttgarden at both sides of the Fehmarnbelt function as departure and as arrival culmination points.

Pigeons, in particular Wood Pigeons have been registered crossing the Fehmarnbelt in large flocks and frequently at altitudes well above 200 m. The passerines are a rich and diverse species group and different migration strategies occur within this

group. Thus, the baseline investigations have shown that species performing active flight (most passerines, pigeons and some birds of prey) tend to follow the coastline as long as the weather conditions are not suitable for crossing, and cross mainly during favourable weather conditions. During autumn, most landbirds seem to cross from Rødbyhavn during tail wind and easterly cross winds, while the relationships to weather conditions at Puttgarden during spring are more complex. Both Rødbyhavn and Puttgarden serve as culmination and as transit points depending on the migration conditions. It is also important to note that both the baseline observations and published data suggest varying migration strategies. Short-distance migrants have a higher flexibility to migrate during favourable weather conditions as their migration timing is not as tight. Long-distance migrants, however, are "bound" to a tight migration schedule and thus may have to also cope with unfavourable weather conditions during their migration. There are no apparent threats, barrier effects or collision risks.

Landbirds migrating broad-front during night-time (type 4 species): Night-time migrating landbirds fly large distances during night, frequently at high altitudes and do not depend on short crossing distances as most of the other species. Most likely, this species group includes by far more birds than diurnal migration altogether, as millions of passerines will migrate at night-time across large regions of Europe. Their migration directions and migration intensity at any given location depend to a certain degree on the local weather conditions, in particular wind speed and wind direction. However, their migration phenology also depends on the larger regional weather situation at their departure regions. Their migration routes will cross over the Fehmarnbelt region in a broad front, thus only a fraction of the large populations will cross the Fehmarnbelt in close vicinity of the proposed link.

It is expected that during most conditions, this nocturnal migration will neither concentrate at the location of the proposed link, nor will large proportions of the actual migration occur at the proposed link at altitudes coinciding with any possible structures.

Passerines are typical representatives of this migration strategy, but some other species migrate during night-time as well. Not all species can be classified as exclusive nocturnal migrants, but may also show daytime migration due to certain migration conditions (see type 3 species). Species like thrushes (Song Thrush, Blackbird, Redwing) and Robin are well-known for their flight calls, while other species like the *Sylvia* warblers and reed warblers are mostly silent during migration, making species-specific observations impossible.

The results of the baseline investigations showed, that during mass migration nights, flight directions were as expected NE in spring and SW in autumn. Flight altitudes of nocturnal migrants as measured by the fixed pencil beam radar showed, that only during autumn 2010 at Fehmarn large proportions were recorded above 1,000 m, while during spring and autumn 2009 at Lolland and in spring 2010 at Fehmarn considerable migration intensities were also recorded at lower altitude bands. Flight altitudes as measured by the vertical surveillance radar continuously during 2010 showed that during high migration intensities the altitude distributions were skewed towards higher altitudes, whereas, during low migration intensities, birds flying at lower altitudes represent a larger proportion. It is further assumed that high migration intensities coincide with good to optimal migration conditions and birds may choose altitudes at which favourable tailwinds occur.

2 INTRODUCTION

On 3 September 2008 Denmark and Germany signed the State Treaty to establish a fixed link across the Fehmarnbelt. The State Treaty was adopted by the national Parliaments and ratified by the two countries in 2009.

The Fehmarnbelt Fixed Link is planned as a combined rail and motorway link comprising of a double-track electrified railway and a four-lane motorway. The 19 km link will run from Rødbyhavn on the Danish side of the Fehmarnbelt to Puttgarden on the island of Fehmarn on the German side, crossing the Danish – German border midway between the coastlines of the two countries.

Denmark is responsible for the planning and design as well as financing, construction and operation of the Fehmarnbelt Fixed Link. The combined rail and road project here has two project applicants: Femern A/S is the project applicant for the railway section of the link in Germany, while the Schleswig-Holstein State Agency for the Road Construction and Transport, Department of Lübeck (Landesbetrieb für Verkehr und Straßenbau des Landes Schleswig-Holstein, Lübeck Niederlassung (LBV)), is the project applicant for the motorway section of the link in Germany.

Femern A/S has commissioned the FEBI consortium to conduct the baseline studies on birds and to assess the impacts of the different possible solutions for a fixed link. In the Fehmarnbelt birdlife is dominated by non-breeding waterbirds which use the area as moulting, staging or wintering area. In addition, a variety of bird species passes through the area on migration. Although a high number of migratory birds do not touch ground in the Fehmarnbelt area, it serves a special function for a number of species which concentrate here. The coastal areas also offer suitable habitats for breeding waterbirds.

2.1 Description of the planning area

The fixed link across the Fehmarnbelt may be constructed as a bridge or a submerged tunnel leading to impacts in the marine habitats and on the land-approaches on Fehmarn and Lolland.

As a final solution and the respective alignment had not been chosen during the start of the investigations, a project area was defined between Puttgarden on Fehmarn and Rødby on Lolland (Figure 2.1). In this area, the most suitable route for a fixed link will be chosen. The Fehmarnbelt has a maximum depth of about 30 m. In the project area the width varies between 18 km (Rødbyhavn-Puttgarden) and 25 km. The seabed in the central parts is smooth with gentle slopes towards the coast of Lolland. On the Fehmarn side the slopes are slightly steeper.

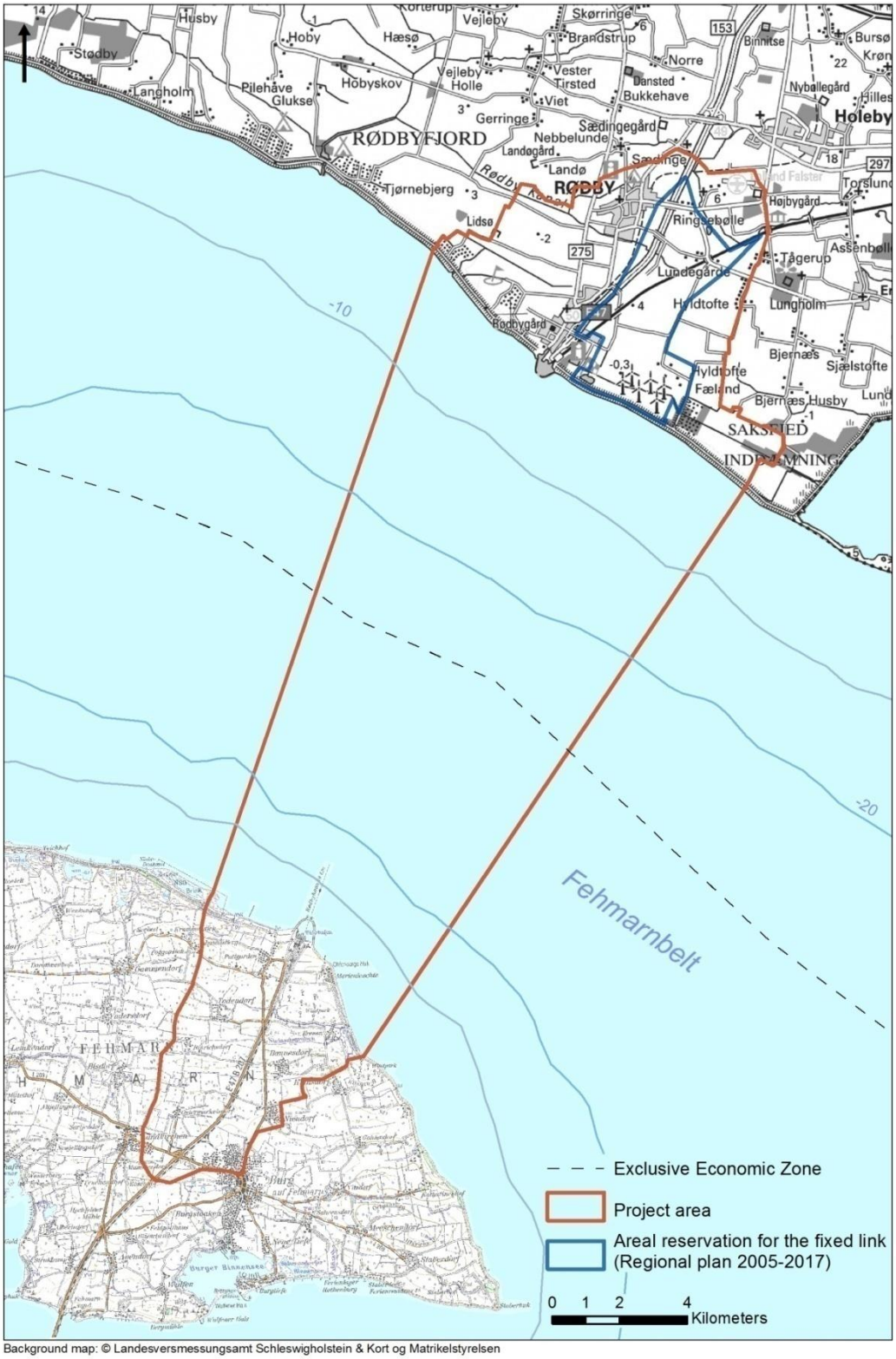

Figure 2.1 Demarcation of the project area for the planning of a fixed link. Map taken from Femern A/S and LBV (2010).

2.2 Demarcation of the study area

The area of investigation for the bird studies stretches from a line between Kiel and Langeland in the west to a line between Gedser and Dahmeshöved in the east (Figure 2.2). The demarcation of the area of investigation ensures that all Natura 2000 sites, namely the SPAs designated for the protection of birds in the Fehmarnbelt and adjacent areas are covered. The relatively wide extent to the east and west allows for the registration of possible distribution gradients and focal points of the different bird species. In addition, the area of investigation covers the maximum area potentially influenced by suspended sediments as identified in earlier investigations. The size of the area also allows for a later separation of non-affected reference areas for the monitoring programme.

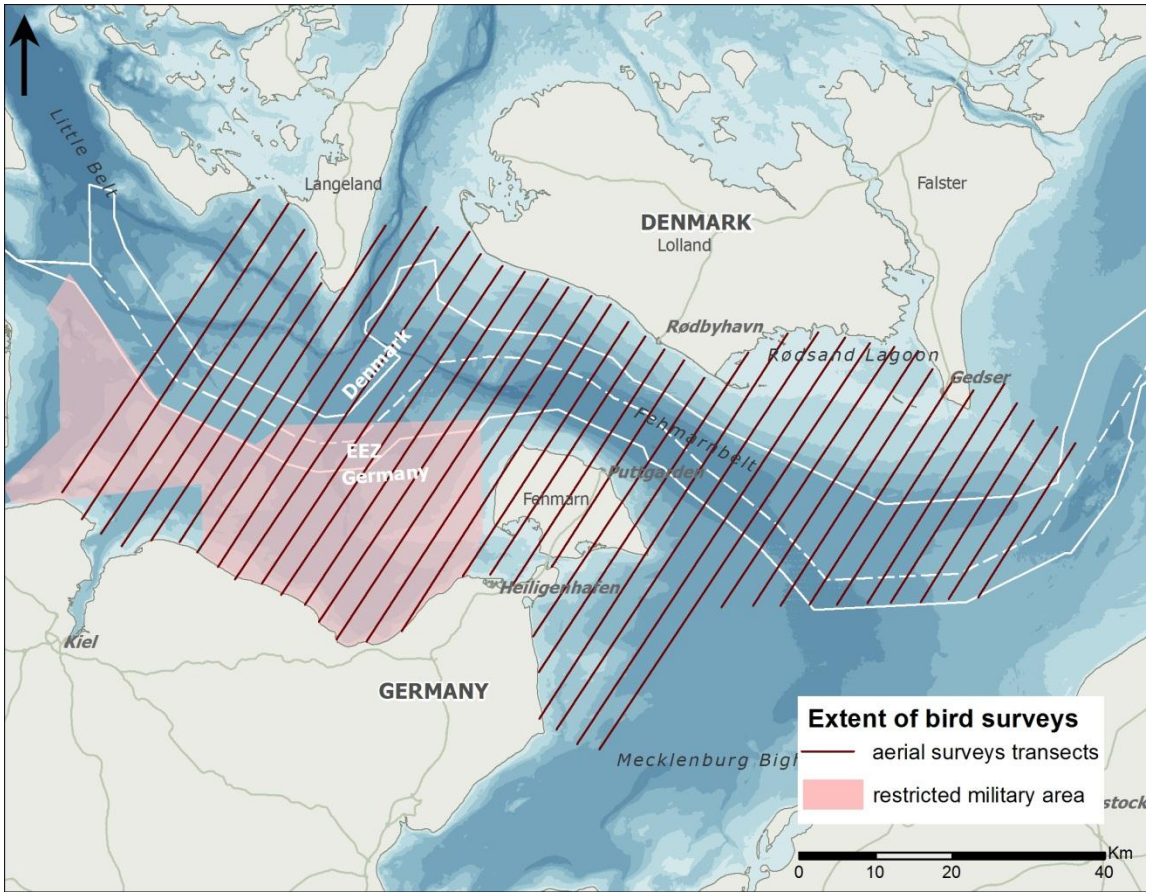

Figure 2.2 Demarcation of the project-specific area of investigation as described by the extent of the aerial surveys.

2.3 Content of the investigations and methodological approach

In order to describe the seasonal abundance of birds, their distribution within the area and in order to analyse the relationships of their abundance to available habitats and existing pressures, FEBI has developed a survey programme using different methods from visual surveys to individual tracking. The survey programme has been described in the scoping report (Femern A/S and LBV 2010).

The aim of the baseline is to provide detailed information on abundance, distribution and habitat use of birds in the project area and adjacent waters, as well as to describe the numbers and patterns of bird migration at the location of the Fehmarn link. The methods applied followed international standards and comply

with the German Standards for Environmental Impact Assessments for Offshore Wind Farms (StUK3) (Bundesamt für Seeschifffahrt und Hydrographie, BSH 2007).

The baseline investigations focused on the following items:

- Abundance, distribution and trends (from historical data) of birds in the approach and ramp areas and the surroundings on Fehmarn and Lolland, as well as of waterbirds and seabirds in the Fehmarnbelt area
- Feeding grounds for seabirds and waterbirds in the sea
- Local flight patterns of land birds, seabirds and waterbirds
- Migration of land birds, seabirds and waterbirds.

For the baseline investigations the following data have been consulted:

- Data from monthly aerial and ship-based surveys of non-breeding birds along transects
- Data from waterbird population density calculations
- Data about bird migration from studies using radar and visual observation as well as acoustic surveys
- Radio, satellite and GPS telemetric data about the foraging patterns and local movements of specific waterbird species
- Analysis of ringing data regarding the origins of populations in Fehmarnbelt
- Other historical data from monitoring and scientific studies which have been carried out in Denmark, German and Baltic Sea countries and which contain information necessary for abundance analysis and for ascertaining population trends. Wherever possible, original data have been used in the analyses.

Overall, the baseline investigations of bird life include the following:

- Quantitative survey of abundance, distribution and trends of breeding and non-breeding birds in the two approach and ramp areas
- Quantitative survey of abundance, distribution and trends of seabirds and waterbirds at sea
- Qualitative and quantitative (where possible) survey of waterbirds' use of feeding grounds
- Survey of the feeding ecology of waterbirds on the basis of habitat mapping and telemetric and food consumption surveys
- Survey of migratory behaviour of water and landbirds with the aid of visual and radar observation as well as night migration study
- Additional evaluation of existing Danish weather radar data.

In this report, the data of the period of the baseline studies from October 2008 to November 2010 are presented for the marine and coastal habitats, while the

investigations of birds in the land-approach areas on Fehmarn and Lolland are presented in a separate report.

2.3.1 Methodologies

Data collection for the quantitative evaluation of abundance, distribution and trends of seabirds and waterbirds at sea consisted of counts carried out using standard visual observation methods, also commonly used in environmental impact assessments for offshore and onshore wind farms and for research studies (according to German regulations, StUK3, BSH 2007). In the area around the Fehmarnbelt, including the alignment corridor and several Natura 2000 sites, aerial and ship based surveys were carried out in monthly intervals in 2009 and 2010 along parallel transects with a spacing of three kilometres. In the coastal lagoons Rødsand Lagoon and Orth Bay additional aerial surveys were conducted to assess the number of herbivorous waterbirds, in particular swans.

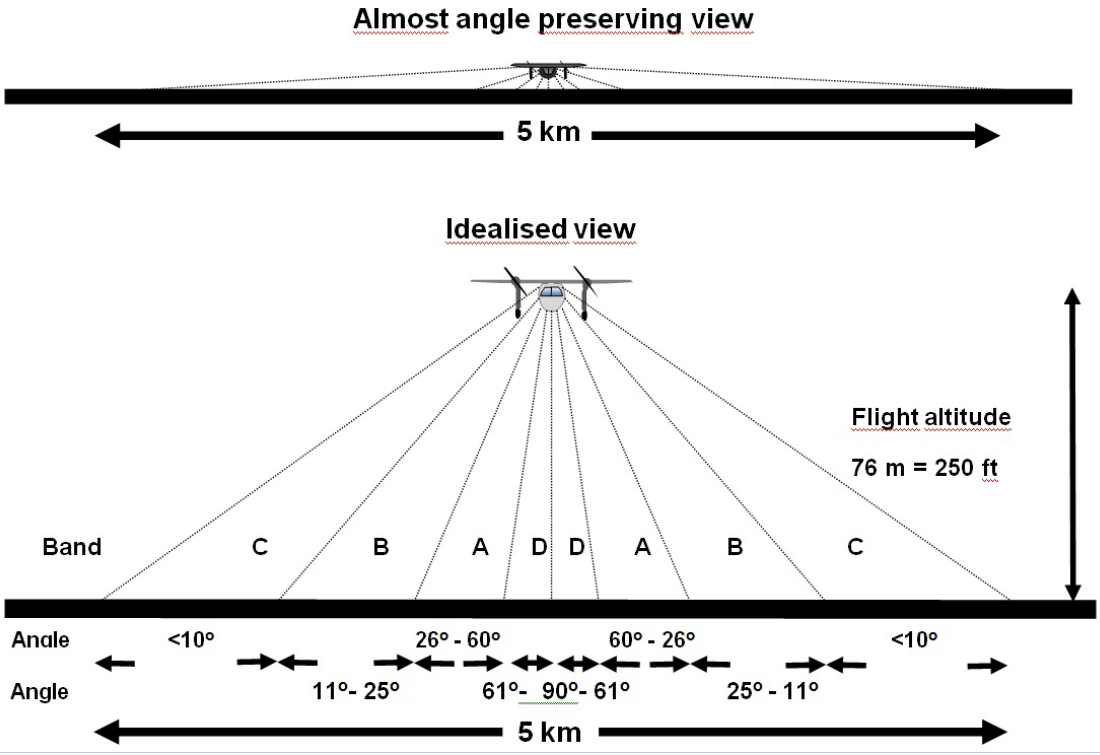

Figure 2.3 Methodology for aerial surveys: division of the transect sections.

The aerial surveys were carried out according to standard methods (Diederichs *et al*. 2002, Petersen *et al*. 2006) with twin-engine airplanes at 250 feet altitude. The surveys were carried out by three observers and all observations recorded with a dictaphone. The airplanes were equipped with 'bubble windows', enabling the observers to look directly down at the birds in the transect. The distance to the birds from transects (see Figure 2.3) was estimated in defined distance categories in order to generate a subsequent calculation of the density (birds per area unit) with the DISTANCE software (http://www.ruwpa.st-and.ac.uk).

Distance analysis was used for estimating bird densities recorded during aerial surveys. This approach allowed full utilization of collected data and extended beyond minimum requirement to estimate bird densities using only band-A of a transect (as outlined in StUK-3). Comparison of estimates indicated highly significant correlation between densities obtained using Distance analysis and those calculated using only band-A. Nevertheless, both estimates (obtained using

Distance analysis and for Band-A) are presented in tables in the Appendix II of volume II of FEBI baseline report.

The counts from ships were carried out in the coastal and open waters of the Fehmarnbelt. Methods were applied according to the standards set by the European Seabird-at-Sea Programme. Four observers recorded birds according to species, behaviour and distance to transect from a raised platform on the ship. The observation platforms were located 7-10 metres above the sea level. The ship counts enabled the surveying of species, which would be harder to survey from an airplane. The calculation of the detection intervals and bird density was carried out with DISTANCE software (http://www.ruwpa.st-and.ac.uk) as for the aerial observations.

The distribution and abundance of birds in various locations, habitats and water depths were determined with statistical distribution models analysing the visual observations of the transect counts, using generalised additive models (GAM). The GAM models were fitted using a two-step or delta model approach. The first step in the delta model consisted of a presence-absence part, fitted with a binomial distribution (with a logit link), and the second step consisted of a positive part with a gamma distribution and a log link. The models included environmental parameters known as important habitat drivers (food resources, water depth, distance from the coast, surface sediments, hydrographic parameters) as well as pressure parameters (ship traffic). Including environmental and pressure parameters in the estimation of densities enabled greater accuracy and greater spatial and temporal resolution of the results. The analyses were based mainly on data and models from the hydrographic (FEHY) and marine biology studies (FEMA).

For the survey of waterbirds' use of feeding grounds, two different methods were combined: Telemetry and diet analysis. The investigations concentrated on selected species of seaducks and diving ducks, but plant-eating waterbirds and fish-eating birds were also be included in the investigation. The telemetry and diet analysis focused on Common Eider, Long-tailed Duck, Common Scoter, and Tufted Duck. Furthermore, diet analysis of swans and fish-eating species such as the cormorant were also carried out. For the telemetry investigations, radio and GPS transmitters were attached to seaducks in order to follow their foraging patterns closely and to record their diving activity. The stomach content of dead birds was analysed for the diet analysis and stable isotope composition of birds' blood was measured to assess origin of nutrients over the long term.

The results of the telemetry investigation and the feeding ecology investigation were analysed together with the investigation results on the distribution of the relevant species as well as the distribution of the organisms they feed on. The dependencies of the bird populations on particular types of habitat in the area were investigated aiming to assess how they can be affected by changes to these habitats.

The investigation of the migration of seabirds, waterbirds and terrestrial birds were based on visual observations and radar observations as well as acoustic surveys in the Fehmarnbelt area. Investigations were carried out at two locations on the coast (Lolland and Fehmarn) and by a ship anchored in the middle of Fehmarnbelt. The investigations were performed during the migratory months and also during the moulting migration, i.e. from February to November in 2009 and 2010.

To produce data on numbers, flock size and the flight paths of the different species, visual observation proved to be essential. The visual range is, however, limited to less than 1.5 km from an off-shore ship and to less than 5 km from the coast with stronger optical equipment. Observations were thus only possible during times with

good visibility. Visual observations were carried out for approximately 120 days per year at the two land stations in Rødbyhavn and Puttgarden and for 60 days per year from ship. The methods applied followed the specifications described in the "Standards for environmental impact assessments" formulated by the German Federal Maritime and Hydrographic Agency (Standarduntersuchungskonzept – StUK 3, BSH 2007).

For surveying bird migration at altitudes above the visible area and during the night, screenshots from surveillance radars were assessed. Migratory directions were surveyed with the help of images from ship surveillance radars with a horizontally turning axis. Altitude distribution and migration intensities were surveyed with the help of images from similar radars turning vertically. The radar images were evaluated visually, and individual birds as well as flocks of birds were identified. Again, the applied methodology followed the specifications set by German regulations, the StUK 3.

To avoid radar reflections from waves, the instruments on land were surrounded by a special fence to shield the lower area. The radar surveys took place in four locations: Rødbyhavn, Puttgarden, a ship in the Fehmarnbelt and at the Westermarkelsdorf weather station on the coast of Fehmarn. At the land stations the radar instruments were constantly in operation and at sea the observations took place during 60 days per year during the main migration periods.

In Rødbyhavn in 2009 and Puttgarden in 2010 a tracking radar with a pencil beam antenna ('Superfledermaus', (Bruderer *et al*. 2007)) was also used to directly track flight paths, altitudes and flight patterns of birds and flocks of birds. The tracking radar enabled a more precise survey of particular aspects of bird migration because of its special antenna and better performance, but could only be employed on land. The 'Superfledermaus' was in operation continuously from March to November 2009 and 2010.

The combination of different methods enabled the comparison and calibration of the methods against each other and thereby reduced fundamental problems in the quantification of migration data. The investigations of bird migration included surveys of local movement patterns between resting and feeding grounds. These cannot be examined in isolation from migratory movements over greater distances during the main migration periods. However, investigations were carried out outside of the main migration periods, enabling a better survey of local movement patterns.

Information on the large-scale patterns of bird migration was also collected through the evaluation of available data from the weather radar station at Stevns in southeast Denmark, supplementing the investigations in the Fehmarnbelt. A method for the analysis of bird echoes from the weather radar data has been developed by the Danish National Environmental Research Institute (NERI) and the Danish Meteorological Institute (DMI). The aim has been to describe the migration dynamics on a large-scale and to identify flyways.

In order to attain as complete picture as possible of the regional migratory patterns in the Fehmarnbelt, data collected during other studies of bird migration along the coast of Fehmarn, Lolland and Falster were separately analysed and compared to own data.

The results of the bird migration investigation have been evaluated with regard to species diversity, migratory direction, migratory routes and altitude distribution with reference to meteorological factors. The data collected was used to estimate the quantity of birds migrating over the Fehmarnbelt.

3 DESCRIPTION OF THE STUDY AREA

3.1 Marine area/Fehmarnbelt

As part of the transition area between the polyhaline Skagerrak and the oligohaline Baltic Sea, the Fehmarnbelt (and the Belt Sea) is characterized by permanent vertical and longitudinal salinity gradients in connection with relatively extensive areas of shallow waters. A wide range of shallow water habitats gives rise to rich food supplies for carnivorous, herbivorous and piscivorous waterbirds. The abundance of waterbirds is clustered within areas shallower than 25 m. As a result of the high level of secondary benthic production the Fehmarnbelt is a region of relatively high abundance of several waterbird species, with species such as Red-necked Grebe *Podiceps grisegena*, Mute Swan *Cygnus olor*, Common Eider *Somateria mollissima*, Common Scoter *Melanitta nigra*, Tufted Duck *Aythya fuligula* and Red-breasted Merganser *Mergus serrator* occurring regularly in numbers of international significance. The breeding waterbird fauna is less important, yet nationally important colonies of terns and gulls are found in the enclosed areas near Fehmarn and in the Rødsand Lagoon.

