ENERGINET ELTRANSMISSION A/S

OFFSHORE SURVEYS OF BIRDS, BATS AND MARINE MAMMALS FOR OFFSHORE WIND FARMS IN DANISH WATERS

TECHNICAL REPORT BIRDS - KRIEGERS FLAK II 2023 – 2024

20-10-2025

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
Bft	Beaufort
BSH	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency of Germany)
CSR	Conservation status report
DCE	Danish Centre for Environment and Energy
DHI	Dansk Hydraulisk Institut (Danish Hydraulic Institute)
EEA	European Environment Agency
EU	European Union
EUNIS	European Nature Information System
GLS	Global location sensor
GPS	Global positioning system
GW	Gigawatts
HELCOM	Baltic Marine Environment Protection Commission (Helsinki Commission)
HIDEF	HiDef Aerial Survey Ltd.
IUCN	International Union for Conservation of Nature
MTR	Mean traffic rate
OWF	Offshore wind farm
SAC	Special Area of Conservation
SCI	Site of Community Importance
SPA	Special Protected Area
UNEP	United Nations Environment Programme
WP	Waypoints

1 SUMMARY

In order to accelerate the expansion of Danish offshore wind production, it was politically decided with the agreement on the Finance Act for 2022 and the subsequent Climate Agreement on Green Power and Heat 2022 of 25 June 2022 to enable the expansion of a minimum of 9 GW offshore wind in Danish waters.

In the agreement on the tender framework, which the Danish Parliament adopted in May 2025, it was decided that the tender for Kriegers Flak II OWF will be included in the pool of development areas that will be tendered at a later, not yet decided, date.

This report presents the results of the two-year study period of bird surveys undertaken in the pre-investigation area for the planned Kriegers Flak II OWF. Data from both investigation years were compared and discussed in light of available literature covering abundance, distribution and densities of the most important species present in the pre-investigation area. The surveys were undertaken between February 2023 and December 2024.

1.1 RESTING BIRDS

Resting / staging birds were recorded through 12 digital aerial surveys between February 2023 and December 2024. A total of 22,415 birds from 22 species were observed in 2023, and 16,831 birds from 26 species in 2024. Sea ducks dominated both years (81% and 78%), primarily common scoters and common eiders, representing about 60% of all records. Their numbers peaked in winter and early spring, favouring shallow coastal waters. Common eiders and long-tailed ducks were sometimes observed within nearby operational Kriegers Flak OWF, suggesting occasional foraging within wind farm areas.

Gulls formed the second most abundant group—mainly herring and common gulls—widely distributed, including within OWF boundaries, reflecting their opportunistic feeding behaviour and association with fisheries. Auks (common guillemots and razorbills) were less numerous but seasonally concentrated offshore, including within wind farm zones. Overall, the Kriegers Flak II region supports high seabird diversity during non-breeding periods, shaped by both natural habitats and human structures.

Migratory birds crossing the area were studied via vessel-based visual and acoustic surveys and radar tracking at central anchor points in KF II N and S during spring (Mar–May) and autumn (Aug–Nov) of 2023 and 2024. Altogether, 65 days were surveyed in the northern area and 49 in the southern one, with particular focus on cranes and raptors.

1.1.1 SPRING MIGRATION:

KF II N: Across 29 days, 33,396 birds of 80 species were observed. Geese made up 83% of all migrants—mainly barnacle geese (55%) and brent geese (6%). Ducks (mainly eiders and scoters) comprised 10%. Mean diurnal migration intensity was 143 ind./h, peaking in May (340 ind./h in 2023; 1356 ind./h in 2024) due to barnacle geese high migration events. Radar detected much higher nocturnal migration (318 MTR) than diurnal migration (47 MTR).

KF II S: Over 24 days, 48,603 birds of 76 species were recorded. Geese and ducks dominated (87% and 8.5%). Brent geese (40%) were more numerous than barnacle geese (16%). Common scoters (5%) outnumbered eiders (3%). Mean intensity was 247 ind./h (median 41), with peaks in mid-May (1663 ind./h in 2023; 2308 in 2024). Radar showed again higher nocturnal migration (425 MTR vs 67 daytime).

1.1.2 AUTUMN MIGRATION:

KF II N: For 34 days, 26,975 birds of 102 species were recorded. Geese (46%) and ducks (27%) remained dominant—mainly barnacle and brent geese, and common scoters and eiders. Songbirds (8%), pigeons (6%), and cormorants (4%) followed. Mean intensity was 146 ind./h (median 69), with major peaks in November 2023 and October 2024. Radar showed higher night activity (200 MTR vs 56 day).

KF II S: Across 23 days, 32,077 birds of 92 species were observed. Geese (40%) dominated—barnacle (21%) and greater white-fronted (3%). Songbirds (25%) and ducks (24%, mostly eider 14%) followed. Cranes contributed 5% after major 2024 events, and cormorants and gulls ~2%. Mean intensity was 257 ind./h (median 142), with peaks in October (1646 ind./h in 2023; 555 ind./h in 2024). Night migration exceeded day rates but less strongly than in KF II N (82 MTR vs 50 day).

1.1.3 CONCLUSIONS:

The results show that the Kriegers Flak II area supports a rich and dynamic bird community, functioning both as an important non-breeding habitat and a major migration corridor. Resting bird surveys revealed consistently high numbers of sea ducks—particularly common scoters and eiders—using the shallow coastal waters, with gulls and auks also frequent throughout the year. Migratory surveys demonstrated that both sub-areas, especially the southern one, are regularly crossed by large numbers of geese, ducks, and songbirds during spring and autumn migration. Geese, mainly barnacle and brent geese, dominated spring movements, while autumn migration featured greater species diversity, including ducks, cranes, and songbirds. Radar data confirmed intense nocturnal migration, particularly in spring, with birds flying at a range of altitudes up to 1,000 m. Overall, the Kriegers Flak II site plays a key ecological role in regional bird movements, supporting both resting and migratory species across seasons.

2 INTRODUCTION

In order to accelerate the expansion of Danish offshore wind production, it was politically decided with the agreement on the Finance Act for 2022 and the subsequent Climate Agreement on Green Power and Heat 2022 of 25 June 2022 to enable the expansion of a minimum of 9 GW offshore wind in Danish waters.

In order to enable the realization of the political agreements on significantly more energy production from offshore wind, the Danish Energy Agency has prepared a plan for the establishment of offshore wind farms in three areas in the North Sea, the Kattegat and the Baltic Sea respectively, and has initiated a large number of feasibility studies in the areas, some of which are reported in this report.

The area for Kriegers Flak II Offshore Wind Farm (OWF) consists of two sub-areas: North and South. The areas are located 25-50 km off the coast of South Zealand and Møn. Kriegers Flak II North is located approximately 15 km from the east coast of Møn, while Kriegers Flak II South is located approximately 30 km southeast of Møn (Figure 2.1). The area for the Kriegers Flak II OWF is approximately 175 km^2, divided into 99km^2 for North and 76km^2 for South. The Kriegers Flak II OWF will be connected to land via subsea cables making landfall close to Rødvig on South Zealand.

In the agreement on the tender framework, which the Danish Parliament adopted in May 2025, it was decided that the tender for Kriegers Flak II OWF will be included in the pool of development areas that will be tendered at a later, not yet decided, date.

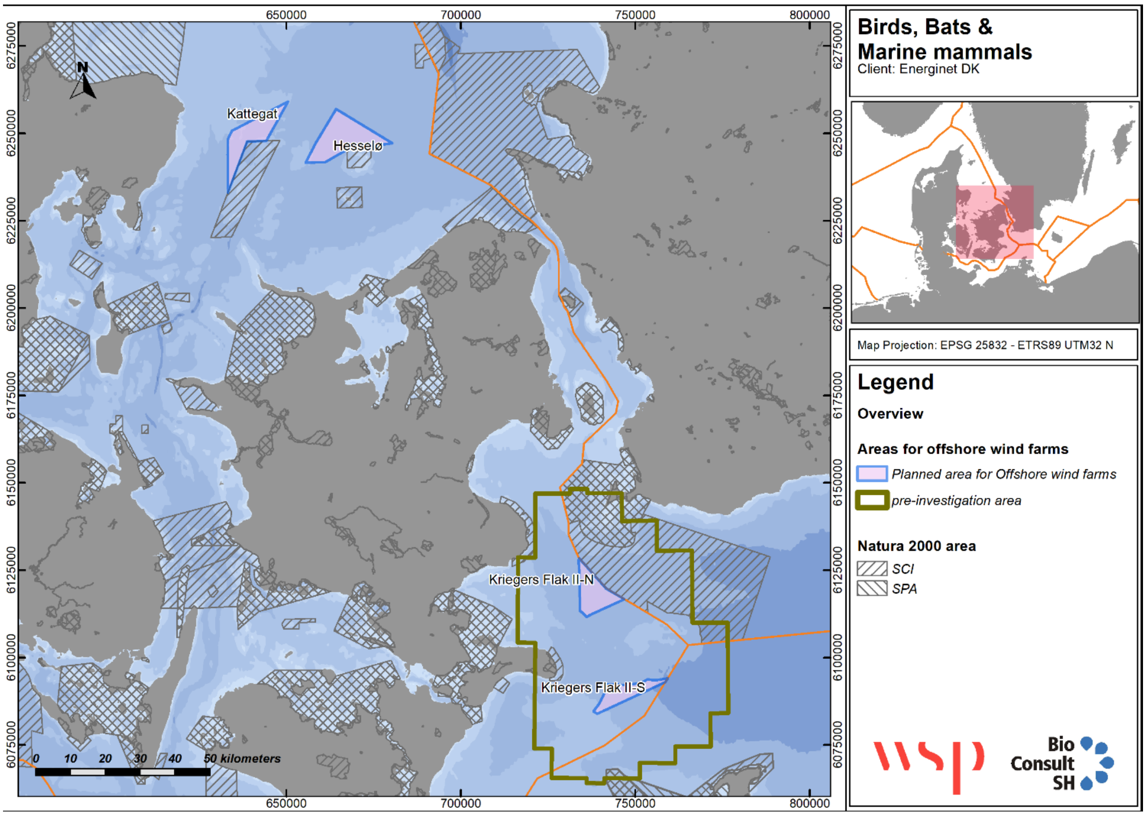


Figure 2.1. Map showing the location of the Kriegers Flak II pre-investigation area. The location of the planned offshore windfarms Kattegat and Hesselø, that were surveyed in 2023 and 2024 in parallel with Kriegers Flak II, is also shown. The present report focuses on Kriegers Flak II.

This report analyses bird presence within the pre-investigation area and is divided into two main sections: one focusing on resting birds and the other on migrating birds. The resting bird section examines seabirds that utilize the area for resting and foraging, while also evaluating the habitat's suitability during various periods of the year. The migrating bird section provides information on birds that cross the area in spring and autumn on its migration routes to their breeding and wintering grounds. For many of the terrestrial species, the sea is a biologically hostile habitat that needs to be crossed as quickly as possible to reach their breeding or wintering grounds. However, since many seabirds and other waterfowl are also migratory birds, the grouping is fluid and some of these species staying in the area but also crossing the pre-investigation area can be classified as migratory or resting birds. These species will be addressed in both parts of this report.

The structure of this report is based on a compilation of data already available from publications, and it is followed by a description of the methodological approach applied to attain the data. Thereafter, the results are given in detail followed by a discussion comparing the data from the second survey year with those of the previous one as well as already existing literature.

2.1 GEOGRAPHICAL DEFINITION

The following section provides and overview of the Baltic Sea, including geographical definitions commonly accepted and use, area-specific terminology and relevant nomenclature to ensure clarity in the interpretation of the project results.

2.1.1 DESCRIPTION OF THE BALTIC SEA

The Baltic Sea is a brackish body of water in northern Europe connected through the Skagerrak with the North Sea and bordered by nine countries: Denmark, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, and Germany. Its complex hydrography was used by the *Convention on the Protection of the Marine Environment of the Baltic Sea Area* (Helsinki Convention or HELCOM) to subdivide it into 18 sub-basins (Figure 2.2). Article 1 of the Convention determined that "the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57° 44.43'N" as agreed by all bordering nations. The Baltic Sea has a surface area exceeding 412,000 km^2 and an average depth of 52 m. The catchment area of over 1,730,000 km2 causes a continuously declining salinity gradient from southwest to northeast approaching zero salinity at the northern end of the Bothnian Bay (Figure 2.3).

The change in salinity causes physiological stress in the Baltic fauna and flora resulting in an almost complete turnover in species composition along the gradient. Furthermore, the low salinity (together with lower temperatures in the north) allows for frequent freezing of the sea surface in winter, whereas ice cover only builds up occasionally in the southwestern part of the Baltic Sea.

The only connection of the Baltic Sea from the Kattegat to the North Sea and the Atlantic Ocean is characterized by a constant outflow of hyposaline surface water and an occasional inflow of oxygenated bottom water. The inflow of salty bottom water through the geographical bottlenecks of the Sound and the Great Belt is usually driven by westerly winter storms.

The seven sub-basins 1 to 7 are frequently called the **Western Baltic Sea**, and within it, the four sub-basins 2 to 5 are called the **Belt Sea**, whereas the six sub-basins 8 to 13 constitute the **Baltic Proper**.

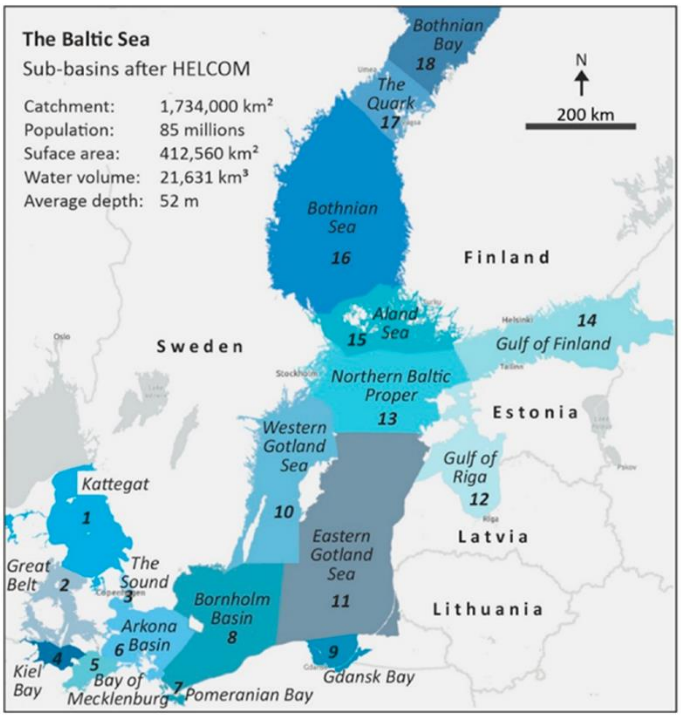


Figure 2.2 The 18 sub-basins of the Baltic Sea as defined by HELCOM; extracted from SCHERNEWSKI ET AL. (2024).

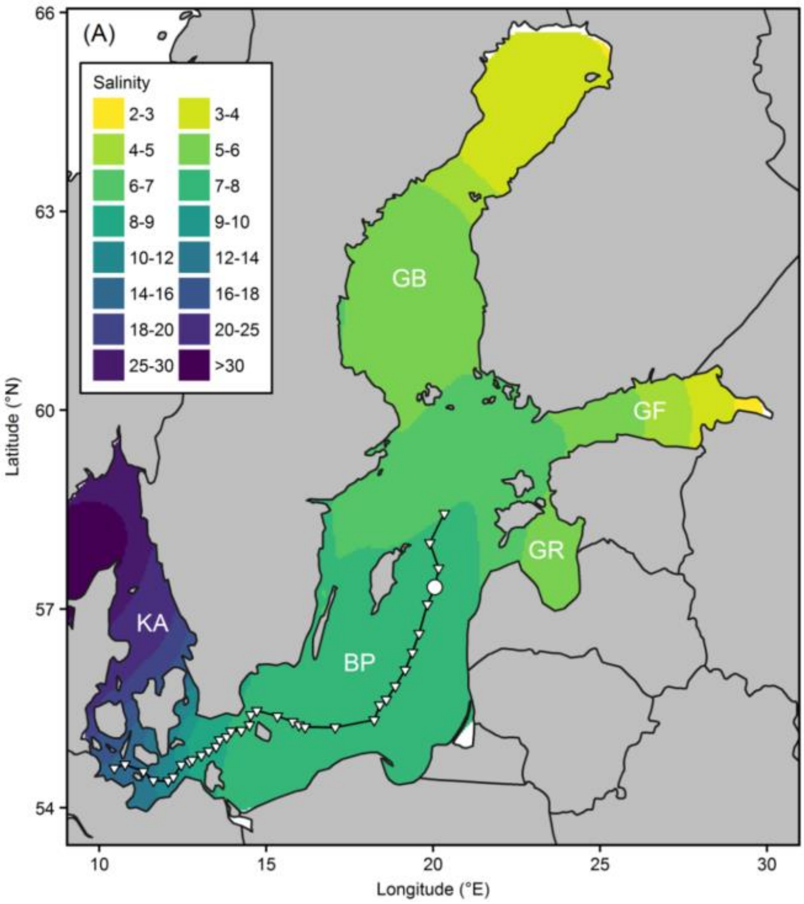


Figure 2.3 Surface salinity distribution throughout the Baltic Sea; extracted from MÜLLER (2018)

3 EXISTING DATA

A review of relevant literature including peer-reviewed journals as well as publicly available “grey literature” has been done. The considered publications included information on the general distribution and biology, as well as the abundance in the pre-investigation area of resting and migratory bird species. Species were selected as relevant, because they either commonly occur in and around the pre-investigation area or have a special conservation status. A detailed description of available information for the most relevant species groups of resting and migratory birds potentially present in the pre-investigation area is given.

Birds potentially utilising the pre-investigation area can be roughly divided into two groups: (i) resting birds, which are typically found within an area for long time periods, and (ii) migrating birds, which alternate between different distant regions such as breeding and wintering grounds and may therefore only cross an area temporarily (i.e. twice a year). In addition, some migrating birds may be also seen on regular local movements (e.g, alternating between feeding and breeding areas). Migrating birds can be found among many different orders, such as songbirds, birds of prey or seabirds. Seabirds include a variety of species specifically adapted to marine environments. They generally breed in coastal regions or on islands and forage at sea (DIERSCHKE & GARTHE 2006). Nevertheless, this grouping is fluid as several resting bird species are also migratory. The chapter on resting birds therefore considers all seabird species, which use the investigation area over longer periods of time for foraging, moulting, wintering, or stopping over during migration.

The chapter on migrating birds partly considers the same seabird species which are already described in the resting bird chapter, when the species (or species group) also occurs during migration. Besides, all other species, which were regularly observed, are presented in the migratory bird chapter. Since radars cannot distinguish between different species, the result of this methodology is presented as migration intensity (Mean traffic Rate, MTR), flight height distribution (vertical radar) and flight direction (horizontal radar) for all birds crossing the area within a few hundred metres around the anchoring vessel.

Four Natura 2000 sites are in the vicinity of the waters of the investigation area. To the north, the Swedish Sydvästskånes utsjövatten (code SE0430187) with an extension of 1,151.3 km^2 and declared as Site of Community Importance (SCI). Marine mammals are the main targeted species for the protection (EUNIS 2019, last accessed 03.04.2025), but three species of resting birds are included in the protection plan due to their relevance in the area: common eider, long-tailed duck and velvet scoter (LÄNSSTYRELSEN SKÅNE 2022).

To the west, the Danish Klinteskoven kalkgrund (code DK00VA306), with an extension of 199.4 km² and declared as Special Area of Conservation (SAC). Although this protected area was declared as such due to the importance of its habitats, especially sandbanks and reefs (EUNIS 2019b), some species of divers such as black-throated diver or red-throated diver, or sea ducks like velvet scoters are reliant on these habitats and are commonly found within this area.

To the south, the German Plantagenetgrund (code DE134301), with an extension of 207 km2 and declared as Special Protection Area (SPA), and Erweiterung Libben, Steilküste und Blockgründe Wittow and Arkona (code DE1345301), with an extension of 76 km^2 and declared as SCI. Both areas are of ecological importance within the Natura 2000 framework and have been designated to protect species such as long-tailed ducks, red-throated divers or common eiders (EUNIS 2019c, last accessed 04.04.2025), or grey seals, common seals, common porpoises and large shallow inlets and reefs.

3.1 RESTING BIRDS

Resting birds include seabirds and other waterfowl species that remain in a non-breeding area during certain periods of the year. They are dependent on the local resources in these areas for moulting, overwintering, foraging etc. They typically tend to be very long-lived and have several adaptations allowing them to exploit resources even during harsh weather conditions.