The salinity gradient seen in the Belt Sea is particularly important for the structure of the non-breeding waterbird community showing a decrease in the proportion of Common Eiders and an increase in the proportion of Long-tailed Ducks with decreasing salinity, - a direct function of the differential size-distribution of their primary prey Blue Mussels *Mytilus edulis* across the salinity gradient (Nilsson 1972, Durinck et al. 1994). Besides, seasonal oxygen deficiency which occurs regularly below the pycnoline provides another stress factor affecting the available supply of mussels to waterbirds such as seaducks in the Belt (FEMA 2013a). Major hydrographic changes regularly impact the oxygen regimes which again impact the stocks of Blue Mussels which again give rise to potential secondary effects on the food supply to the regional seaduck populations. It is estimated that the large majority of the abundance of non-breeding waterbirds in the Fehmarnbelt traditionally has been dependent on a rich supply of Blue Mussels (Skov et al. 1998).

Eelgrass meadows and mussel beds are the most important habitats to birds in the Belt Sea with a potential habitat area of approximately 10,000 km^2 as defined by sufficient light intensity at bottom (i.e. larger than 10 to 15% of the incident surface insolation, (FEMA 2013b)). The benthic fauna in the Fehmarnbelt area is distributed according to depth and substrate and the important Blue Mussels and other filter-feeding epifauna that are a prerequisite for the populations of e.g. seaducks, are mainly occurring at or above the pycnocline where phytoplankton is available in large quantities. Dense beds are located where currents are strong providing continuous supply of foods to seaducks in areas such as west of Fehmarn and along the coast of Lolland (FEMA 2013a). In addition, small fish like sticklebacks (Gasterosteidae) and gobies (Gobiidae) concentrate in the ecotones between the lagoons and offshore waters (FEBEC 2013), and here large numbers of piscivorous mergansers and grebes are found.

3.2 Marine Protected Areas (Natura 2000)

The Fehmarnbelt area is of international importance for a variety of waterbird species, and several Special Protection Areas (SPA) have been declared by Germany and Denmark under the Natura 2000 network. Four SPAs are of special relevance for the EIA of a fixed link:

- **SPA DK 006X087 Maribo Lakes**: Possible disturbance of Tufted Duck populations that utilise Fehmarnbelt as feeding ground during the night

- **SPA DK 006X083 Hyllekrog-Rødsand**: Possible impacts on bird species that are part of the conservation objectives, e.g. through potential effect on benthic fauna and flora from sediment spill

- **SPA DE 1530-491 Eastern Kiel Bight**: Possible structural and functional impairment of resting grounds and flyways of birds due to bridge construction. In the northern part of the area, benthic fauna and flora may be affected by sediment spill

- **SPA DE 1633-491 Baltic Sea east of Wagrien**: In the northern part of the area, benthic fauna and flora may be affected by sediment spill

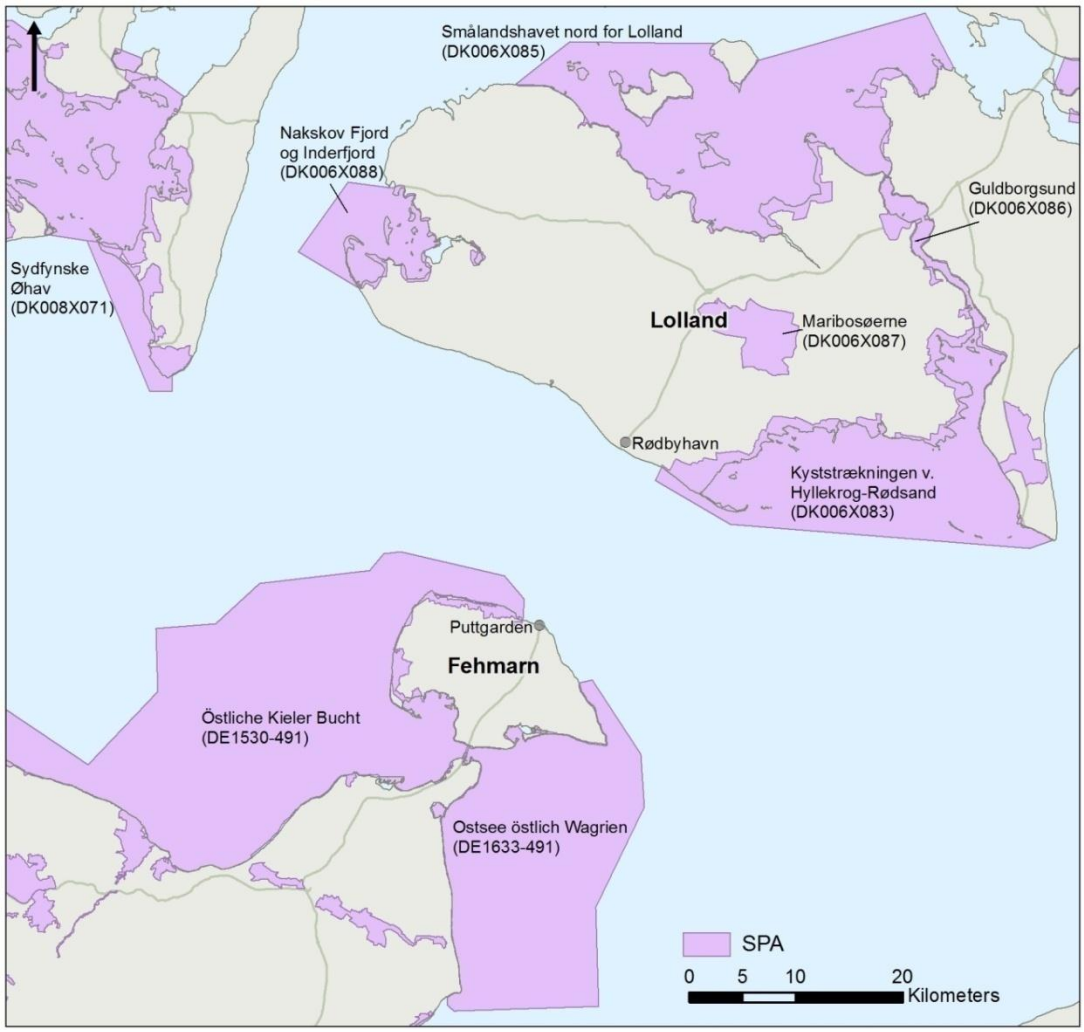

Figure 3.1 German and Danish SPAs in the region around the planned Fehmarnbelt Fixed Link.

In addition, the SCI (Sites Eligible for identification as sites of community importance) Fehmarnbelt, which is situated in the German EEZ between Lolland and Fehmarn, has also been in focus of the impact assessment, as some bird species are listed in the standard data forms of this protected area.

The NATURA 2000 areas will be described in detail in the contribution to the Appropriate Assessment.

4 PRESSURE ANALYSIS

4.1 Introduction and scope

The baseline pressure analysis, based on expert judgement, attempts to assess the existing pressure drivers and the pressures deriving from them.

The wintering waterbird populations constitute one of the most important and spectacular elements of the Baltic ecosystem. The investigations in this project show low to high densities of waterbirds depending on the species, area and season.

The aim of this chapter is to outline major pressure drivers that could lead to impacts on waterbirds and their habitats and to discuss some of the documented effects of resulting pressures. This forms the basis for the assessment of existing anthropogenic pressure drivers with respect to their influence on waterbirds in the Fehmarnbelt, and how they may interact with pressures from the planned project.

4.2 Overall Pressures in the Baltic Sea

In a recent publication (HELCOM, 2010b), the Helsinki Commission (HELCOM) has established no less than 52 anthropogenic pressure factors and derived the so-called Baltic Sea Pressure Index (BSPI). The BSPI brings together all available data layers relevant to human uses and pressures acting on the Baltic Sea and evaluates the spatial distribution of the cumulative impact of these pressures.

The Baltic Sea Impact Index (BSII) is a tool to estimate the potential anthropogenic impacts on the marine ecosystem, based on an approach identifying which areas of the Baltic Sea are sensitive to human-induced pressures. The concentration of anthropogenic pressures (=BSPI) is combined with the spatial distribution of species, biotopes and biotope complexes to yield the potential anthropogenic impacts (=BSII).

The BSII was established for the entire Baltic Sea on a grid of 5 km $\times$ 5 km (HELCOM 2010b). Only the open sea areas of the Gulf of Bothnia are considered to be relatively free of direct human impact, whereas almost all coastal areas of the Baltic Sea are impaired. Among the most notorious and widespread of anthropogenic stressors are: extraction of species by trawling and net fisheries, eutrophication, input of hazardous substances and hunting of birds. The Belt Sea and Arkona Basin are under relatively high pressure, and focussing on the basins of the Kiel Bight and the Mecklenburg Bight (of which the Fehmarnbelt is the connecting sea strait) a number of area-specific pressures could be identified. The area-specific anthropogenic pressures that ranked highest within these basins (not necessarily the most important drivers for birds) were:

- Extraction of species by bottom trawling, gillnet fishery, surface and mid-water trawling and fishing with coastal stationary gear (standing nets, fykes)
- Input of nutrients (nitrogen) and heavy metals (lead and cadmium)
- Disturbance of the seabed by bottom trawling
- Underwater noise by shipping activities (coastal and offshore)

The BSPI, the sum of the anthropogenic pressures within the study area in the Fehmarnbelt has a range between 47 and 90, see Figure 4.1. The areas with the highest index values are notably the ferry harbour entrances at Puttgarden,

Rødbyhavn and Gedser and the Fehmarnsund between the island of Fehmarn and the German mainland. Also, southeast offshore Langeland and areas in the central Fehmarnbelt are assigned high pressure indices. Areas with notably low BSPI values are the Lagoon of Rødsand, the central Lolland coast and the eastern part of the Kiel Bight, west offshore Heiligenhafen. It should be noted that the BSPI values were estimated without the newly constructed offshore wind farm Rødsand II.

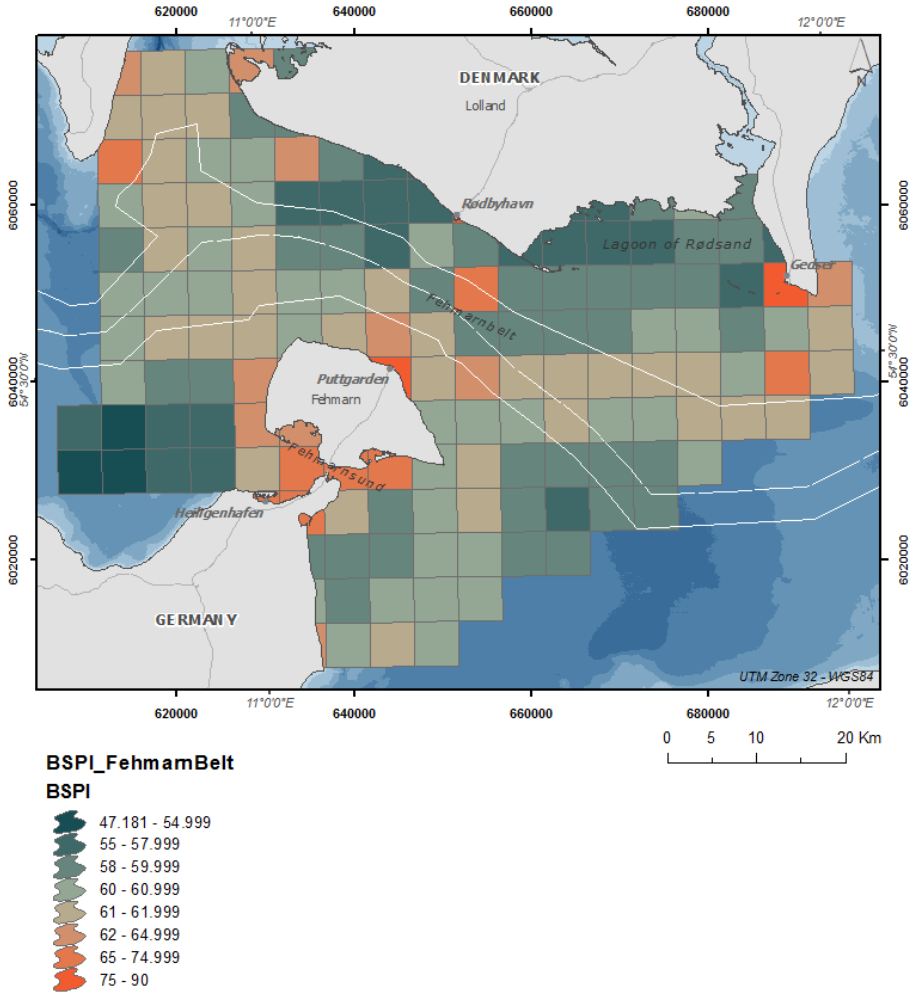

Figure 4.1 The Baltic Sea Pressure Index (BSPI), for the Fehmarnbelt area. Data: HELCOM (2010b).

4.3 Fisheries

Both extraction of species and bottom abrasion due to deployment of heavy fishing gear affect seabirds by directly reducing the available supply of prey and changing the food web structure. The Baltic pelagic food web has shown clear signs of a lack of resilience towards changes in fishing pressures, and in concert with eutrophication and climate change effects a complex series of changes in the Baltic Sea has been observed in all Baltic basins, including the Fehmarnbelt over the last 30 years (HELCOM 2010b). As many as three regime shifts seem to have occurred in the Baltic Sea during the 20th century (Österblom et al. 2007). The way that these regime shifts have affected the populations of breeding and non-breeding piscivorous species in the Fehmarnbelt is not known.

Gulls and other birds that follow ships profit from the discarded bycatch in their wake. Hüppop et al. (1994) assumes that the affected bird species have adapted their life-cycle so strongly to fishing that any other form of food sourcing would be extremely difficult. Scavenging on discards and offal is a widespread phenomenon in the Baltic Sea as it is in other shelf areas of Europe, but the number of bird species involved is generally lower and strongly biased towards gulls, especially Herring Gulls (Garthe 2003). It is not known to what extent the drop in fishing effort after the mid-1990s has affected the distribution and abundance of gulls in the Fehmarnbelt.

Besides a residual effect on birds in general, fishing directly affects the mortality of diving bird species. On account of intensive gillnet fishing there is a regular loss of benthic-feeding and piscivorous seabirds. Gillnets are frequently used in shallow coastal zones, which are also the preferred resting places for wintering birds. Divers, seaducks and alcid birds drown in great numbers in gillnets (Olsson et al. 2000, Schirmeister 2003, Dagys and Žydelis 2002). Žydelis et al. (2009) calculated that a total of 76,000 birds drown in gillnets annually in the Baltic Sea. Intensive gillnet fishing is carried out in the shallow depth zones around Fehmarn (Figure 4.2). Kirchhoff (1982) estimated losses of waterbirds, mainly seaducks, in set nets along the Baltic coast of Schleswig-Holstein to be at least 15,000 birds per year. In unsystematic controls in 4 seaward harbours on the island of Usedom, Schirmeister (2003) registered over 1,000 dead birds each year (50-100 diving birds, 1,000-2,000 seaducks, 10-20 Guillemots). In the sea area east of the island of Rügen it is estimated that 10,000-50,000 seabirds perish in gillnets annually (Leipe et al. unpubl.). IFAÖ (2009) estimated the total bycatch in gillnets set by fishermen from Mecklenburg Western Pomerania to be from 17,345 to 19,841 birds per winter season (November-May). Bird bycatch was also studied around the island of Ærø, an area west of the Fehmarnbelt, in 2001-2003. This study estimated 841 birds caught in gillnets, about 70% of them being Common Eiders (Degel et al. 2010).

Bird mortality in fishing nets was not specifically studied in the Fehmarnbelt. However, considering results of bycatch investigations in the surrounding areas, numbers of diving birds in the Fehmarnbelt and presence of gillnet fisheries here, it could be safely assumed fisheries bycatch presents a constant pressure on birds in the Fehmarnbelt, likely resulting in hundreds of casualties every year.

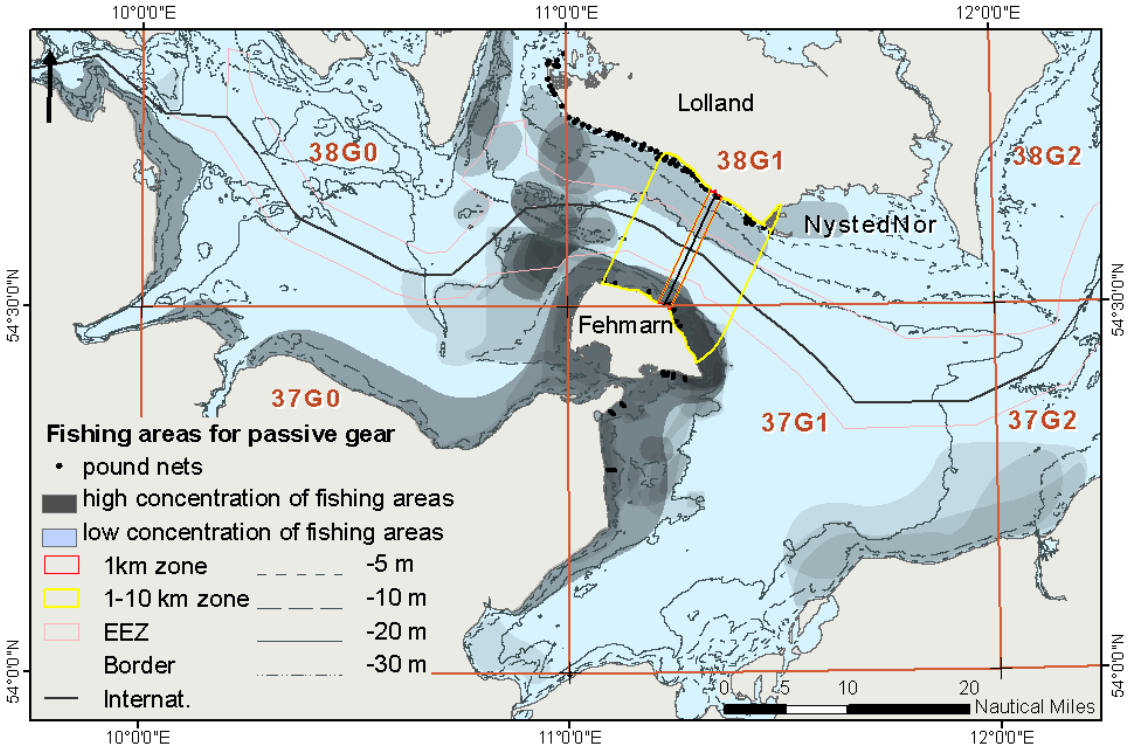

Figure 4.2 *The estimated distribution of the German and Danish fisheries that use passive gear (primarily gill/trammel nets and pound nets (black dots along the Danish and German coast) in Fehmarnbelt and regional area. Data derived from interviews with Danish and German fishermen (figure taken from FeBEC 2013).*

4.4 Hunting

Bird hunting is a widespread leisure activity in the Baltic Sea region (Table 4.1). Hunting affects virtually all migratory waterfowl (swans, geese, ducks) in the Baltic Sea region. According to the Danish hunting statistics, number of annually shot Common Eiders has been declining steadily since mid-1980s from 190,000 birds shot in 1982 to 47,700 in 2009 (http://www.dmu.dk/dyrplanter/dyr/vildtudbytte/). A total of 66,350 Common Eiders were bagged in the Baltic Sea area in 2007 (Skov et al. 2011). This equates to 8.7% of the winter population of 760,000 individuals (Desholm et al. 2002). A large portion of the shootings in Germany and Denmark are wintering gulls from the Baltic Sea area. In Germany, around 90% of the shooting of migrating Woodcocks takes place in Northern Germany, whereby mainly the Scandinavian breeding birds are affected (IfAÖ 2010). The Great Cormorant population in Estonia, Germany, Finland and Sweden is reduced annually. Between 10,000 and 15,000 cormorants were shot in 2006 (HELCOM 2009b).

In total, some 1.9 million birds are shot in Germany annually, in Denmark around 1.3 million, in Finland and Sweden taken together some 1.2 million birds, see Table 4.1. Illegal bags and shootings and undetected or injured birds should be added to this total (Bellebaum et al. 2010).

Table 4.1 Average annual shootings of selected migratory birds in the Baltic Sea area.

Species	Denmark	Norway	Sweden	Finland	Lithuania	Germany
Cormorants	4,300	10,400	6,000	–	-	-
Grey herons	600	-	-	–	-	-
Geese	57,500	12,420	73,200	12,000	212	30,810
Ducks	701,600	53,700	117,000	573,500	10,750	555,400
Woodcocks	64,200	-	10,000	3,800	2,950	8,100
Seagulls	25,500	21,100	33,000	–	-	21,305
Pigeons	336,500	37,060	50,000	n. a.	-.	769,300

Denmark: 2009, according to the Danish game bag statistics
http://www.dmu.dk/dyrplanter/dyr/vildtudbytte/
Norway: according to data from Statistics Norway (www.ssb.no)
Sweden: estimated from data in www.jagareforbundet.se/forsk/viltrapporteringen/
Finland: according to www.rktl.fi and www.riista.fi
Lithuania: 1997/98-2000/01, according to Statistics Lithuania in lit.
Germany: according to www.jagd-online.de, Hirschfeld and Heyd 2005.

Since the 1980s and 1990s, the annual bag of Common Eider and many other waterbird species has declined in all Scandinavian countries (Noer et al. 2009). According to Noer et al. (2009) hunting pressure in the Fehmarnbelt area should be lower as compared to other parts of Danish waters. As hunting at sea from boats in Germany is not allowed and large areas are declared as nature reserves without waterbird hunting, hunting pressure in Fehmarnbelt in general is considered to be low.

Despite recent decrease in the annual bag of Common Eiders (Bregnballe et al. 2006, Noer et al. 2009), hunting represents the major and consistent additive mortality source for this species, which very likely has an effect on population dynamics.

4.5 Eutrophication

Eutrophication in general is an increased nutrient availability compared to the natural status and one of the most serious threats to species diversity and stability of marine ecosystems worldwide. The Baltic Sea has been exposed to high amounts of nutrients throughout the last 50–80 years.

With the exception of the Gulf of Bothnia and the north-eastern part of the Kattegat, all parts of the Baltic Sea are affected by eutrophication. The Baltic Sea is particularly vulnerable because of the relatively low exchange of water through the Danish Straits compared to the overall volume of the Baltic Sea itself. Furthermore, the catchment area is comparatively large and intensively used by humans. Consequently, the concentration levels of nutrients such as nitrogen and phosphorus are high in the Baltic Sea (HELCOM 2009a).

The efforts of HELCOM countries to reduce the nutrient input into the Baltic Sea has led to a 30% decrease of nitrogen and 45% of phosphorus concentration levels from 1990 and onwards to 2006 (HELCOM 2010b). Nitrogen levels in the coastal waters of the Danish Straits (including the Fehmarnbelt Belt) were in the 1980s among the highest in the Baltic Sea, and 3–4 times higher than the levels in the open waters, indicating the large influence of land-based sources (HELCOM 2009a). Since the mid-1980s, dissolved inorganic nitrogen levels in the coastal waters of the Danish Straits have decreased to approximately half compared to the levels in the mid-1980s. Dissolved inorganic phosphorous concentrations in the open waters of the Danish Straits increased from 1970 to the mid-1980s as well, with subsequent declines reaching levels that are now below the levels in 1970. While

the dissolved inorganic phosphorous levels in coastal waters of the Danish Straits were among the highest of all Baltic regions in the mid-1980s and about 3 times higher than in the open Danish Strait waters, the levels have declined and are now comparable to those in open Danish Strait waters (HELCOM 2009a).

Measurements from stations in the Fehmarnbelt Region (Mecklenburg Bight) from 1980 and onwards show similar trends (FEMA 2013c). However, problems persist and HELCOM classifies the eutrophication status of the Fehmarnbelt region (Kiel and Mecklenburg Bights) as poor to bad (HELCOM 2009a, HELCOM 2009b).

Despite the persisting problems, the long-term reduction in loads of nitrogen and phosphorous observed in the southern Baltic may be coupled to wide-spread declines in waterbird populations feeding on benthic invertebrates since 1993, especially in Kattegat, the Straits, Kiel Bight and Mecklenburg Bight (Skov et al. 2011).

4.6 Shipping

The Fehmarnbelt is part of the important navigation route connecting the Baltic Sea and the North Sea and is consequently intensively used by ship traffic. Ship traffic generates acoustic and visual disturbances and is a potential source of pollution (oil, non-organic substances), both through improper handling and accidents.

Since 2005, the majority of ship traffic has been monitored by the HELCOM using an Automatic Identification System (AIS). From the HELCOM AIS data it is known that between 3,500-5,000 ships travel through the Baltic region each month (HELCOM 2010c). In the Fehmarnbelt, ferry services between Rödby and Puttgarden add to high frequency of shipping between Kiel Canal and eastern Baltic using the T-route. The average number of ferries crossing Fehmarnbelt is 3200 per month (Ramboll et al. 2011). Figure 4.3 illustrates the traffic routes and intensities derived from the AIS data.

Ship traffic to and from windfarms during operations adds to the shipping intensity.