3.1.1 DIVERS (RED-THROATED DIVER AND BLACK-THROATED DIVER)

Divers, also called loons (American), include four species of fish-eating birds strongly linked to aquatic environments that inhabit the taiga and tundra regions of the Holarctic. All divers are migratory, and the focal geographic population of this study breeds in freshwater lakes mainly in Scandinavia and in Russia and spends the winter season at sea (DURINCK et al. 1994; BIOCONSULT SH et al. 2019; HEMMER 2020). Two diver species are commonly found in the western Baltic Sea, the red-throated diver (*Gavia stellata*) and the black-throated diver (*Gavia arctica*).

Both species use the western Baltic Sea almost exclusively as wintering and staging grounds and as a migration corridor to wintering areas further south and west, such as the North Sea or Atlantic coastal waters. These are predominantly divers breeding in northern Russia (MENDEL et al. 2008a; BIOCONSULT SH et al. 2019) which will arrive in or cross the area from October to January and leave until June. BELLEBAUM and colleagues (2010a) report higher numbers of migrating red-throated divers near the coast as opposed to areas further offshore, assuming a more southward concentration of spring migration along the German coast and an autumn migration further north, with counts of 4,000 individuals in total passing between the Swedish Skåne coast and Bornholm. GPS tracks of about 20 tagged red-throated divers (BIOCONSULT SH et al. 2019) suggest that individuals are rather evenly spread across the area and did not confirm these patterns.

Flight heights of both diver species are generally estimated to be low (JOHNSTON et al. 2014b). Especially during headwind situations divers tend to fly closely above the water surface. They will usually not be observed flying higher than 50 m and often just up to 10 metres (KRÜGER & GARTHE 2001; BELLEBAUM et al. 2010b; BIOCONSULT SH et al. 2020).

During wintering, divers forage on a broad range of fish species (KLEINSCHMIDT et al. 2019). For the western Baltic Sea, the diet of red-throated divers has been investigated in the Pomeranian Bay, which is one of their main wintering areas probably due to the suitability of the area as spawning, nursery and feeding ground for many fish species. In this area, zander (*Sander lucioperca*) and herring (*Clupea harengus*) constituted the majority of the consumed biomass of red-throated divers in winter and spring respectively (GUSE et al. 2009).

Both species of divers are widely distributed in the Baltic Sea. Most individuals occur in the Gulf of Riga at water depths below 30 m (DURINCK et al. 1993). Other important areas are located off the coast of Lithuania and the Pomeranian Bay (DURINCK et al. 1994). According to both studies, most divers winter offshore at waters with depth ranging between 5 and 30 m. They arrive in the western Baltic Sea in September with increasing numbers during the winter peaking in February and March in the Kriegers Flak II (SKOV et al. 2011).

Divers start leaving the areas in April and May to migrate to their breeding grounds and are thus expected to be present in the investigation area from September to June. During the rest of the year, they are expected to appear sporadically only. In a report by DHI (2019) low densities were found during winter and spring in offshore areas in Kattegat. In contrast, medium to high densities were detected during spring in coastal areas with water depths < 20m. PETERSEN AND NIELSEN (2011) reported high densities of both diver species during the winter particularly in the areas between Læsø and Anholt with 0.81 – 2.3 ind./km² with birds preferring water depths between 10 and 22m. Similar high densities were observed on the northern coasts of Sjælland as well as close to the coast of Falster. While SKOV ET AL. (2011) reported that the most important wintering area for black- and red-throated divers in the Baltic Sea is located along the coast north of Rügen in Germany, they also identified the areas in the northwest and south Kriegers Flak II as important wintering sites in Danish waters.

Estimates conducted almost two decades ago suggested overall wintering numbers of 150,000 – 450,000 red-throated divers and 250,000 – 500,000 black-throated divers for the population inhabiting northwest Europe (MENDEL et al. 2008a; SKOV et al. 2011). More recent evaluations estimate 210,000 – 340,000 wintering red-throated diver individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024) and 390,000 – 590,000 black-throated divers (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 23.02.2022). It is still unclear whether populations of both species are in decline in the North Sea (VILELA et al. 2021; GARTHE et al. 2023).

Since their populations may have decreased and since they are among the seabird species most vulnerable to many anthropogenic factors, they are included in the Annex I of European Union (EU) Birds Directive (Council Directive 2009/147/EC on the conservation of wild birds, EUROPEAN UNION 2010) and in the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA, UNEP/AEWA SECRETARIAT 2019). Moreover, their wintering populations are considered critically endangered (CR) by HELCOM (HELCOM 2013a). Within the Danish part of the Baltic Sea, most of the wintering divers are found southwest of Lolland and north of Sjælland (Figure 3.1).

Oil spills, habitat degradation and being bycaught in fishing nets are the most common threats for divers (MENDEL et al. 2008a). Additionally, contamination in lakes for example by mercury pollution may affect their reproduction (e.g., ERIKSSON 2015). Ship traffic and offshore wind farms have been shown to have detrimental effects on divers. They display strong avoidance behaviour towards OWFs (DIERSCHKE et al. 2016; WELCKER & NEHLS 2016; HEINÄNEN et al. 2020), which can be noticeable up to a distance of 16 km away from OWF (MENDEL et al. 2019; VILELA et al. 2021; GARTHE et al. 2023).

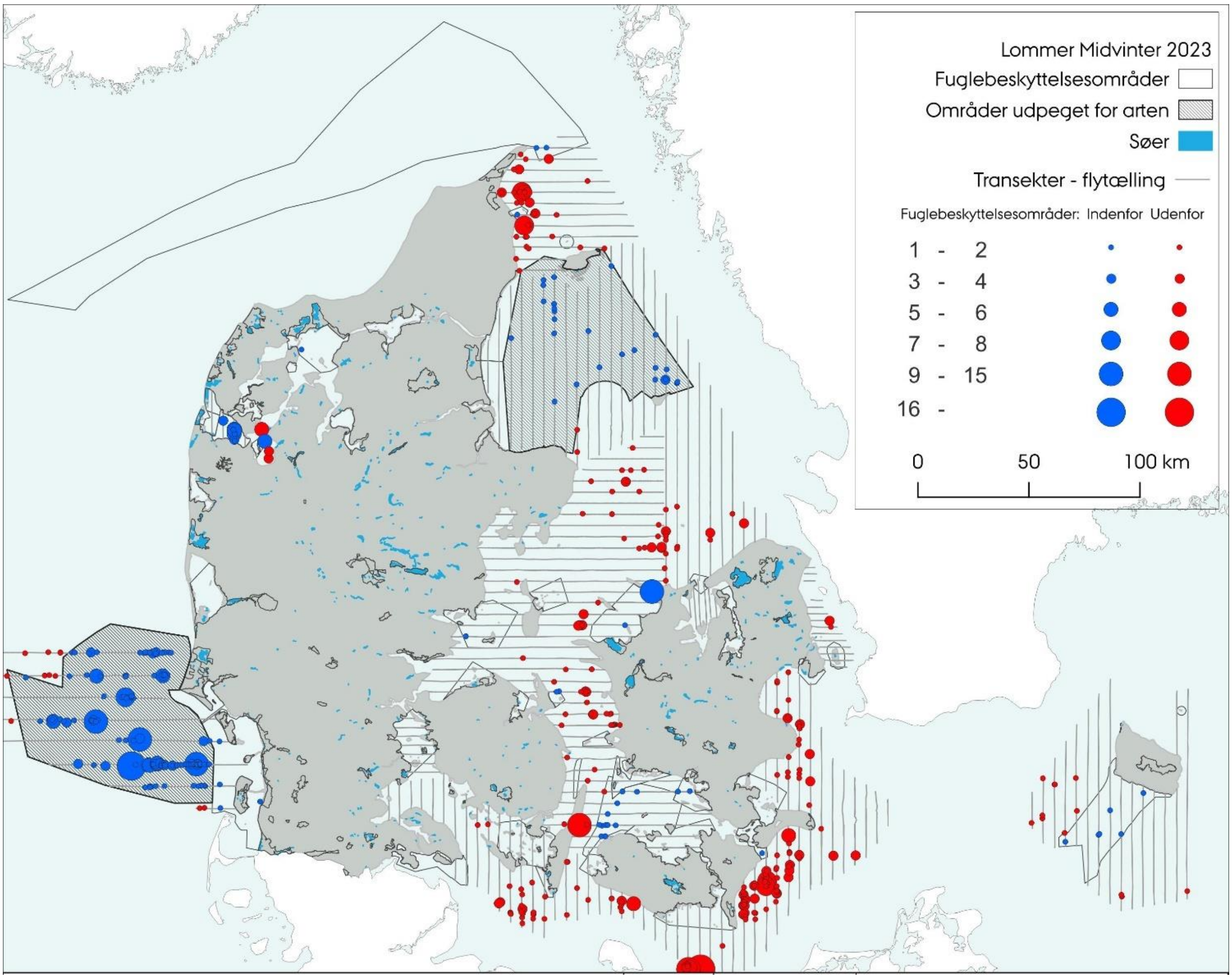


Figure 3.1 Spatial distribution of divers in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of divers for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

3.1.2 GREBES

Grebes occur in coastal areas with shallow waters outside of the breeding season. The most important species of grebes which can be found in the pre-investigation area are red-necked grebes (*Podiceps grisegena*), great-crested grebes (*Podiceps cristatus*), and Slavonian grebes (*Podiceps auritus*). Durinck et al (1994) reported that the main wintering area for all three species was found in the Pomeranian Bay. In the western Baltic Sea, they found a small concentration of wintering great-crested grebes north-west of Kriegers Flak II along the coast northeast of Aalborg (mean density of 0.3 ind./km^2). For red-necked grebes, they reported high densities of up to 2.4 ind./km^2 particularly in the Aalborg Bight. These high densities were also confirmed in a recent report by DHI (2019).

An estimated of 3,500 pairs of great-crested grebes breeds in Denmark (BIRDLIFE INTERNATIONAL 2015). Many of these concentrate in lakes and coastal waters during July-September (MELTOFTE 1996). Based on the IUCN categories and the recent Birdlife International Red List for Europe, the European populations of Slavonian grebes are considered near threatened, those of red-necked grebes are categorised as vulnerable and those of great-crested grebes are considered to be of least concern (BIRDLIFE INTERNATIONAL 2021). However, within the the Baltic, the red-necked grebe wintering population is considered as endangered (HELCOM 2019a).

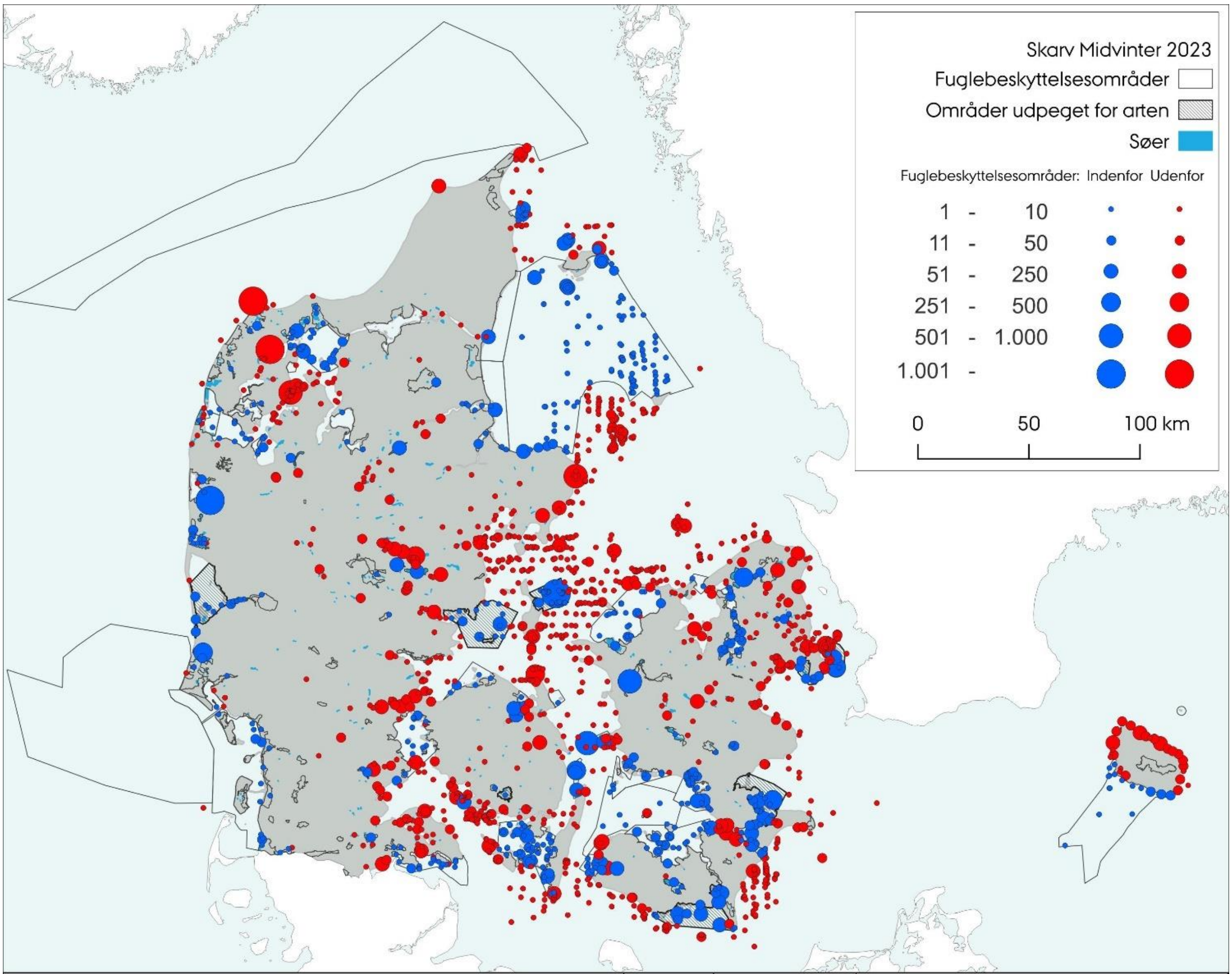
3.1.3 GREAT CORMORANT

Two of the six subspecies of the great cormorant (*Phalacrocorax carbo*) may occur in north Europe: *P. carbo carbo* and *P. carbo sinensis*, the latter is the subspecies that can occur in the pre-investigation area. Cormorants are diving birds that mainly feed on herring, perch, eelpout, cyprinids and sprat among other species found in the Baltic Sea (e.g. BOSTRÖM et al. 2012a; b; LARSSON 2017).

According to population estimates by Birdlife, 828,000 – 1,030,000 great cormorant individuals are found across Europe (BIRDLIFE INTERNATIONAL 2021). In the Baltic Sea, they occur during the whole year but mainly associated to coastal habitats. Largest concentrations can be generally found in the Mecklenburg region of Germany, the southern part of Bohuslän and Gdansk Bay and the Sound, as well as in Danish waters (SKOV et al. 2011). In Danish waters high concentrations of wintering great cormorants were mainly found along the coast of Sjælland and Fyn, as well as in the ABight (Figure 3.2) with densities varying between 100 and 2,500 ind./km^2.

During the 19th century, the species went almost extinct. After protection measures established in the mid-20th century, the population has increased in the Baltic with a total of 190,000 – 210,000 breeding pairs occurring in the entire region, and between 2014 and 2022 30,000 - 33,000 pairs occurred in Denmark (STERUP & BREGNBALLE 2022). Recent IUCN assessments consider them as least concern (BIRDLIFE INTERNATIONAL 2021). Besides the common threats affecting most sea birds like oil spills, habitat degradation and fishing nets, great cormorants may suffer from conflicts with the fishing industry. Since their diet includes fish also utilised by humans, they have been blamed for potentially reducing fish stocks. Although a reduction of perch was associated to the colony size of cormorants, no significant results were observed for other species (ÖSTMAN et al. 2012). Most probably, the relationship between cormorants and fish is more complex and further research is needed (OVEGÅRD et al. 2021).

Great cormorants can be attracted to OWFs and other man-made structures, as these provide them with resting sites, thus allowing them to expand their foraging grounds further offshore (DIERSCHKE et al. 2016).



Fugle talt i alt:	29.593	Procentandel:	Firkantet signatur: Antallet overstiger
Heraf talt i fuglebeskyttelsesområder:	14.030	47,4 %	gældende 1%-bestandskriterium
Heraf talt i fuglebeskyttelsesområder udpeget for arten:	3.899	13,2 %	(Vandfugleaftalens CSR8)
Fugle talt i fuglebeskyttelses- og habitatområder (Natura 2000)	15.587	52,7 %	Kriteriet for bestanden er: 6.200

Figure 3.2 Spatial distribution of cormorants in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of cormorants for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

3.1.4 SEA DUCKS

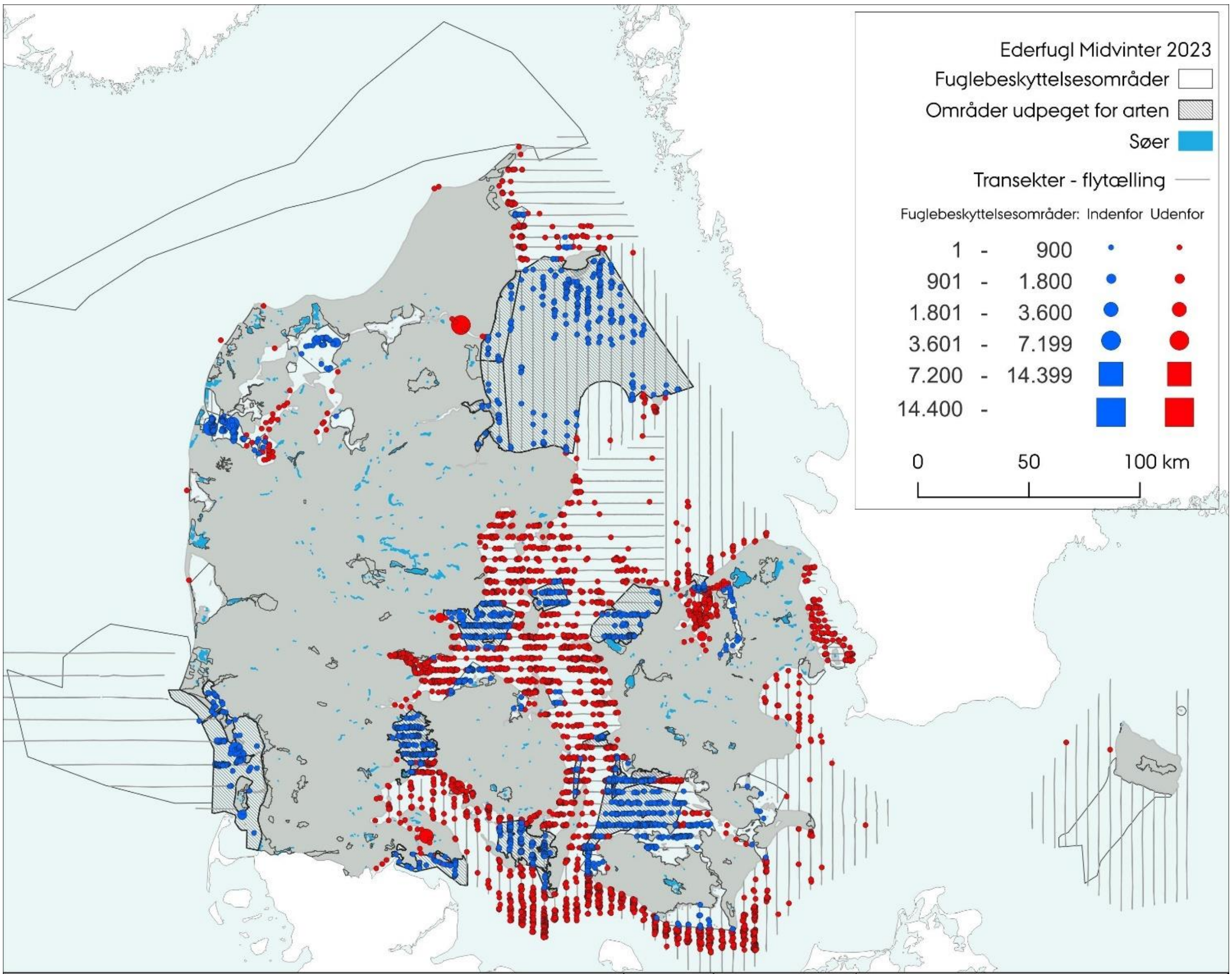
Sea ducks spend their non-breeding season in marine environments feeding mainly on bivalves (MADSEN 1954; NEHLS 1989; MEISSNER & BRÄGER 1990; NEHLS 2001; MENDEL et al. 2008a). The Baltic Sea offers important moulting and wintering sites for sea ducks with individuals mainly located in coastal waters and shallow offshore banks, where they can easily dive to obtain their food (e.g., BRÄGER et al. 1995). Among the most common and abundant sea ducks that may occur in the pre-investigation area are long-tailed ducks, common eiders, common scoters and velvet scoters. In general, all sea duck populations have suffered from declines in recent years (e.g., DURINCK et al. 1993; MENDEL et al. 2008a; BELLEBAUM et al. 2012; NILSSON & HAAS 2016). They are subject to many anthropogenic threats including oil pollution, being bycaught in fishing nets and habitat degradation (MENDEL et al. 2008a; BELLEBAUM et al. 2012; NILSSON 2016). In addition, breeding populations may suffer predation from gulls and other predators (BELLEBAUM et al. 2012). Some sea duck species such as common scoter are strongly disturbed by ship traffic showing long escape distances, while others may be less disturbed (FLIESSBACH et al. 2019). The same applies to the disturbance caused by OWFs, as the reaction towards offshore windfarms differs among species as well (PETERSEN & FOX 2007; PETERSEN et al. 2014; DIERSCHKE et al. 2016).