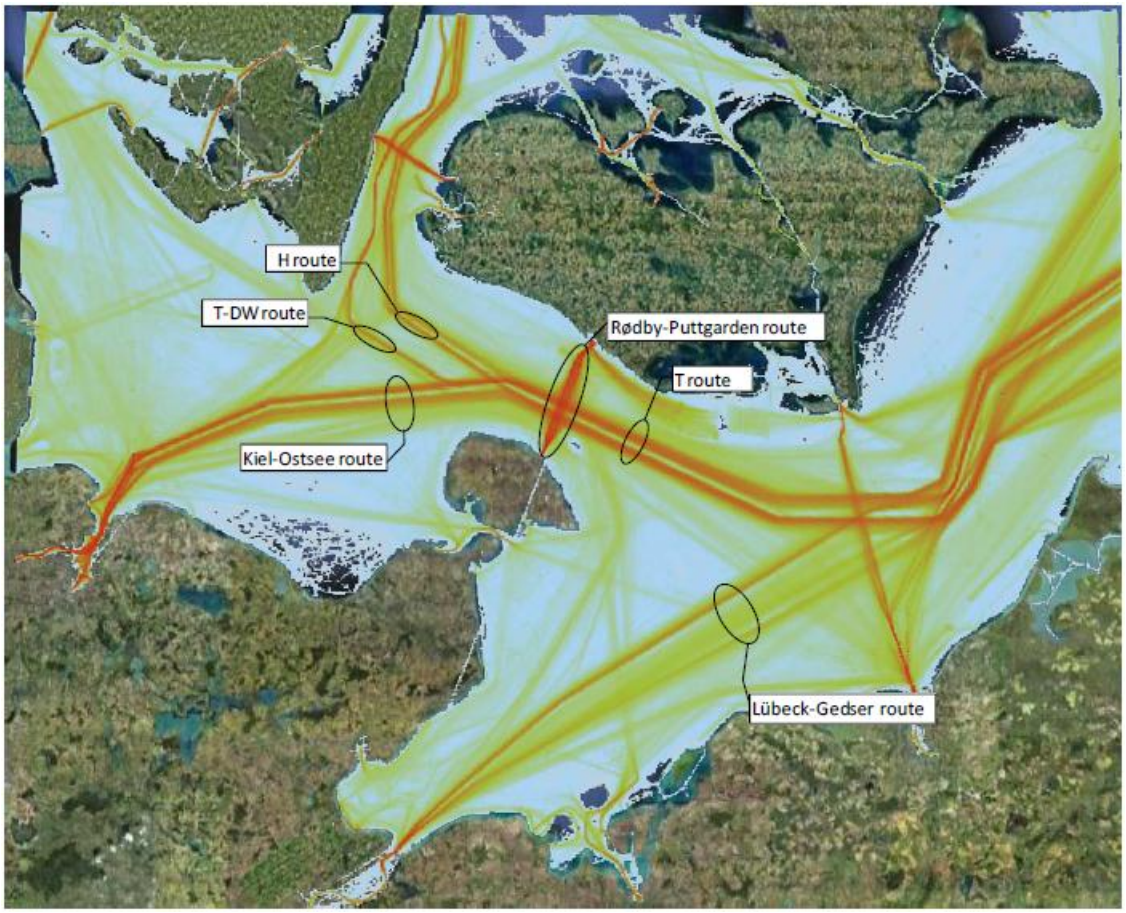

Figure 4.3 Primary shipping lanes of the Fehmarnbelt area (based on 2009 AIS registrations; taken from Rambøll 2011).

Waterbird species differ in their responses to ship traffic, and information on this topic is only beginning to emerge. Divers appear among the most sensitive species as they flush from approaching ships at a median distance of 400 m and a 90% percentile over 1,000 m (Bellebaum et al. 2006). A passing ship thus causes disturbances within a radius of about 2 km. These disturbance distances and avoidance zones have different consequences and can range from a brief disturbance by single ships to permanent avoidance of intensively navigated shipping routes. Schwemmer et al. (2011) found that divers showed clear avoidance of areas with high shipping intensity. Common Scoters are also sensitive to ship traffic. Their flight reactions have been recorded at a distance of 1,000 m (Garthe 2003). Higher flushing distances from 1,000 to 2000 m for Common Scoters were recorded by Kaiser et al. (2006). Schwemmer et al. (in press) found a median flushing distance of 804 m for Common Scoters, 404 m for Velvet Scoter, 293 m for Long-tailed Duck and 208 m for Common Eider.

4.7 Pollution

With the exception of the western Kattegat, all areas of the open Baltic Sea were found to be contaminated with toxic persistent chemical compounds and heavy metals during the latest reported observation period from 1999 to 2007 (HELCOM 2010a). Parts of the Kiel and Mecklenburg Bays were among the areas with the highest contamination of mainly by Poly Chlorinated Biphenyls (PCB), TBT (a major constituent in anti-fouling paints until their ban in 2008), lead, cadmium and octylphenol.

The levels of persistent chemical compounds (for which production is now banned, or their use restricted, e.g. dioxins, DDT, PCBs, TBT) are all declining. However, their concentrations remain high (Skov et al. 2011). The thresholds for cadmium and mercury in fish and bivalves were found to be exceeded in almost the entire Baltic (HELCOM 2010a). The pollution level is generally higher in coastal areas than on the open sea (Skov et al. 2011).

Besides the contamination from various toxic chemical compounds and heavy metals, all seabird species are potentially exposed to oil pollution released either as a consequence of shipping accidents, or incidents of illegal spills. Wintering waterbirds are the predominant oil victims (IfAÖ and LUNG MV 2010). During the last major accident in the Baltic Sea in 2008, 318 tonnes of crude oil were released (HELCOM 2010b). As a consequence, 1,500 birds from the seabird colony on Græsholm in the Ertholm Archipelago north-east of Bornholm died with an anticipated long-term effect on the colony (IfAÖ 2010). While the numbers of recorded oil spills have decreased since 1995, chronic oil pollution prevails, and even an increase in the Central Baltic Sea is reported (Skov et al. 2011). 20% of the ships entering or leaving the Baltic Sea through the Kattegat in 2008 were oil tankers with an estimated 170 million tonnes of oil on board (HELCOM 2009d). The intensity of shipping in the Baltic Sea is likely to increase further (e.g. Rytkönen et al. 2002) and the export of Russian oil through the Baltic Sea is expected to rise. As a consequence, the probability of large-scale oil spill accidents in the Fehmarnbelt is high and will rise in the years to come (HELCOM 2010b).

4.8 Offshore wind farms

Two offshore wind farms are in operation; Nysted, constructed in 2003 and Rødsand II, constructed in 2010 (Figure 4.4). Three other offshore wind farms are planned (Beltsee, Beta Baltic, GEOFReE) in the German coastal area west of Fehmarnbelt.

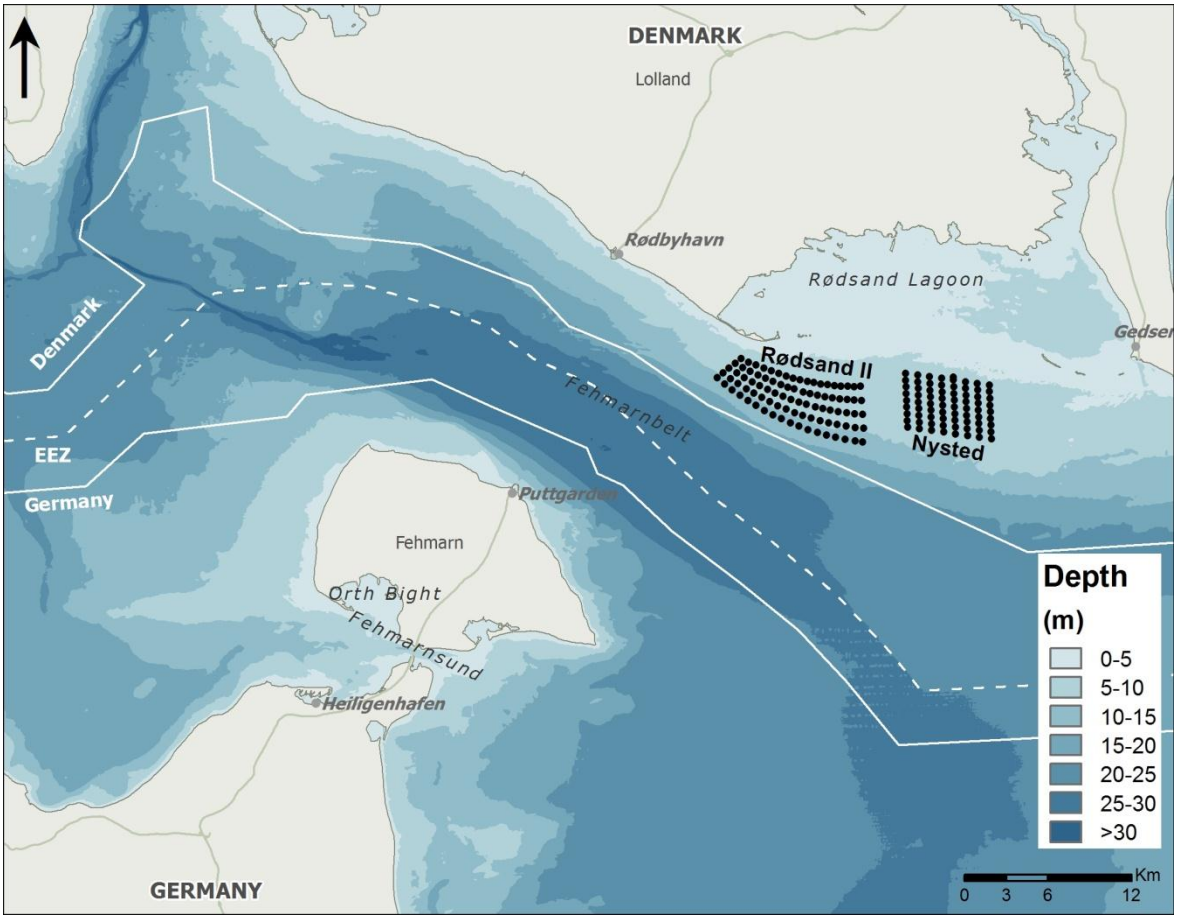

Figure 4.4 Location of Nysted and Rødsand II offshore wind farms.

Pressures from existing wind farms are related to the construction and operation phases. Pressures during construction are mainly associated with shipping activity around the site and seabed disturbance by dredging and construction cranes. The highest impacts to birds are, however, related to the operational phase. Here, pressures are induced by disturbance (visual impact of the wind farm and movement and noise from maintenance boats), barrier effects and collisions.

4.8.1 Disturbance (habitat displacement)

Habitat displacement effects on waterbirds during construction of offshore wind farms may vary as a function of the intensity of construction activities. Disturbance levels will probably approach disturbances due to the wind farm structures during operation during intensive construction works, especially due to the concentration and movements of boats in the wind farm area. The evidence gathered from existing monitoring programmes at offshore wind farms indicate that specific responses of waterbirds to wind farms are highly variable, both as a function of specific disturbance stimuli and site-specific characteristics (for Nysted see Table 4.2). In addition, some indications of habituation to turbines have been observed (Petersen et al. 2006). A further complication is that habitat displacement impacts, as documented during the monitoring programme at Nysted, may not have taken (natural) changes of food supply into consideration. Studies of changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm with particular emphasis on Common Scoter do not exclude the possibility that changes in food supply may have an effect on habitat displacement in offshore wind farms (NERI 2007). An investigation of the possible influence of environmental variables, such as benthic biomass, on the observed spatial and temporal variation in the numbers

of Long-tailed Ducks at Nysted is ongoing (Danish Energy Agency 2011). Despite these possible uncertainties, habitat displacement is generally regarded as the main source of impact on birds from offshore wind farms (Petersen et al. 2006).

Table 4.2 Reported response types of waterbirds during the post-construction monitoring at Nysted in relation to potential habitat displacement within a distance of 2 km from the wind farm (Petersen et al. 2006).

Species	Response type
Red-throated Diver (*Gavia stellata*)	Complete avoidance of wind farm area
Black-throated Diver (*Gavia arctica*)	Complete avoidance of wind farm area
Cormorant (*Phalacrocorax carbo*)	No avoidance of wind farm area
Common Eider (*Somateria mollissima*)	No or moderate avoidance of wind farm area
Long-tailed Duck (*Clangula hyemalis*)	High avoidance of wind farm area
Common Scoter (*Melanitta nigra*)	Complete avoidance of wind farm area
Herring Gull (*Larus argentatus*)	No significant avoidance or attraction of wind farm area
Great Black-backed Gull (*Larus marinus*)	Indication of no avoidance of wind farm area

From Table 4.2 it can be seen that a pattern has emerged from the monitoring at the Nysted wind farm where species occurring widespread close to human developments, like gulls, are generally not disturbed by wind farms, while waterbirds like divers and seaducks associated with offshore habitats seem to be disturbed. Despite the documented reductions in densities of some waterbird species following construction of offshore wind farms it should be pointed out that the displacement numbers reported so far for separate wind farms are relatively small in comparison to total population levels. No cumulative assessments have been conducted to date, which would evaluate cumulative effects of existing and planned wind farms on bird populations.

4.8.2 Barrier effects

A barrier effect exists if birds as part of a long-distance migration, or movements related to resting and feeding are partly or entirely hindered by ships, wind farms or other obstacles to do so, resulting in a change of migration or flight routes and altitudes and thus in energetic costs to the birds (e.g. Masden et al. 2009, 2010).

Monitoring at existing offshore wind farms has partly involved combined visual and radar-based observations of behavioural responses of migrating birds to the structures; experiences related to species-specific responses in the Baltic Sea have been gathered at the Nysted wind farm. Waterbirds reacted to the Nysted wind farm at distances of 5 km from the turbines, and generally deflected at a distance of 3 km from the wind farm (Petersen et al. 2006). Within a range of 1-2 km more than 50% of birds heading for the wind farm avoided passing within it. Waterbirds entering the wind farm minimised their risk of collision by re-orientating to fly down between turbine rows, frequently keeping equidistance between turbines and by reducing their flight altitude below rotor height and by readjusting flight orientation once within the wind farm to take the shortest exit route.

Studies at the Nysted wind farm have shown that the wind farm site is avoided and detoured to a greater extent by migratory birds than by resident birds (Blew et al. 2008). During construction of the wind farm 16 to 48% of waterbird echoes were registered in the farm area. The radar echo density was reduced to 9% after operation commenced. The decrease in the echo density was more prominent during the day than during night (4-7% day, 11-24% night), leading to the

conclusion that the disturbance effect is related to visibility. Changes in flight direction varied markedly from a distance of 3 km (with maximum reaction distances up to 6 km) at day-time to 1 km during night. The change in flight direction occurred in a way that birds passed either north or south of the wind farm. Extreme reactions such as turning back on encountering the wind farm were not observed. The avoidance of the offshore wind farm occurred by birds flying around it as well as above it (Blew et al. 2008).

4.8.3 Collisions

The collision of migratory birds with offshore wind farms is a major concern, in particular as a considerable increase in the number of offshore wind farms is expected in the near future.

A number of investigations at different offshore wind farms have pointed to both the barrier effect and the collision risks (Guillemette et al. 1998, Langston and Pullan 2003, Blew et al. 2008, Desholm et al. 2006, Krijgsveld et al. 2005, 2006, 2008, 2010, Pettersson 2005, Everaert and Stienen 2007, Hüppop et al. 2009). Investigations of collision rates of birds with offshore wind farms exist e.g. for the Nysted wind farm (Petersen et al. 2006). Most birds avoided the wind farm, and it could be established that Common Eiders reduced their flight altitude within the wind farm so that they often flew below the rotors. Using radar surveys and TADS (Thermal Animal Detection System), (Petersen et al. 2006) predicted that of 235,000 birds passing in one autumn, 0.018-0.02% collided with the wind farm structures (equates to 41-48 birds). Collision modelling results conclude, that, given selected circumstances, between 190,000 and 1.9 million birds could collide with offshore wind farms in the Baltic Sea, if all currently planned wind farms would be erected (Bellebaum et al. 2010).

On the research platforms FINO 1 (North Sea) at least 442 collisions were recorded during a 14 months period (Orejas et al. 2005) and approximately 30-40 victims during a 5 month period at FINO 2 (Baltic Sea) (own data IfAÖ). Aumüller et al. (2011) described that strong collision incidents at the platform FINO 1 coincided with changing weather conditions during migration; especially decreasing visibility and increasing wind speed forced birds to lower their flight altitude. This points out that bird collisions at offshore structures are not occurring continuously but in discrete events triggered by weather conditions during migration.

4.9 Other Structures

In the Fehmarnbelt area several onshore wind farms are situated on the islands of Lolland and Fehmarn close to the sea. Recent investigations on bird collisions at the wind farms on Fehmarn revealed moderate collisions rates, mainly by local breeding or resting birds, while there was no indication of elevated collisions from migratory birds (BioConsult SH and ARSU 2010). Numerous surveys exist about bird collisions with onshore wind farms elsewhere (e.g. Everaert et al. 2002, Exo et al. 2002, Hötker et al. 2005, Hötker 2006, Karlsson 1983, Witte and van Lieshout 2003). A study, where the search efficiency and removal by scavengers were taken into account, arrived at a collision rate in coastal locations of between 1.34 and 58 birds per turbine per year (Witte and van Lieshout 2003), or for example some 13 birds per onshore turbine per year on Fehmarn (BioConsult SH and ARSU 2010). According to Exo et al. (2002), most studies on wind farms calculated collision rates of 0-40 birds per year per turbine. Maximum collision rates of 125 birds per turbine per year were calculated for different wind farms and locations in a Belgian coastal region (Everaert et al. 2002).

Collisions with other structures lead to considerable mortality of migrating birds in particular. Each year, millions of birds collide with man-made structures in the Scandinavian and Baltic Sea area. An analysis of the most common causes of mortality is provided by (Kube 2002) for these areas (Table 4.3) or by Bellebaum et al. (2010) for Germany.

Table 4.3 Estimation of bird collisions with anthropogenic structures in the Scandinavian and the Baltic Sea area (adapted according to Kube 2002).

Anthropogenic cause of death	Affected birds	Death rate (Ind. a^{-1})
Collision with buildings	land birds	100,000
Collisions with lighthouses, transmitter masts and high-voltage power lines, etc.,	land birds	100,000
Collisions with vehicles	land birds	10,000,000
Collisions with trains and airplanes	land birds	1,000
Collisions with ships	land birds	100,000

4.10 Climate Change

Global climate change is expected to cause species to markedly change their geographical distribution as they follow the local climate to which they are adapted (e.g. Walther et al. 2002, Parmesan and Yohe 2003, Jetz et al. 2007). Recent model studies predict that the potential breeding ranges of many European bird species are likely to move 100s of kilometres in mainly north-easterly direction (Huntley et al. 2007). In Denmark, climate change is predicted to result in a turnover rate as high as 20% in the breeding bird composition within the next 50 years (Poulsen 2003). Observation of empirical changes in species distributions in recent years are generally in accordance with model predictions (Parmesan 2006).

Non-breeding distributions of waterbirds are – just like breeding ranges – affected by climate in addition to food availability and disturbance, e.g. (Huntley et al. 2006, 2008, Doswald et al. 2009).

5 SYNTHESIS: IMPORTANCE OF FEHMARNBELT FOR NON-BREEDING WATERBIRDS AND BIRD MIGRATION

5.1 Introduction and scope of work

The task of the baseline study has been to describe numbers, seasonal abundance and spatial distribution of birds in the Fehmarnbelt area and to conduct specific studies as for example habitat relationships in waterbirds or flight altitude measurements in bird migration. The aim of this chapter is not only to evaluate the importance of the area as one unit but also to evaluate the importance of subareas and specific habitats wherever possible at a high spatial resolution in order to distinguish between subareas and habitats of different importance. The main purpose of this exercise has been to provide the basis for the impact assessment which will be conducted by relating the importance of specific areas to the magnitude of given pressures associated with construction and operation of a fixed link. This will take spatial extension, timing and duration of a pressure into account.

5.2 Criteria

General assessment criteria for the evaluation of the importance of the area as provided by Femern A/S in four levels have been transferred and adapted by FEBI into importance criteria for birds. The main step is to relate the conservation status of a species to its numerical abundance in the area (Table 5.1). This is recommended in order to avoid that a low number of individuals leads to high importance levels although only a very low proportion of the population occurs in the area, or on the other hand, high numbers of a species of low conservation status may be only be assigned a minor importance level, although the area may serve a vital function for the population.

FEBI thus uses the accepted criterion of international importance originating of the Ramsar convention giving highest importance to areas containing at least 1% of the biogeographic population of a species as a basis for defining importance criteria. Numerical criteria are balanced against international protection status of a species and a high protection status requires a lower proportion of the population to achieve a certain ranking of the importance. In this respect, general recommendations of BirdLife International (2004) of balancing conservation status and numerical abundance are transferred into assessment criteria for the Fehmarnbelt. In general, FEBI does not adopt the Ramsar criterion 5 that an area receives highest importance category if it contains more than 20,000 waterbirds, except for non-breeding waterbirds species with populations over 2 million birds for which this crierion is used instead of the 1% criterion. Due to the lack of clearly defined borders in the marine environment this criterion is not applicable across species. However, following BirdLife International (2004) this Ramsar criterion was applied for assessment of waterbird species instead of 1% value, if the biogeographic population size exceeds 2 million individuals.

There are no accepted criteria for the assessment of bird migration, though migration hotspots have been mentioned as sites of conservation interest (BirdLife International 2004). As the task of the EIA for a fixed link across Fehmarnbelt is the assessment of potential impacts on the marine environment which needs to assess which part of a population or total numbers may be exposed to a certain impact, assessment criteria for non-breeding waterbirds have been transferred to criteria on migrating birds. This is considered appropriate, as the RAMSAR convention from 1971 and the further development of its principles follow the idea, that the protection of all sites hosting more than 1% of a biogeographical population is will

protect the species. This is also valid for migrating birds, as they are dependent on the integrity of their migratory pathways just the same way.

Table 5.1 Assessment criteria for the evaluation of the importance of the area for non-breeding waterbirds and migrating birds.

Environmental factor	Criteria	Importance	Explanation
Non-breeding waterbirds	International conservation status Proportion of the bio-geographic population* Numbers of individuals	very high	• Areas containing regularly more than 1.0% of the biogeographic population of a species • Areas containing regularly between 0.5 and 1% of the biogeographic population of a species of very high international protection status (Annex I Bird Directive) or species of global or European conservation concern (SPEC 1 or SPEC 2) • Areas containing more than 20,000 individuals of a species
		high	• Areas containing regularly between 0.5 and 1.0% of the biogeographic population of a species of high international conservation status (SPEC 3) • Areas containing regularly between 0.1 and 0.5% of the biogeographic population of a species of very high or high international conservation status or species of global or European conservation concern (Annex I Birds-Directive or SPEC 1 or SPEC 2 or SPEC 3)
		medium	• Areas containing regularly between 0.5 and 1.0% of the biogeographic population of a species with medium or no international conservation status (NON-SPEC^{E} or NON-SPEC) • Areas containing regularly between 0.1 and 0.5% of the biogeographic population of a species with medium international conservation status (NON-SPEC^{E})
		minor	• All other areas
Migrating birds (waterbirds and landbirds)	International protection status Proportion of the bio-geographic * or the respective relevant reference population**	very high	• Flight corridors being used by more than 1.0% of the biogeographic/relevant reference population of a species • Flight corridors being used by 0.5 to 1.0% of the biogeographic /relevant reference population of a species of very high international conservation status (Annex I Bird Directive) or species of global or European conservation concern (SPEC 1 or SPEC 2)
		high	• Flight corridors being used by 0.5 to 1.0% of the biogeographic /relevant reference population of a species of high international conservation status (SPEC 3) • Flight corridors being used by 0.1 to 0.5% of the biogeographic/relevant reference population of a species of very high or high international conservation status or species of global or European conservation concern (Annex I Birds-Directive or SPEC 1 or SPEC 2 or SPEC 3)

Environmental factor	Criteria	Importance	Explanation
		medium	• Flight corridors being used by 0.5 to 1.0% of the biogeographic/relevant reference population of a species with medium or no international conservation status (NON-SPEC^{E} or NON-SPEC) • Flight corridors being used by 0.1 to 0.5% of the biogeographic/relevant refeference population of a species with medium international conservation status (NON-SPEC^{E})
		minor	• All other areas

* A biogeographic population can be defined as a distinct assemblage of individuals who does not experience significant emigration or immigration (Wetlands International 2006).

** For landbirds, for which no biogeographic reference population is given, the breeding populations of Sweden and Finland (breeding pair number multiplied by 4) were defined as relevant reference population according to numbers in BirdLife International (2004) and Mebs and Schmidt (2006).

In the assessment of importance, two complexes of criteria are used, which are abundance of the species as recorded or estimated for the Fehmarnbelt and the protection status of the species. These criteria were entered into a cross table such that the result is a combined importance level (Table 5.2). This table is not completely "symmetric", as the international so-called 1%-criterion cannot be lowered by a low protection status.

Table 5.2 *Scheme of determination of the importance level of Fehmarnbelt to a species: the importance level depends on the species' abundance in relation to its biogeographic population and the species' protection/conservations status.*

		Protection/conservation status			
		Very high	High	Medium	Minor
Abundance in % of the biogeographic/relevant reference population	Very high	very high	very high	very high	very high
	High	very high	high	medium	medium
	Medium	high	high	medium	minor
	Minor	minor	minor	minor	minor

The abundance criterion for determination of importance levels are based on the proportion of the respective biogeographic/relevant reference population occurring in the area (Table 5.3).

Table 5.3 Abundance based importance classification of an area according to species abundance in relation to its biogeographic/relevant reference population.

Criterion	Description
Very high	≥1% of the biogeographic/relevant reference population, or ≥20,000 individuals of a waterbird species*
High	≥0.5%, but <1% of the biogeographic/relevant reference population
Medium	≥0.1%, but <0.5% of the biogeographic/relevant reference population
Minor	< 0.1% of the biogeographic/relevant reference population

* For waterbird species with populations over 2 million birds, 20,000 birds was set as threshold for very high importance, adjusted to Ramsar Convention criterion 5.

Two international conservation statuses were chosen for classification of a species importance based on its protection and conservation status: whether a species is listed in the Annex I of the EU Bird Directive or not, and the SPEC status according to BirdLife International (2004) (Table 5.4). Is a species listed in Annex I of the EU Bird Directive, but is classified to a lower SPEC status, the highest classification (very high) applies.

Table 5.4 Importance classification of an area based on the protection/conservation status of the species according to the EU Bird Directive and the SPEC status of a species according to BirdLife International (2004).

Criterion	EU Bird Directive	SPEC Status
Very high	Listed in Annex I	SPEC 1 or 2
High		SPEC 3
Medium		Non-SPEC^{E}
Minor		Non-SPEC

Explanations to Table 5.4 (BirdLife International 2004):

SPEC 1 European species of global conservation concern, i. e. classified as Critically Endangered, Endangered, Vulnerable, Near Threatened or Data Deficient under the IUCN Red List Criteria at a global level (BirdLife International 2004, IUCN 2004).

SPEC 2 Species whose global populations are concentrated in Europe, and which have an Unfavourable Conservation Status in Europe.

SPEC 3 Species whose global populations are not concentrated in Europe, but which have an Unfavourable conservation status in Europe.

Non-SPEC^{E} Species whose global populations are concentrated in Europe, but which have a Favourable conservation status in Europe

Non-SPEC Species whose global populations are not concentrated in Europe, and which have a Favourable conservation status in Europe.

5.3 Breeding birds

Breeding birds which could be relevant for the Environmental Impact Assessment of the planning of a fixed link across Fehmarnbelt are almost completely restricted to the Natura 2000 sites of the area. Special Protection Areas (SPAs) have been

established in Germany and Denmark because of the importance of the bird fauna. This emphasizes that these areas are already of high importance for birds. To show a differentiation in the importance a two-scale approach is taken:

Special importance:

Areas in which more than 2 species of birds listed in the Annex I of Birds Directive are breeding with several or many pairs regularly.

General importance:

Areas in which single species of birds listed in the Annex I of Birds Directive are breeding with few or several pairs regularly.

By using this matrix all SPAs listed in Table 5.5 are of special importance.

Table 5.5 List of NATURA 2000 areas.

SPA	No. of Annex I species	Breeding pairs
DE 1530-491 Eastern Kiel Bight	17	357
DE 1633-491 Baltic Sea east of Wagrien	6	56
DK 006X083 Hyllekrog-Rødsand	6	75
DK 006X087 Maribo Lakes	4	100

Of the SPAs in the Fehmarnbelt area the SPA Eastern Kiel Bight has the highest number of Annex I species and the highest number of breeding pairs of Annex I species. However, this is partly due to species not occurring in the marine environment. Of the species occurring in the marine environment colonies of four species of breeding terns are to be highlighted, because breeding sites for these species are rare in the southern Baltic. Similarly, the breeding colonies of different gull species need to be mentioned as well as the breeding colonies of the Avocet. In addition the high number of breeding Common Eider and Red-brested Merganser, which rear their young in the marine environment, provides special value for the area as breeding ground for waterfowl. Most breeding areas are located at some distance to the alignment of a fixed link. However, terns and gulls breeding at Grüner Brink on Fehmarn are likely to forage in the alignment area and also birds from the larger gull colonies in the Rødsand Lagoon might at least partly be utilising this part of the Fehmarnbelt.

5.4 Non-breeding waterbirds

5.4.1 General approach

The evaluation of the importance follows the criteria described in Section 5.2. Population estimates are taken from Wetlands International (2006) or BirdLife International (2004). The approach to evaluate the study area or parts of it differs from classic approaches to identify areas of conservation interest as it has to be taken into account that the study area covers only a small proportion of the distribution of bird species in the region. Parts of the study area, which only hold a low proportion of the population, might extend across the border of the study area and be part of a larger area of high or very high importance. For dispersed species the study area might simply be too small to hold 1% of a population, especially when considering the smaller area covered by ship-based surveys, In order to take this into account it is referred to BirdLife's proposal (BirdLife International 2004) for identification of marine Important Bird Areas that the 1% criterion can be regarded

as fulfilled if 1% of a population occurs in an area smaller than 3,000 km^2 [1]. In order to allow a classification of subareas, this is translated into a density criterion in such a way, that the resulting density of 1% of a population divided by 3,000 km^2 is assigned very high importance and densities for lower importance levels are derived from this value following the steps defined in Table 5.1. Considering densities alone may lead to the classification of fractions to the study area to a certain level of importance even though total numbers are below the defined criterion. However, in order to achieve a consistent evaluation of the study areas it has to be accepted that parts of the area are evaluated differently to the entire area which simply reflects the uneven distribution of species over different habitats.

FEBI aerial and ship-based surveys have been taken as the main source for evaluating the importance of the area. Whenever the data allowed distribution modelling of the spatial distribution of a bird species, the evaluation is based on the output of the model. For all other species, spatial differentiation of the evaluation is restricted.

For several species the main data source for describing abundance and distribution are from Natura 2000 monitoring in the SPAs of the area. Data from NATURA 2000 monitoring programmes in Germany (Koop 2008, Koop and Struwe-Juhl 2008) and Denmark (Miljøcenter F., Denmark (unpublished), Storstrøms Amt – Teknik og Miljøforvaltningen 2005, Storstrøms Amt – Teknik og Miljøforvaltningen 2006) were used to describe the baseline conditions. Supplementary data used consist of German coastal counts by OAG Schleswig-Holstein (OAG 2010) and AKVSW Hamburg (AKVSW 2010), Danish mid-winter surveys (Petersen et al. 2006, 2010) and database of bird observations by voluntary ornithologists in Denmark compiled by the Dansk Ornitologisk Forening (DOF 2010, 2011). Even though a full description of the occurrence of the various species in the SPAs will be part of the Appropriate Assessment, the data are displayed here in order to evaluate the general importance of the areas for these species.

5.4.2 Overview

Table 5.6 provides an overview of maximum numbers of waterbird species estimated for the Fehmarnbelt study area as well as numbers estimated for an alignment area, arbitrarily defined to be 5 km around the planned fixed link. Numbers were assessed to be the maximum estimates based on FEBI baseline investigations and supplementary datasets available.

[1] An update of BirdLife International's proposal for designation of marine IBAs is expected in autumn 2011

Table 5.6 *Maximum estimate of non-breeding waterbird species in the Fehmarnbelt study area and for the area of the alignment (5 km around the planned fixed link construction, see Figure 2.21 in FEBI baseline report Volume II). The three columns on the right indicate the derivation of the importance levels based on the combination (Table 5.2) of the conservation status of a species (Table 5.4) with its abundance in the Fehmarnbelt (Table 5.3). Note: The size of the area covered varies with the survey method. Numbers combined with a '+' indicate numbers for different sub-areas obtained by different data packages, which cannot get combined to one maximum number for the entire area.*

Species	Annex I	SPEC category	1% level	Max. estimate in		Max. estimate based on					Conservation status	Abundance	Importance level
				Fehmarnbelt	Alignment area	FEBI aerial surveys	FEBI ship-based surveys	DK mid-winter surveys and land-based counts	DE land-based surveys	Breeding birds in SPAs			
Divers	X	SPEC 3	3,000	1,711	29	X							
Great Crested Grebe		Non-SPEC	3,600	1,540	225		X		X				
Red-necked Grebe		Non-SPEC	510	**1,100**	36		X						
Slavonian Grebe	X	SPEC 3	200	10	single birds			X					
Great Cormorant		Non-SPEC	3,900	**>10,000**	500		X	X	X				
Mute Swan		Non-SPEC^{E}	2,500	**10,400**	100			X	X				
Bewick's Swan	X	SPEC 3W	200	138	no records			X	X				
Whooper Swan	X	Non-SPEC^{E}W	590	**>1,500**	single birds			X	X				
Bean Goose		Non-SPEC^{E}W	6,000	>2,200	single birds			X	X				
Greater White-fronted Goose		Non-SPEC	10,000	>1,900	no records			X	X				
Greylag Goose		Non-SPEC	5,000	**>5,000**	240			X	X				
Barnacle Goose	X	Non-SPEC^{E}	4,200	**>8,000**	single birds			X	X				
Brent Goose		SPEC 3W	2,000	1,800	single birds			X	X				
Eurasian Wigeon		Non-SPEC^{E}W	15,000	**>17,000**	>1,500			X	X				
Gadwall		SPEC 3	600	**>800**	a few tens of birds			X	X				
Common Teal		Non-SPEC	5,000	**>3,000**	several tens of birds			X	X				
Mallard		Non-SPEC	45,000*	>11,000	1,200			X	X				
Shoveler		SPEC 3	400	**>1,000**	single birds			X	X				
Common Pochard		SPEC 2	3,500	**>3,500**	710			X	X				
Tufted Duck		SPEC 3	12,000	**>30,000**	7,100			X	X				
Greater Scaup		SPEC 3W	3,100	**>12,000**	<310			X	X				
Common Eider		Non-SPEC^{E}	7,600	**327,505**	7,395	X							
Long-tailed Duck		Non-SPEC	46,000*	23,800	284		X						
Common Scoter		Non-SPEC	16,000	**66,290**	1,150		X						
Velvet Scoter		SPEC 3	10,000	3,050	275		X						

Species	Annex I	SPEC category	1% level	Max. estimate in		Max. estimate based on					Conservation status	Abundance	Importance level
				Fehmarnbelt	Alignment area	FEBI aerial surveys	FEBI ship-based surveys	DK mid-winter surveys and land-based counts	DE land-based surveys	Breeding birds in SPAs			
Common Goldeneye		Non-SPEC	11,500	6,400	160	X			X				
Smew	X	SPEC 3	400	**>1,400**	single birds			X	X				
Red-breasted Merganser		Non-SPEC	1,700	**7,800**	253		X						
Goosander		Non-SPEC	2,700	>600	161			X	X				
White-tailed Eagle	X	SPEC 1	150	>20	single birds			X	X				
Common Coot		Non-SPEC	17,500	>15,000	340			X	X				
Little Gull	X	SPEC 3	1,230	**5,720**	285	X							
Black-headed Gull		Non-SPEC^{E}	42,000*	8,250	650	X			X				
Common Gull		SPEC 2	20,000	6,700	470	X	X						
Lesser Black-backed Gull		Non-SPEC^{E}	3,800	9	single birds	X	X						
Herring Gull		Non-SPEC^{E}	26,500*	10,600	1,170	X							
Great Black-backed Gull		Non-SPEC^{E}	4,400	1,200	70	X							
Sandwich Tern	X	SPEC 2	1,700	350	a few tens of birds			X					
Common Tern	X	Non-SPEC	11,000	255	42					X			
Arctic Tern	X	Non-SPEC	(20,000)*	150	single birds					X			
Common Guillemot		Non-SPEC	43,000*	10	single birds	X	X						
Razorbill		Non-SPEC^{E}	5,000	1,180	18		X						
Black Guillemot		SPEC 2	105	18	single birds	X	X						

* For populations over 2 million birds, Ramsar Convention criterion 5 (20,000 or more waterbirds) applies. Arctic Tern: estimate in WPE4 given as >1,000,000 without 1% threshold; according to Wahl et al. (2007) leading to the application of the maximum 1% threshold of 20,000 (cf. criterion 5 Ramsar Convention).

** FEBI numbers refer to the smaller model area of ship-based surveys (2,340 km^2).

5.4.3 Species accounts

Red-throated Diver/Black-throated Diver – *Gavia stellata/Gavia arctica*

Following estimates of FEBI baseline investigations and assuming that the majority of divers wintering in the Fehmarnbelt are Red-throated Divers, wintering numbers would comprise up to 0.5% of the biogeographic population of the Red-throated Diver. For the Black-throated Diver the results of FEBI surveys indicate that wintering numbers in the Fehmarnbelt may exceed 0.1% of the biogeographic population of the species (1% = 3,750 birds) in some years. Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area is considered as being of very high importance to Red-throated Diver and of high

importance to Black-throated Diver. Thus, for unidentified divers the Fehmarnbelt area is precautionarily assessed to be of very high importance.

The distribution of divers indicates the species occurring in highest densities in the very southern parts of the study area (Figure 5.1, Figure 5.2). In the alignment area divers were observed mainly near the coast, whereas divers were only rarely observed in the central Fehmarnbelt. Thus, large parts of the alignment area are assessed to be of minor importance to this species group. The general pattern did not differ between winter and spring (Figure 5.1, Figure 5.2).

Importance level	Very high

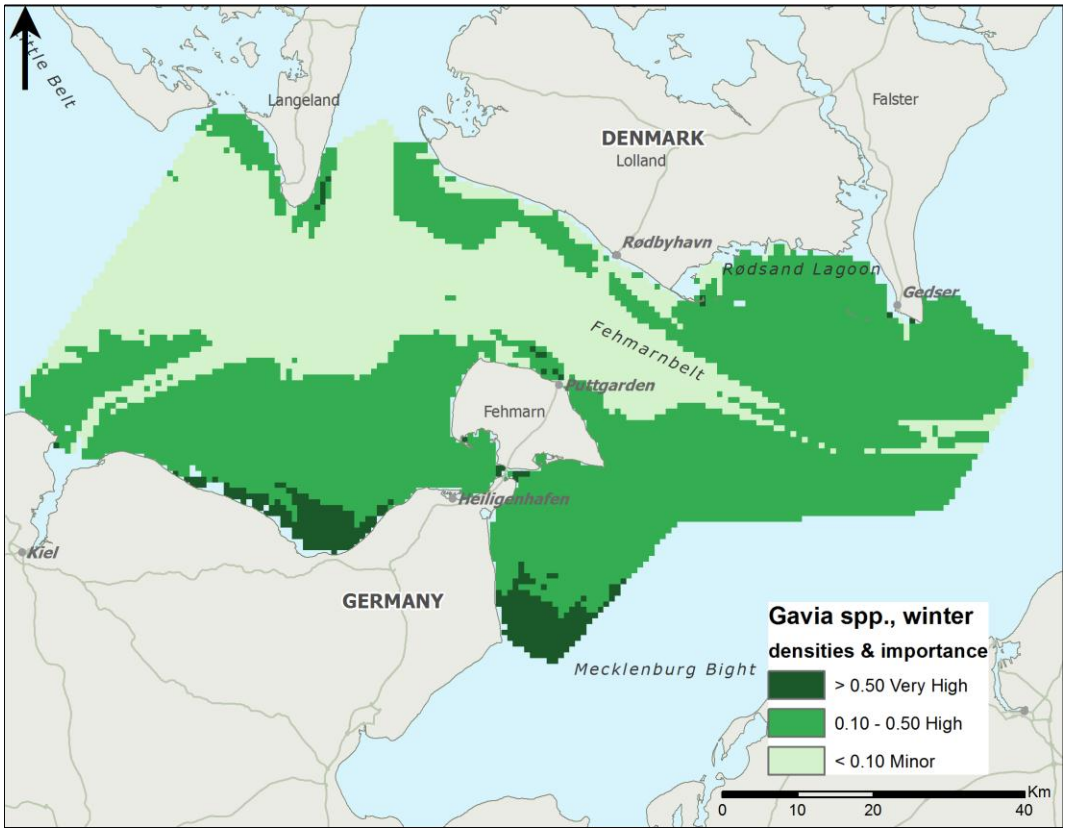

Figure 5.1 *Classification of the importance of Fehmarnbelt to Red-throated and Black-throated Divers during winter (November – early March), based on modelled densities derived from aerial surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.*

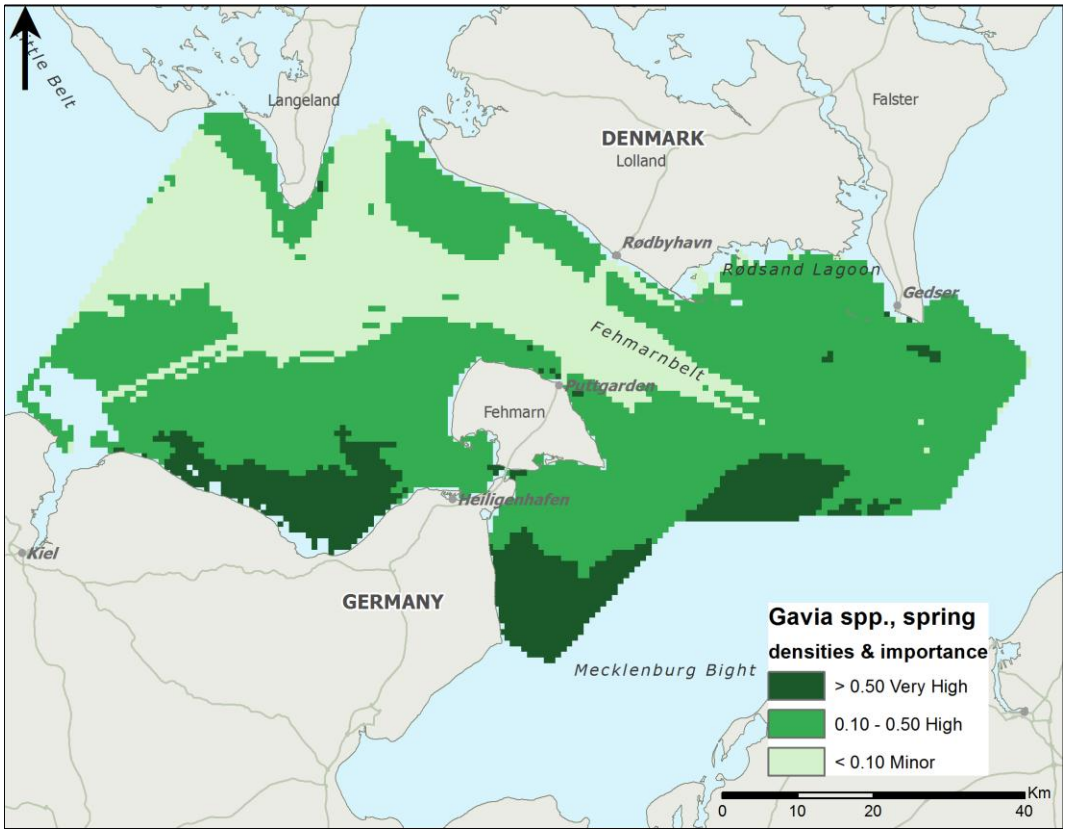

Figure 5.2 Classification of the importance of Fehmarnbelt to Red-throated and Black-throated Divers during spring (March/April), based on modelled densities derived from aerial surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Great Crested Grebe – *Podiceps cristatus*

About 0.3% of the biogeographic population of Great Crested Grebe winters in the Fehmarnbelt, although this proportion may be higher during cold winters. Supplementary datasets indicate that during autumn migration higher numbers occur in coastal areas, especially of Hohwacht Bay (SPA Eastern Kiel Bight). However, there is no indication that internationally important numbers of this species use the Fehmarnbelt area on a regular basis.

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the area is of minor importance to Great Crested Grebe. However, FEBI baseline investigations indicate that this species uses the German coastal areas of the Fehmarnbelt more intensively in some winters, including areas close to the alignment, which partly got classified as being of very high importance to the species according to the observed species distribution in winter 2008/2009 (Figure 5.3).

The subsequent severe winter 2009/2010 showed a very different, more offshore distribution pattern of the species, based on which the coastal areas of Fehmarn and the alignment area were assessed as being mostly of minor importance to Great Crested Grebe (Figure 5.4). The difference in species distribution and habitat use between the two winters of baseline investigations can be explained by the severe winter conditions in 2009/2010, when large parts of especially coastal parts in the study area were covered with ice. Therefore, the Environmental Impact

Assessment will be based on the importance assessment of winter 2008/2009 (Figure 5.3), which represents more typical winter conditions in the region.

Importance level	Minor

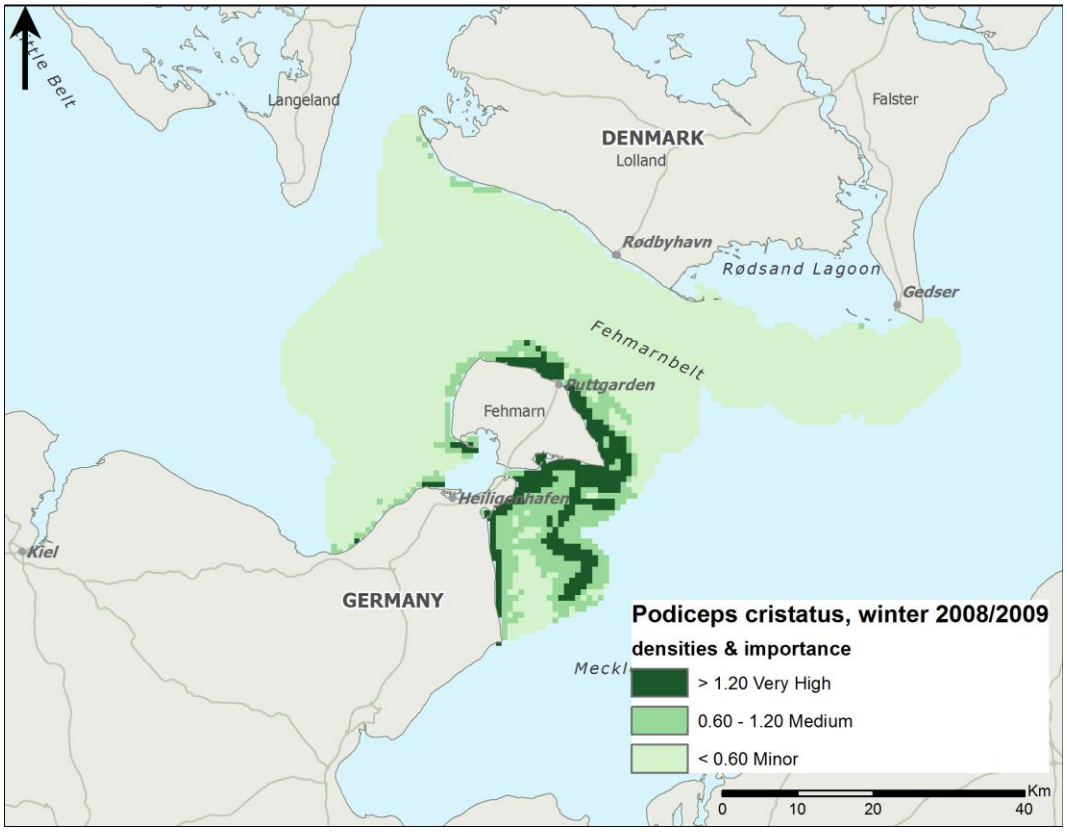

Figure 5.3 Classification of the importance of Fehmarnbelt to Great Crested Grebe during winter 2008/2009 (November – March) based on modelled densities derived from ship-based surveys (Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

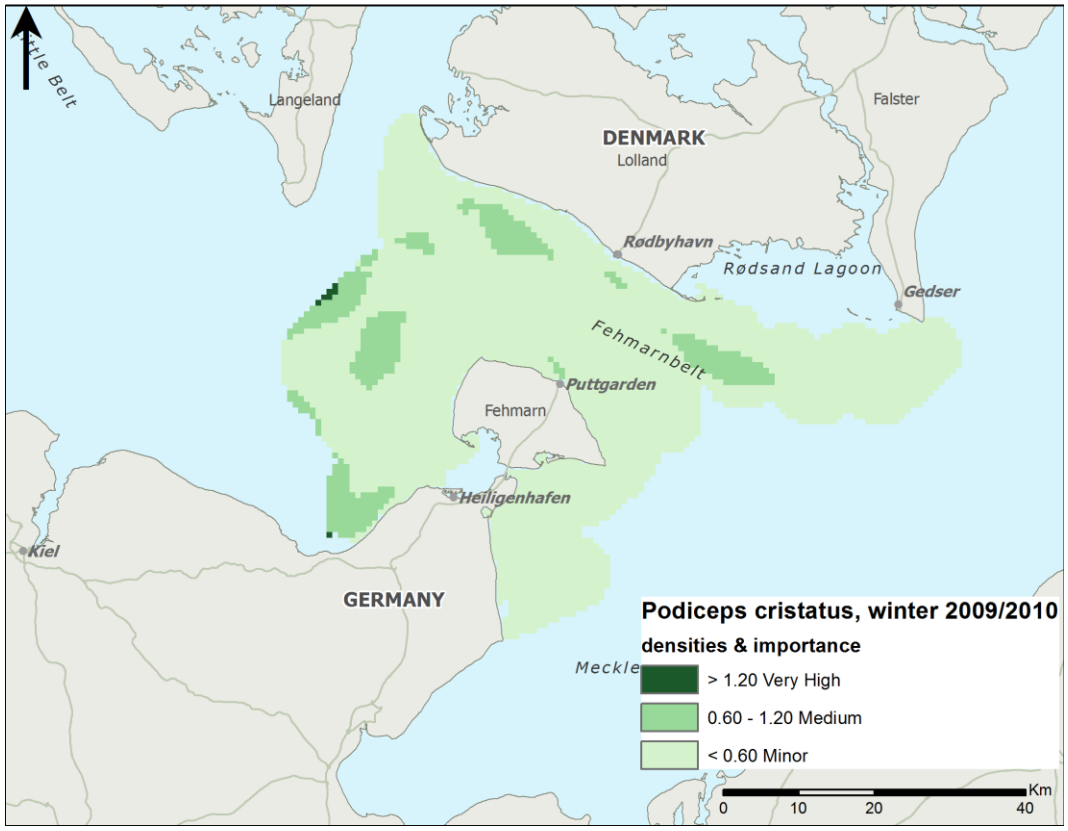

Figure 5.4 *Classification of the importance of Fehmarnbelt to Great Crested Grebe during winter 2009/2010 (November – March) based on modelled densities derived from ship-based surveys (Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.*

Red-necked Grebe – *Podiceps grisegena*

More than 1% of the biogeographic population of Red-necked Grebe (> 510 birds) winters in the ship-based survey area of the Fehmarnbelt. The SPA Eastern Kiel Bight is the most important among protected areas, and supports up to 0.5% of the biogeographic population during the wintering period.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the area is of very high importance to Red-necked Grebe. The distribution of Red-necked Grebes indicates the species being widely distributed in coastal an inshore areas of the study area (Figure 5.5). In the alignment area Red-necked Grebes were observed mainly in coastal areas, whereas the species was only rarely observed in the central Fehmarnbelt. Thus, large parts of the alignment area were assessed to be of minor importance to the species (Figure 5.5).