COMMON EIDER

The breeding population of common eiders (*Somateria mollissima*) in Denmark has increased during the 20th century (LYNGS 2000). The censuses indicate a population of about 23,000 eiders between 1988 and 1993 (DESHOLM et al. 2002). The last censuses of 2000-2002 reported a similar number of eiders, indicating that the breeding population in Denmark remained stable (LYNGS 2008). Based on Petersen and Nielsen (2011), estimates suggested 503,000 common eiders wintering in Danish waters during 2008. More recent evaluations between 2000 and 2008/09 estimated this population to be stable as well (EKROOS et al. 2012).

During summer, common eiders are mostly located in the coastal areas around Samsø and the northwestern coasts of Sjælland with up to 252.85 ind./km^2 (PETERSEN & NIELSEN 2011). High concentrations were also found around Læsø and Smålandsfarvandet with up to 66.61 ind./km^2. During winter, their main concentration areas are found along the Samsø belt and Vejle fjord, and especially around the southwestern coast of Fyn with up to 419.60 ind./km^2 (PETERSEN & NIELSEN 2011). High densities were also observed south of Læsø (up 70 43.85 ind./km^2) and in the coastal regions of Aalborg Bugt (up to 27.46 ind./km2; PETERSEN & NIELSEN 2011, Figure 3.3).

Common eider is considered as a near threatened species under the IUCN. In Europe, they are generally considered endangered (BIRDLIFE INTERNATIONAL 2021). Like other sea duck species, they are also listed in the Annex II B of the European Birds Directive (EUROPEAN UNION 2010). Recent evaluations estimate 560,000 – 920,000 wintering common eider individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024) for the Baltic, North & Celtic Seas population, with a declining trend.



Fugle talt i alt:	136.585	Procentandel:	Firkantet signatur: Antallet overstiger
Heraf talt i fuglebeskyttelsesområder:	63.819	46,7 %	gældende 1%-bestandskriterium
Heraf talt i fuglebeskyttelsesområder udpeget for arten:	39.698	29,1 %	(Vandfugleaftalens CSR8)
Fugle talt i fuglebeskyttelses- og habitatområder (Natura 2000)	70.251	51,4 %	Kriteriet for bestanden er: 7.200

Figure 3.3 Spatial distribution of common eider in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of common eider for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

LONG-TAILED DUCK

Long-tailed ducks (*Clangula hyemalis*) have a circumpolar distribution range and migrate between arctic breeding grounds and temperate wintering areas. They mainly breed in freshwater habitats located in the arctic tundra areas, or in areas that provide similar conditions – e.g., the alpine areas of the Norwegian west coast (GLUTZ VON BLOTZHEIM & BAUER 1992). During the breeding season long-tailed ducks forage on a variety of organisms including insect larvae, fish spawn, crustaceans, and molluscs (GLUTZ VON BLOTZHEIM & BAUER 1992). During the non-breeding season, long-tailed ducks are gregarious, and often seen in flocks at temperate marine coastal areas and offshore banks, where they mainly feed on bivalves supplemented by polychaeta worms, echinoderms, and fish spawn (MADSEN 1954; KIRCHHOFF 1979; STEMPNIEWICZ 1995; EVERT 2004; ŽYDELIS & RUSKYTE 2005).

Long-tailed ducks wintering in the pre-investigation area are part of the Fennoscandian-West Siberian population. They arrive from the breeding grounds from October to moult in the Baltic Sea, are most numerous during winter (January-February) and leave until April to migrate to their breeding grounds (MENDEL et al. 2008a). Observations of long-tailed ducks in the pre-investigation area during summer are thus unlikely except for sporadically appearing young non-breeding individuals. The most important areas in the Baltic Sea with highest observed densities are in the Pomeranian Bay, the Gulf of Riga, and the Midsjö banks south of Gotland (SKOV et al. 2011). In Danish waters, highest densities were mainly observed on Rønne Banke. The Danish Center for Environment and Energy (DCE) has regularly conducted aerial surveys of the region and has estimated a total of 18.000-30.000 wintering individuals at Rønne Banke (PETERSEN et al. 2016). Other areas such as Kriegers Flak, Køge Bugt, Præstø Bugt and the waters south of Falster, Lolland, Langeland and Ærø (Figure 3.4) showed higher concentrations as well with up to 21.05 ind./km^2 (PETERSEN & NIELSEN 2011). Lower densities were found in the Åalborg Bight with up to 8.83 ind./km^2. (PETERSEN & NIELSEN 2011).

Based on a coordinated Baltic Sea survey from 2007 to 2009, roughly 1.5 million long-tailed ducks were estimated to winter in the Baltic Sea (SKOV et al. 2011). This is a decline of 65 % compared to the census in 1988-1993, where a number of 4.7 million individuals was estimated (WETLANDS INTERNATIONAL 2006).

Long-tailed duck populations have decreased in the last decades due to various anthropogenic factors, especially oil pollution (Skov et al. 2011). Various anthropogenic factors are suspected to have influenced this decline (e.g., SKOV ET AL. 2011; NILSSON 2016; NILSSON & HAAS 2016). Due to this drastic population decline, they are considered as vulnerable under the IUCN and are listed in Appendix II B of the European Birds Directive (EUROPEAN UNION 2010).

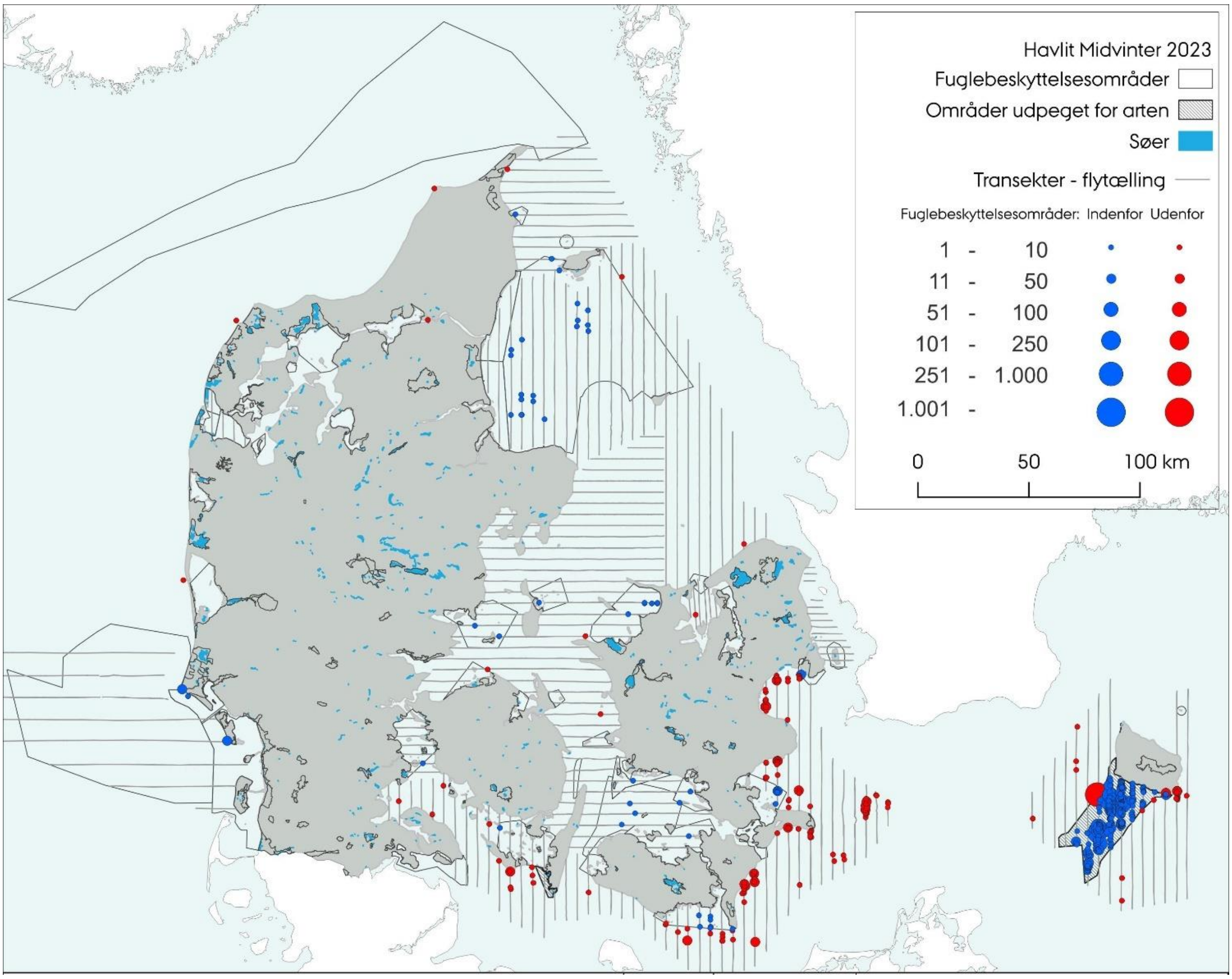


Figure 3.4 Spatial distribution of long-tailed duck in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of long-tailed duck for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

COMMON AND VELVET SCOTER

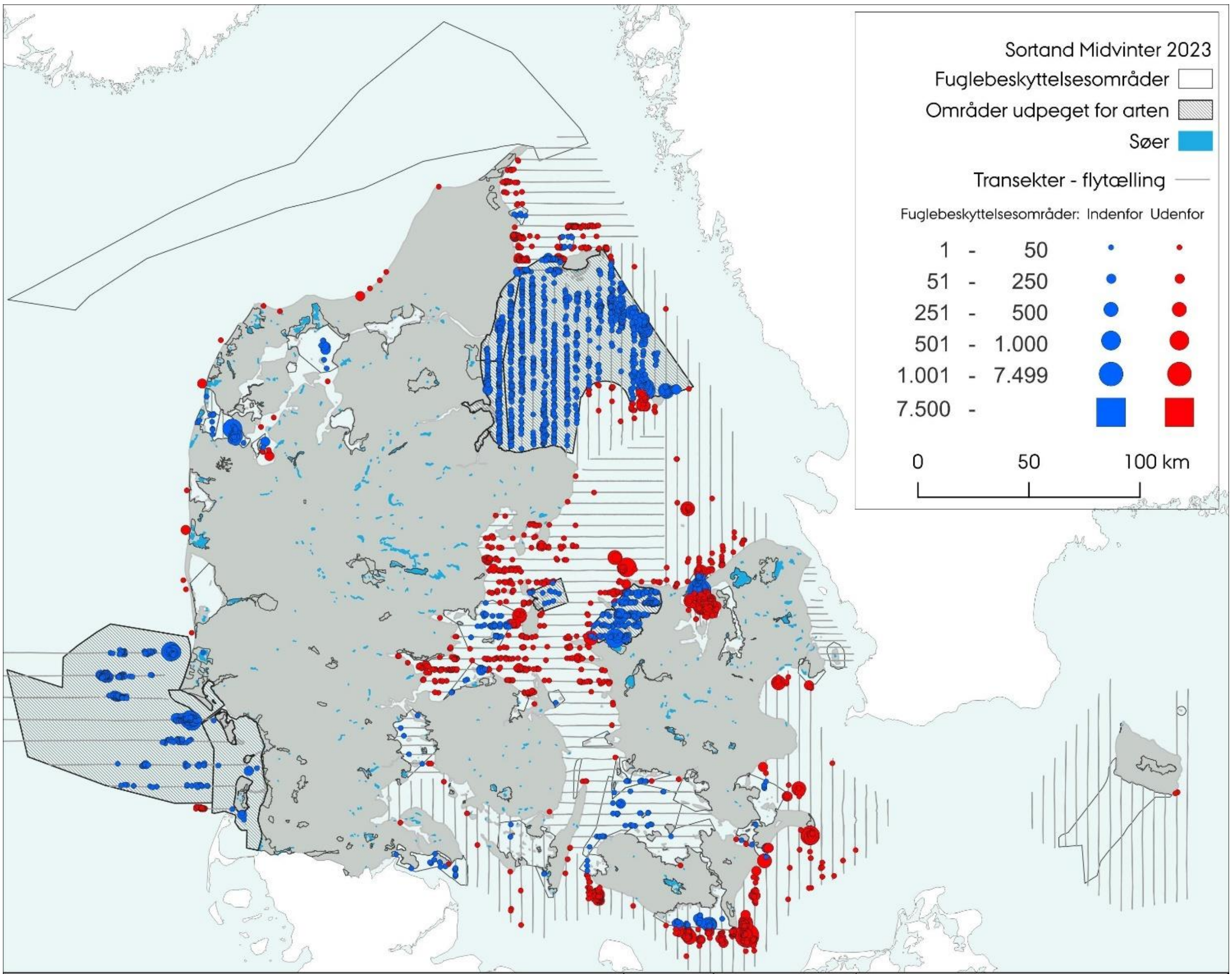
In winter, most common scoters (*Melanitta nigra*) occur in the western Baltic Sea (DURINCK et al. 1993) and the Kattegat area (HELCOM 2019b). Besides, the Pomeranian Bight and the Kriegers Flak are important moulting areas from June to September. In the German Baltic Sea, they may be found during the whole year, especially in the Pomeranian Bay and surrounding area (MENDEL et al. 2008a). In the Baltic Sea, common scoters show a preference for areas with water depths between 5 and 15 m (SKOV et al. 2011). In the wintering areas their diet consists largely of marine bivalves, which are harvested on or up to three centimetres below the surface (MADSEN 1954; FOX 2003; KAISER et al. 2006). Thereby, common scoters are assumed to choose their diet according to abundance, availability and energetic content of prey items rather than being restricted to certain prey species.

The results of the Baltic coordinated survey in 2007 to 2009 indicate that the winter population of common scoters has declined markedly from 783,310 birds in 1988–1993 to 412,000 birds in 2007–2009, equivalent to a 47% decline over 16 years (HELCOM 2019b). However, recent evaluations for the Northwest European population estimate 678,000 – 815,000 wintering common scoter individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024), with an increasing trend.

High densities of wintering common scoters have been found in Aalborg Bugt and the areas around Læsø and Anholt with up to 303 ind./km^2 (PETERSEN & NIELSEN 2011) and lower densities in Sejerøbugten with up to 105 ind./km^2 (Figure 3.5). In the pre-investigation area, densities were estimated to be low, with less than 50 ind./km^2. In summer during their moulting period, high common scoter densities were mainly found around Læsø and in Aalborg Bugt with up to 284.78 ind./km^2. Smaller concentrations were also located in the southern parts of Sejerøbugten and Bredegrund with up to 23.17 ind./km^2 (PETERSEN & NIELSEN 2011). No data was however available for the pre-investigation area. According to Skov et al. (2011), the closest key wintering areas to the pre-investigation area are the German Darss-Plantagenet Ground and Danish Faxe Bay.

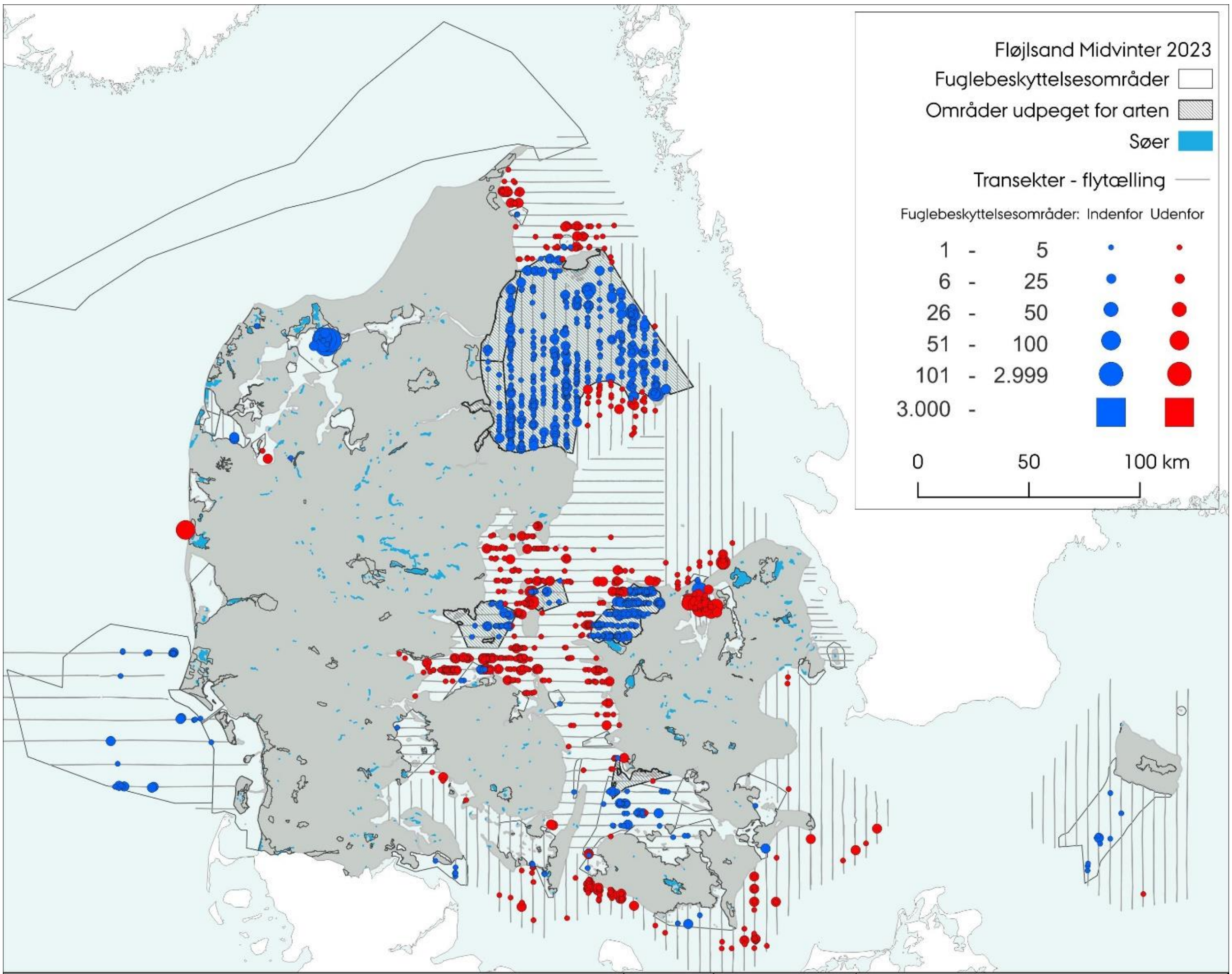
Velvet scoters (*Melanitta fusca*) breed along the Baltic Sea coast of Sweden, Finland, Russia and Estonia. The species is a regular and common winter and migration visitor in the Baltic Sea area from September to May. An important moulting area is located in the Pomeranian Bay around the Odra Bank (SKOV et al. 2011). Thus, velvet scoters can be found in the Baltic Sea throughout the year (DURINCK et al. 1994; SONNTAG et al. 2006). A study of velvet scoters wintering along the Lithuanian coast demonstrated a preference for marine areas with sandy substrates at depths between 2 and 30 m (ZYDELIS 2000). In the Pomeranian Bay, the species occurred in waters with sandy sediments on water depths up to 30 m but was most frequently found up to 15 m depth (SONNTAG et al. 2009). The closest identified key area relative to the pre-investigation area is the Faxe Bay (SKOV ET AL. 2011, Figure 3.6). However, bird densities were rather low as compared to other key sites (e.g. Pomeranian Bay).