Importance level	Very high

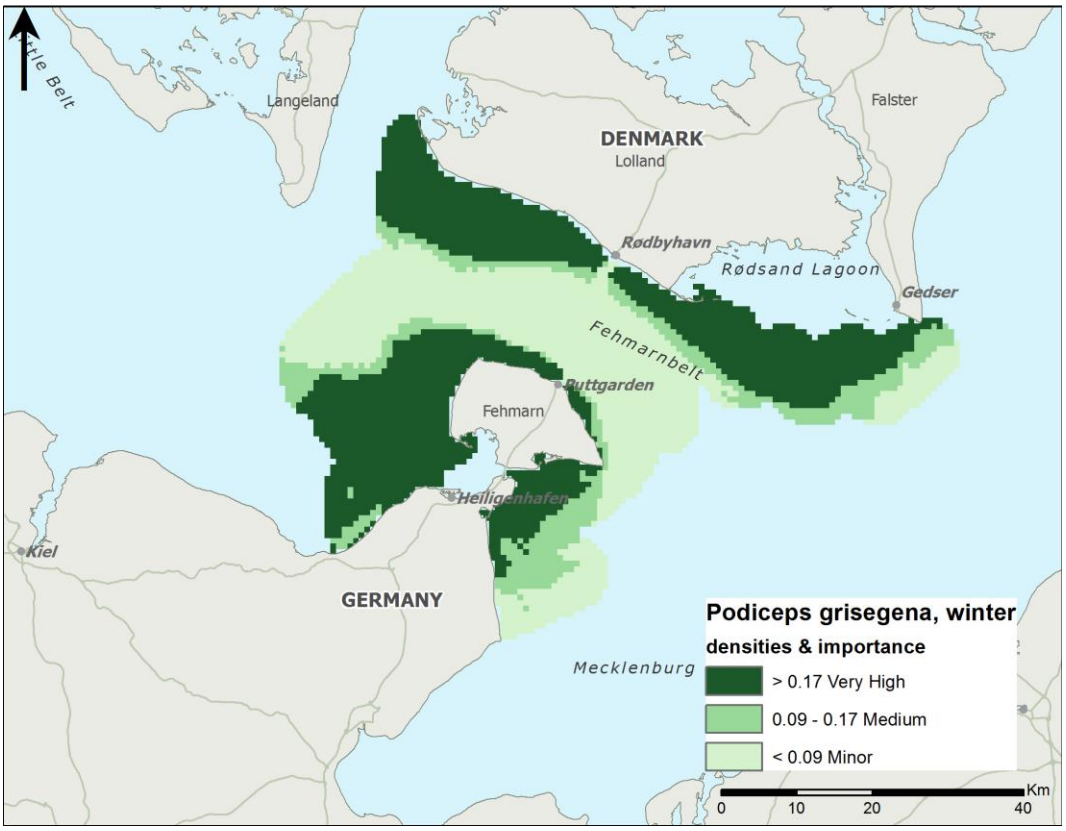

Figure 5.5 Classification of the importance of Fehmarnbelt to Red-necked Grebe during wintering season (October – April) based on modelled densities derived from ship-based surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Slavonian Grebe – *Podiceps auritus*

The Slavonian Grebe is a rare wintering guest in the study area. All available data sources indicate that this species regularly occurs in the Fehmarnbelt during migration and winter periods, but usually only single birds are recorded. Available data sources suggest that the abundance of Slavonian Grebe is unlikely to exceed 0.1% of the biogeographic population (20 birds) in the Fehmarnbelt. Following the criteria of assessing the importance of Fehmarnbelt to a species (Table 5.1) the area is of minor importance to the Slavonian Grebe.

FEBI baseline investigations indicate the species being widely distributed in the study area. There is no indication that major concentrations of Slavonian Grebes occur in any part of the study area, thus also the immediate alignment area is of minor importance to the species.

Importance level	Minor

Great Cormorant – *Phalacrocorax carbo*

The NW European breeding population of *P. c. sinensis* comprises 380,000-405,000 birds (Wetlands International 2006). As the 1% value for this biogeographic population is 3,900 individuals, the baseline results indicate that more than 1% of the population presently uses the Fehmarnbelt area in the course of the year. Available datasets indicate that numbers of international importance occur in the SPAs Hyllekrog-Rødsand (maximum 6,500 birds) and Eastern Kiel Bight (more than 3,900 birds expected). Following the criteria of assessing the importance of the Fehmarnbelt to a species (Table 5.1) the area is of very high importance to the Great Cormorant.

The FEBI baseline investigations showed Great Cormorants aggregating on their roosting sites (e.g. Rødsand), but the species was observed to be widely distributed in the study area while foraging. The immediate alignment area was also highly frequented by the species.

Importance level	Very high

Mute Swan – *Cygnus olor*

Mute Swans are present in high numbers in the study area throughout the year. Within the study area Rødsand Lagoon is an internationally important site since the area regularly supports more than 10,000 moulting Mute Swans during summer months (4.0–6.5% of the biogeographic population). German coastal areas, especially sheltered bays in the south of the island of Fehmarn, regularly hold more than 0.5% of the European Mute Swan population in winter as well (AKVSW 2010, OAG 2010). Following the criteria of assessing the importance of the Fehmarnbelt to a species (Table 5.1) the area is of very high importance to the Mute Swan.

The FEBI baseline investigations showed Mute Swans occurring in highest densities in sheltered bays and lagoons, such as Rødsand Lagoon and Orther Reede, but the species occurred only in low numbers in the shallow coastal areas and was almost absent in deeper water areas. The species occurs in low numbers in the alignment area.

Importance level	Very high

Whooper Swan – *Cygnus cygnus*

The Whooper Swan occurs mainly during transitional periods and winter time in the study area. Internationally important numbers were observed in both Danish and German parts of the Fehmarnbelt. In Denmark the SPA Hyllekrog-Rødsand supports internationally important numbers (886 birds; 1.6% of the biogeographic population; Petersen et al. 2010). In Germany the SPA Eastern Kiel Bight likely meets the 1% criterion in late winter (555 birds counted in February 2010, without Fehmarn being included in the survey; OAG 2010). Following the criteria of assessing the importance of the Fehmarnbelt to a species (Table 5.1) the area in general is of very high importance to the Whooper Swan.

The majority of Whooper Swans counted in Germany were observed inland (89% of the birds recorded during the mid-winter survey of 2009; AKVSW 2010, OAG 2010). In Denmark a high proportion of Whooper Swans was recorded using marine or brackish habitats such as Rødsand Lagoon.

The FEBI baseline investigations and supplementary datasets showed Whooper Swans only rarely occurring in coastal areas of the Fehmarnbelt and only in low numbers in the alignment area.

Importance level	Very high

Bewick's Swan – *Cygnus (columbianus) bewickii*
Bewick‟s Swan is a rare wintering species in the Fehmarnbelt area and is mainly confined to inland habitats. The maximum available number recorded in the study area is one sighting of 138 birds (equalling to 0.7% of the biogeographic population) on inland areas of the SPA Hyllekrog-Rødsand in 2008 (DOF 2010). At the German side a maximum of 61 birds (0.3% of the biogeographic population) were recorded in inland areas of the SPA Eastern Kiel Bight (OAG 2010). Due to the small population size and the protection status of the species the study area is of very high importance to the Bewick's Swan (see criteria Table 5.1). However, the species was mostly observed in inland areas of the SPAs, and only in low numbers in the alignment area.

Importance level	Very high

Bean Goose – *Anser fabalis*
Bean Geese regularly winter in the Fehmarnbelt area, but the species is mostly confined to inland areas. Numbers recorded on the German side are low (maximum count - 102 birds) and all birds were observed inland. Within the Danish study area several hundred birds, occasionally up to 3,000 (equalling up to 0.5% of the biogeographic population) winter inland near Rødsand Lagoon. Thus, according to the criteria of assessing the importance of Fehmarnbelt to a species (Table 5.1) the study area is of medium importance to the species. However, the area between Lolland and Fehmarn and the alignment of a fixed link are usually not used by Bean Geese.

Importance level	Medium

Greater White-fronted Goose – *Anser albifrons*
The highest numbers of Greater White-fronted Geese within the Fehmarnbelt area were recorded in the SPA Eastern Kiel Bight. Available datasets indicate that more than 1,700 birds (> 0.2% of the biogeographic population) utilise this SPA during spring and autumn migration periods (OAG 2010), but there is no indication that numbers exceed 4,500 birds (equalling 0.45% of the biogeographic population) as reported in the Standard Data Form.

In the Danish part of the Fehmarnbelt area the maximum reported number was 200 birds in the SPAs Hyllekrog-Rødsand (DOF 2010).

Greater White-fronted Geese were reported using mostly inland habitats. Marine areas like sheltered lagoons or fjords are only used as resting sites, not as foraging sites. The Danish coastal areas usually support less than 0.1% and the German part of the Fehmarnbelt less than 0.5% of the biogeographic population of the Greater White-fronted Goose. Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area is of minor importance to the species.

Importance level	Minor

Greylag Goose – *Anser anser*
Coastal waters and adjacent inland freshwater habitats in the Fehmarnbelt area support high numbers of resting Greylag Geese especially during autumn migration. Available datasets indicate that the 1% level (5,000 birds) is being reached in the SPA Eastern Kiel Bight. FEBI baseline investigations and supplementary datasets suggest that the SPA Hyllekrog-Rødsand supports more than 0.5% of the biogeographic population (> 2,500 birds) in autumn.

According to the Danish mid-winter survey of 2008 (Petersen et al. 2010), 29% of Greylag Geese were observed inland. According to the German mid-winter coastal counts in 2009, 61% of Greylag Geese were recorded inland (AKVSW 2010, OAG 2010). Although a substantial proportion of Greylag Geese use marine habitats as resting and retreat areas, the key feeding grounds are located inland (Berndt et al. 2005).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the entire study area is of very high importance to Greylag Goose. However, due to the predominantly inland distribution of the species, only low numbers were recorded in the alignment area.

Importance level	Very high

Barnacle Goose – *Branta leucopsis*
Barnacle Geese can be observed in the study area mainly during the migration periods in autumn and spring. However, there is also an increasing trend in the number of birds that stay in the area for the wintering period (Berndt et al. 2005, Petersen et al. 2010). Most Barnacle Geese pass the Fehmarnbelt area without stops during migration periods. However, high numbers of resting birds have been recorded in the area for short periods in autumn.

More than 0.5% of the biogeographic Barnacle Goose population use the SPA Eastern Kiel Bight in autumn, but numbers reaching the 1% level (4,200 birds) are not expected within the German part of the study area.

In Denmark, the SPA Hyllekrog-Rødsand usually supports between 0.5% and 1.0% of the biogeographic population. During the recent ten years the 1% criterion of international importance was only met once, when 5,350 Barnacle Geese (1.3% of the biogeographic population) were observed resting in the area in October 2007 (DOF 2010).

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area is of very high importance to the species. However, the area between Lolland and Fehmarn and the alignment of a fixed link are usually not used by resting Barnacle Geese.

Importance level	Very high

Brent Goose – *Branta bernicla*
The majority of Brent Geese pass the Fehmarnbelt during migration without stopping. Birds that were observed resting in the Fehmarnbelt usually use the area only for a short break during migration. In the German part of the study area only low numbers have been recorded and resting flocks rarely exceed 20 individuals. Higher numbers have been recorded in Rødsand Lagoon with a maximum count of 1,800 birds, corresponding to 0.9% of the biogeographic population.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area is of high importance to the species. However, the area between Lolland and Fehmarn and the alignment of a fixed link are usually not used by Brent Geese.

Importance level	High

Eurasian Wigeon – *Anas penelope*

The Eurasian Wigeon is a common species in shallow water areas of the Fehmarnbelt, where the species mainly feeds on aquatic vegetation. In winter the species is also found inland feeding on arable crops. Highest numbers usually occur in the area in late autumn. Analysed datasets and literature indicate that sheltered marine areas of the Fehmarnbelt, especially around the island of Fehmarn, are frequently used by this species. A German coastal count in January 2009 indicates more than 0.75% of the biogeographic population (> 10,000 birds) wintering in the area (AKVSW 2010, OAG 2010). As Fehmarn mid-winter counts in some years nearly met the 1% criterion and autumn numbers are usually higher than numbers in mid-winter, it is expected that regularly more than 1% of the biogeographic population uses the German part of the Fehmarnbelt. The Danish part of the Fehmarnbelt supports comparably low numbers of Eurasian Wigeon with a total number rarely exceeding 1,500 birds (0.1% of the biogeographic population; DOF 2010, Petersen et al. 2010).

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area is of very high importance to Eurasian Wigeon. During FEBI baseline investigations the species was observed being confined to shallow coastal areas and sheltered bays and lagoons.

Importance level	Very high

Gadwall – *Anas strepera*

The Gadwall is present in the Fehmarnbelt area all year, but highest numbers are usually observed in spring and autumn periods, when birds are mostly recorded on inland freshwater habitats. Wintering numbers are generally low, but an increasing trend of wintering birds has been recorded. Internationally important numbers of Gadwall (>600 birds) have been recorded in the German study area, where the SPA Eastern Kiel Bight is expected to meet the 1% criterion of international importance regularly. Gadwall numbers in the Danish Fehmarnbelt rarely exceed the 0.1% of the biogeographic population (maximum count 64 birds in Rødsand Lagoon in April 2009, equalling 0.11% of the biogeographic population; DOF 2010).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area is of very high importance to the species. However, the baseline investigations showed Gadwall mainly using inland areas and only rarely occurred in the immediate alignment area.

Importance level	Very high

Common Teal – *Anas crecca*

The Common Teal is present in the Fehmarnbelt area all year. Highest numbers are typically observed during migration periods, especially in autumn, when birds are mostly recorded using inland freshwater habitats. In winter the numbers of Common Teal drop remarkably in the study area. Supplementary datasets indicate

higher numbers of Common Teal occurring along the German coast on inland areas of the SPA Eastern Kiel Bight, where maximum numbers are expected to reach and exceed 0.5% of the biogeographic population in some years. In Denmark coastal areas of Rødsand Lagoon regularly support more than 100 Common Teal, but internationally important numbers were not reported for this area (DOF 2010).

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area is of medium importance to the species. The baseline investigations showed Common Teal only rarely using the marine areas between Lolland and Fehmarn and the immediate alignment area of a fixed link.

Importance level	Medium

Mallard – *Anas platyrhynchos*

The Mallard is a very common species in Europe and occurs in high numbers in coastal areas of the Danish and German parts of the Fehmarnbelt. The species is present in the area all the year with highest numbers being reported during winter months. The species is widely distributed within the study area and occurs in numbers reaching several thousand individuals (7,400 birds for the German part of the study area in January 2009; AKVSW 2010, OAG 2010; 3,250 birds in coastal areas of the Danish Fehmarnbelt in February 2008; Petersen et al. 2010). There were no internationally important numbers of Mallard recorded in the Fehmarnbelt area.

Following the criteria of assessing the importance of Fehmarnbelt to a species (Table 5.1) the study area was assessed to be of minor importance to Mallard.

Importance level	Minor

Shoveler – *Anas clypeata*

Shoveler is present in the Fehmarnbelt area all year, but wintering numbers are usually very low. Highest numbers are typically observed during migration periods in spring and autumn, when birds are mostly recorded on inland freshwater habitats. In autumn internationally important numbers of Shoveler regularly occur on the German side of the Fehmarnbelt, especially within the SPA Eastern Kiel Bight, where e.g. almost 1,000 Shoveler (2.5% of the biogeographic population) were recorded on the inland lake Großer Binnensee in September 2009 (OAG 2010). Within coastal habitats of the Danish study area Shoveler is rarely recorded and numbers usually do not exceed 0.1% of the biogeographic population (DOF 2010).

Following the criteria of assessing the importance of the Fehmarnbelt to a species (Table 5.1) the study area (including inland areas of the SPAs) was assessed to be of very high importance to Shoveler. However, the species is mainly confined to inland areas.

Importance level	Very high

Common Pochard – *Aythya ferina*

Common Pochard is a common species in the Fehmarnbelt area, which is more abundant during the non-breeding period between September and March. Analysed datasets and literature indicate that sheltered marine areas of the Fehmarnbelt are frequently used by this species. German coastal waters support approximately

1,750 Common Pochard counted in the area in January 2009 (AKVSW 2010, OAG 2010), which corresponds to 0.5% of the biogeographic population of the species. Aggregations were found in the two German SPAs Eastern Kiel Bight and Baltic Sea east of Wagrien with main resting areas located along the mainland coast and in the south of the island of Fehmarn. Long-term dataset analysed by Kieckbusch (2010) suggest that internationally important numbers of Common Pochard may occur in the German Fehmarnbelt area in some years.

No internationally important numbers of this species were recorded for the Danish part of the study area (DOF 2010). Aggregations were reported in the SPA Hyllekrog-Rødsand, where a maximum of 1,800 Common Pochard (equalling 0.5% of the biogeographic population) were recorded, but usually numbers are much lower in this area (DOF 2010, Petersen et al. 2006, 2010). High numbers of up to 9,480 Common Pochard occur at Maribo Lakes (DOF 2010).

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area (including inland areas of the SPAs) was assessed to be of very high importance to Common Pochard. The baseline investigations indicate that the species occurs in higher densities in sheltered areas and also uses the immediate areas around the ferry harbours in high numbers for resting. The species is night-time active, thus night-time distribution may differ. However, it is expected that the alignment area is also of high importance for night-time foraging of the species.

Importance level	Very high

Tufted Duck – *Aythya fuligula*

The shallow coastal waters of the Baltic Sea and adjacent inland lakes in the Fehmarnbelt area represent an internationally important wintering area for Tufted Ducks. Depending on winter conditions up to several 10,000s of individuals can be present in the Fehmarnbelt area. More than 20,000 Tufted Ducks have been reported for the SPA Maribo Lakes (Jørgensen 1990), and at least some of these birds are expected to use Fehmarnbelt for night foraging (Skov et al. 1998). Internationally important numbers were also reported for the SPA Hyllekrog-Rødsand (17,500 birds; equals 1.5% of the biogeographic population) and the SPA Guldborgsund (22,500 birds; equals 1.9% of the biogeographic population), indicating that 1-2% of the biogeographic population regularly uses the Danish part of Fehmarnbelt in winter.

Internationally important numbers of 14,000 Tufted Ducks (1.2% of the biogeographic population; minimum estimate due to incomplete coverage of coastal areas by this survey) also occur in German coastal areas of the Fehmarnbelt (mid-winter survey 2009; AKVSW 2010, OAG 2010), with especially high aggregations being observed in the Fehmarnsund area (Berndt et al. 2005).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area (including inland areas of the SPAs) was assessed to be of very high importance to Tufted Duck. The baseline investigations indicate that the species occurs in higher densities in sheltered areas, such as Fehmarnsund, than in the immediate alignment area, but also the areas around the ferry harbours hold high important numbers of resting Tufted Ducks. The species is night-time active, thus night-time distribution may differ. However, it is expected that the alignment area is also of high importance for night-time foraging of the species.

Importance level	Very high

Greater Scaup – *Aythya marila*
The numbers of wintering Greater Scaup in the study area are highly variable among years. For the Baltic Sea coast of Schleswig-Holstein numbers are described to vary between 50,000 birds in severe winter conditions to comparably low numbers in mild winters (Berndt and Busche 1993). High variability in winter number was also observed in the analysed datasets of 2009-2011. Whereas 1,716 birds counted along the mainland coast of Kiel Bight were comparably low in winter 2009, more than 10,000 Greater Scaup were recorded in the same area in winters 2010 (OAG 2010) and 2011 (Wilfried Knief pers. comm.). These records show that more than 3% of the biogeographic population of Greater Scaup regularly occur in the SPA Eastern Kiel Bight, indicating this area being of international importance to this species. In some years internationally important numbers are also expected to occur in the SPA Baltic Sea east of Wagrien, especially in the Fehmarnsund area (Kiekbusch 2010).

There is no indication of internationally important concentrations of Greater Scaup wintering in the Danish part of the Fehmarnbelt (< 0.1% of the biogeographic population).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area (including inland areas of the SPAs) was assessed to be of very high importance to Greater Scaup. The baseline investigations showed the species using the areas between Lolland and Fehmarn and the alignment area of a fixed link, but internationally important numbers were only observed in the south-western part of the study area in the Kiel Bight.

Importance level	Very high

Common Eider – *Somateria mollissima*
The total number of Common Eiders in the Western Palearctic has been estimated at between 1.82 and 2.38 million, of which 760,000 comprise the Wadden Sea – Baltic Sea population (Wetlands International 2006). The uncertainties regarding the size of the flyway population are mainly due to uncertain estimates of the breeding populations in NW Russia and Iceland (Wetlands International 2006).

Up to 18% of the Western Palearctic winter population and up to 43% of the Wadden Sea – Baltic Sea population winters in the Fehmarnbelt. Numbers of Common Eider in the Fehmarnbelt as estimated from the present study are higher than previous studies and possibly reflect a local increase against the background of a general decrease of the population. The feasibility study, however, reported similar estimates (Skov et al. 1998). This renders the Fehmarnbelt to be probably the most important region for this biogeographic population of Common Eider.

The baseline confirms the results of the feasibility study and monitoring programmes in both countries that Common Eiders aggregate on Flüggesand, Sagasbank, Stoller Grund, Albue Bank, Hyllekrog and Gedser Rev which harbour numbers of international importance. The very high importance of the SPAs Eastern Kiel Bight and Baltic Sea east of Wagrien to wintering Common Eiders has been confirmed. Consequently, the Fehmarnbelt area was assessed to be of very high importance to the species.

The FEBI baseline investigations indicate major parts of the study area being of very high importance to the species (Figure 5.6, Figure 5.7). However, it has to be noted that within the areas classified to be of very high importance to Common Eider according to the definition of the assessment criteria, large differences exist and the map does not reflect the main concentration areas (see distribution maps

in Volume II, chapter 4.1.22). The area of the alignment of a fixed link showed lower densities of Common Eider in the offshore areas, where large areas are assessed to be of minor to medium importance. The general distribution pattern did not differ between winter and spring (Figure 5.6, Figure 5.7).

Importance level	Very high

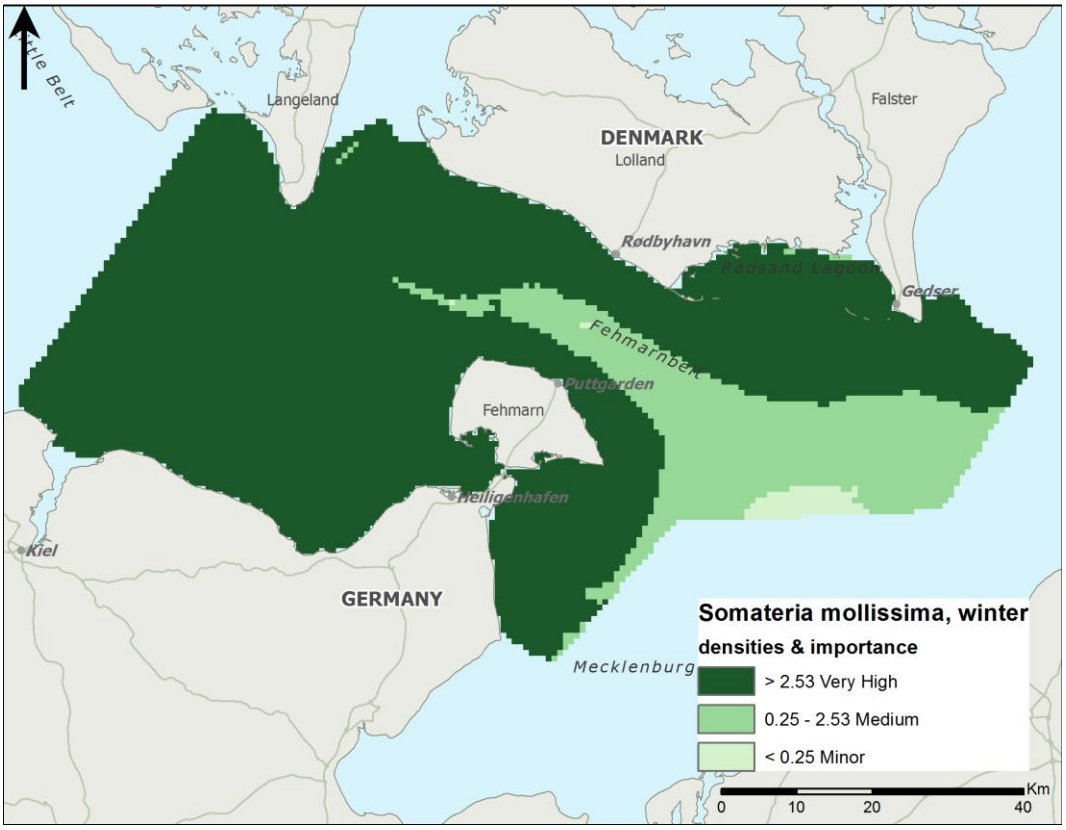

Figure 5.6 *Classification of the importance of Fehmarnbelt to Common Eider during winter (November – early March), based on modelled densities derived from aerial surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.*

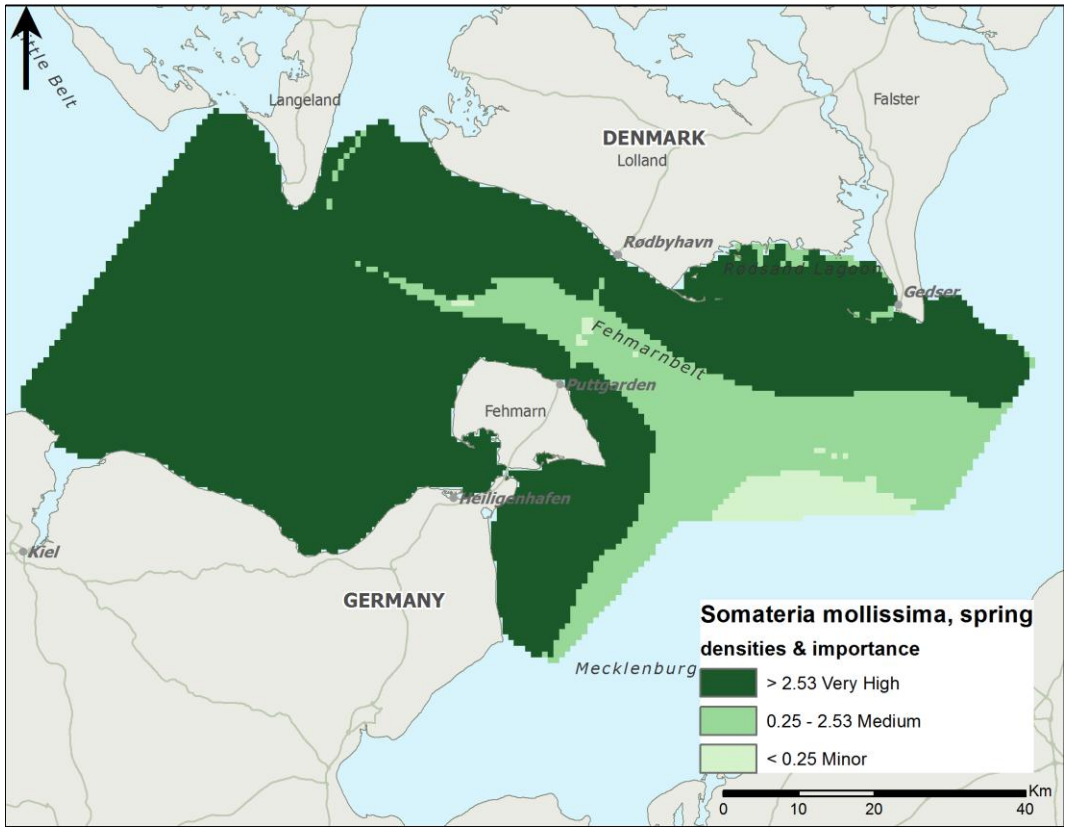

Figure 5.7 *Classification of the importance of Fehmarnbelt to Common Eider during spring (March/April), based on modelled densities derived from aerial surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.*

Long-tailed Duck – *Clangula hyemalis*

Considering the population size suggested by Wetlands International (2006), about 0.5% of the biogeographic population of Long-tailed Duck regularly uses the Fehmarnbelt area. Accounting for the latest population decline by more than 50% (Skov et al. in press), Long-tailed Duck numbers would meet the 1% criterion of international importance. The Southern Baltic, including the Fehmarnbelt, represents the southernmost end of the distribution range of the Long-tailed Duck (Durinck et al. 1994; Wetlands International 2006).