While the common scoter is listed as a species of least concern by the IUCN, the velvet scoter is considered vulnerable (BIRDLIFE INTERNATIONAL 2021). Recent evaluations for the Northwest European population estimate 220,000 – 410,000 wintering velvet scoter individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024), with a probably increasing trend.



Fugle talt i alt:	87.880	Procentandel:	Firkantet signatur: Antallet overstiger
Heraf talt i fuglebeskyttelsesområder:	46.879	53,3 %	gældende 1%-bestandskriterium
Heraf talt i fuglebeskyttelsesområder udpeget for arten:	34.279	39,0 %	(Vandfugleaftalens CSR8)
Fugle talt i fuglebeskyttelses- og habitatområder (Natura 2000)	50.902	57,9 %	Kriteriet for bestanden er: 7.500

Figure 3.5 Spatial distribution of common scoter in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of common scoter for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.



Fugle talt i alt:	8.376	Procentandel:	Firkantet signatur: Antallet overstiger
Heraf talt i fuglebeskyttelsesområder:	4.870	58,1 %	gældende 1%-bestandskriterium
Heraf talt i fuglebeskyttelsesområder udpeget for arten:	3.278	39,1 %	(Vandfugleaftalens CSR8)
Fugle talt i fuglebeskyttelses- og habitatområder (Natura 2000)	5.224	62,4 %	Kriteriet for bestanden er: 3.000

Figure 3.6 Spatial distribution of velvet scoter in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of velvet scoter for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

3.1.5 GULLS

The general term 'gulls', groups different species of small and larger gulls (genus *Larus*). Four species can occur frequently in the pre-investigation area: black-headed gull (*Chroicocephalus ridibundus)*, little gull (*Hydrocoloeus minutus*), herring gull (*Larus argentatus*), common gull (*Larus canus*) and black-legged kittiwake (*Rissa tridactyla*). All gull species are opportunistic and omnivore feeders. Little and black-headed gulls feed mainly on insects and crustaceans whereas large gulls feed mainly on small or medium-sized fish (MENDEL et al. 2008a). Except for great black-backed gull (*Larus marinus*), they tend to be gregarious. While little gulls may be slightly affected by offshore wind farms avoiding these areas, other species are known to be attracted by OWF structures (DIERSCHKE et al. 2016).

LITTLE GULL

Little gull (*Hydrocoloeus minutus*) is the smallest gull species in the world. Being widely distributed along Europe, they perform a migratory route from their breeding grounds in the northwestern Eurasian marshy wetlands and wintering offshore or in coastal waters, along the western Baltic or North Sea. The spring migration towards breeding grounds is influenced by many factors such as weather or food availability, but in general little gull is a coastal species and surface feeder (SCHWEMMER & GARTHE 2006). The population within Europe is estimated at 96,000-180,000 individuals and, while its status is Least Concern (BIRDLIFE INTERNATIONAL 2021) , the trend is decreasing (Wetlands International, AEWA CSR, accessed on 03.04.2025).

Although this species is present in the Baltic Sea during its wintering stage, the highest densities—exceeding 1 ind./km^2—have been recorded in the Gulf of Riga. However, during harsh winters, little gull populations tend to migrate westward toward the waters of Kattegat (Denmark-Sweden), where wintering densities range from 0.10 to 0.99 ind./km^2 (HELCOM 2019c). Due to its declining population in the Baltic Sea region, this species has been classified as Near Threatened. In Denmark, the breeding population is extremely marginal (50< mature individuals) and is considered Critically Endangered in the Danish red list. However, the migratory population needs further assessment, and it is currently listed with Data Deficiency status (STERUP, 2019).

COMMON GULL

In the Baltic Sea, common gull (*Larus canus*) breeds along the coast mainly in Sweden and Finland. These gulls are mainly migratory, some birds winter in the northeast and southern Baltic Sea, but most overwinter in the North Sea (DURINCK et al. 1994). They feed on terrestrial and aquatic invertebrates as well as fish, but also on fish discards and garbage dumps (DURINCK et al. 1994). In fact, they are typical ship followers (WALTER & BECKER 1997; KUBETZKI 2002). They are observed in large flocks of up to 100 birds (DURINCK et al. 1994).
Common gull may occur in the pre-investigation area throughout all year but might be more numerous in winter. During winter, low densities are expected in the Kriegers Flak II region in general with only a mean density of 0.3 ind./km^2, whereas highest densities were observed west of Bornholm (1-5 ind./km^2, DURINCK et al. 1994). Previous surveys indicated they were distributed over most of the Baltic Sea (DURINCK et al. 1993). Recent evaluations for the Northwest European population estimate 1,400,000– 2,000,000 common gull individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024). They are considered as a species of least concern based on the recent IUCN Red List (BIRDLIFE INTERNATIONAL 2021).

LESSER BLACK-BACKED GULL

Lesser black-backed gull is distributed throughout Europe. Three subspecies exist: the eastern variation *Larus fuscus fuscus,* which breeds from Sweden to northern Norway and eastwards to Russia. The western variation *L. f. graelssii* breeding from SW Greenland to Iceland and to Spain and the intermediate form *L. f. intermedius* mainly occurring in the Netherlands and Denmark (MENDEL et al. 2008a). In Denmark, two of these subspecies may occur (*L. f. fuscus* and *L. f. intermedius*). Breeding lesser black-backed gull individuals can be found on Græsholm (3-5 breeding pairs) and single individuals on Bornholm. By the Øresund strait, breeding pairs are reported for Saltholm island which is the closest breeding colony to the pre-investigated area, but the exact number is unknown (HELCOM 2013b). In the study by Petersen et al. (2021), lesser black-backed gulls were only recorded in very small numbers in the pre-investigation area and thus the area is probably of low importance for this species.

Almost two decades ago, estimates suggested a population of 300,000 to 350,000 breeding pairs of lesser black-backed gulls (MENDEL et al. 2008a). Recent evaluations for the 'intermedius' population estimate 560,000 – 610,000 lesser black-backed gulls individuals with a stable trend. (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 09.04.2024). They are considered as a species of least concern based on the recent IUCN Red List (BIRDLIFE INTERNATIONAL 2021) but are listed as vulnerable by HELCOM (2013b).

HERRING GULL

The numbers of herring gulls (*Larus argentatus*) have increased in Denmark during the last decades. While the first censuses of 1920 estimated a population of around 3,000 pairs, more recent counts in 2010 estimated roughly 87,000 pairs. Currently, significant declines in bird populations have been observed across parts of the Baltic region, particularly in Finland. (HARIO & RINTALA 2016; WETLANDS INTERNATIONAL 2022, retrieved on 03.03.2022). Most of the growth of the population occurred after the 1960s and parallels the growth observed in north-western Europe, apparently linked to an increase due to protection measures and the availability of additional food resources for example by garbage dumps and fisheries discards (BREGNBALLE & LYNGS 2014).

The development of the population of herring gull differed between eastern and western Denmark. Before the mid-seventies, most herring gulls (61%) bred in the eastern part of Denmark (BREGNBALLE & LYNGS 2014), with the colony of Ertholmene being the second largest colony in Denmark (LYNGS 1992). Around 1974, the government installed culling programs in the largest colony, which resulted in a decline of the entire breeding population and shifted their centre of distribution towards the western part of the country (BREGNBALLE & LYNGS 2014). Although herring gulls breeding at Ertholmene have been reduced from about 20,000 pairs in 1970s (LYNGS 1992) to about 9,000 pairs (BREGNBALLE & LYNGS 2014), the breeding colony is still important. During winter, a high-density area in the Middelgrunden area, has been identified (Durinck et al. 1994). Using more recent data, also DHI (2019) showed that herring gulls occurred commonly in the pre-investigation area during winter, with locally high densities that were probably associated with fishing vessels. Recent evaluations for the Northwest European population estimate 860,000 – 1,000,000 herring gull individuals (Wetlands International 2022, AEWA CSR 8, accessed on 10.04.2024). Herring gull is considered a species of least concern based on the recent IUCN Red List (BIRDLIFE INTERNATIONAL 2021) but listed as vulnerable in the HELCOM Red List (2013c). Herring gull is regarded as the most common gull species in the offshore sites of the German Baltic Sea. Thus, their occurrence is expected in the pre-investigation area.

GREAT BLACK-BACKED GULL

The great black-backed gull *(Larus marinus*) occurs in small numbers in the Baltic Sea throughout the year. The highest populations are observed in winter when birds migrate southward from northern breeding sites. In Danish waters, an important key area has been identified by Durinck et al. (1994), stretching along the Swedish coast. Great black-backed gulls feed mainly on fish and are solitary or observed in small loose flocks (DURINCK et al. 1994). They also gather near fishing vessels as ship followers (DURINCK et al. 1994; GARTHE & SCHERP 2003; MENDEL et al. 2008a). In the pre-investigation area, great black-backed gulls were commonly found with a dispersed pattern which is probably associated to the presence of fishing vessels (DHI 2019). Recent evaluations for the Northwest European population estimate 240,000 – 310,000 great black-backed gull individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 10.04.2024). The species is considered a species of least concern based on the recent IUCN Red List (BIRDLIFE INTERNATIONAL 2021).

BLACK-LEGGED KITTIWAKE

Black-legged kittiwakes show a very wide distribution in the North Sea and adjacent waters, especially during the non-breeding season. In the Baltic Sea, the Kriegers Flak II area is the main wintering area for this species

(DURINCK et al. 1994). The black-legged kittiwake breeds only at a few locations in north Jutland (https://dk.birdmigrationatlas.dk; accessed 22.04.2024). The main breeding areas are in Northwest Europe (e.g. UK, Iceland and Norway). Kittiwakes mainly feed on small shoaling fish like sandeels and clupeidae but also on the pelagic larval states of crustaceans (MENDEL et al. 2008a). They are often found following fishing vessels (GARTHE & HÜPPOP 1994).

In the Kriegers Flak II area, black-legged kittiwakes were found in locally low densities in the eastern part of the area (DURINCK et al. 1994) and this was also confirmed in more recent studies (DHI 2019; PETERSEN et al. 2021). Birds mainly occurred there between November and March.

The Atlantic biogeographical population of the black-legged kittiwake (to which individuals in the pre-investigation area would mainly belong) was recently estimated to be 6.1 million individuals (AEWA CSR 8, http://wpe.wetlands.org/, accessed 22.04.2024), with a declining trend.

3.1.6 AUKS

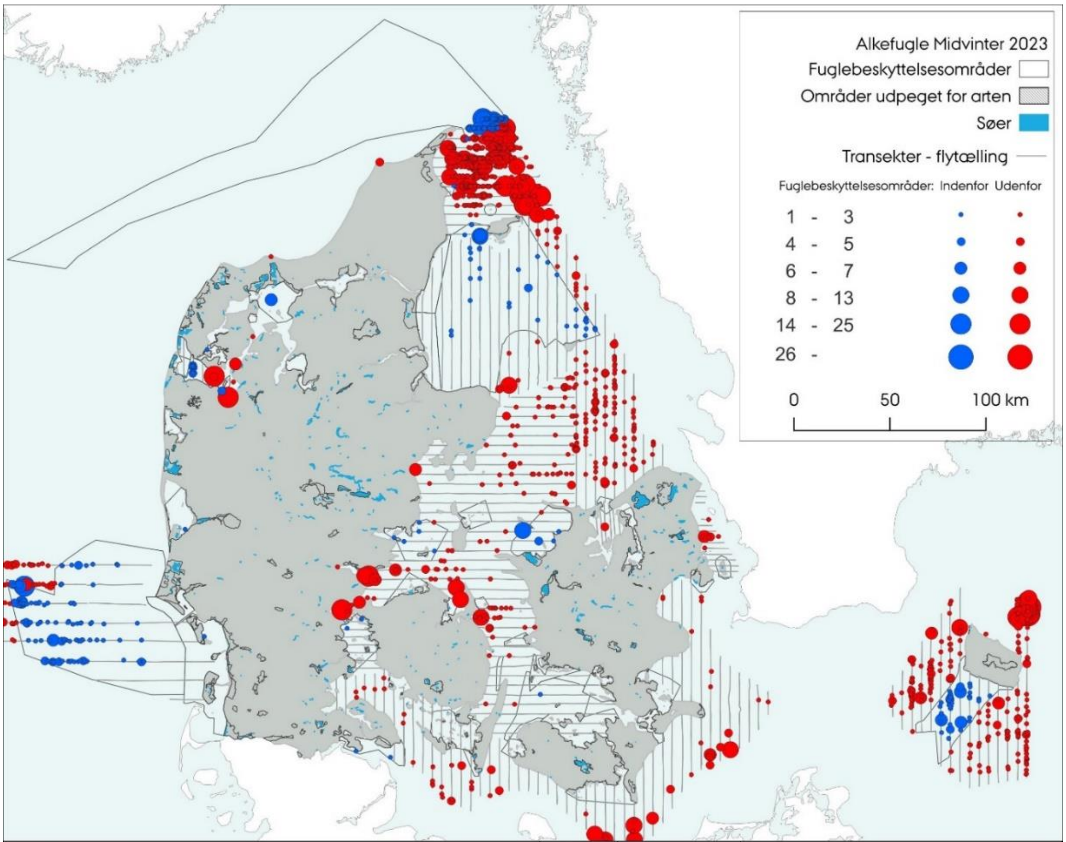
Auk species typically found in the Baltic Sea are common guillemot (Uria aalge) and razorbill (Alca torda). Occasionally, other auks such as Atlantic puffin (Fratercula arctica) and black guillemot (Cepphus grylle) may appear as well. Black guillemot´s highest concentration is found in the nearby Rønne Bank, for which this species is considered an important bird area (Heath & Evans 2000). Within Denmark, the breeding population is mainly located in Kattegat and Storebælt, being the island of Græsholmen the largest population with 1,032 breeding pairs registered in 2022 (Novana & Vihlborg Staalsen 2024).

Over two thirds of the Baltic Sea population of common guillemot and 30% of the populations of razorbill breed on Stora Karlsö (and Lilla Karlsö), two small islands located west of the island of Gotland (Sweeden), which are famous for hosting the largest fish-eating seabird colonies of the Baltic Sea (Olsson & Hentati-Sundberg 2017). Other colonies are in different areas of the Baltic Sea, but most are relatively small. The second largest colony of common guillemot in the Baltic Sea is found on Græsholmen, a very small island north of the island of Bornholm, which hosts about 2,000-3,000 breeding pairs (Olsson et al. 2000). Lyngs (1992) suggested that there were 2,000 pairs of common guillemot and around 450 pairs of razorbills breeding in Græsholmen in the 1980s. In the early 2000s, the breeding pairs of razorbills had increased to 780 pairs (Lyngs 2001). The archipelago of Ertholmene is one of the Danish important bird areas and the only site in Denmark known to have breeding colonies of both auk species (Heath & Evans 2000).

During winter, surveys in the Inner Danish Waters found razorbills/guillemots almost exclusively in the central area, between Nordsjælland, Anholt and Læsø. Most birds were found in areas with water depths of 20 - 40 m (Petersen & Nielsen 2011). Durinck et al. (1994) also found key areas with high densities of razorbill in the Middelgrundene and the Djursland coast. This was also confirmed by a more recent study (DHI 2019). Also, common guillemot reached the highest densities in the Middelgrundene area (Durinck et al. 1994) and a more recent study also showed a high persistency of occurrence in the central, eastern and northeastern parts of the Middelgrund study area (Petersen et al. 2021). Recent surveys from winter 2020 also showed high numbers further south, towards the coast of Sjællands *Odde* (Figure 3.7; https://novana.au.dk, accessed 22.04.2024). Of black guillemots, only a small population winters in the northern Kriegers Flak II (Durinck et al. 1994). Higher densities of this species may occur in the Pomeranian Bay and south of Rønne Bank (Durinck et al. 1994; Mendel et al. 2018). Compared to the other two auk species, black guillemot prefers shallower waters (depths < 25 m, Durinck et al. 1994).

In general, the auk distribution pattern seems to be concentrated around coastal areas, especially by the northern tip of Denmark. Lower densities have been reported in the pre-investigated area, with densities of 1-3 ind./km2 during the winter (Figure 3.7).

While the two most common auk species have relatively stable populations or are increasing, other auk species are threatened (HELCOM 2019d). In general, auks are long-lived but start reproducing only after several years of life. Moreover, these species were heavily hunted by humans, and their populations almost went extinct. Both the common guillemot and the razorbill are listed a species of least concern on the IUCN Red List (BIRDLIFE INTERNATIONAL 2021). For common guillemot, individuals from several subspecies might occur in the Kriegers Flak II and the exact proportion of birds from the different breeding areas/flyways/subspecies is not known. Recent evaluations for the Northwest European population estimate 500,000 common guillemot and 830,000 – 2,000,000 razorbill individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, accessed on 09.04.2024), with an increasing trend. Among the two other species that may rarely occur in the area, the black guillemot is listed as a species of least concern as well, whereas the Atlantic puffin is considered endangered (BIRDLIFE INTERNATIONAL 2021).



Fugle talt i alt:	3.469	Procentandel:	
Heraf talt i fuglebeskyttelsesområder:	696	20,1 %	
Heraf talt i fuglebeskyttelsesområder udpeget for arten:	0	0,0 %	
Fugle talt i fuglebeskyttelses- og habitatområder (Natura 2000)	827	23,8 %	

Figure 3.7. Spatial distribution of auks in winter 2023. The map shows distributions inside (*indenfor; blue*) and outside (*udenfor; red*) of bird protected areas in which circle sizes are increasingly proportional to the number of counts. In the legend: midwinter counts of auks for 2023. Blank rectangle refers to nature reserves or protected bird areas, while the grey rectangle refers to areas specifically designated for the species and/or species group. Blue rectangle refers to inner water bodies such lakes. Transect lines refer to the transects taken during aerial surveys. From https://novana.au.dk.

3.2 MIGRATING BIRDS

Throughout the annual cycle, migrating birds alternate between breeding and non-breeding regions. They can travel over long distances twice a year. Although this is a regular, annually recurring phenomenon, the magnitude of migration can vary strongly from year to year and is subject to great variability. The distance covered during migration varies among species as well, some migrate over long distances of several 100 or 1000 km, others travel short distances with only a few kilometres. Among some species, only parts of the population migrate while the rest resides in their area of distribution, also conducting local movements between breeding or roosting areas and feeding areas. Among some species, only part of the population is migratory (BAIRLEIN et al. 2014; CORDES & MAY 2023).

Estimates for the western Baltic Sea (including Belt Sea and Kriegers Flak II) suggest that about half a billion birds belonging to approximately 200 different species cross the area during autumn and roughly ~ 250 million birds during spring (BSH 2021; NUSSBAUMER et al. 2021). The majority of these are songbirds (> 95%). The rest is composed of seabirds and other waterfowl such as divers, grebes, ducks, geese, waders, gulls, terns and auks (BSH 2021). Especially daily migrants like thermal gliders such as birds of prey and cranes tend to avoid crossing open sea when migrating (ALERSTAM 1978) and thus are frequent migrants in the Belt with shorter distances across sea areas compared to other parts of the Baltic Sea. Instead, they follow land areas until a crossing is unavoidable and therefore concentrate at peninsulas or other narrow stretches of land in order to reduce the risks and energy expenditures associated with active flight over water (ALERSTAM 1990).

As previously mentioned, bird migration is very variable and thus hard to predict. However, the timing of migration is influenced by weather conditions such as temperature, precipitation, fog, wind speed and direction, as energetic costs necessary for flying itself are related to the presence and magnitude of these parameters (LIECHTI & BRUDERER 1998; LIECHTI 2006; SHAMOUN-BARANES et al. 2010; NILSSON et al. 2019). Thus, migration mostly takes place during only a few days of the migration period with the most favourable weather conditions (BSH 2021).

For many Scandinavian and Siberian breeding bird species, the western Baltic Sea and the Belt Sea are part of their annual migration routes (WELCKER & VILELA 2020) (see Figure 3.8). Numerous night-migrating songbirds are thought to cross the offshore area in a broad front mainly with a south-western/north-eastern orientation (depending on the season), but local aggregations and deviating directions are also possible. Most day-migrating birds follow landmarks like in spring from the eastern edge of the Djursland peninsula over the island of Anholt to the Swedish mainland in the pre-investigation area Kriegers Flak II or from the Falsterbo peninsula in south Sweden over Danish islands such as Zealand and Lolland and German Fehmarn to the mainland of Europe in autumn, but fractions of those populations also directly cross the open water. Waterfowl like geese, ducks or divers mainly move through the area in an east-west direction (BELLEBAUM et al. 2010a).