The winter distribution of Long-tailed Duck in the study area indicate highest densities occurring in the SPAs Baltic Sea east of Wagrien and Eastern Kiel Bight at Sagasbank and Flüggesand, but also southeast of Rødsand Lagoon and southwest of Lolland (Figure 5.8). The immediate alignment area holds only low numbers of Long-tailed Duck and is mostly of minor importance to the species (Figure 5.8).

Importance level	Very high

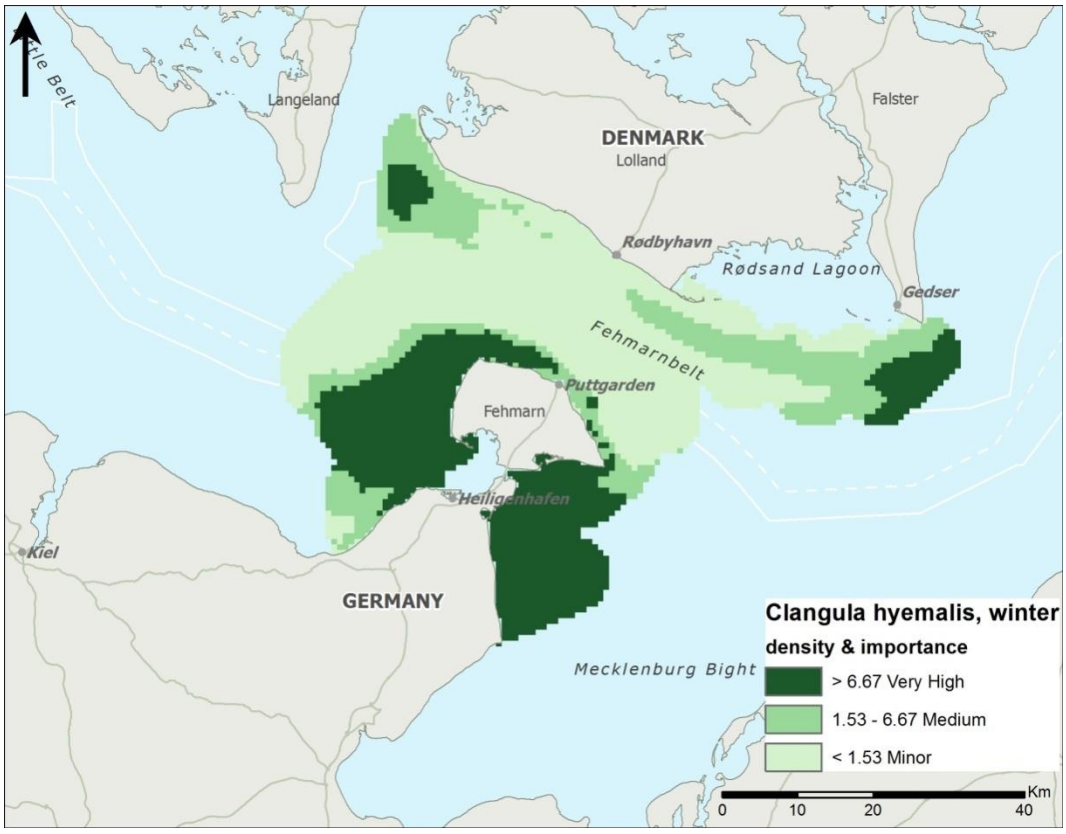

Figure 5.8 Classification of the importance of Fehmarnbelt to Long-tailed Duck during wintering season (November – April), based on modelled densities derived from ship-based surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Common Scoter – *Melanitta nigra*

The total number of Common Scoter in the Western Palearctic has been estimated at 1.6 million (Wetlands International 2006). The baseline results for 2008/2009 indicate that about 3-4% of the Western Palearctic population occur in the Fehmarnbelt.

FEBI baseline investigations confirm the results of the feasibility study and waterbird monitoring in Germany that Common Scoters aggregate on Flüggesand and Sagasbank, both sites being of international importance for the species.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of very high importance to Common Scoter. However, the species was not evenly distributed in the study area with highest densities observed in the SPAs Eastern Kiel Bight Baltic Sea east of Wagrien, but also in offshore areas southeast of Rødsand Lagoon and southwest of Lolland (Figure 5.9). Large parts of the area between Lolland and Fehmarn and the alignment area of a fixed link show lower densities of Common Scoter and were consequently assessed to be of minor importance to the species (Figure 5.9).

Importance level	Very high

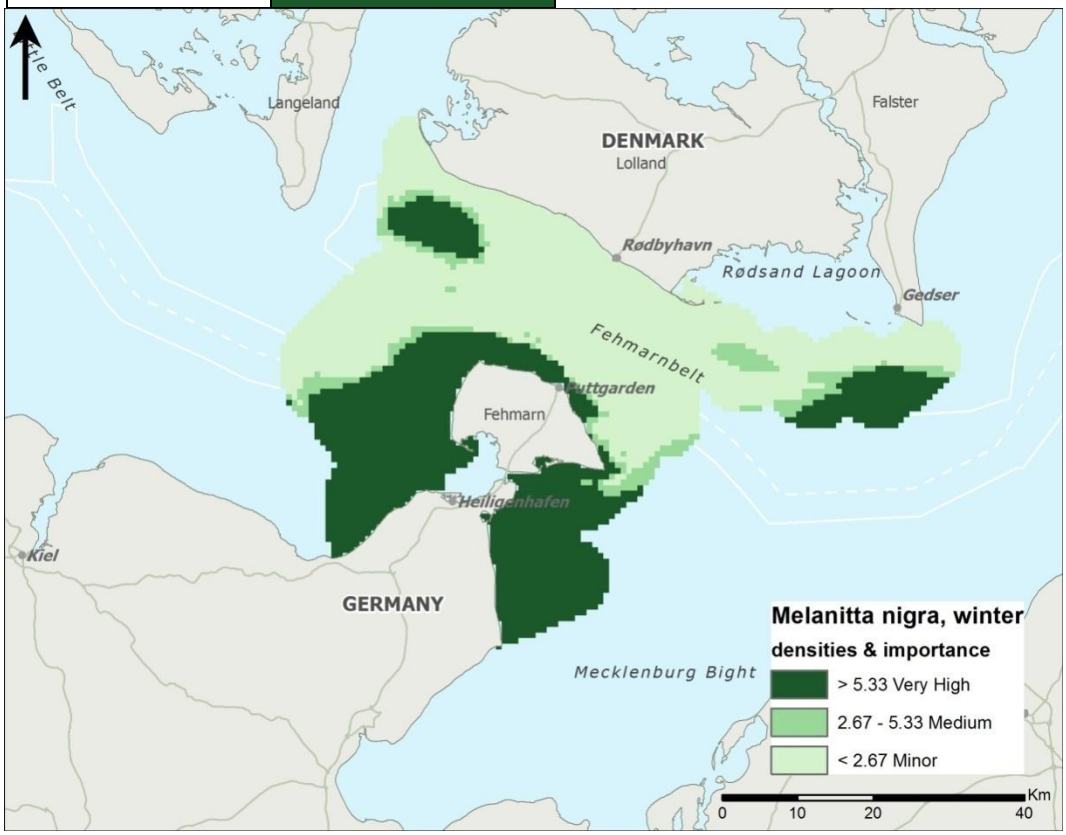

Figure 5.9 Classification of the importance of Fehmarnbelt to Common Scoter during wintering season (November – April), based on modelled densities derived from ship-based surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Velvet Scoter – *Melanitta fusca*

The population of Velvet Scoter wintering in the Baltic Sea and Western Europe has been estimated at 1 million (Wetlands International 2006). In the first year (2008/2009) of FEBI baseline investigations only low numbers of Velvet Scoter were observed in the Fehmarnbelt. A maximum of 83 birds was recorded during the ship-based survey in March 2009. The species was more numerous during the second year of baseline investigations (2009/2010) with estimated numbers regularly exceeding 1,000 birds in late winter (maximum estimate 3,050 birds in March 2010; equals to 0.3% of the biogeographic population).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of high importance to the Velvet Scoter. Velvet Scoters were mainly observed associated with Common Scoters and showed a similar distribution pattern. Thus, the areas between Lolland and Fehmarn and the alignment area of a fixed link held lower numbers of Velvet Scoters than e.g. the area west of Fehmarn.

Importance level	High

Common Goldeneye – *Bucephala clangula*

The estimate of the northwest European winter population of Common Goldeneye has been updated to 1.0–1.3 million birds (Wetlands International 2006). As the

1% criterion for this population is 11,500 birds the FEBI baseline results and supplementary datasets indicate that on average approximately 0.25% of this population winters in the Fehmarnbelt area and reach 0.5% during the periods of peak abundance. High numbers representing more than 0.1% of the biogeographic population occur in the SPAs Hyllekrog-Rødsand and Eastern Kiel Bight.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of medium importance to Common Goldeneye. The FEBI baseline investigations showed that the species aggregates mostly in sheltered coastal areas, such as Rødsand Lagoon or the Fehmarnsund and is almost absent in the offshore areas (Figure 5.10). Due to a likely underestimation of Common Goldeneye densities along the mainland coast of the Kiel Bight by the spatial model, the importance classification of coastal areas of Kiel Bight may be too low. The large areas between Lolland and Fehmarn and the alignment of a fixed link were assessed to be mostly of minor importance to the species (Figure 5.10).

Importance level	Medium

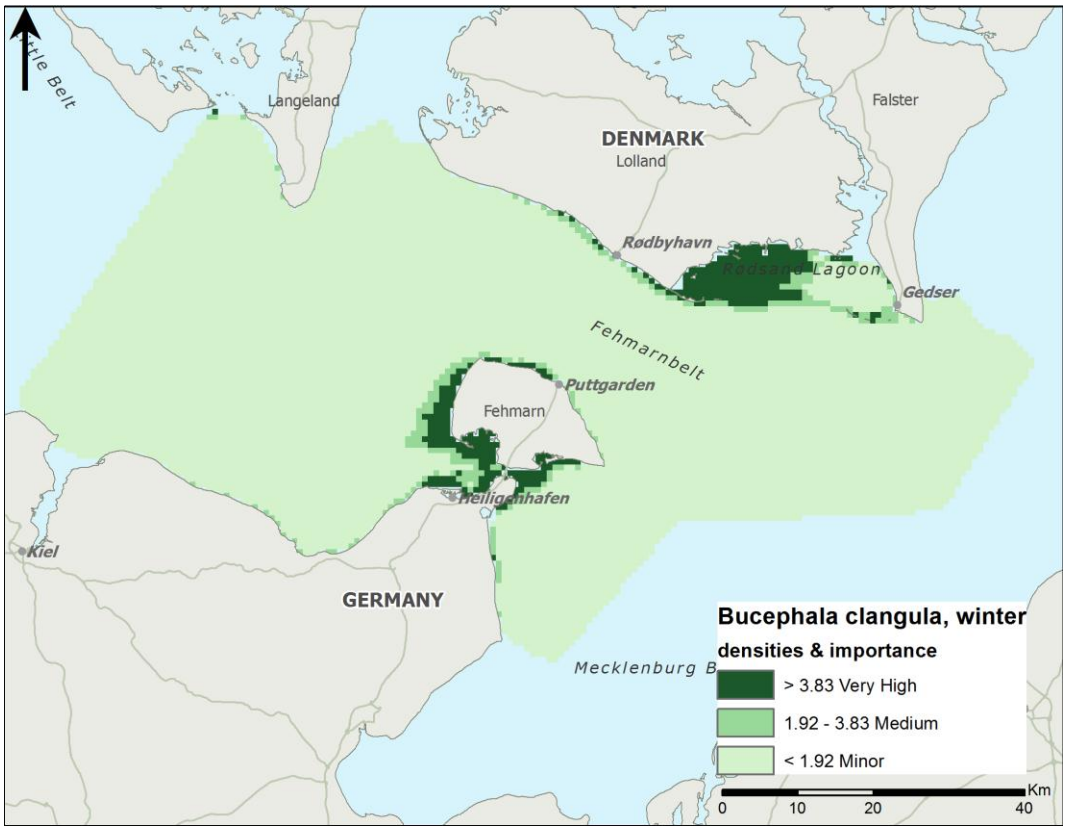

Figure 5.10 Classification of the importance of Fehmarnbelt to Common Goldeneye during wintering season (November – April), based on modelled densities derived from aerial surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Smew – *Mergus albellus*

The Baltic Sea is an important wintering area for the northwest European Smew population (Sudfeldt et al. 2003). The Fehmarnbelt area lies outside of the core wintering range in the Baltic (Sudfeldt et al. 2003). However, internationally important numbers of Smew were observed in the Fehmarnbelt region during

wintering period with a peak of 1,300 birds (3.3% of the biogeographic population) counted in the SPA Hyllekrog-Rødsand alone (January 2009; DOF 2010). Numbers occurring in the study area vary substantially depending on winter conditions; and more birds were recorded during cold winters (Berndt et al. 2005). Smew abundance regularly exceeds the 1% population threshold in the SPA Hyllekrog-Rødsand (DOF 2010).

The highest number of Smew on the German side of the study area is 163 individuals recorded during the mid-winter land-based count of 2009, but this is a rather exceptional occurrence (AKVSW 2010, OAG 2010). There is no indication that more than 0.5% of the biogeographic population would be regularly present in the German part of the Fehmarnbelt. However, exceptionally high number of 604 Smew counted in Fehmarnsund and Burger Binnensee in January 2003 shows that internationally important numbers are occasionally observed in the area.

During the FEBI aerial survey of late winter 2009/2010 relatively high numbers of Smew were recorded in offshore areas of the Fehmarnbelt (47 birds in March 2010). This case, however, represents atypical habitat use of the species when all inland and coastal waters were covered with ice and forced the Smew to aggregate offshore.

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area was assessed to be of very high importance to Smew. The FEBI baseline investigations showed that the species aggregates mostly in sheltered coastal areas, such as Rødsand Lagoon or the Fehmarnsund and is only rarely observed in the offshore areas.

Importance level	Very high

Red-breasted Merganser – *Mergus serrator*

FEBI baseline investigations revealed that up to 7,800 Red-breasted Mergansers may use the Fehmarnbelt area as it occurred in the severe winter of 2010. This number corresponds to 4.6% of the biogeographic population making the Fehmarnbelt of international importance for this species (1% of the population, equals to 1,700 birds). Beside this unusual high estimate spatial modelling and Distance analysis estimates suggested that more than 1% of the Red-breasted Merganser population regularly winters in the Fehmarnbelt. However, none of the SPAs in the Fehmarnbelt was found holding internationally important numbers of this species.

The baseline investigations show the species is not evenly distributed in the study area, but mainly concentrating in sheltered areas like Rødsand Lagoon and being mostly confined to the inshore zone (Figure 5.11). Consequently, also coastal areas between Lolland and Fehmarn and the alignment area of a fixed link were assessed to be partly of very high importance to the species, but the larger part of the deep water alignment area was assessed to be of minor importance to the species (Figure 5.11).

Importance level	Very high

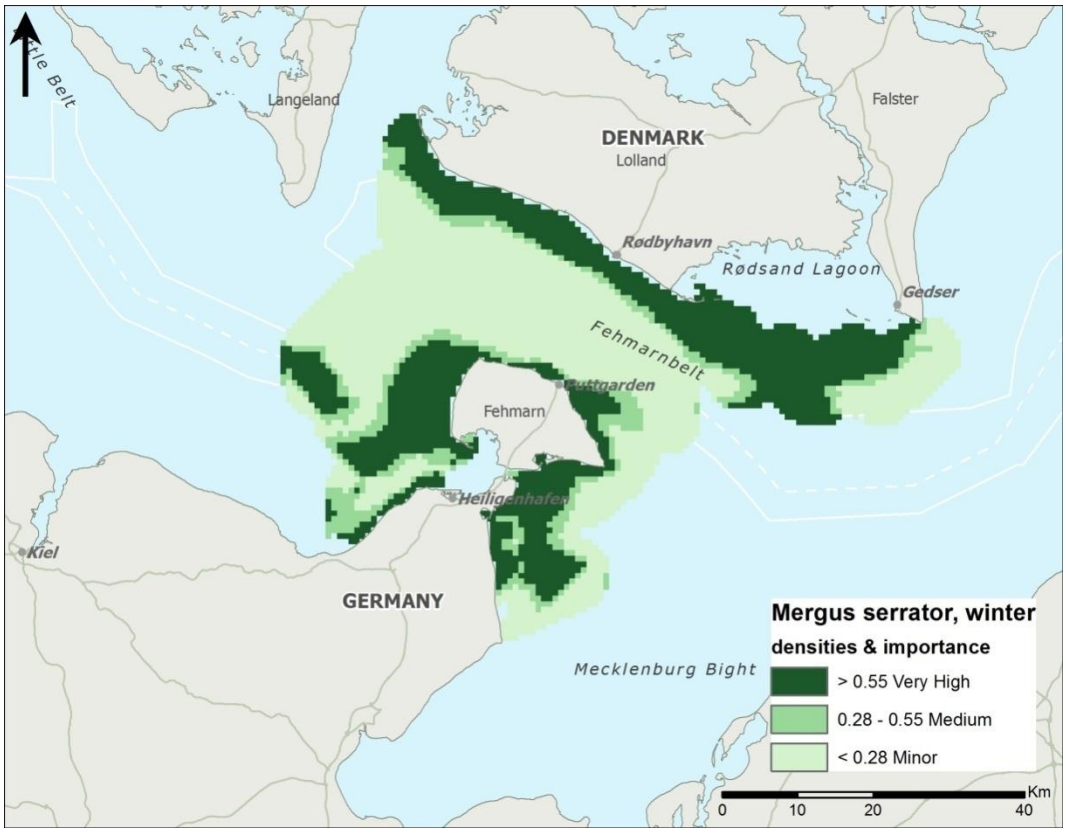

Figure 5.11 Classification of the importance of Fehmarnbelt Red-breasted Merganser during wintering season (November – April), based on modelled densities derived from ship-based surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to the criteria described in Table 5.1. Note: Only three out of four importance criteria are represented as a consequence of definitions in Table 5.2.

Goosander – *Mergus merganser*

Results of the baseline investigations and supplementary datasets indicate that less than 1% of the biogeographic Goosander population uses the Fehmarnbelt area in the course of the year. Numbers in the SPA Eastern Kiel Bight regularly exceed 0.1% of the biogeographic population (270 birds; OAG 2010), in the SPA Hyllekrog-Rødsand numbers exceeding this level are only exceptionally reported (DOF 2010). Wintering Goosanders use inland freshwater habitats, shallow coastal waters and sheltered bays and lagoons in the study area.

Importance level	Minor

White-tailed Eagle – *Haliaeetus albicilla*

The Fehmarnbelt area is regularly used by staging or wintering White-tailed Eagles. The area is important as a feeding ground for year-round present resident birds, with several breeding pairs on the German and the Danish side, but also juvenile and immature birds are expected to use the Fehmarnbelt. During winter, numbers of White-tailed Eagles on the Danish side of the Fehmarnbelt can reach 20 individuals and more (> 0.1% of the biogeographic population). However, even the

maximum numbers observed in cold winters in the Fehmarnbelt do not represent more than 0.3% of the biogeographic population of the species.

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area was assessed to be of high importance to White-tailed Eagle.

Importance level	High

Common Coot – *Fulica atra*

Analyses of supplementary datasets suggest that 0.1-0.5% of the Common Coot biogeographic population winters in the coastal areas of the German Fehmarnbelt (maximum count of 6,500 birds recorded in January 2010; AKVSW 2010, OAG 2010). Higher numbers of this species occur in the Danish waters of the Fehmarnbelt with highest aggregations reported for the SPA Hyllekrog-Rødsand (max. 8,500 birds in February 2006; DOF 2010) representing almost 0.5% of the biogeographic population. This indicates that also numbers exceeding 0.5% of the population might occur in the Danish part of the study area in some years. However, recent data sources do not indicate that the 1% criterion of international importance (17,500 birds) is reached neither in the Danish nor in the German part of the study area at any time of the year.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed as being of medium importance to Common Coot. FEBI baseline investigations showed that the species aggregates mostly in sheltered coastal areas, such as Rødsand Lagoon, and is almost absent in the offshore areas.

Importance level	Medium

Little Gull – *Larus minutus*

As the 1% criterion for the Little Gull population is 1,230 individuals. The results of the FEBI baseline investigations indicate that more than 4% of the biogeographic population occur in the Fehmarnbelt area during transitional periods.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed as being of very high importance to Little Gull. The FEBI baseline investigations showed the species using the entire study area with no aggregation areas detectable. Thus, also the areas between Lolland and Fehmarn and the alignment area of a fixed link are used by this species.

Importance level	Very high

Black-headed Gull – *Larus ridibundus*

The baseline results and supplementary datasets indicate that numbers of Black-headed Gull using the Fehmarnbelt area do not meet international importance criteria due to the large population size of this species. Between 5,000 and 10,000 birds use the study area. Aggregations of more than 8,000 Black-headed Gulls were reported for the SPA Eastern Kiel Bight, but a high proportion (40%) of these birds was counted on inland parts of this SPA (OAG 2010).

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of medium importance to Black-headed Gull. The FEBI baseline investigations showed the species using the entire study area with no

aggregation areas detectable. Thus, also the areas between Lolland and Fehmarn and the alignment area of a fixed link are frequently used by this species.

Importance level	Medium

Common Gull – *Larus canus*

Common Gull is an abundant and common species, and is present in the Fehmarnbelt area all year. The highest numbers typically occur during transitional periods. FEBI baseline investigations and supplementary datasets indicate several thousands of birds using the area regularly with the highest estimate of 6,700 birds (0.3% of the biogeographic population) for the entire Fehmarnbelt area.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of high importance to Common Gull. The FEBI baseline investigations showed the species using the entire study area with no aggregation areas detectable. Thus, also the areas between Lolland and Fehmarn and the alignment area of a fixed link are frequently used by this species.

Importance level	High

Lesser Black-backed Gull – *Larus fuscus*

The FEBI baseline investigations and supplementary data sources indicate Lesser Black-backed Gulls regularly occurring in the Fehmarnbelt area between spring and autumn, but numbers are low with mostly single birds being recorded. It can be concluded that a very low proportion (< 0.1%) of the biogeographic population uses the Fehmarnbelt area in the course of the year.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of minor importance to Lesser Black-headed Gull.

Importance level	Minor

Herring Gull – *Larus argentatus*

The Herring Gull is an abundant and common species, and is present in the Fehmarnbelt area all the year. Highest numbers occur in winter time, when FEBI baseline investigations and supplementary datasets indicate more than 11,000 birds using the area. The species is widely distributed in the Fehmarnbelt and distribution patterns vary among surveys. The baseline results indicate that close to 0.5% of the biogeographic population uses the Fehmarnbelt area in the course of the year.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of medium importance to Herring Gull. The FEBI baseline investigations showed the species using the entire study area with no aggregation areas detectable. Thus, also the areas between Lolland and Fehmarn and the alignment area of a fixed link are frequently used by this species.

Importance level	Medium

Great Black-backed Gull – *Larus marinus*
The European breeding population of Great Black-backed Gull comprises of 330,000–540,000 birds (Wetlands International 2006). As the 1% value for this biogeographic population is 4,400 individuals, the FEBI baseline investigations indicate up to 0.3% of the biogeographic population using the Fehmarnbelt area in the course of the year. The species is widely distributed in coastal and offshore areas of the Fehmarnbelt, and distribution patterns varied among surveys.

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area was assessed to be of medium importance to Great Black-backed Gull. The FEBI baseline investigations showed the species using the entire study area with no aggregation areas detectable. Thus, also the areas between Lolland and Fehmarn and the alignment area of a fixed link are frequently used by this species.

Importance level	Medium

Sandwich Tern – *Sterna sandvicensis*
The Sandwich Tern occurs in the Fehmarnbelt mainly as migratory species. It is present in the study area during the summer season and transitional periods in April/May and August/September. Numbers observed during FEBI baseline investigations as well as reported in supplementary datasets (DOF 2010, OAG 2010) and literature (Mendel et al. 2008) indicate that observations exceeding 100 individuals are rare. The highest count of 350 birds in the SPA Hyllekrog-Rødsand (DOF 2010) accounts for approximately 0.2% of the biogeographic population of Sandwich Tern.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of high importance to Sandwich Tern. During baseline investigations no numbers representing more than 0.1% of the biogeographic population were reported for outside Rødsand Lagoon.

Importance level	High

Common Tern/Arctic Tern – *Sterna hirundo/Sterna paradisaea*
Common Tern and Arctic Tern occur in the Fehmarnbelt area as breeding and migratory species. These species are present almost exclusively during the summer season, mostly between April and August/September. No internationally important aggregations were identified within the study area. Numbers observed during the FEBI baseline investigations and those reported in supplementary datasets (DOF 2010, OAG 2010) and literature (Mendel et al. 2008) rarely exceeded 100 individuals. Breeding pair numbers indicate that about 250 Common Terns and 110 Arctic Terns use the German Fehmarnbelt area (mainly SPA Eastern Kiel Bight). In summary, numbers well below 0.1% of the particular biogeographic populations of Common Tern and Arctic Tern occur in the Fehmarnbelt area.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of minor importance to Common and Arctic Tern.

Importance level	Minor

Common Guillemot – *Uria aalge*
The baseline results indicate that a very low (< 0.1%) proportion of the biogeographic population occurs in the Fehmarnbelt. The species was mainly

observed in offshore areas, but no specific aggregation areas were identified in the study area.

Following the criteria of assessing the importance of Fehmarnbelt (Table 5.1) the study area was assessed to be of minor importance to Common Guillemot.