Concerning especially the pre-investigation area Kriegers Flak II, the area of Gjerrild is considered to be the second most important site after Skagen for landbirds migrating between Jutland and Sweden in spring (DHI 2009). Although the numbers will be much lower than at Skagen, the northernmost tip of Jutland, numbers migrating from Gjerrild is still considerable. Raptors are considered the most important species group in the Anholt area, specifically common (*Buteo buteo*) and honey buzzard (*Pernis apivorus*), sparrowhawk (*Accipiter nisus*) and red kite (*Milvus milvus*). Important are also diurnally migrating passerines (e.g. chaffinch/brambling, wagtails, pipits, larks and swallows) as well as swifts and pigeons (wood pigeons *Columba palumbus*). Waterbird counts revealed the importance of the area for sea ducks such as common scoters and eiders as well as gulls.

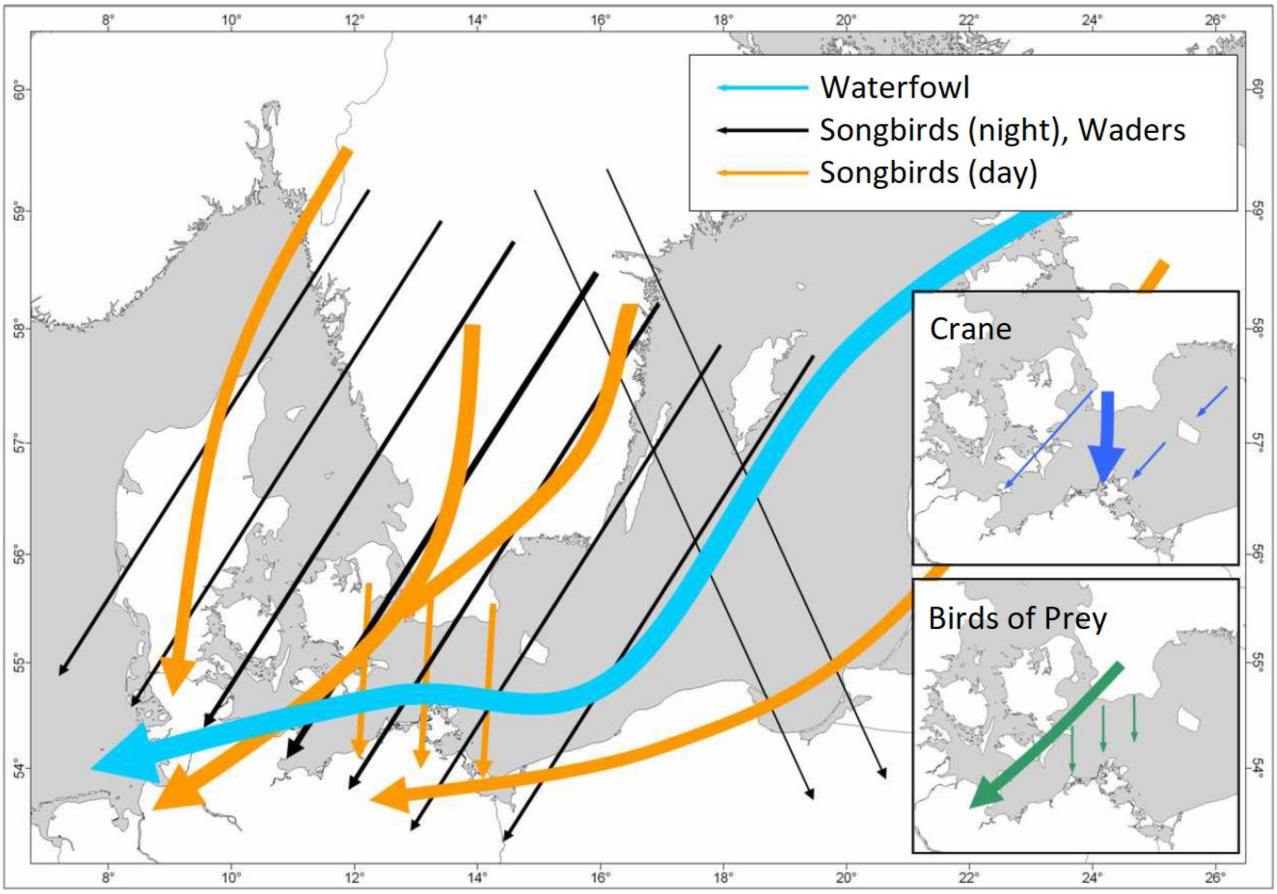


Figure 3.8. Most important migration routes in the Baltic Sea during autumn. From Bellebaum et al. (2010a).

In the following, the migratory bird species or species groups identified to be most relevant for the study area are described in more detail. We consider and define most relevant groups in terms of abundance, but also in terms of their potential susceptibility to the construction of offshore wind farms, i.e., those species groups that may be more subject to collision risk or avoidance behaviour and are otherwise requiring conservation measures.

3.2.1 GEESE AND SWANS

At least three goose species of the *Anser* genus, two "black" *Branta* species of barnacle and brent goose, and three species of swans migrate annually through the Belt Sea/Kriegers Flak II region. In general, these species are either polytypic (except for *Branta leucopsis* and two of the swan species), or if monotypic, have populations that rarely exchange genetic material. Most geese breed on lakes, pools, rivers and in a variety of wetland habitats and winter on farmland in open country or in swamps, lakes, saltmarshes and coastal lagoons further south than their breeding areas (SCOTT & ROSE 1996). Moreover, the subspecies or populations of geese and swans that may be encountered in the Kriegers Flak II area have all increased in size in the last decades partly because of protection of their main wintering and staging sites in northwestern Europe, and also a reduction of hunting pressure on some of these species (for example *Branta leucopsis*).

Whereas the specific biology and requirements of each of the species mentioned here varies, mostly all of them follow the same migration pattern. They start their migration towards the wintering areas (reaching from Denmark to southwest Europe) by September, reaching peak numbers in January and February in their winter quarters and migrate back to their breeding areas from March onwards (SCOTT & ROSE 1996). For example, the whooper swans overwinter in Denmark with numbers of 57,303 in 2020 and 60,612 in 2021 (HOLM et al. 2021).

Only the greylag goose (*Anser anser*) breeds relatively close to the pre-investigation area since the greylag goose is a common breeding bird in Denmark, estimated at 18,000 breeding pairs (HOLM et al. 2021) and migrates further south in winter, whereas some of the populations of the barnacle goose (*Branta leucopsis*) have recently established new breeding sites in these regions but in farther distances to the Kriegers Flak II area (FEIGE et al. 2008) e.g. 4.500 pairs on Saltholm close to Copenhagen in 2019 (HOLM et al. 2021).

Regarding observed migration altitudes, geese often fly at high altitudes. The barnacle goose for example is known to fly at faster speeds and higher altitudes in spring than in autumn (341 m vs 215 m, GREEN & ALERSTAM 2000).

As already mentioned, the populations of these species of geese have increased in recent years. However, this increase has also resulted in some conflict with humans. *B. b. bernicla* has increasingly turned to new food sources grazing on cultivated crops near the coast, causing a conflict with farmers, for example in Britain (SALMON & FOX 1991). As a result, and a possible solution, studies have been conducted to evaluate whether an increase of the hunting bag for some of these geese species could help to control their populations without representing a threat. Similar conflicts arise with many of the other species, and with the exception of the barnacle goose no other species of these waterbirds is listed under the Annex I of the Birds Directive.

Geese and swans are known to show avoidance behaviour to wind farms. Almost 95% of pink-footed geese (*Anser brachyrhynchus*), a species which is more often encountered in the North Sea, showed strong vertical and horizontal avoidance behaviour as a response to offshore windfarms (PLONCZKIER & SIMMS 2012). Moreover, these authors also showed that during periods of reduced visibility geese tended to fly at lower altitudes (100-150 m) compared to periods of good weather conditions when they flew higher (250-300 m). Nevertheless, they said that in their study most of the migration took place early in the afternoon under favourable conditions, thus possibly reducing the risk of collision (PLONCZKIER & SIMMS 2012).

3.2.2 BIRDS OF PREY

Birds of prey, also known as raptors, are all top predators. About 39 species of breeding diurnal birds of prey are inhabiting Europe (THOMPSON et al. 2003). More than half of the species known worldwide (at least 62% or 183 species) undertake seasonal migrations with many of them being long-distance migrants undertaking sometimes intercontinental flights (BILDSTEIN 2006). Several species of raptors can soar, meaning they are able to maintain flight without flapping their wings by making use of the rising air currents and thereby reducing energetic costs. Soaring is an efficient form of transport, both during and outside of long-distance migration (BILDSTEIN 2017). Especially long-distant migrants are strongly dependent on soaring flight. However, when crossing large waterbodies such as the pre-investigation area Kriegers Flak II, which usually lack upwinds, soaring provides quite a challenge. Other species such as ospreys, harriers and most accipiters and falcons migrate with powered flight by flapping their wings. Most raptors are day migrants, but few species such as peregrine falcons, ospreys, and merlins also migrate during nights.

The migration corridors of raptors, which often travel in flocks, are well-known (BILDSTEIN 2006). Their most important flyway in Europe is the western European-western Africa flyway (BILDSTEIN 2017). A comparative study of satellite tracking and ring recoveries for four common raptor species gathered detailed information on the taken routes (STRANDBERG et al. 2009).

At Falsterbo in South Sweden, raptor autumn migration has been studied since the early 1940s (KJELLÉN & ROOS 2000), whereas standardized counts of raptors and other migratory birds have been conducted since 1973 (KJELLÉN 2019). Therefore, this spot has often been used to describe the common pattern of migratory birds in the western Baltic Sea region including Kriegers Flak II and Belt Sea. An average of 46,000 migrating raptors and falcons are observed annually. The most common species there are the Eurasian sparrowhawk (*Accipiter nisus)*, the common buzzard (*Buteo buteo)* and the red kite (*Milvus milvus)* (KJELLÉN 2019). Species with more southerly distribution breeding close to Falsterbo are more commonly observed compared to species with northerly distributions (KJELLÉN 2019). Similarly, thermal migrants tend to be more concentrated than active flyers at Falsterbo. Since raptors tend to fly at lower altitudes in these regions, the censuses at Falsterbo have been particularly important for raptor studies (e.g., KJELLÉN 1997). The numbers of the most common birds of prey have either increased or remained stable within the last decades (cf. KJELLÉN 2019). Three species show negative trends at Falsterbo: the European honey buzzard (*Pernis apivorus),* the rough-legged buzzard (*Buteo lagopus)* and the northern goshawk (*Accipiter gentilis)* (KJELLÉN 2019). In comparison to a previous study on the trends of raptors from 1940s to the late 1990s in the same area, there seems to be a slight recovery of raptors currently migrating through Falsterbo (KJELLÉN & ROOS 2000; KJELLÉN 2019).

The baseline study as well as specific investigations on collision risks for the OWF Anholt in the northern part of the pre-investigation area revealed the area of Gjerrild to be the second most important site after Skagen for landbirds migrating between Jutland and Sweden in spring (DHI 2009: Anholt OWF Baseline 2009). Although the numbers will be much lower than at Skagen, the northernmost tip of Jutland, specifically common and honey buzzard, sparrowhawk and red kite are migrating regularly and in high numbers across the pre-investigation area Kriegers Flak II.

There is, however, a large variation in the number of raptors being observed during the autumn migration every year. This may not only be linked to more birds being counted under favourable weather conditions. When birds fly against the wind, they tend to fly at lower altitudes and may be more easily observed and thus counted. It could also be caused by changes in population numbers due to changes in reproduction. Species like the Eurasian honey buzzard and the rough-legged buzzard are known to produce varying numbers of juveniles depending on the availability of prey such as wasps or rodents during the breeding season (KJELLÉN 2019).

As top predators, most birds of prey are k-selected species with relatively little annual reproduction and their young require many years to mature before breeding (DWYER et al. 2018). Thus, they have naturally low densities. The population sizes of raptor species are relatively small compared to other breeding birds. Their life-history traits and their high trophic level make them extremely susceptible to anthropogenic threats such as land use change, direct killing, poisoning and environmental contaminants, electrical injuries causing death and climate change. They are among the most threatened group of birds in the world (MCCLURE et al. 2018). In Europe, the most influential impacts affecting the populations of the most vulnerable diurnal raptor species include habitat loss/change, intensification of agricultural habitats, direct persecution (e.g. shooting), pesticide contamination, disturbance of nest sites and many others (THOMPSON et al. 2003; SERRATOSA et al. 2024).

Due to the particular vulnerability of birds of prey and the reduction of their population sizes caused by numerous threats they have already faced by the first half of the last century (BIJLEVELD 1974; BILDSTEIN 2017), they are among the rarest birds in Europe: 46% of European birds with less than 1,000 breeding pairs are birds of prey (THOMPSON et al. 2003). Thus, many of the species are protected by European legislation and have also been included in other conventions (see Figure 3.8 for the most common species likely crossing through the Baltic Sea including Kriegers Flak II).

Since no collision victim search underneath offshore wind turbines is possible, all studies measuring direct mortality are based on onshore studies. Direct mortality from collisions with onshore wind turbines are relatively common in birds of prey. The collision of individuals by wind turbines were already observed with the first large wind farms placed in Altamont Pass in California and have been documented in many other onshore places ever since. In Germany, in March 2013 at least 37% of all reported bird collisions corresponded to birds of prey confirming that they made up a disproportionately large amount of all collisions (HÖTKER 2017). Some species were especially susceptible. Among them were Red Kites, whose breeding populations in Germany have been rapidly declining since 1991 (MAMMEN et al. 2017), which is why they are a focal species in relation to potential risks of wind turbines.

Despite the estimates of collision rates being very variable and the difficulty of obtaining reliable data, some overall findings and conclusions have been achieved from a German database (RASRAN & DÜRR 2017). According to this study, most frequently killed birds at onshore wind farms were red kite and common buzzards, but other species such as white-tailed eagles, common kestrels and black kites were also often reported as victims. Most collision victims were adult birds mainly occurring in spring and late summer (RASRAN & DÜRR 2017). The collision risk directly depends on the rotor swept area. Red kites often flew at heights within the rotor swept area of onshore wind turbines. Up to 50% of all recorded red kite flights are at a collision risk height (MAMMEN et al. 2017). Nonetheless, preliminary results of the Eurokite project indicate that other anthropogenic factors are more important mortality causes for this species than collisions with wind turbines (e.g., poisoning, road and rail collisions, electrocution, etc., RAAB 2024),

Whereas collisions with onshore turbines have been documented for at least 34 species of birds of prey, the effect this may have on population level has been explored for comparatively fewer species. For example, a study modelling the population of red kites in Germany has predicted a further decline due to additional mortality from collisions with wind turbines (BELLEBAUM et al. 2013). Indirect effects such as modifying flight altitudes to avoid wind farm collision and displacement and effective habitat loss have also been studied for different species. Golden eagles for example are apparently able to detect and avoid turbines during migration after the construction of wind farms (JOHNSTON et al. 2014a). Black kites have been found to reduce the use of areas up to 674 m away from turbines with an estimated loss of 3-14 % of the suitable areas at the migratory bottleneck of the Strait of Gibraltar (MARQUES et al. 2019). After the construction of the Anholt wind farm in Kriegers Flak II specific investigations were conducted to assess the weather dependent collision risk for raptors passing the OWF during spring migration (JACOBSEN et al. 2019). The study shows, that 73 % of the observed raptors showed avoidance behaviour to the OWF with three quarters of all reacting birds returning back to mainland indicating that an OWF could potentially act as a barrier by forcing some birds to use alternative routes. Accordingly, the authors recommend that important raptor migration routes should be taken into consideration when planning OWF sites. Further examples of study cases of the effects of wind turbines on different birds of prey are reviewed by WATSON and colleagues (2018).

However, since reliable methods for the monitoring of bird collisions with offshore turbines are still under development, all numbers on potential collision victims in offshore areas are based on models with the BAND model the most famous one (BAND 2012).

3.2.3 CRANES

The population of common cranes breeding in Northwest Europe and Scandinavia increased and is estimated to support 350,000 individuals (WETLANDS INTERNATIONAL 2022, AEWA CSR 8, retrieved on 25.02.2022). Especially for cranes inhabiting Finland and Sweden, the Southwestern Baltic Sea is an integral part of their migration route to and from wintering quarters in Southwestern Europe. In Denmark the migration intensity of cranes is decreasing towards northwest and in the Kriegers Flak II area migrating cranes are not observed in high numbers (HOLM et al. 2021). The Rügen-Bock region in Germany is an important resting area, hosting temporarily up to 40,000 individuals (BSH 2021). A huge part of these birds crosses the Arkona basin in a 1–2-hour flight. Especially in autumn, a proportion of cranes will also move in a southwestern direction over the area of Bornholm (Figure 3.9). Nonetheless, common cranes migrate also towards the north potentially crossing the pre-investigation area (cf. bird migration atlas, https://migrationatlas.org/).

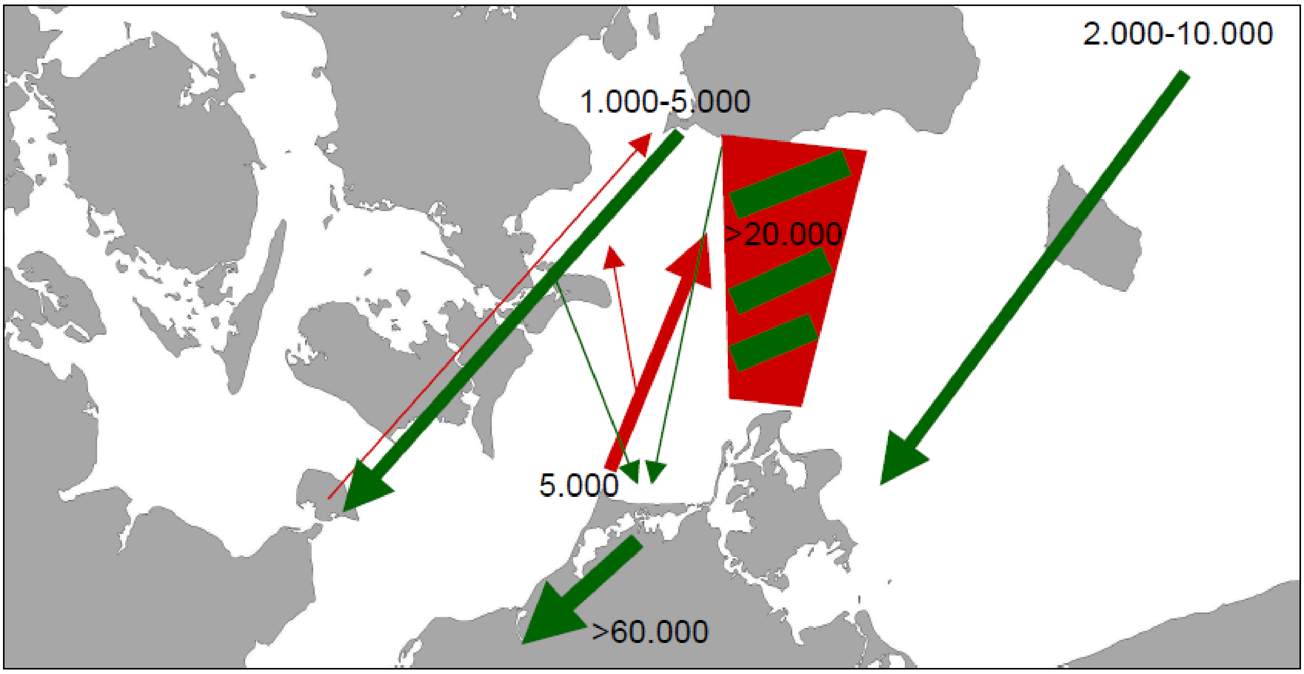


Figure 3.9: Migration routes of common cranes in the southern Baltic area (BSH 2021 based on Falsterbo, Bornholm and other observation data). Red = spring migration, green = autumn migration. Estimated numbers may be higher today due to an increasing population trend.