Importance level	Minor

Razorbill – *Alca torda*

The baseline results indicate that on average about 400 Razorbills winter in the Fehmarnbelt area that was covered by ship-based surveys. This constitutes less than 0.1% of the NE Atlantic population. However, some surveys indicated higher numbers, including one survey with 1,184, compared to the numbers estimated by distribution modelling. Therefore, numbers exceeding the 0.1% of the biogeographic population are expected to occur in the entire Fehmarnbelt area.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of medium importance to Razorbill. The baseline investigations revealed the species is mostly being confined to the offshore, where large parts within the study area were assessed as being of medium importance to the species (Figure 5.12). The alignment area of a fixed link and major parts of the areas between Lolland and Fehmarn were less frequented by Razorbill and thus were assessed to be of minor importance to the species (Figure 5.12).

Importance level	Medium

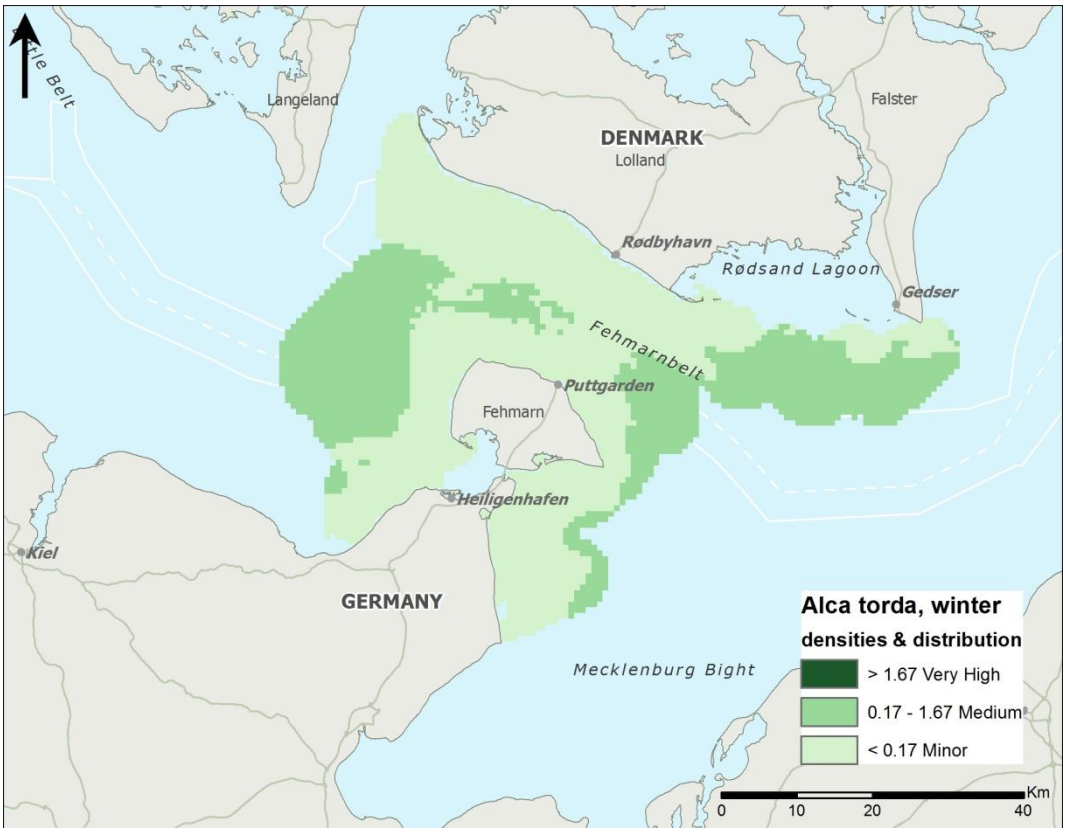

Figure 5.12 Classification of the importance of Fehmarnbelt to Razorbill during winter (November – February), based on modelled densities derived from ship-based surveys (average values of seasons 2008/2009 and 2009/2010; Volume II, chapter 4) according to criteria described in Table 5.1.

Black Guillemot – *Cepphus grylle*

The Black Guillemot is a rare wintering bird in the Fehmarnbelt area. However, the Baltic wintering population is small, thus it is assumed that the area is possibly used by 0.1-0.5% of the biogeographic population (11-53 individuals) during winter.

Following the criteria of assessing the importance of the Fehmarnbelt (Table 5.1) the study area was assessed to be of high importance to Black Guillemot. The few sightings of Black Guillemots in the study area during baseline investigations showed the species occurring in different parts of the Fehmarnbelt. There were also individuals sighted in the alignment area of a fixed link.

Importance level	High

5.4.4 Concluding remarks

The investigations reveal a high importance of the Fehmarnbelt area for nonbreeding waterbirds with special importance of seaducks. Numbers of international importance (> 1% of population) are found for 19 species within the study area. The high proportion (43%) of the population of Eider in the

Fehmarnbelt area is outstanding and identifies this area as the most important wintering area of the Baltic Sea-Wadden Sea population. In addition, other molluscivorous seaducks and diving ducks occur in internationally important numbers in the area identifiying the mollusc-waterfowl foodlink as a highly relevant path of the energy flow in the ecosystem. A substantial proportion of the species of international importance are linked to inland or coastal habitats as dabbling ducks, swans and geese. In swans, the Mute Swan concentrates in the Rødsand Lagoon for moult and this area serves a highly important function for the species. Furthermore, several piscivorous species occur in international important numbers. Thus, the Fehmarnbelt is characterised by high importance for different ecological groups and is obviously of very high value for bird conservation. This is reflected by the substantial proportion of the area being included in the Natura 2000 network. The Fehmarnbelt area can in general be considered as being one of the most important areas for non-breeding birds in the Baltic Sea. Within the Fehmarnbelt area, the most valuable areas are the offshore shallows east and west of Fehmarn, the Albue Bank and the Rødsand Lagoon, all areas well outside the alignment of a planned fixed link.

5.5 Migrating birds

5.5.1 General approach

Counted numbers of migrating species as registered by visual observations from the three field stations provide the estimate of species individuals using the Fehmarnbelt on migration. The number of field days amounts to almost 700, distributed over two years and three field stations. The number of migrating species registered by visual observations is presented as the fraction of the actual biogeographic population estimates or relevant breeding populations (relevant reference populations).

A number of assumptions have been made in estimating relevant numbers of birds from the investigations, as described in the following.

For migrating birds crossing the Fehmarnbelt (e.g. passerines, birds of prey) the relevant number is the highest accumulated sum registered by any of the three field stations either during spring or autumn of the two baseline years. Therefore, numbers from the field stations are not added up per season, since this would bias numbers towards overestimation, as birds may be registered two or three times along the link. Consequently, this estimate is a conservative one, as the chance of an individual bird / flock to be counted more than once is still low. Analyses show, that in general numbers at the departure coast are the highest, while numbers at the receiving coast tend to be underestimated as birds are harder to register.

For migrating birds flying perpendicular to the link (mainly waterbirds), or independently of the Belt (some goose species, waders, etc.) spring or autumn counts of the field stations were added per season, as double counts are unlikely to occur. Thus, the relevant number is the accumulated sum of all three stations.

For daytime migrating birds, most counting results can still be underestimates, as birds may be missed and it cannot be expected that all birds passing the Fehmarnbelt can be observed at a given station. For birds being residents or temporal residents (e.g. seaducks, grebes, swallows etc.), an overestimation due to double counts may occur. The numbers of waterbirds have been registered from the land stations aided by binoculars and scopes covering an observation range of up to 5 km. The numbers of birds of prey were basically registered aided by binoculars and telescopes have been used for species identification, when needed.

For birds of prey starting to cross the Fehmarnbelt coastline more than 1 km away from the land stations, registration was limited. Of the daytime migrating songbirds most species have been spotted only if they were more or less directly above the observation station; exceptions might be larger species, e.g. pigeons or crows and large flocks. For all daytime observations it must be noted, that observations exist only for the selected observation days, and during these for 50% of the time. Therefore, the results represent a sample of the real numbers and thus constitute minimum estimates limited in time and space, as birds are inevitably missed during times of no effort.

Numbers of night-time migrants cannot be estimated. Acoustic observations register the number of calls, but not the number of individuals, and provide only a relative estimate of migration intensity. In addition, calling frequencies depend on numerous factors, and many bird species do not call during night migration. Radar observations cannot deliver data on species level. Bird species migrating during night-time and mainly covered by night acoustics or radar data are marked with "NN", i.e. quantitative data are not available.

Species with counting results below 10 individuals were not considered further as these species are regarded irrelevant for the further assessment. However, if the Impact Assessment of specific pressures indicates some of these species being relevant, these are included in the EIA report anyway.

For most waterbird species biogeographic populations are defined (Wetlands International 2006) and were chosen as reference populations. The pelagic species Common Guillemot, Black Guillemot and Razorbill are not listed in Wetlands International (2006). For these three species, the reference populations are selected from BirdLife International (2004).

For bird species other than waterbirds biogeographic populations are not defined and assumptions must be made about where the individuals occurring at the Fehmarnbelt originate from (breeding N or NE of the Fehmarnbelt). The assumptions are that mainly individuals from the breeding populations from Sweden and Finland will cross the Fehmarnbelt, which has been applied to birds of prey and passerines. Exceptions may apply for bird species, which are partial migrants and may cross the Fehmarnbelt coming either from Norway (e.g. Rough-legged Buzzard, Twite) or are distribution from breeding areas nearby after the breeding season (e.g. White-tailed Eagle, Stonechat, Goldfinch etc.). The reference estimates will be the number of breeding pairs plus 2 juveniles per pair (Bellebaum et al. 2010). For most species the size of the breeding populations are taken from Birdlife International 2004, for birds of prey updated numbers are taken from Mebs and Schmidt (2006).

5.5.2 Overview

A list of 104 species, which were recorded with at least 10 individuals, is given in Table 5.7 with their importance level. This species list is based on the number of birds registered by visual observations following the approach described in the chapter above.

For species migrating at night (owls and most passerine species) such a derivation of importance levels is not possible, as no quantitative data from visual observations or other investigation methods are available; thus, only 32 species have been identified with the methods applied. Consequently, for all these and all other obligatory and facultative night-time migrating species an importance level of medium was assessed (Table 5.7).

For daytime migrating passerines visual observations are available; however, these are not regarded representative in terms of quantitative results, as the detection range for these species is small and birds flying at >100 m distance or altitude can easily be overlooked. Since a concentration effect for daytime migrating species and thus also for daytime migrating passerines is expected for the Fehmarnbelt, for daytime migrating passerines an importance level of high was assessed (Table 5.7).

From Table 5.7, all species listed with an importance level of at least "medium" are further described in the following species accounts; night-time migrating passerines as well as daytime migrating passerines (Table 5.8) are summarised in an extra chapter.

Table 5.7 Derivation of the importance levels based on the combination (Table 5.2) of column "Conservation status" (Table 5.4) and "Abundance" (Table 5.3). SPEC status taken from BirdLife International (2004). 1% level for waterbirds taken for biogeographic populations from Wetlands International (2006) and for other species for breeding populations of Finland and Sweden (breeding pairs x 4; 2 adults plus 2 juveniles) BirdLife International (2004). Maximum numbers as recorded by visual observations in the Fehmarnbelt during baseline investigations. Numbers in bold highlight that the 1% population level is exceeded.

Species	Annex I	SPEC	1% level	Maximum numbers visual observations spring	Maximum numbers visual observations autumn	Conservation status	Abundance	Importance level
Red-throated Diver	X	SPEC 3	3,000	602	192			
Black-throated Diver	X	SPEC 3	3,750	586	200			
Diver sp.	*X*	*SPEC 3*	*3,750*	*2,400*	*392*			
Great Crested Grebe		Non-SPEC	3,600	1,046	296			
Red-necked Grebe		Non-SPEC	510	222	450			
Slavonian Grebe	X	SPEC 3	200	40	6			
Northern Gannet		Non-SPEC^{E}	7,800	24	0			
Great Cormorant		Non-SPEC	3,900	**6,950**	**26,454**			
Great White Egret	X	Non-SPEC	470	16	2			
Common Heron		Non-SPEC	2,700	188	428			
White Stork	X	SPEC 2	12	6	**106**			
Mute Swan		Non-SPEC^{E}	2,500	1,785	2,194			
Bewick's Swan	X	SPEC 3W	200	80	96			
Whooper Swan	X	Non-SPEC^{E} W	590	224	78			
Bean Goose		Non-SPEC^{E} W	6,000	234	1,142			
Greater White-fronted Goose		Non-SPEC	10,000	2,050	1,936			
Greylag Goose		Non-SPEC	5,000	4,038	**15,734**			
Canada Goose*		Non-SPEC	-	136	104			
Barnacle Goose	X	Non-SPEC^{E}	4,200	**50,939**	**81,918**			
Brent Goose		SPEC 3W	2,000	**41,947**	**5,670**			
Shelduck		Non-SPEC	3,000	752	706			
Eurasian Wigeon		Non-SPEC^{E} W	15,000	2,556	13,650			
Gadwall		SPEC 3	600	83	184			
Common Teal		Non-SPEC	5,000	474	1,838			
Mallard		Non-SPEC	45,000$^{x)}$	343	2,760			
Northern Pintail		SPEC 3	600	128	**1,058**			
Garganey		SPEC 3	20,000	11	6			

Species	Annex I	SPEC	1% level	Maximum numbers visual observations spring	Maximum numbers visual observations autumn	Conservation status	Abundance	Importance level
Northern Shoveler		SPEC 3	400	294	354			
Common Pochard		SPEC 2	3,500	90	62			
Tufted Duck		SPEC 3	12,000	404	342			
Greater Scaup		SPEC 3W	3,100	936	788			
Common Eider		Non-SPEC[E]	7,600	**323,729**	**311,774**			
Long-tailed Duck		Non-SPEC	46,000[x)]	2,484	674			
Common Scoter		Non-SPEC	16,000	**48,052**	**49,458**			
Velvet Scoter		SPEC 3	10,000	192	328			
Common Goldeneye		Non-SPEC	11,500	562	426			
Red-breasted Merganser		Non-SPEC	1,700	**3,794**	**2,264**			
Goosander		Non-SPEC	2,700	137	106			
Honey-Buzzard	X	Non-SPEC[E]	416	**790**	**4,080**			
Black Kite	X	SPEC 3	1	**10**	**6**			
Red Kite	X	SPEC 2	17	**112**	**812**			
White-tailed Eagle	X	SPEC 1	24	**26**	**44**			
Marsh Harrier	X	Non-SPEC	75	**132**	**372**			
Northern (Hen) Harrier	X	SPEC 3	134	18	48			
European Sparrow Hawk		Non-SPEC	1,740	645	**2,432**			
Eurasian Buzzard		Non-SPEC	1,640	**1,954**	**6,236**			
Rough-legged Buzzard		Non-SPEC	230	14	40			
Osprey	X	SPEC 3	186	18	98			
Eurasian Kestrel		SPEC 3	220	69	174			
Red-footed Falcon**		SPEC 3	-	0	12			
Merlin	X	Non-SPEC	298	37	58			
Hobby		Non-SPEC	180	70	32			
Peregrine Falcon	X	Non-SPEC	9	**20**	**18**			
Pheasant*		Non-SPEC	NA	0	26			
Common Crane	X	SPEC 2	1,500	**1,916**	328			
Oystercatcher		Non-SPEC[E]	10,200	187	426			
Avocet	X	Non-SPEC	730	62	82			
Little Ringed Plover		Non-SPEC	2,500	2	18			
Ringed Plover		Non-SPEC[E]	10,000	120	334			
Golden Plover	X	Non-SPEC[E]	7,500	632	1,930			
Grey Plover		Non-SPEC	2,500	2,190	446			
Lapwing		SPEC 2	67,500[x)]	458	1,878			
Red Knot		3W	3,400	**14,020**	450			
Sanderling		Non-SPEC	1,200	50	106			
Curlew Sandpiper***		NA	10,000	0	28			
Dunlin		SPEC 3	13,300	**23,042**	2,390			
Ruff	X	SPEC 2	12,500	28	54			
Common Snipe		SPEC 3	25,000[x)]	18	392			
Bar-tailed Godwit	X	Non-SPEC	1,200	**31,262**	898			
Whimbrel		Non-SPEC E	2,700	62	104			
Eurasian Curlew		SPEC 2	8,500	**13,232**	2,268			
Spotted Redshank		SPEC 3	900	8	38			

Species	Annex I	SPEC	1% level	Maximum numbers visual observations spring	Maximum numbers visual observations autumn	Conservation status	Abundance	Importance level
Common Redshank		SPEC 2	2,800	34	96			
Common Greenshank		Non-SPEC	2,300	14	152			
Green Sandpiper		Non-SPEC	17,000	18	82			
Wood Sandpiper	X	SPEC 3	10,500	14	74			
Common Sandpiper		SPEC 3	17,500	16	68			
Ruddy Turnstone		Non-SPEC	1,500	4	120			
Arctic Skua****		Non-SPEC	-	60	52			
Great Skua****		Non-SPEC[E]	-	0	10			
Mediterranean Gull	X	Non-SPEC[E]	6,600	18	4			
Little Gull	X	SPEC 3	1,230	**7,707**	**4,564**			
Black-headed Gull		Non-SPEC[E]	42,000[x)]	7,549	8,792			
Common Gull		SPEC 2	20,000	1,809	4,522			
Lesser Black-backed Gull		Non-SPEC[E]	3,800	43	22			
Herring Gull		Non-SPEC[E]	26,500	4,569	4,943			
Great Black-backed Gull		Non-SPEC[E]	4,400	627	676			
Sandwich Tern	X	SPEC 2	1,700	538	**3,638**			
Common Tern	X	Non-SPEC	11,000	770	1,606			
Arctic Tern	X	Non-SPEC	(20,000)[x)]	2,401	198			
Little Tern	X	SPEC 3	490	132	108			
Black Tern	X	SPEC 3	7,500	60	100			
Common Guillemot		Non-SPEC	43,000[x)]	32	40			
Razorbill		Non-SPEC[E]	5,000	172	92			
Stock Dove		Non-SPEC[E]	400	**1,500**	**4,356**			
Woodpigeon		Non-SPEC[E]	33,000	**40,920**	**289,884**			
Collared Dove		Non-SPEC	126	52	16			
Cuckoo		Non-SPEC	4,600	10	4			
Swift		Non-SPEC	13,800	6,052	1,318			
Great Spotted Woodpecker		Non-SPEC	16,000	6	56			
Eurasian Jay		Non-SPEC	19,000	0	240			
Black-billed Magpie		Non-SPEC	25,000	92	140			
Eurasian Jackdaw		Non-SPEC[E]	15,200	5,532	5,616			
Rook		Non-SPEC	1,544	376	**4,320**			
Carrion Crow		Non-SPEC	22,600	228	36			
Obligatory daytime migrating passerines								
Facultative night-time migrating passerines								
Obligatory night-time migrating passerines								

[x)] For populations over 2 million birds, Ramsar Convention criterion 5 (20,000 or more waterbirds) applies. Arctic Tern: estimate in WPE4 given as >1,000,000 without 1% threshold; according to Wahl et al. (2007) leading to the application of the maximum 1% threshold of 20,000 (cf. criterion 5 Ramsar Convention).

* Canada Goose and Pheasant not assessed, since these are introduced species.

** Red-footed Falcon not assessed, as this species is a rare vagrant and closest breeding populations are located in Hungary and Ukraine.

*** Curlew Sandpiper has no protection status, as it does not breed in any European country .

**** For Arctic and Great Skua no reference population could be estimated.

Table 5.8 Passerine species (excluding corvid birds) migrating in the Fehmarnbelt region. Migration behaviour: d = obligatory daytime, d/n = facultative night-time, n = obligatory night-time.

Passerine species	**Migration behaviour**
Woodlark	d/n
Skylark	d/n
Shorelark	d
Sand Martin	d
Barn Swallow	d
House Martin	d
Tree Pipit	d/n
Meadow Pipit	d
Red-throated Pipit	d
Rock Pipit	d
Yellow Wagtail	d
Grey Wagtail	d/n
White Wagtail	d
Waxwing	d
Winter Wren	n
Dunnock	d/n
Robin	n
Thrush Nightingale	n
Black Redstart	n
Common Redstart	n
Whinchat	n
Stonechat	n
Wheatear	n
Ring Ouzel	n
Blackbird	n
Fieldfare	n
Song Thrush	n
Redwing	n
Mistle Thrush	n
Sedge Warbler	n
Marsh Warbler	n
Reed Warbler	n
Icterine Warbler	n
Barred Warbler	n
Lesser Whitethroat	n
Whitethroat	n
Garden Warbler	n
Blackcap	n
Green Warbler	n
Wood Warbler	n
Chiffchaff	n
Willow Warbler	n
Goldcrest	n
Spotted Flycatcher	n
Red-breasted Flycatcher	n
Pied Flycatcher	n
Bearded Tit	d
Long-tailed Tit	d
Marsh Tit	d
Willow Tit	d
Crested Tit	d
Coal Tit	d

Passerine species	Migration behaviour
Blue Tit	d
Great Tit	d
Nuthatch	d
Eurasian Treecreeper	n
Penduline Tit	d
Eurasian Golden-Oriole	n
Red-backed Shrike	n
Northern Shrike	d
Common Starling	d/n
House Sparrow	d
Tree Sparrow	d/n
Chaffinch	d/n
Brambling	d/n
European Serin	d
Greenfinch	d
Goldfinch	d/n
Siskin	d/n
Linnet	d/n
Twite	d/n
Common Redpoll	d/n
Common Crossbill	d/n
Parrot Crossbill	d/n
Common Rosefinch	d/n
Bullfinch	d/n
Hawfinch	d
Lapland Bunting	d/n
Snow Bunting	d/n
Yellowhammer	d/n
Ortolan Bunting	d/n
Reed Bunting	d/n
Corn Bunting	d/n

5.5.3 Species accounts

Red-throated Diver / Black-throated Diver – *Gavia stellata / Gavia arctica*
As many diver individuals could not be determined to species level (e.g. 2,400 individuals during spring 2010 and 392 during autumn 2009), the two main species are here treated together.

The maximum numbers of migrating Red-throated Divers were recorded in spring and autumn 2009 during visual observations. During spring 2009, a total of 602 individuals (i.e. 0.2% of the biogeographic population) was recorded, whereas during autumn 2009 192 individuals (i.e. 0.06% of the biogeographic population) crossed the Fehmarnbelt region.

Results of visual observations of Black-throated Diver are nearly the same as for Red-throated Divers. Maximum numbers were recorded in 2009 with 586 individuals during spring and 200 individuals during autumn, representing 0.16% and 0.05%, respectively.

According to the criteria of assessing the importance of the Fehmarnbelt to these species, both Red-throated and Black-throated Divers would be assigned a "high" importance category according to the "very high" protection status of this species (SPEC 3, Annex I Birds Directive). However, if the numbers undetermined to species are taking into account, a precautionary approach, i.e. assuming that those 2,400 individuals do belong to only one species and thus represent 0.64% or 0.8% of the respective biogeographic population, leads to a very high importance level.

Importance level	Very high

Red-necked Grebe – *Podiceps grisegena*
The maximum recorded numbers of 222 Red-necked Grebes in spring and 450 in autumn represent 0.44% and 0.88% of the biogeographic population. Thus the area between Lolland and Fehmarn and the alignment of a fixed link is assessed to be of medium importance for this species.

Importance level	Medium

Slavonian Grebe – *Podiceps auritus*
Slavonian Grebes were registered only during spring 2009 in somewhat higher numbers (40 individuals, i.e. 0.2% of the biogeographic population). Thus the area between Lolland and Fehmarn and the alignment of a fixed link is assessed to be of high importance for this species.

Importance level	High

Great Cormorant – *Phalacrocorax carbo*
Great Cormorants were regularly observed in high numbers during both migration seasons. The highest number of 26,454 Great Cormorants was recorded during autumn 2009; during spring 2009 about 7,000 Cormorants have been observed. Thus, during spring 1.8% and during autumn 6.8% of the biogeographic population were observed in the Fehmarnbelt area. This high proportion of the biogeographic population leads to a very high importance of the area between Lolland and Fehmarn for Great Cormorants.

Importance level	Very high

White Stork – *Ciconia ciconia*
Except for autumn 2010, White Storks have only been recorded in numbers of less than 10 individuals. However, during autumn 2010, about 100 White Storks w observed. The estimated population from breeding numbers of White Storks in Sweden and Finland comprises 12 birds according to BirdLife International (2004). However, after a re-introduction program in Sweden it is reported that there are 27 breeding pairs of storks in Sweden in 2011 (www.skof.se). Thus, numbers recorded during autumn observations in 2010 exceed the numbers expected based on breeding population sizes. Also the breeding population in Denmark is rather small (1-3 birds; BirdLife International 2004). However, these 100 White Storks observed represent a substantial fraction of the Scandinavian breeding population. Also, White Stork has a very high conservation status (Annex I Birds Directive, SPEC 2). This in combination with the proportion of the biogeographic population the importance of the area between Lolland and Fehmarn and the alignment of a fixed link was very high for White Storks. However, it must be noted that this refers to a

very small Scandinavian breeding population and importance in relation to the European population (800,000) would be minor.

Importance level	very high

Mute Swan – *Cygnus olor*

The observed numbers of migrating Mute Swans were nearly the same with about 1,750 birds during both spring seasons of the two baseline years. During autumn numbers were slightly higher and reached about 2,200 migrating Mute Swans in autumn 2010. The biogeographic population of Mute Swans is 250,000, thus, proportions between 0.7% and 0.9% of the biogeographic population were recorded during the baseline years. The high proportion of the biogeographic population migrating through the Fehmarnbelt leads to medium importance of the area between Lolland and Fehmarn and the alignment of a fixed link for Mute Swans.

Importance level	Medium

Bewick's Swan – *Cygnus (columbianus) bewickii*

Seasonal numbers of observed migrating Bewick's Swans stayed below hundred. As the biogeographic population of the species comprises 20,000 individuals, the observed proportion is below 0.5% of the biogeographic population. However, the protection status of the species is very high (Annex I Birds Directive), and therefore, the combination of the protection status and the proportion of the biogeographic population leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Whooper Swan – *Cygnus cygnus*

During the two baseline years, numbers of Whooper Swans migrating over the Fehmarnbelt area were higher during spring than during autumn. During spring 2009, 224 Whooper Swans were registered, whereas during spring 2010 about 150 Whooper Swans were recorded. During autumn numbers of migrating Whooper Swan did not exceed 100 birds. The biogeographic population of Whooper Swan comprises 59,000 birds, thus, the maximum proportion recorded in the two baseline years is 0.4% in spring 2009. This proportion of the biogeographic population in combination with the very high protection status (species listed in Annex I of Birds Directive) leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Bean Goose – *Anser fabalis rossicus*

During spring and autumn migration 2009 the number of registered Bean Geese was quite similar with about 230 birds in each season. During autumn 2010 there were nearly 1,250 migrating Bean Geese recorded, whereas in spring 2010 less than 80 were registered. The relevant biogeographic population of the Bean Goose, that is *Anser fabalis rossicus,* comprises 600,000 birds, thus, the maximum proportion of 0.2% of the biogeographic population was registered in autumn 2010. Bean Goose has the SPEC-level Non-SPEC^{E} W; this SPEC-level in combination with the proportion of the biogeographic population of 0.2% results in a medium

importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Greylag Goose – *Anser anser*
During both baseline years the numbers of migrating Greylag Geese over the Fehmarnbelt were higher in autumn than in spring. During autumn 2010 the maximum sum of about 15,730 Greylag Geese was recorded. As the biogeographic population comprises 500,000 birds, this represents a proportion of more than 3%. Even though Greylag Goose is not listed in the Annex I of the Birds Directive nor does it have a SPEC status, the registered proportion of the biogeographic population leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Barnacle Goose – *Branta leucopsis*
Barnacle Goose was one of the species migrating with the highest numbers over the Fehmarnbelt area during the baseline years. In spring 2009 more than 50,000 Barnacle Geese were counted, whereas during spring 2010 about 28,500 were recorded. During autumn 2009 about 35,000 and during autumn 2010 even about 82,000 Barnacle Geese were registered. As the biogeographic population of the species comprises 420,000 birds according to Wetlands International (2006), proportions between 6.8 and 19.5% have been reached. Even considering the recent increase of this species to some 700,000 individuals (Fox et al. 2010), proportions registered at the Fehmarnbelt link are still very high. Additionally, Barnacle Goose is listed in the Annex I of the Birds Directive. Thus, this very high proportion of the biogeographic population in combination with the protection status leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Brent Goose – *Branta bernicla*
Most migrating Brent Geese were recorded during spring in both baseline years. During spring 2009 some 42,000 Brent Geese were registered; during spring 2010 numbers of registered Brent Geese were lower with about 20,000 birds. During autumn considerably lower numbers around 5,500 were registered in both baseline years. The biogeographic population comprises 200,000 birds, therefore the registered proportion ranges between 2.6% and 21.0%. This very high proportion in combination with a high protection status by SPEC (3W) results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Eurasian Wigeon – *Anas penelope*
Observations of Eurasian Wigeon were most frequent during the autumn seasons. In autumn 2009 13,650 and in autumn 2010 9,660 Eurasian Wigeon were recorded, whereas during spring between 1,240 (2009) and 2,556 (2010) birds of this species were recorded. The biogeographic population of this species comprises

1,500,000 birds; thus, in autumn 2009 a proportion of 0.9% was migrating above the Fehmarnbelt area. As the Eurasian Wigeon has the SPEC-level Non-SPEC^{E} W, the combination with the high registered proportion of the biogeographic population results in a medium importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Gadwall – *Anas strepera*

Numbers of migrating Gadwall were highest during autumn 2010 with a total of 182 birds registered migrating over the Fehmarnbelt area. During the other observation periods numbers of registered birds stayed below a hundred. As the biogeographic population comprises 60,000 Gadwall, the maximum proportion of registered migrating birds amounts to 0.3%. Gadwall is classified to the conservation status SPEC 3 and has therefore a high protection status. In combination with the proportion of the biogeographic population this leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Northern Pintail – *Anas acuta*

The numbers of Northern Pintails registered during spring migration are 34 (2010) and 128 (2009). During autumn migration numbers were about 1,000 birds in both baseline years. As the biogeographic population comprises 60,000 birds, the proportion of migrating Pintails in autumn is about 1.8%. Pintail was classified to SPEC 3 conservation status; this, in combination with the very high proportion of the biogeographic population results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Northern Shoveler – *Anas clypeata*

The numbers of migrating Northern Shoveler registered range between 58 during spring 2010 and 354 during autumn 2009. The biogeographic population comprises 40,000 individuals, thus, the maximum proportion of registered migrating Shoveler over the Fehmarnbelt is 0.9%. Northern Shoveler has the SPEC-level 3. This, in combination with the high proportion of the biogeographic population, leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Greater Scaup – *Aythya marila*

Numbers of migrating Greater Scaup registered varied considerable between the two covered spring seasons with only 96 registrations in 2009 and 936 in 2010. Numbers in autumn were more similar with 618 in 2009 and 788 in 2010. The biogeographic population of the species comprises 310,000 birds, thus the maximum proportion observed is 0.3% in spring 2010. This proportion in combination with the SPEC-level 3W leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. It

should be noted, that Greater Scaup is a species frequently counted at the Fehmarnsund and adjacent areas (see chapter 5.4).

Importance level	High

Common Eider – *Somateria mollissima*
The Common Eider was the most frequent species migrating in the Fehmarnbelt area during the two baseline years. Between 242,000 (autumn 2009) and 324,000 (autumn 2009) Eiders were registered during the observation periods. These numbers equate to 32%-43% of the Baltic Sea – Wadden Sea biogeographic population of 760,000 birds. Common Eiders exceed the 1%-level the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Common Scoter – *Melanitta nigra*
Common Scoter was also a frequently migrating species during the two years of baseline investigations. During spring 2009 30,000, during spring 2010 48,000 Common Scoters were observed. During autumn 2009 49,500, during autumn 2010 36,300 Common Scoters were registered. The biogeographic population of this species comprises 1,600,000 birds. Thus, the proportion ranges between 1.8% and 3.1%. As for the Common Eider, Common Scoter is not listed in the Birds Directive and has no SPEC status, but the very high proportion of the biogeographic population migrating over the Fehmarnbelt leads to very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Red-breasted Merganser – *Mergus serrator*
Numbers of registered Red-breasted Mergansers migrating over the Fehmarnbelt area ranged between 1,900 (autumn 2009) and 3,800 (spring 2009). As the biogeographic population of the species comprises 170,000 birds, a proportion of more than 1% was registered during all observation periods ranging between 1.1% and 2.2%. Even though Red-breasted Mergansers have no protection status according to SPEC or Birds Directive, the very high proportion of migrating birds leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Honey-Buzzard – *Pernis apivorus*
Numbers of observed Honey Buzzards migrating and thus crossing the Fehmarnbelt were higher during autumn migration than in spring. During spring 2009 368, and during spring 2010 790 Honey Buzzards were registered, but particularly high numbers were recorded during autumn: 4,080 in in 2009 and 1,764 individuals were registered in 2010. These numbers represent a very high proportion of the relevant reference population of 41,600 birds (breeding birds of Finland and Sweden with their young) with a maximum of 9.8% in autumn 2009. Additionally Honey Buzzard is listed in Annex I of the Birds Directive. This very high protection status according to the criteria (see above) in combination with the very high proportion of the relevant reference population registered in the Fehmarnbelt area

results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Black Kite – *Milvus migrans*

Numbers of observed Black Kites during the observation periods in the two baseline years were very low with a maximum of ten individuals during spring 2010. This represents a calculated proportion of 18.5% of the relevant reference population. However, it must be noted, that a) the breeding population N and NE of the Fehmarnbelt is very low, since this species is at its northern limit of distribution (Mebs and Schmidt 2006), and b) registered individuals of Black Kites may well be coming from other parts of the region. As Black Kite is listed in Annex I of the Birds Directive and has the SPEC-level 3, this leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. However, it has to be remarked that this refers to a very small Scandinavian breeding population and importance in relation to the entire population (> 300,000 in the West-Palaearctic) would be minor.

Importance level	Very high

Red Kite – *Milvus milvus*

During spring migration numbers of registered Red Kites were quite similar in both baseline years with around 110 individuals. During autumn migration numbers were higher than during spring with 812 registered birds in 2009 and 554 in 2010. The relevant reference population of Red Kite comprises 1,650 individuals. Thus, the maximum proportion observed in the two baseline years is nearly half of the relevant reference population with 49.2%. However, it should be noted that a) the breeding population of this species N and NE of Fehmarnbelt is rather low. even that it might have been increasing recently, b) individuals registered at the Fehmarnbelt may also come from other parts of the region and even from the South. In combination with the very high protection status (Annex I of the Birds Directive, SPEC 2), the numbers observed lead to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. Though the reference to the relevant reference population may overestimate the proportion registered, even considering the entire European population (84,000) (Mebs and Schmidt 2006), more than 1% of would be reached. Therefore, the importance level would also be "very high".

Importance level	Very high

White-tailed Eagle – *Haliaeetus albicilla*

A total of 15 White-tailed Eagles were registered in spring 2009, and 26 individuals in spring 2010. During autumn numbers were slightly higher with some 40 individuals registered during both baseline years. The relevant reference population comprises 2,400 birds. Therefore, the proportion of this species ranges between 0.6% and 1.8%. As White-tailed Eagle is listed in the Annex I of the Birds Directive and has the highest SPEC-level SPEC 1, this leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. It must be noted, that one breeding pair nested close to the planned alignment on the island of Fehmarn, and several pairs are breeding within 30 km of the link both at the German and the Danish side. Thus, both dispersing and resident individuals may have been counted more than once.

Importance level	Very high

Marsh Harrier – *Circus aeruginosus*

Numbers of registered Marsh Harriers were lower in spring than in autumn. In spring 2009 132 birds were registered, in spring 2010 only 40. During autumn migration 2009 211 Marsh Harriers were recorded and during autumn 2010 the maximum of 372 migrating birds were observed. The relevant reference population of Marsh Harrier comprises 7,500 birds. Therefore, a maximum proportion of some 5% was recorded during autumn 2010. This very high proportion in combination with the protection status of the species (Annex I of the Birds Directive) results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. However, it has to be remarked that this refers to a very small Scandinavian breeding population and importance in relation to the entire population (> 400,000 West-Palaearctic) would be minor.

Importance level	Very high

Northern (Hen) Harrier – *Circus cyaneus*

For Northern Hen Harriers numbers in spring as well as in autumn of the two baseline years were quite similar. In spring 18 and 16 migrating birds were registered respectively in 2009 and 2010, and in autumn 40 and 48 migrating individuals. The relevant reference population of Northern Hen Harriers is comparatively large consisting of 13,400 birds. Therefore, the proportion of migrating birds ranged between 0.1% in spring and 0.3% in autumn. In combination with the very high protection status (Annex I of the Birds Directive, SPEC 3) this leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

European Sparrow Hawk – *Accipiter nisus*

Numbers of European Sparrow Hawks ranged between 340 in spring 2010 and 2,432 in autumn 2010; during both baseline years numbers were higher during autumn migration. The relevant reference population comprises 174,000 birds; thus, the maximum proportion of the relevant reference population crossing the Fehmarnbelt is 1.4%. Even though the European Sparrow Hawk is not protected by the Birds Directive or SPEC, the importance of the area between Lolland and Fehmarn and the alignment of a fixed link is very high, due to the very high proportion crossing the Fehmarnbelt.

Importance level	Very high

Eurasian Buzzard – *Buteo buteo*

Eurasian Buzzard was the most common raptor registered migrating over the Fehmarnbelt area with 1,954 and 1,302 birds in spring and 1,280 and 6,236 in autumn of 2009 and 2010 respectively. As the relevant reference population comprise 164,000 birds, the proportion of the birds crossing the Fehmarnbelt ranges between 0.7% and 3.8%. Even though the Eurasian Buzzard is not protected by the Birds Directive or SPEC, the high proportion of the relevant reference population crossing the Fehmarnbelt, leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Osprey – *Pandion haliaetus*
The numbers of registered migrating Ospreys stayed below a hundred in both baseline years and seasons. During both spring seasons some 15 birds were registered, during both autumn seasons 82 and 98 birds were recorded crossing the Fehmarnbelt respectively in 2009 and 2010. The relevant reference population comprises 18,578 birds; thus, a maximum proportion of 0.5% of this crossed the Fehmarnbelt. This high proportion in combination with the very high conservation status (Annex I of the Birds Directive, SPEC 3) leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Eurasian Kestrel – *Falco tinnunculus*
Numbers of registered migrating Eurasian Kestrels were higher during autumn migration than during spring migration in the two baseline years. During spring 2009 69 individuals were registered, whereas during spring 2010 18 individuals were observed during migration. During autumn 108 and 174 birds were observed crossing the Fehmarnbelt in 2009 and 2010 respectively. The relevant reference population comprises 22,000 birds. The maximum proportion of observed birds is thus 0.8%. Eurasian Kestrel is not listed in Annex I of the Birds Directive, but has the SPEC 3-status. Therefore, the combination of a high proportion crossing the Fehmarnbelt and a high protection status according to SPEC leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Merlin – *Falco columbarius*
The number of registered migrating Merlins ranged between 18 and 58 individuals. Most Merlins were recorded during autumn 2009. The relevant reference population comprises 29,800 birds; thus, the proportion of the relevant reference population registered crossing the Fehmarnbelt area is 0.2%. The Merlin is listed in the Annex I of the Birds Directive. The combination of a very high protection status and the medium proportion of the population results in a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Peregrine Falcon – *Falco peregrinus*
Numbers of registered Peregrine Falcons were not higher than 20 in both years and migration seasons. The relevant reference population comprises 910 birds. Therefore, the proportion of migrating birds in the Fehmarnbelt area is 2.2%. Due to the very high protection status of Peregrine Falcon (Annex I of the Birds Directive), the area between Lolland and Fehmarn and the alignment of a fixed link is of very high importance for this species.

Importance level	Very high

Common Crane – *Grus grus*
Numbers of migrating Cranes registered in the two baseline years were higher in spring than in autumn. During spring 2009 1,916 Cranes were recorded, whereas during spring 2010 1,394 Cranes were observed. During autumn 328 and 80 birds were recorded in 2009 and 2010 respectively. The estimated population from breeding numbers of Cranes in Sweden and Finland comprises 140,000 birds; thus, up to 1.3% of these crossed the Fehmarnbelt during spring migration. This very high proportion in combination with the protection status (Annex I Birds Directive, SPEC 2) results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Avocet – *Recurvirostra avosetta*
Numbers of recorded Avocets stayed below a hundred during both baseline years and seasons and ranged between 6 sightings in autumn 2009 and 82 sightings in autumn 2010. The biogeographic population of Avocet comprises 73,000 birds; thus, a maximum proportion of 0.1% was recorded migrating in the Fehmarnbelt area. The Avocet is listed in Annex I of the Birds Directive. The combination of the medium proportion of the biogeographic population and the very high protection status results in a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Golden Plover – *Pluvialis apricaria*
Observations of migrating Golden Plovers were more numerous during autumn than during spring. In spring 2009 94 individuals were observed, in spring 2010 632. During autumn migration 2009 1,160 migrating Golden Plovers were recorded, and 1,930 birds were observed in 2010. Golden Plovers were also frequently registered during the night according to night acoustic observations. These registrations cannot be transferred to numbers of individuals. However, it can be assumed, that migrating numbers are considerably higher than registered by daytime visual observations only. The biogeographic population comprises 7,500,000 Golden Plovers. Therefore, the proportion of observed birds ranges between 0.01% and 0.3%. The Golden Plover is listed in the Annex I of the Birds Directive and has the SPEC-level Non-SPEC^{E}. The combination of the medium proportion of the biogeographic population and the very high importance leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Grey Plover – *Pluvialis squatarola*
The maximum number of migrating Grey Plovers is slightly higher than that of Golden Plover and numbers in spring were higher than in autumn. In spring 2009 2,190 individuals were recorded, and 1,132 were observed in spring 2010. During autumn migration numbers were nearly the same in both baseline years with some 400 migrating Grey Plovers. The biogeographic population consists of 247,000 birds and is considerably smaller than that of Golden Plovers. Thus, the maximum proportion of the biogeographic population is 0.9%. Even though Grey Plover has no protection status according to Birds Directive or SPEC, the high proportion of the biogeographic population migrating over the Fehmarnbelt area, leads to a medium

importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Red Knot – *Calidris canutus*
During spring migration much more migrating Knots were registered than during autumn migration. In spring 2009 some 14,000 Knots were recorded, whereas 7,800 Knots were recorded in spring 2010. Numbers in autumn were considerably lower with 58 migrating Knots in 2009 and 450 in 2010. The 1% criterion for the relevant biogeographic population of *C. c. canutus* is 3,400; thus, 4.1% of the biogeographic population was registered on their migration over the Fehmarnbelt area in spring 2009. The Knot is not listed in Annex I of the Birds Directive, but has the SPEC-level 3W. The combination of a very high proportion of the biogeographic population migrating over the Fehmarnbelt area and the high protection level leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Dunlin – *Calidris alpina*
Numbers of migrating Dunlins varied considerably during the observation periods in the two baseline years. During spring 2009 some 23,000 Dunlins were recorded and this high number was not achieved again during the other seasons. 2,390 Dunlins were registered in autumn 2009 2,390, 636 in spring 2010 and 2,244 in autumn 2010. The relevant biogeographic population comprises 1,330,000 Dunlins. Therefore, the observed proportion of the population ranges between 0.05% and 1.8%. Dunlin is not listed in Annex I of the Birds Directive, but has the SPEC-level 3 and therefore a high protection status. In combination with the very high proportion of the biogeographic population, this high protection status leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Bar-tailed Godwit – *Limosa lapponica*
Numbers of recorded Bar-tailed Godwits were considerably higher during spring migration than during autumn migration. In spring 2009 14,300, in spring 2010 even 31,262 Bar-tailed Godwits were registered migrating above the Fehmarnbelt area. During autumn migration numbers ranged between 262 in 2009 and 989 in 2010. As the relevant biogeographic population *L. l. lapponica* comprises 120,000 birds (Wahl et al. 2007), the proportion of observed birds in the Fehmarnbelt area ranges between 0.2% and 26%. This very high proportion of the biogeographic population in combination with the very high protection status (listed in Annex I Birds Directive), results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Eurasian Curlew – *Numenius arquata*
The number of migrating Curlew ranged between 862 in autumn 2009 and 13,232 in spring 2010. As the biogeographic population comprises 850,000 birds, the

maximum proportion of observed migrating Curlews over the Fehmarnbelt is 1.6%. Even though the Curlew is not listed in Annex I of the Birds Directive, it has the SPEC-level SPEC 2. This very high protection status in combination with the very high proportion of the biogeographic population migrating over the Fehmarnbelt leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Little Gull – *Larus minutus*

Numbers of Little Gulls ranged between some 1,000 (autumn 2009) and some 7,700 (autumn 2010) sightings in the two baseline years. The biogeographic population comprises 123,000 birds; thus, the proportion of migrating individuals in the Fehmarnbelt ranges between 0.8% and 6.3% and is thus very high. Additionally Little Gull is listed in the Annex I of the Birds Directive and has the SPEC-Level 3. This very high protection status in combination with the very high proportion of the biogeographic population crossing the Fehmarnbelt, leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Black-headed Gull – *Larus ridibundus*

Numbers of observed Black-headed Gulls ranged between some 3,600 (spring 2010) and some 8,800 (autumn 2010). The estimate for the biogeographic population is 2,000,000; thus, the proportion ranges between 0.2% and 0.4%. As Black-headed Gull is not listed in Annex I of the Birds Directive and has a non-SPEC^{E} status, the protection status is medium. This medium protection status in combination with the medium proportion of the biogeographic population leads to a medium importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Common Gull – *Larus canus*

Numbers of Common Gull were quite similar during both spring and autumn. During spring some 1,000 birds were recorded and during autumn some 4,500 birds were registered in both baseline years. The biogeographic population is 2,000,000 birds; thus, the maximum proportion is 0.2%, what leads to medium importance. Common Gull has the SPEC-status SPEC 2 and therefore a very high protection status. This results in a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Herring Gull – *Larus argentatus*

Numbers of registered Herring Gulls were quite similar in both seasons of 2009 and 2010, thus, this species shows no particular seasonality in migration pattern. In 2009 numbers were around 4,700; in 2010 numbers were slightly lower with around 3,200 birds. The biogeographic population is 2,000,000. Thus, the maximum proportion is 0.2%, what means medium importance. As Herring Gull has no relevant SPEC-level, the importance level is medium. This medium protection

status in combination with the medium proportion of the biogeographic population leads to a medium importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Great Black-backed Gull – *Larus marinus*

Numbers of registered Great Black-backed Gull ranged between 286 and 676 individuals. The biogeographic population comprises 440,000 birds; thus, the proportion ranges between 0.07% and 0.2%. The Great Black-backed Gull is not listed in Annex I of the Birds Directive, and has non-SPEC^{E} level. This medium protection status in combination with the medium proportion of the biogeographic population leads to a medium importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Medium

Sandwich Tern – *Sterna sandvicensis*

Numbers of Sandwich Terns were considerably higher during autumn migration than during spring migration. During both spring seasons some 500 migrating Sandwich Terns were registered, but during autumn 2,450 (2009) and 3,650 (2010) Sandwich Terns were recorded. The biogeographic population comprises 170,000 birds; thus, the maximum proportion of 2.1% was observed migrating across the Fehmarnbelt area. This very high proportion of the relevant population in combination with the very high protection status of the species (Annex I of the Birds Directive, SPEC 2) results in a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Common Tern – *Sterna hirundo*

Numbers of Common Tern were quite similar during both spring and autumn. During spring some 750 birds were recorded, whereas during autumn some 1,500 birds were registered in both baseline years. The biogeographic population comprises 1,100,000 birds; thus, the maximum proportion is 0.2%, what means medium importance. Common Tern is listed in Annex I of the Birds Directive and has therefore a very high protection status. This results in a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species. Furthermore a rather large fraction of observed terns (658 and 2,346 individuals during spring 2009 and 2010 and 1,126 and 1,668 during autumn 2009 and 2010 respectively) could not be determined to species level and thus were just recorded as Common/Arctic Tern. Thus, the proportion of the biogeographic population has to be considered as a minimum value.

Importance level	High

Arctic Tern – *Sterna paradisaea*

Numbers of observed Arctic Terns were considerably higher during spring migration than during autumn migration in both baseline years. In spring 2009 a total of 2,400 Arctic Terns were observed, and some 960 in spring 2010. In contrast, during autumn migration 150 (2009) and 200 (2010) birds were recorded. The biogeographic population comprises as for Common Terns 1,100,000 birds. Thus,

the maximum proportion observed is 0.2%. These proportions have to be considered as minimum values because of the fraction of unidentified terns. Arctic Tern is listed in Annex I of the Birds Directive and has therefore a very high protection status. The medium proportion of the biogeographic population in combination with the very high protection level leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Little Tern – *Sterna albifrons*
Numbers of observed Little Terns were some 70 individuals during both observation periods in 2009 and some 120 during both observation seasons in 2010. As the biogeographic population comprises 49,000 birds, the maximum observed proportion migrating over the Fehmarnbelt area is 0.3%. Little Tern is listed in Annex I of the Birds Directive and has therefore a very high conservation status. The medium proportion of the biogeographic population in combination with the very high protection level leads to a high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	High

Stock Dove – *Columba oenas*
Highest numbers of migrating Stock Doves were observed during autumn migration periods. In both spring seasons of the two baseline years some 1,500 migrating Stock Dove were registered, whereas some 4,350 and 1,950 birds were observed during autumns 2009 and 2010 respectively. As the estimated population from breeding numbers of Sweden and Finland comprises 40,000 birds, the proportion ranges between 3.7% during spring and 10.9% during autumn 2009. This very high proportion leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Woodpigeon – *Columba palumbus*
Nearly 20% of all observed birds during the baseline observations were Woodpigeons. During spring 2009 some 40,000 and during spring 2010 some 33,000 birds were registered, but during autumn, numbers were much higher with some 250,000 in 2009 and some 290,000 in 2010. The estimated population from breeding pair numbers of Sweden and Finland comprises 3,300,000 birds. Thus, the proportion ranges between some 1% and 8.8% of the relevant reference population. Woodpigeon have the SPEC-level Non-SPEC^{E}. The very high proportion of the population leads to a very high importance of the area between Lolland and Fehmarn and the alignment of a fixed link for this species.

Importance level	Very high

Obligatory daytime migrating passerines
Daytime migrating passerines have been registered by visual observations, and many species, e.g. finches, have been recorded in high numbers. However, it must be noted that registrations of these species are not representative in terms of quantitative numbers (see above). For daytime migrating landbird species the

Fehmarnbelt functions as a bottleneck. Birds, which preferably migrate over land, cumulate at the shortest crossing over the Baltic Sea in the region, thus a funnelling effect to the Fehmarnbelt is observed. Consequently, daytime migrating passerines cross over the Fehmarnbelt in such high numbers, that importance for this species group is generally assessed as being high.

Importance level	High

Obligatory and facultative night-time migrating passerines

For facultative and obligatory night-time migrating passerine species, no quantitative numbers are available, thus no direct derivation of importance level is possible. For the night-migrating passerine species it is assumed that they migrate broad-front, starting at their breeding locations in Sweden, Finland or other places north-east of Fehmarnbelt and flying more or less straight south-east disregarding of topographic features. Thus, a fraction of these species will also cross in the nearer region of the Fehmarn link. This fraction cannot be quantified. In the absence of quantitative data we suggest an importance level of medium for these species.

Importance level	Medium

5.5.4 Concluding remarks

The results of the present study reveal a very high to high importance of the Fehmarnbelt area for a number of species, different ecological groups and migration strategies. High to very high importance of the area is stated for diurnal migrating landbirds, especially birds of prey, pigeons and also diurnal migrating passerines, which cross the Fehmarnbelt on the shortest route between Lolland and Fehmarn. For some of these species, which also have a very high protection status, a high to very high proportion of the Scandinavian breeding population migrates along the 'Vogelfluglinie'. In addition, a number of waterbird species passes in very high to high proportions of their populations through the Fehmarnbelt. For these species which explicitly tend to migrate over the sea and avoid crossing land areas, the Fehmarnbelt serves as a migration corridor. This is most pronounced in divers and seaducks, but high proportions of populations of terns and Little Gulla have also been recorded. In addition, a number of waterbirds which have intermediate migration strategies such as geese and waders were found in numbers leading to very high or high importance. For these species the Fehmarnbelt lies on their main flyway between staging areas in the Wadden Sea and northern breeding grounds. For nocturnally migrating landbirds – which are probably the most numerous species group migrating in the region – quantitative data do not exist. It is assumed that they are migrating broad-front across the Fehmarnbelt region, thus a medium importance of the area to this group is assessed.

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