Due to the increasing population, the common crane currently is listed as a species of least concern (BIRDLIFE INTERNATIONAL 2021). However, its susceptibility to increasing offshore wind power generation remains unclear. One important behavioural trait in this regard might be the flight height of cranes crossing the western Baltic Sea including Kriegers Flak II. They tend to use soaring flight over land, but due to the lack of thermal updrafts over the open water, they have to gain or hold their altitude in powered flight after leaving the coasts (ALERSTAM 1990). Studies of flight altitudes of cranes in the Baltic offshore region so far revealed a certain variety, with cranes observed flying clearly below 200 m height as well as far above (SCHULZ et al. 2013; SKOV et al. 2015). Even though a study from an onshore wind farm determined avoidance rates for Cranes of 99.93-100% (DRACHMANN et al. 2021), their flight behaviour and flight height during the crossing of the Baltic Sea leads to the fact that a theoretical risk of collision in the offshore area cannot be ruled out and therefore this species is a significant factor in the discussion about shutdowns of turbines in the western Baltic Sea.

3.2.4 TERNS

Terns are in general not abundant but can be seen with certain regularity in Danish waters and thus in the pre-investigation area. Most common species are the Sandwich tern (*Thalasseus sandvicensis*), the Arctic tern (*Sterna paradisea*) and the common tern (*Sterna hirundo*). Sandwich terns were not breeding in the Baltic Sea region at the beginning of the 20th century (HERRMANN et al. 2008). The Danish population of Sandwich terns was counted at 5,125 breeding pairs in 2021, but the majority bred in the North Sea region (HOLM et al. 2021).

The Arctic tern (2021: ca. 1700 breeding pairs), the common tern (2021 ca. 880 breeding pairs) and the little tern (2021: ca. 630 breeding pairs) may also be observed close to the pre-investigation area, but mainly close to the coast and only in the summer months. None of the tern species are expected to occur abundantly, they are seabirds requiring protection (all species are listed in Annex I of the European Birds Directive and under the AEWA), and at least the sandwich tern seems to react negatively towards OWF (DIERSCHKE et al. 2016).

3.2.5 SONGBIRDS

Passerines include more than half of all described bird species in the world and are also referred to as songbirds or perching birds, due to the arrangements of their toes, which facilitates perching.

Since passerines include a very large number of species, it is not surprising that they also comprise most of the bulk of migrating birds. One of the best studied bird migration systems is the one involving the Palearctic-African flyway. The first evaluation of the number of passerine birds migrating between Europe and Africa birds by Moreau in 1972 estimated 4.3 billion (HAHN et al. 2009). Newer estimations suggest only half of this number (~ 2.1 billion birds) migrating from Europe to Africa every autumn with almost three quarters of those birds corresponding to the migration of 16 passerine bird species (HAHN et al. 2009). This estimation corresponds to numbers of birds migrating from largest parts of Europe not only crossing the Western Baltic Sea, but it gives an impression of the importance of passerine birds during migration. European passerines show a variety of migration patterns and strategies of which a lot is still unknown (BUSSE 2001). European migrating passerine birds typically travel from their breeding sites often located in the north of Europe to their wintering quarters located in warmer regions in southern Europe or northern Africa. Passerine migration is often occurring in broad fronts instead of corridors (see Figure 3.10 for an example).

Passerine birds can be long-distance migrants with their breeding wintering sites geographically separated by an area which the species is only crossing or using as a stopover site during migration. Other species are short-distance migrants with their wintering grounds being close to or overlapping with their breeding sites. For several species it is known that their populations only partially migrate. For example, there may be different migration patterns between sexes or ages or even populations (e.g., only northern populations of European robins are migratory, southern populations are resident and populations at intermediate distributions are partially migratory). According to the review by BUSSE (2001), at least 63 species of European passerines are long-distance migrants, whereas 69 species can be classified as short-distance migrants (BUSSE 2001).

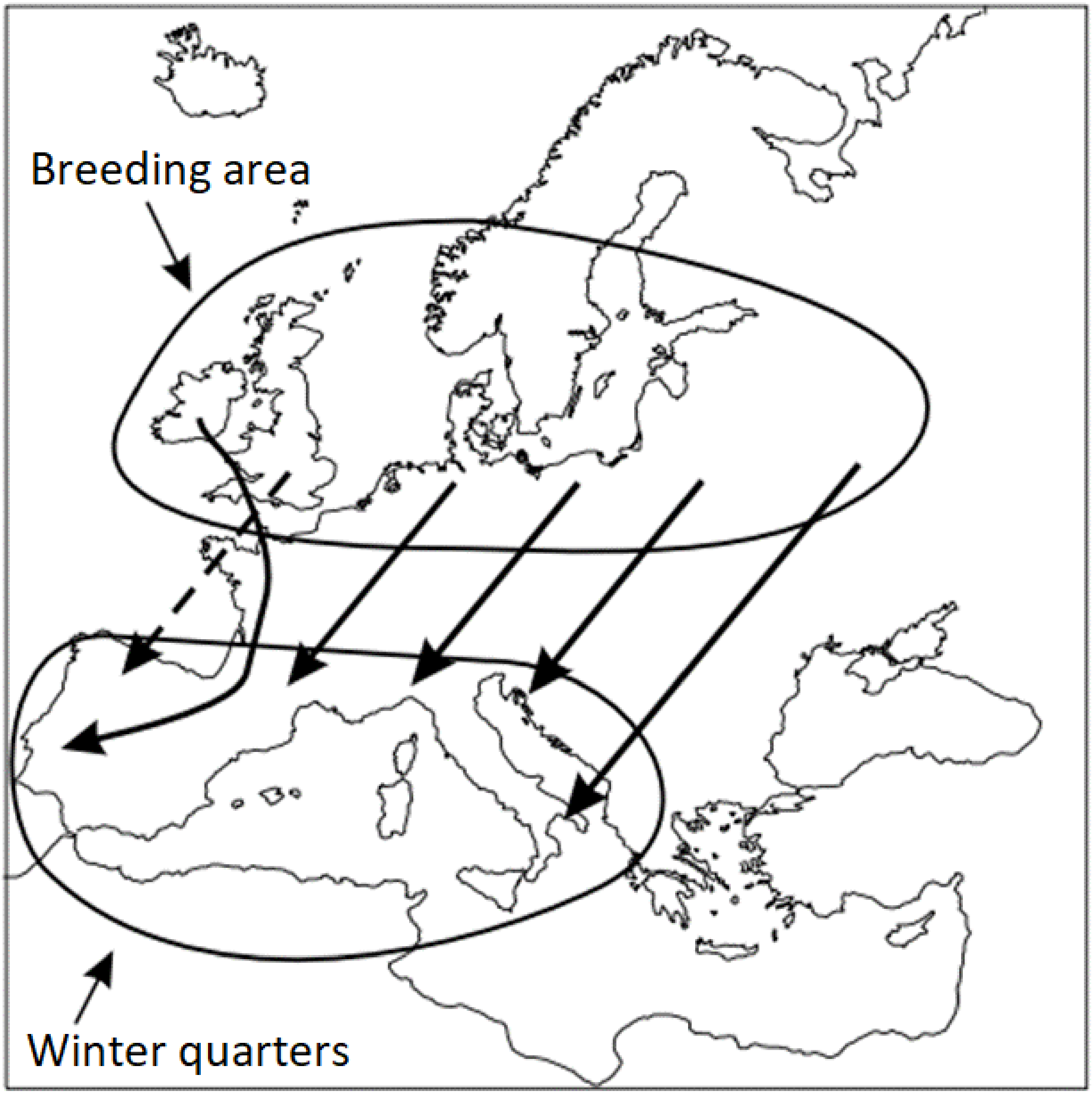


Figure 3.10: Example of broad front migration from the breeding region to the wintering quarter. Taken from Busse (2001).

Most recent interpretations of migration studies and routes suggest that there might be four main passerine flyways in the Western Palearctic: 1) the Western/Atlantic flyway, 2) the Central/ Apennine flyway, 3) the South-Eastern (Balkan-SE) flyway and 4) the Eastern (Indian) flyway, which are shown in Figure 3.11 (Busse et al. 2014). The different lines shown in Figure 3.11 connect breeding sites with wintering quarters (as summarized from ringing recovery studies). Most (passerine) birds fly on these routes across broad fronts, but there are some passages with bottlenecks.

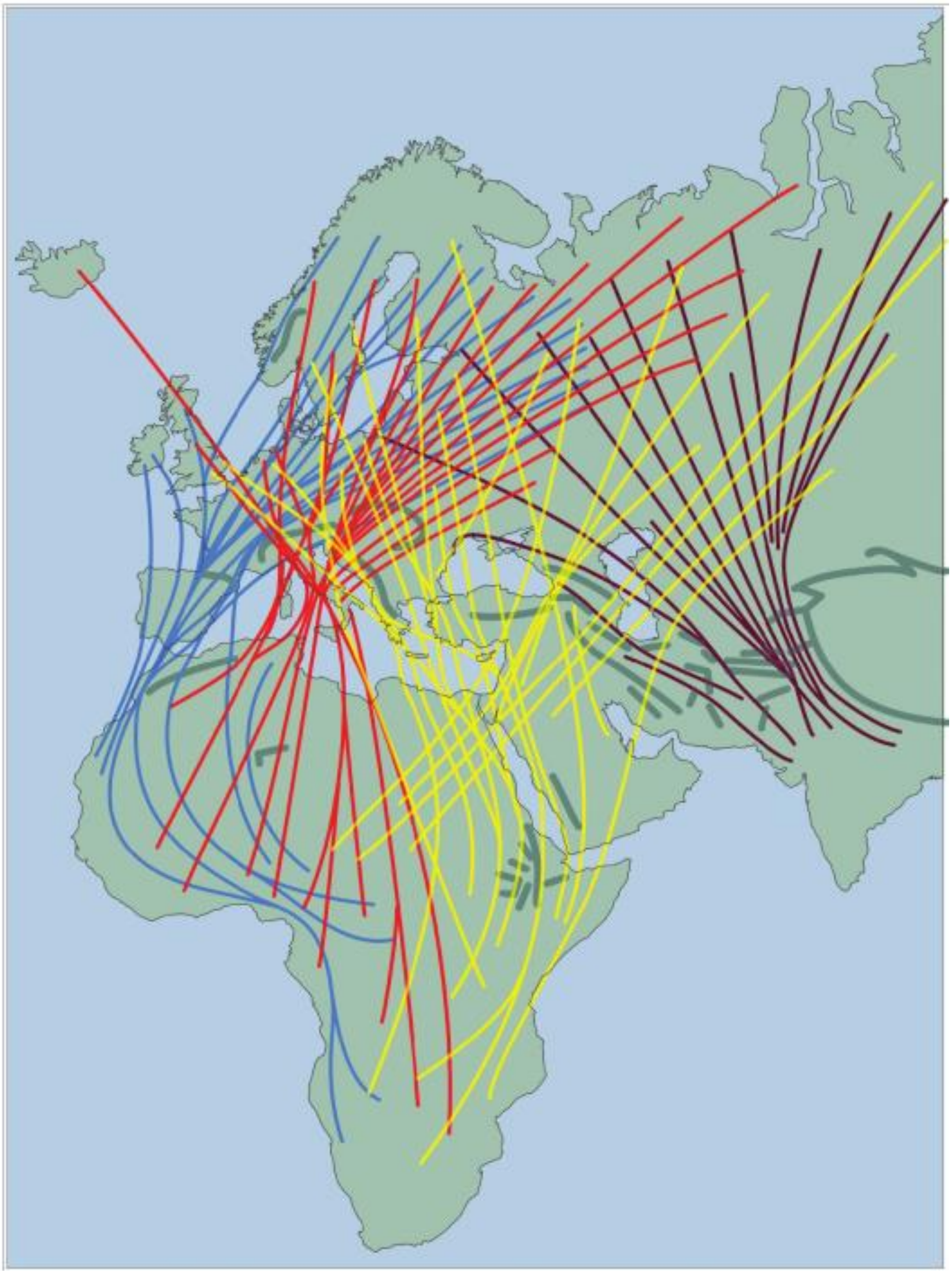


Figure 3.11: The four main fly way routes occurring in the Palearctic: 1) the western/Atlantic (blue), 2) the Central (Apennine, red), 3) South-Eastern (Balkan, yellow) and 4) Eastern (Indian, brown). Taken from Busse et al., 2014.

Migration of passerine birds occurs during day and night with species having adapted to migrate at a particular time of day. Most diurnal migrating species include low and mid-distance migrants, such as finches and wagtails, which are more dependent on visual orientation cues. Birds migrating during night are mid-distance migrants, such as thrushes and robins, as well as long-distance migrants such as warblers.

As seen in Figure 3.8 and Figure 3.11 most common migrating passerine birds cross the Kriegers Flak II area fly in a SW direction in autumn (the flyway 1). Nevertheless, there are some migrating in a SE direction (BELLEBAUM et al. 2010a).

Given the large number of passerine birds potentially crossing the Baltic Sea including the pre-investigation area especially during the autumn migration, they are potentially affected by wind turbines, especially during (mass) migration. Some studies have shown that many species and a large proportion of birds killed by turbines correspond to passerines birds. For example, in South Africa, a fourth of all species and all individuals killed by wind turbines corresponded to Passeriformes. They fell second only in terms of collisions kills only after raptors (PEROLD et al. 2020).

In temperate waters and during migration, the proportion of migrating passerines that may be affected by direct collisions with wind turbines may be much larger. HÜPPOP ET AL. (2006) found that over 98% of all carcasses recovered at FINO1, an offshore research platform in the North Sea, belonged to passerine birds. Despite the study by HÜPPOP ET AL. (2006) covering the German North Sea, some of the overall findings may also be expected for the Baltic Sea. Migration intensity concentrates on certain days of the whole migration period (75% of all passerines were observed during 17-33% of the migration days in the study). These results obtained from visual observations were also confirmed from the study of radar echoes. With regards to flight altitudes during migration, it was observed that almost half of the radar echo signals (registered up to an altitude of 1,500 m) corresponded to the first 200 m of altitude (within the range at which wind turbines may be in operation).

4 METHODOLOGY

4.1 RESTING BIRDS

The recording of resting birds was performed using the digital video technology developed by the company HiDef (HIDEF AERIAL SURVEYING LTD 2024, WEISS ET AL. 2016). This method has already been used for several years in various studies also in the western Baltic Sea and Skagerrak area (e.g., ZYDELIS et al. 2019; BIOCONSULT SH et al. 2020). The HiDef system, specifically designed for this type of work, follows a methodology that is widely accepted by the industry and relevant authorities. Since 2014, BioConsult SH has conducted more than 1,000 survey missions in the North Sea and the Baltic Sea, most of them in relation to offshore wind farms, gaining images of several hundred thousand birds and some thousand marine mammals. Digital aerial surveys have been developed and established in the UK and became in 2014 the standard method for offshore wind farm studies in Germany (BSH 2013). The method has proven to be highly suitable for offshore surveys and to consolidate the basis for consenting offshore wind farms.

4.1.1 DESCRIPTION OF THE SURVEY TRANSECTS

To determine abundances, densities, and distribution patterns of resting birds in the pre-investigation area, six aerial surveys were conducted between February and December 2024. In this report, we present the six aerial surveys conducted between January and December 2024 and compare the results with the previous year of monitoring, from January to December 2023. Given the proximity of the two proposed OWF areas—Kriegers Flak II North and South—a single survey design was applied to both. This unified design was adapted to ensure full coverage of the Kriegers Flak II pre-investigation area within each survey (see Figure 4.1).

For the analysis, results from the whole survey are presented. A total of 13 transects with varying lengths between ranging from 25.9 to 84.7 km in length, were covered during the study period, resulting on an average of 834.3 ± 0.5 km covered per survey (see Figure 4.1, Table 4.1and Table 4.2) for information regarding single surveys. The transects ran parallel to each other in a north-south direction and were 5 km apart. In total, 3,739.1 km² were covered during the surveys.

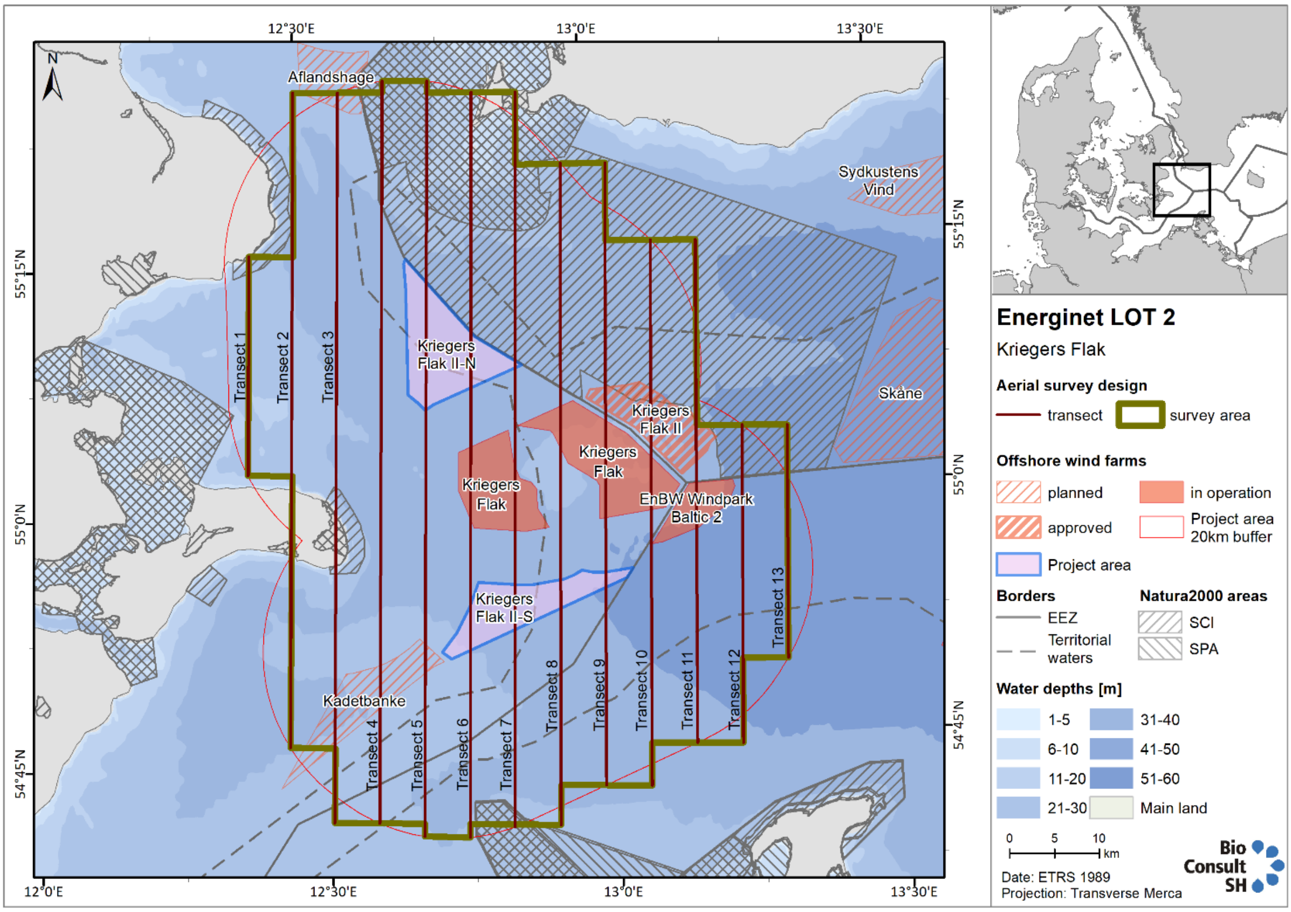


Figure 4.1 Aerial survey transect design for the survey area used during all flights. The figure includes the proposed OWF area (Kriegers Flak II, pink) and the Natura 2000 areas (diagonals, crosshatched). The red polygons are existing offshore windfarms.

Table 4.1. Overview of the six digital aerial surveys carried out in the survey area between February and December 2024. Survey dates, distances, and survey effort as well as the covered area are given for every single flight.

Survey no.	Date	Distance (km)	Effort (km²)	Coverage (%)
1	29.02.2024	834.74	444.75	11.89
2	15.04.2024	834.71	442.54	11.84
3	21.06.2024	835.74	446.09	11.93
4	13.08.2024	834.6	445	11.90
5	12.10.2024	833.94	445.01	11.90
6	01.12.2024	832.2	432.48	11.57
		Total: 5,005.9	**Total: 2,655.9**	**Average: 11.84**

Table 4.2. Waypoints (WP) show the start and end transect coordinates and transect lengths during the digital aerial surveys in the pre-investigation area.

Transect	Waypoint	Start Coordinates	Waypoint	End Coordinates	Transect Length [km]
1	1	55.25736°N; 12.40568°E	2	55.03848°N; 12.38576°E	24.40
2	3	54.76499°N; 12.43648°E	4	55.41892°N; 12.49748°E	72.90
3	5	55.41678°N; 12.57595°E	6	54.68753°N; 12.50645°E	81.30
4	7	54.68479°N; 12.58426°E	8	55.42622°N; 12.65561°E	82.66
5	9	55.42399°N; 12.73385°E	10	54.66939°N; 12.6609°E	84.12
6	11	54.66589°N; 12.73898°E	12	55.41029°N; 12.81078°E	82.98
7	13	55.40829°N; 12.88752°E	14	54.67413°N; 12.81805°E	81.84
8	15	54.67378°N; 12.8972°E	16	55.33462°N; 12.95984°E	73.66
9	17	55.33248°N; 13.03839°E	18	54.71077°N; 12.97924°E	69.30
10	19	54.70801°N; 13.05826°E	20	55.25289°N; 13.10999°E	60.74
11	21	55.25074°N; 13.18862°E	22	54.74793°N; 13.14068°E	56.05
12	23	54.74524°N; 13.21973°E	24	55.06281°N; 13.2507°E	35.40
13	25	55.06031°N; 13.32938°E	26	54.82762°N; 13.30673°E	25.94

4.1.2 DATA COLLECTION

A twin-engine, high-wing propeller-driven aircraft (Partenavia P 68) was used for the acquisition of digital videos, see Figure 4.2. This aircraft is equipped with four high-resolution video camera systems, which take approximately seven images per second and can achieve a resolution of two cm at sea surface. Since the camera system is not directed vertically downwards (depending on the sun position, it can be slightly inclined or even set against the flight direction), interferences arising from solar reflections (glare) can be effectively reduced. The external cameras (indicated by A and D, Figure 4.2) cover a strip of 143 m width while the internal ones cover a width of 129 m each, resulting in 544 m effectively covered. There is however about 20 m distance between each strip to avoid double counting of individuals detected by the cameras. Thus, the total recorded strip of 544 m is distributed over a width of 604 m. By this nearly 11 % of the area was covered.

The aircraft flew at an average speed of approx. 220 km/h (120 knots) at an altitude of 509 m. A GPS device (Garmin GPS Map 296) recorded the position every second, which permitted to geographically assign a location to the images and the individuals registered on them. The collected data was stored on mobile hard disks for subsequent review and analysis. For further details regarding the method see Weiß et al. (2016).

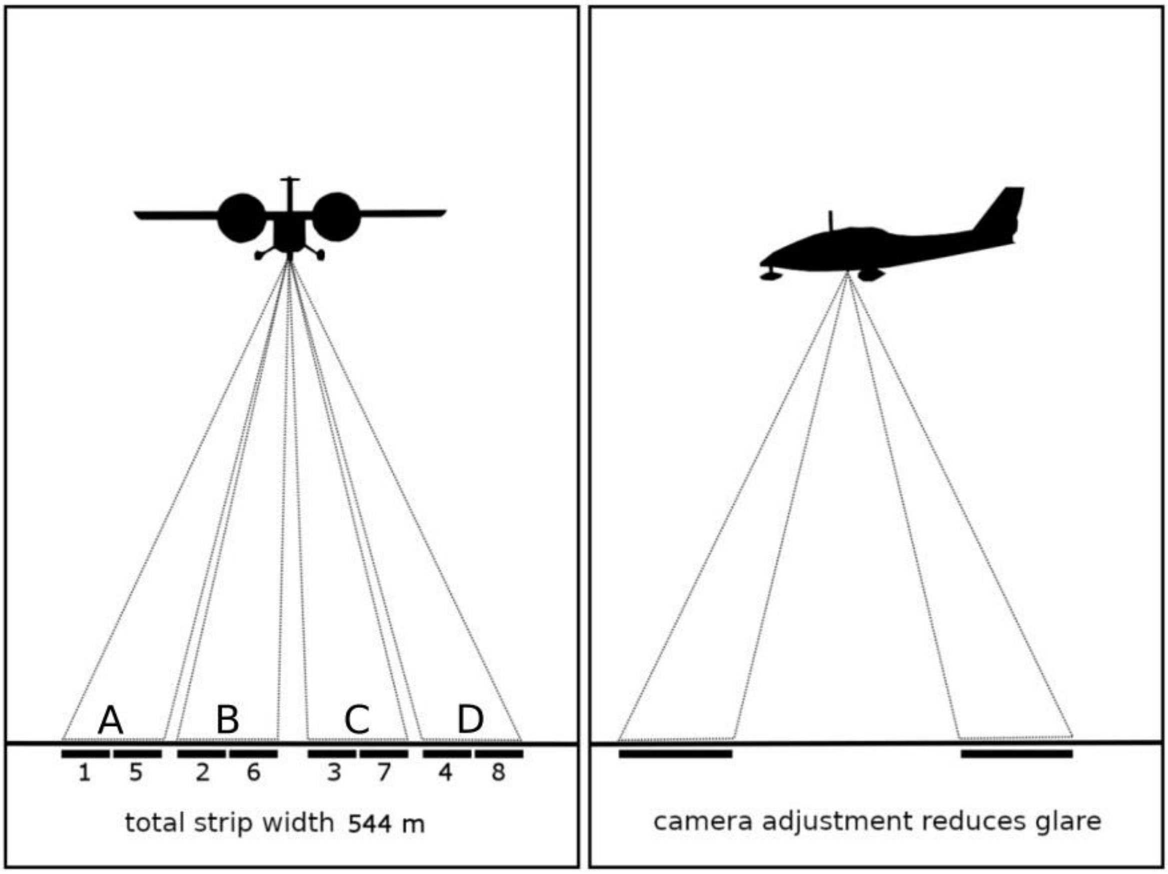


Figure 4.2. The HiDef Camera-System. The four cameras (A to D) cover an effective strip width of 544 m of the sea surface at a flight altitude of 549 m (left: frontal view; right: side view). The numbering indicates the camera images as they are used in the evaluation (the images from each camera are divided into two halves).

4.1.3 DATA PROCESSING

To facilitate the detection of objects, the video sequences taken from each camera were split into two halves, so that each half of the picture fitted the width of a large monitor. The video files were then processed using an image capture and management software (StreamPix). First, the images were examined and all the detected objects (birds, mammals, ships, etc.) were marked and pre-sorted for subsequent identification. To guarantee a consistent high quality, 20% of each film was randomly selected and processed again by another reviewer. If both reviewers reached a consensus of 90% regarding object identification, discrepancies were rechecked, and the film afterwards approved for further analysis. If the consensus was below 90%, the film was reanalysed entirely. Sections of the footage that could not be assessed due to backlight or the presence of clouds were not considered for further analysis.

The next step involved the identification of the previously marked objects (birds). This was done by experienced observers. Often birds can be identified on the images to species level. Due to strong similarities between some species (e.g. common guillemots and razorbills, common and Arctic terns, red-throated and black-throated divers), an identification on species level is not always possible. However, it is usually possible to identify individuals as belonging to a species group formed by two (or few) closely related species. In addition to the identification, other information such as position, age, behaviour (swimming or flying) and flight direction were determined whenever possible. Environmental parameters (air turbidity, sea state, solar reflection, and water turbidity) were recorded for every 500 images (approx. covering 4 km).

To assure quality control, 20% of the objects identified were re-assessed by a second reviewer. All discrepancies between the first and second identification process were checked again by a third expert. If there was a consensus of at least 90%, the data collected was released for further analysis. If the consensus was below 90%, systematic errors (e.g., problems in determining specific species groups) were corrected and all objects were re-identified.

4.1.4 DATA ANALYSIS

All detected resting birds were either identified to species level or assigned to a species group category (see below). Among these, relevant species/species groups were defined based on the frequency of occurrence in the pre-investigation area and the importance of the area as habitat for species according to reference literature.

The individuals not identified to species level in the aerial surveys were initially grouped into a larger taxonomic group of very similar species. Examples of these are common guillemot/razorbill and unidentified divers (red-throated and black-throated diver). These groups consisting of two species include a large proportion of the resting birds not identified to species level. Other resting birds that could not be assigned to any of the previously mentioned or other two-species group, are in most cases identified to family level.

4.1.5 CALCULATION OF DENSITIES

Based on the number of detected individuals for each species or species group, monthly mean densities given as ind./km² were calculated. As the survey effort differed among transects (see Table 4.1), densities were corrected by dividing them by the area covered for each transect. As the effect of the aircraft on birds is negligible, no correction factors are applied to the abundances of species (ZYDELIS et al. 2019). Therefore, it is assumed that all individuals present in the study during the time of the survey are captured by the images.

Dependent on the species-specific biology the timing of migration and breeding as well as phenological patterns can differ considerably among species. Therefore, species specific seasons are defined, to allow comparisons of distribution patterns between species (GARTHE et al. 2007a). For example, for divers, March and April are considered spring whereas for cormorants, spring starts in February and ends in March (GARTHE et al. 2007a). Thus, the spatial distribution was determined for all surveys grouped according to the species-specific seasonal classification by GARTHE et al. (2007a). The spatial distribution was displayed using grid density maps. A grid was laid over the pre-investigation area with its grid cells aligned with the EEA grid (EEA 2019).

4.2 MIGRATING BIRDS

Bird migration was studied from an anchored ship using four different methods, each looking at different aspects of bird migration. Observer-based observations (Table 4.3) are divided into 1) visual observations during daylight which provide information on species composition, flight height distribution (up to a maximum of 200 m altitude), migration direction, phenology and migration intensity and 2) acoustic observations during night for adding information on migration intensity (especially of thrushes) and species composition crossing the area during night (only possible for calling species in the lower altitudes). Standardised (vertical and horizontal) radar surveys (4.2.3) were applied continuously when the ship was laying at anchor for migration intensity and flight height distribution as well as flight direction. Table 4.3 indicates the type of information that is possible to investigate with each method.

Table 4.3 Survey methods and data output

Data/Method	Species determination posible		No species determination	
	Visual observations	Acoustic observations	Horizontal radar	Vertical radar
Species composition	X	X		
Altitudinal distribution	X			X
Flight direction	X		X	
Migration intensity	X	X		X
Phenology	X			X

The surveys were conducted from vessels equipped with radar devices suitable for monitoring bird movements. During a survey, the vessel was anchored centrally in any of the two subareas of the KF II OWF (N and S) proposed OWF (Figure 4.3). The anchoring position of the N area was 55° 12.68’ N, 12° 41.75’ E and that of the S area was 54° 54.84’ N, 12° 57.52’ E. The anchor position was verified upon arrival of the vessel and controlled hourly during adverse weather conditions. A survey was only interrupted, if adverse weather conditions (e.g. wind speeds above 17 m/s and >2.5 m waves) prevented bird observations or prevented the vessel from maintaining the anchoring position at the survey site. Weather conditions (precipitation, wind speed and direction, temperature, visibility, and wave height/sea state) were recorded every full hour. The alignment of the vertical radar antenna was checked every 30 minutes and realigned, if necessary, to keep the direction of the antenna perpendicular to the main migration direction.

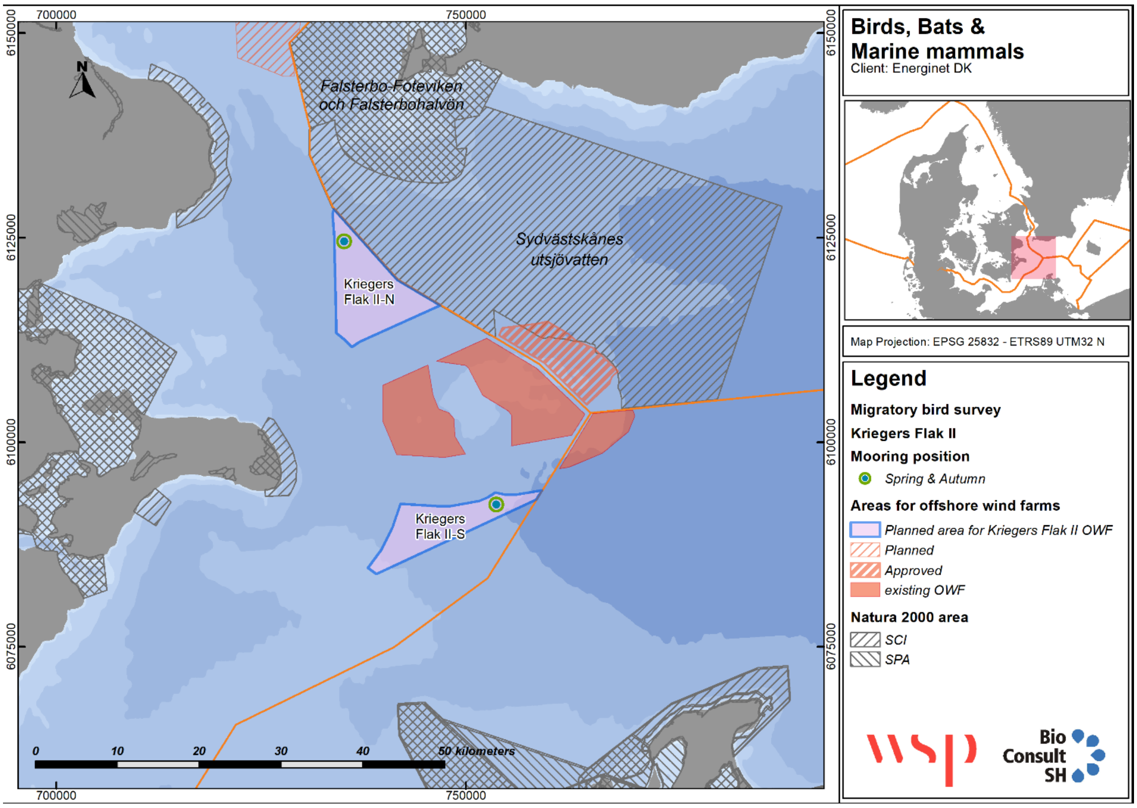


Figure 4.3 Overview of the KF II OWF pre-investigation area (pink), consisting of two areas (KF II OWF North and South), together with other approved, planned and in production offshore wind farms. The green point at the middle of each area indicates the anchoring point for the vessel during the observations and measurements of migrating birds (spring and autumn of 2023 and 2024).

4.2.1 SURVEY EFFORT

Surveys were conducted during spring and autumn of 2023 and 2024 using the ships ‘Arne Tiselius’ and ‘Fortuna Kingfisher’. Table 4.4 and Table 4.5 show the survey dates for both areas, KF II OWF N and S. Observations usually began at dawn (at civil morning twilight) or dusk (at civil evening twilight) at the given date and then continued for two to five 24 h cycles (Table 4.4, Table 4.5). Civil twilight is defined as the moment when the sun is 6 degrees below the horizon, corresponding to the time when the light is barely enough for reading. The total number of days/nights in which surveys took place is also given in those tables. Of all survey dates, some had to be discarded because they did not reach a minimum of 70% valuable data of the total daytime/nighttime due to weather (rain, fog strong wind) or sea state (see tables). Radar measurements were conducted simultaneously.

Table 4.4 Survey information during 2023 and 2024 in the pre-investigation area KF II OWF N. Starting and finishing periods of every survey, number of days/nights and dates for the collection of every type of data are provided.

Survey	Survey periods		Number of 24 h cycles	Number of days/nights	
	Start: Date and time	End: Date and time		Visual observations	Nocturnal flight calls
		2023			
1	17.03.2023, 02:00	19.03.2023, 02:00	2	2	2

2	26.03.2023, 07:30	29.03.2023, 04:30	3	3	3
3	08.04.2023, 07:30	11.04.2023, 03:00	3	3	3
4	17.04.2023, 18:30	19.04.2023, 18:30	2	2	2
5	12.05.2023, 07:00	15.05.2023, 02:30	2.5	3	3
6	19.05.2023, 04:30	21.05.2023, 01:30	2	2	2
7	10.08.2023, 03:30	12.08.2023, 01:30	2	2	2
8	19.08.2023, 03:30	22.08.2023, 03:30	3	2 (3) *	3
9	07.09.2023, 04:00	10.09.2023, 03:00	3	2 (3) *	3
10	21.09.2023, 19:00	23.09.2023, 04:30	1.5	1	2
11	22.10.2023, 15:30	25.10.2023, 15:00	3	3	3
12	28.10.2023, 17:20	29.10.2023, 16:00	1	1	1
13	12.11.2023, 06:00	15.11.2023, 15:30	3.5	4	3
14	17.11.2023, 06:30	20.11.2023, 06:30	3	3	3
Total [planned]			**34.5 [35]**	**33 [35]**	**35 [35]**
		2024			
1	17.03.2024, 08:40	19.03.2024, 05:00	2	2 (1) *	0*
2	29.03.2024, 05:45	30.03.2024, 04:30	1	1	1
3	24.04.2024, 07:30	27.04.2024, 03:00	3	3	3
4	09.05.2024, 02:30	14.05.2024, 02:30	5	5	5 (automatic detection)*
5	18.05.2024, 02:30	22.05.2024, 02:04	4	4	4
6	07.08.2024, 07:00	09.08.2024, 03:00	2	2	2
7	13.08.2024, 07:00	16.08.2024, 03:30	3	3	3
8	11.09.2024, 04:30	14.09.2024, 03:00	3	3	3
9	21.09.2024, 07:00	23.09.2024, 03:00	2	2	2
10	15.10.2024, 07:00	16.10.2024, 05:00	1	1	1
11	21.10.2024, 08:00	23.10.2024, 03:30	2	2	2
12	26.10.2024, 05:30	28.10.2024, 16:30	2.5	3	2
Total [planned]			**30.5 [30]**	**31 (30) [30]**	**28 [30]**

* Due to bad weather the survey was interrupted on 19.08.2023 and 08.09.2023, not enough hours could be done on those days and were removed from further analysis. In 2024, the first day of observation did not include enough hours of data collection so it was discarded. During the first and fourth survey of 2024, acoustic observations could not be done from observers so instead flight calls were recorded from automatic detectors. Unfortunately, the data from the first survey was lost.

Table 4.5 Survey information during 2023 and 2024 in the pre-investigation area KF II OWF S. Starting and finishing periods of every survey, number of days/nights and dates for the collection of every type of data are provided.

Survey	Survey periods		Number of 24 h cycles	Number of days/nights	
	Start: Date and time	End: Date and time		Visual observations	Nocturnal flight calls
		2023			
1	19.03.2023, 05:00	21.03.2023, 01:00	2	2	1 (2)*
2	11.04.2023, 06:00	13.04.2023, 04:00	2	2	2
3	21.04.2023, 06:30	24.04.2023, 02:00	3	3	3
4	16.05.2023, 02:30	19.05.2023, 01:30	3	3	3
5	21.05.2023, 04:30	23.05.2023, 02:30	2	2	2
6	10.09.2023, 06:00	12.09.2023, 04:00	2	2	2
7	18.09.2023, 01:30	19.09.2023, 01:30	1	1	1
8	20.09.2023, 18:00	21.09.2023, 16:00	1	1	1

Survey	Survey periods		Number of 24 h cycles	Number of days/nights	
	Start: Date and time	End: Date and time		Visual observations	Nocturnal flight calls
9	16.10.2023, 08:00	18.10.2023, 23:30	2.5	3	2 (3)*
10	25.10.2023, 17:30	28.10.2023, 15:00	3	3	3
11	20.11.2023, 15:00	21.11.2023, 06:30	0.5	0	1
Total [planned]:			**22 [22]**	**22 [22]**	**21) [22]**
			2024		
1	27.03.2024, 04:30	29.03.2024, 03:30	2	2	2
2	27.04.2024, 05:30	29.04.2024, 03:30	2	2	2
3	14.05.2024, 04:57	17.05.2024, 02:30	3	3	3 (automatic detection) *
4	22.05.2024, 04:50	27.05.2024, 02:00	5	5	5
5	14.09.2024, 06:00	17.09.2024, 04:30	3	3	3
6	23.09.2024, 06:00	25.09.2024, 04:30	2	2	2
7	12.10.2024, 05:00	15.10.2024, 04:00	3	3	3
8	23.10.2024, 06:00	25.10.2024, 05:30	2	2 (1)	2
9	20.11.2024, 06:30	22.11.2024, 14:00	2.5	3	2
10	29.11.2024, 15:30	01.12.2024, 06:30	1.5	1	2
Total [planned]:			**26 [27]**	**26 (25) [27]**	**26 [27]**

Due to bad weather, not enough hours of collection were achieved on the night of 20.03.23 and on the night of 18.10.23. In 2024, not enough hours of collection were available for the date 24.10, so it was not used for further analysis. During the third survey, night calls were analysed from automatic detectors.

4.2.2 OBSERVER-BASED DATA

VISUAL OBSERVATIONS (DAY MIGRATION)

Visual observations provide extensive information on diurnal bird migration. Migration intensities, flight altitudes and directions as well as species composition are derived from data collected by observers (Table 4.3).

Visual observations were conducted during the daylight phase, starting with civil morning twilight until civil evening twilight. Every hour, two 15-minute intervals were recorded, during which two observers scanned the surrounding area for flying birds with bare eyes and binoculars. Each observer covered a 180°area. Species and number of individuals of flying birds or bird flocks were noted, as well as estimations of flight altitude and flight directions (subdivided in eight directions: N, NE, E, SE, S, SW, W, NW). Observers also annotated if birds were visibly associated with the observer's vessel or other (especially fishing) vessels, because birds were assumed to be foraging in those cases rather than migrating. The observers entered the observation data directly via a tablet, and data were backed up daily to a database to prevent data loss.

DATA ANALYSIS

The evaluation only included observations of flying birds that were not associated with the observation vessel. The most commonly occurring species and species groups (higher category taxa, e.g., gulls, auks, etc.) are shown in pie charts that represent the proportion of their occurrence based on the number of total registered individuals per season.

Migration intensity was calculated as a rate of birds per hour, extrapolating from 30 minutes of observations per hour. Based on this, the annual as well as the daily course of migration intensity were presented for all birds combined as well as for single species groups. Only data from days during which the observations covered at least 70 % of the daylight period were used. Of the 35 dates of analysis in 2023 for the area KF II OWF N, two dates in autumn were discarded because they included low effort. Similarly, in 2024 one spring date was discarded for the same reason (see Table 4.4).

To evaluate the distribution of flight altitudes, the recorded migratory altitudes of all observations were grouped into altitudinal ranges (0-5 m, 5 - 10 m, 10 - 20 m, 20 - 50 m, 50 - 100 m, 100 – 200 m, > 200m) as proposed by German authorities (BSH 2013) and presented according to their relative frequency. Observations are also combined for systematic groups. Migratory directions of flight were shown in 45° increments, also according to their relative frequency. Flight altitudes and directions of 2023 and 2024 were pooled, unless patterns of each year strongly differed. Migration intensity and species composition pie charts are nevertheless shown separately for each year.

FLIGHT CALLS (NOCTURNAL MIGRATION)

Recording of flight calls provides information on the species composition and the intensity of nocturnal bird migration. The nocturnal flight call observations were carried out by one observer at a time with two observation units of 15 minutes per hour from civil evening twilight to civil morning twilight. Here, as well, only data from nights during which the observations spanned through at least 70 % of the night period were used.

For the recording of bird calls, the number of single calls were noted and not the number of (estimated) individuals. Calls which typically consist of a certain series of single elements, as for instance the call of common greenshank, were only counted as one call.

DATA ANALYSIS

The recorded calls were corrected for effort and converted into call rates (calls per hour). To illustrate the temporal pattern of the migratory activity during a night, the call intensity was determined for each hour of the night, beginning with the onset of civil twilight. To determine seasonal patterns, the calling activity was determined for each recorded night. All analyses were carried out separately for all taxonomic groups and in summary for all species.

4.2.3 RADAR MEASUREMENTS

Horizontal and vertical radar devices (Figure 4.4) emit electromagnetic waves which are reflected by objects that can thus be spatially located. Detection depends on the wavelength emitted by the radars, the size of the objects, the distance to the radar and the direction of movement of the objects in relation to the radar. Compared to ships and other objects usually detected by radar, birds are very small and therefore best detected with shorter wavelengths. For this reason, devices transmitting with a power of 25 kW in the X-band range (9,410 MHz) were used.

Figure 4.4 Horizontal and vertical radar mounted on a research vessel.

VERTICAL RADAR

Data from the vertical radar provided information on the intensity, temporal pattern, and flight altitude distribution of bird migration during day and night (Table 4.3). The vertically rotating radar antennae were aligned perpendicular to the assumed main migratory direction and manually readjusted every 30 minutes.

DETECTION METHODOLOGY

The detection radius of the radar was set to 1,500 m and the sensitivity (gain) of the radar antenna was set to 70%. Filters for rain and sea clutter were switched off, as these would also filter out an unknown number of bird signals. The afterglow duration of the radar signals was set to 45 seconds. For moving objects, the "radar shadow", i.e. signals of the same object detected during previous revolutions of the antenna, were displayed as a track in addition to the current signal (Figure 4.5). Every four minutes an image of the radar screen was captured and stored for analysis.

During a reanalysis of the vertical radar data of 2023, it was realised that afterglow duration was not always set to 45 seconds, but sometimes erroneously to 60 seconds. Migration intensities have then been recalculated using the corresponding afterglow duration and thus slightly higher migration intensities values are provided for 2023 (see Results).

The recorded radar screenshots were visually scanned for bird signals, which were identified based on size and the trail caused by the time of afterglow. The bird signals were marked, and their image coordinates were converted into flight altitudes and distance to the radar unit. The number of individual birds that correspond to a bird signal cannot be determined. A bird signal thus represents at least one bird. Images were not evaluated if more than 25% of the radar screen was obscured by rain clutter superimposing bird signals.

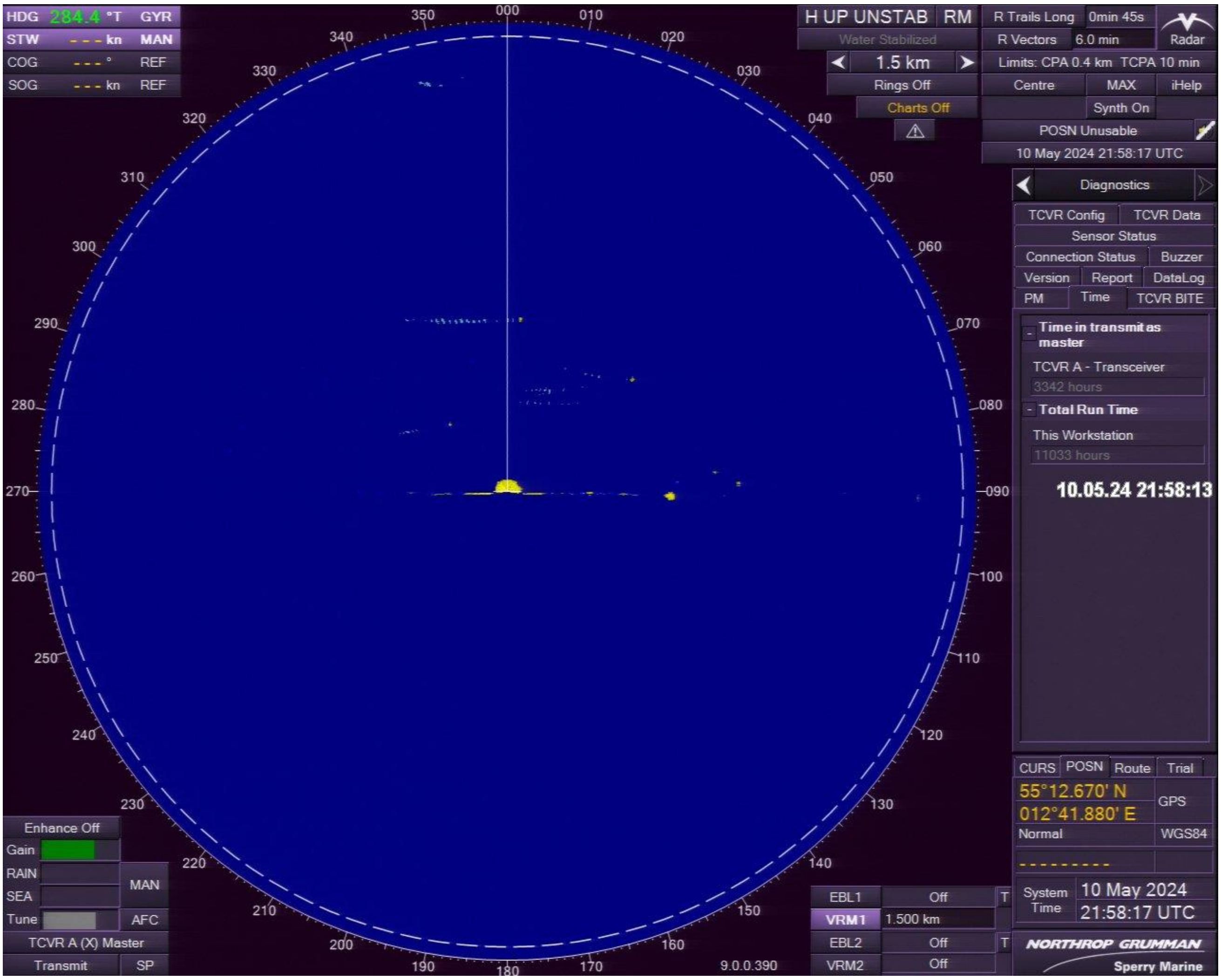


Figure 4.5 Example of a screenshot from vertical radar with characteristic bird signals (the yellow line represents the sea surface, the signals in the upper half of the radar area are bird echoes).

EFFORT

The efforts of the vertical radar during spring and autumn of both years for each area is shown in Figure 4.6 and Figure 4.7.

As the detectability of bird signals is highly dependent on the distance to the radar, the raw data obtained as described above had to be distance-corrected before analysis. For this, empirical bird signal data of 50 to 150 m altitude were selected. The distance from the radar unit was determined for all signals in this altitude band and a distance-dependent detection probability was calculated according to BUCKLAND et al. (2001), using "Distance" package (MILLER et al. 2019) and the R software 4.2.2 (R CORE TEAM 2022). "Half normal" and "hazard rate" models up to 5th order were tested, choosing the best-fitting model per radar device based on Akaike information criterion (AIC). As in close vicinity of a radar the device generally does not record bird signals, an area of 100 m around the device was not considered for the determination of the correction functions.

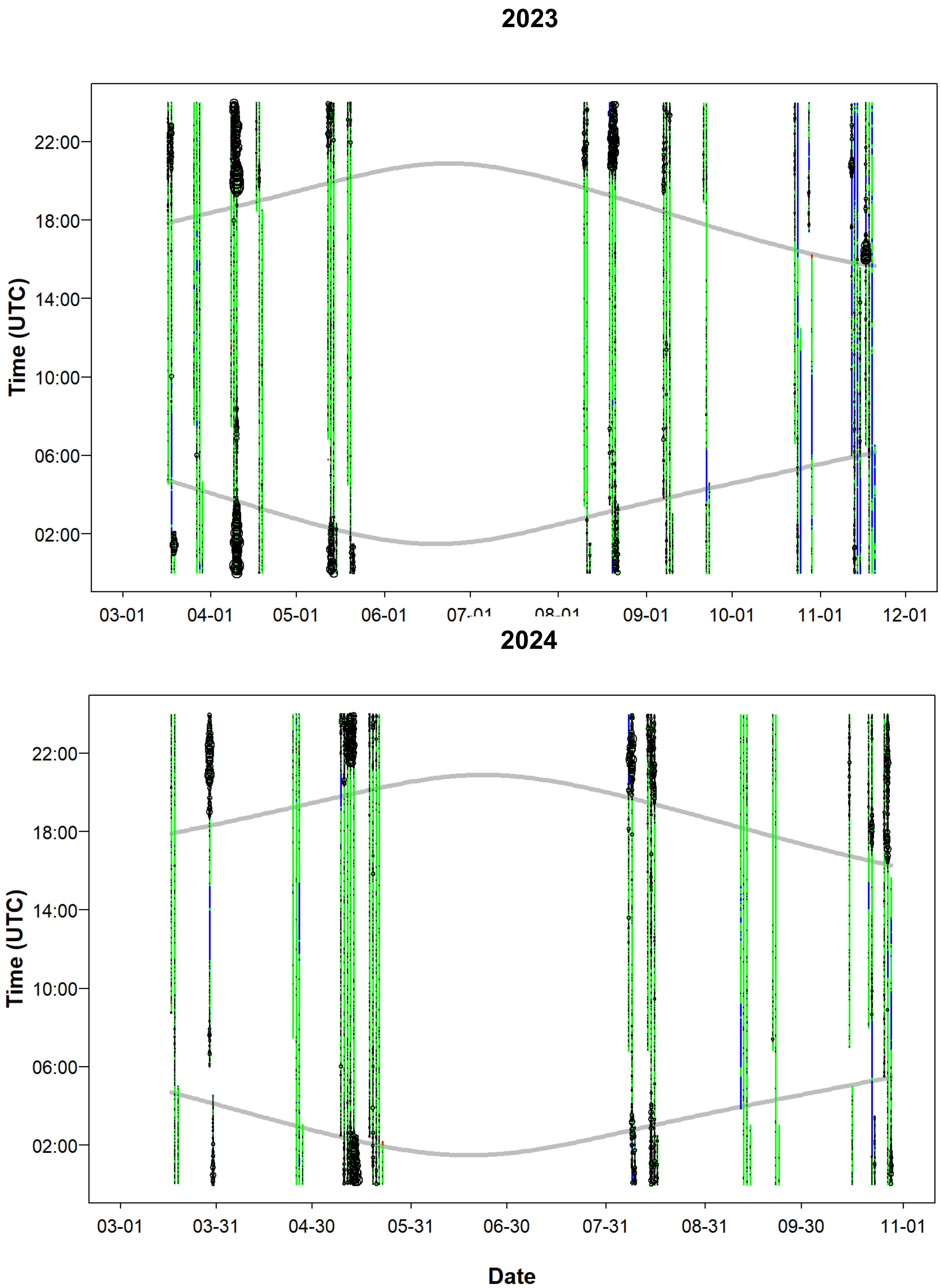


Figure 4.6 Effort of vertical radar at the KF II OWF N in 2023 (top) and 2024 (bottom). Colours during the time of recording indicate the possibility to analyse the data: green indicate periods with analysable data, blue are periods not evaluable due to precipitation, red are periods not analysable due to other disturbances. Black circles indicate the number of bird signals and grey lines mark the sunrise and sunset.

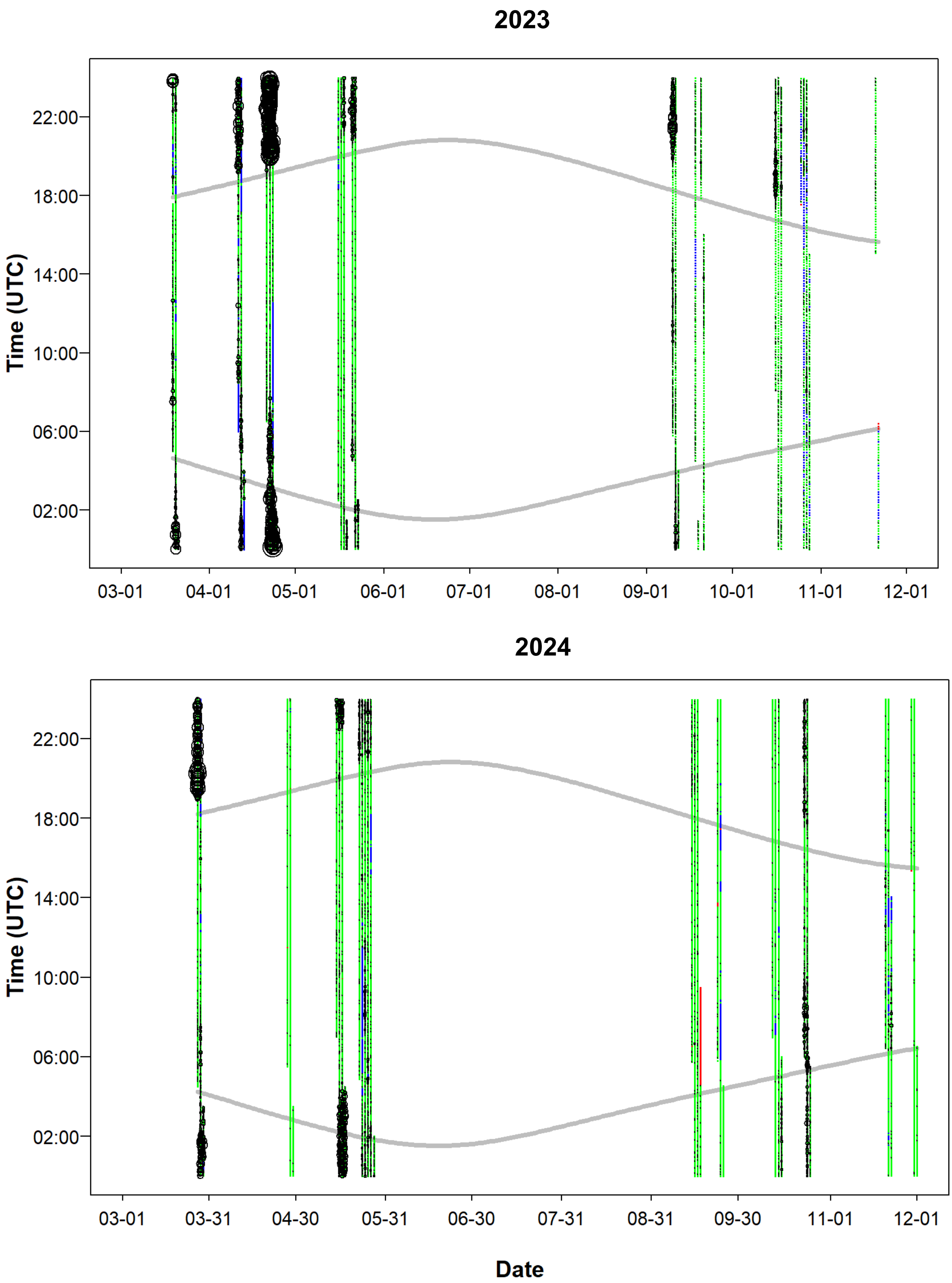


Figure 4.7 Effort of vertical radar at the KF II OWF S in 2023 (top) and 2024 (bottom). See Figure 4.6 for details.

Using the distance functions derived from the 50 - 150 m data, individual distance correction factors were calculated for all recorded signals of the whole detection range up to 1 km height, and the number of signals at each given altitude was corrected accordingly.

MIGRATION INTENSITY

The migration intensity was calculated as migration traffic rate (MTR). This is the number of signals that cross a virtual stretch of 1,000 m perpendicular to the migration direction every hour up to an altitude of 1000 m. Migration intensity was calculated for all hours of the recording periods for which at least three valid radar images were available.

For each day and night, the mean migration intensity was determined from the corresponding hourly results. Only days or nights for which hourly migration intensities were available for at least 70 % of the time, were taken into consideration. Like visual and acoustic observation data, results were depicted as an annual phenology as well as its temporal pattern in the course of 24 hours.

FLIGHT ALTITUDE DISTRIBUTION

To represent the flight altitude distribution from vertical radar, the relative proportion of signals was determined for each 100 m height increment up to 1,000 m. The evaluation was carried out separately for diurnal and nocturnal migration and for spring and autumn migration, respectively. Furthermore, in order to show potential differences in altitudinal distribution between days/nights with high and low migration intensity, this evaluation was also conducted separately for the five days/nights with the highest migration intensities compared to the rest of days and nights sampled.

HORIZONTAL RADAR

Flight directions of birds were determined with the horizontal radar (Table 4.3). A radar device similar to the one used for vertical radar with a transmission power of 25°KW and 9,410 MHz wavelength was used, but the antenna was aligned horizontally instead of vertically.

DETECTION METHODOLOGY

Filters for rain and waves were turned off as they would also suppress an unknown number of bird signals. The detection radius of the radar was set to 3,000 m and the sensitivity (gain) of the radar antenna to 60 %. The afterglow duration (i.e., echo) was extended to 90 seconds in order to record flight paths of birds, which were used to determine the flight direction. The horizontal radar devices were operated in “north up” mode, the radar screen therefore always displayed north to the top independently of the ship’s orientation. Every four minutes, an image of the radar screen was captured and stored for analysis.

The recorded radar screenshots were visually scanned for bird signals, which were identified based on their size and the flight paths visible due to the afterglow period. Head (current position of a bird) and tail (end of the visible flight path) of each track were marked using the software “GSA Bird Counter 1.17” and stored as image coordinates, which were then converted into flight directions in relation to north.

EFFORT

Horizontal radar screenshots are very often affected by sea clutter and therefore cannot be analysed. Since only relative information regarding flight directions is to be obtained from the data, quantification is not necessary. Only screenshots with less than 50% of the image area covered by sea clutter were evaluated. The effort of horizontal radar surveys is shown in Figure 4.8 and Figure 4.9.

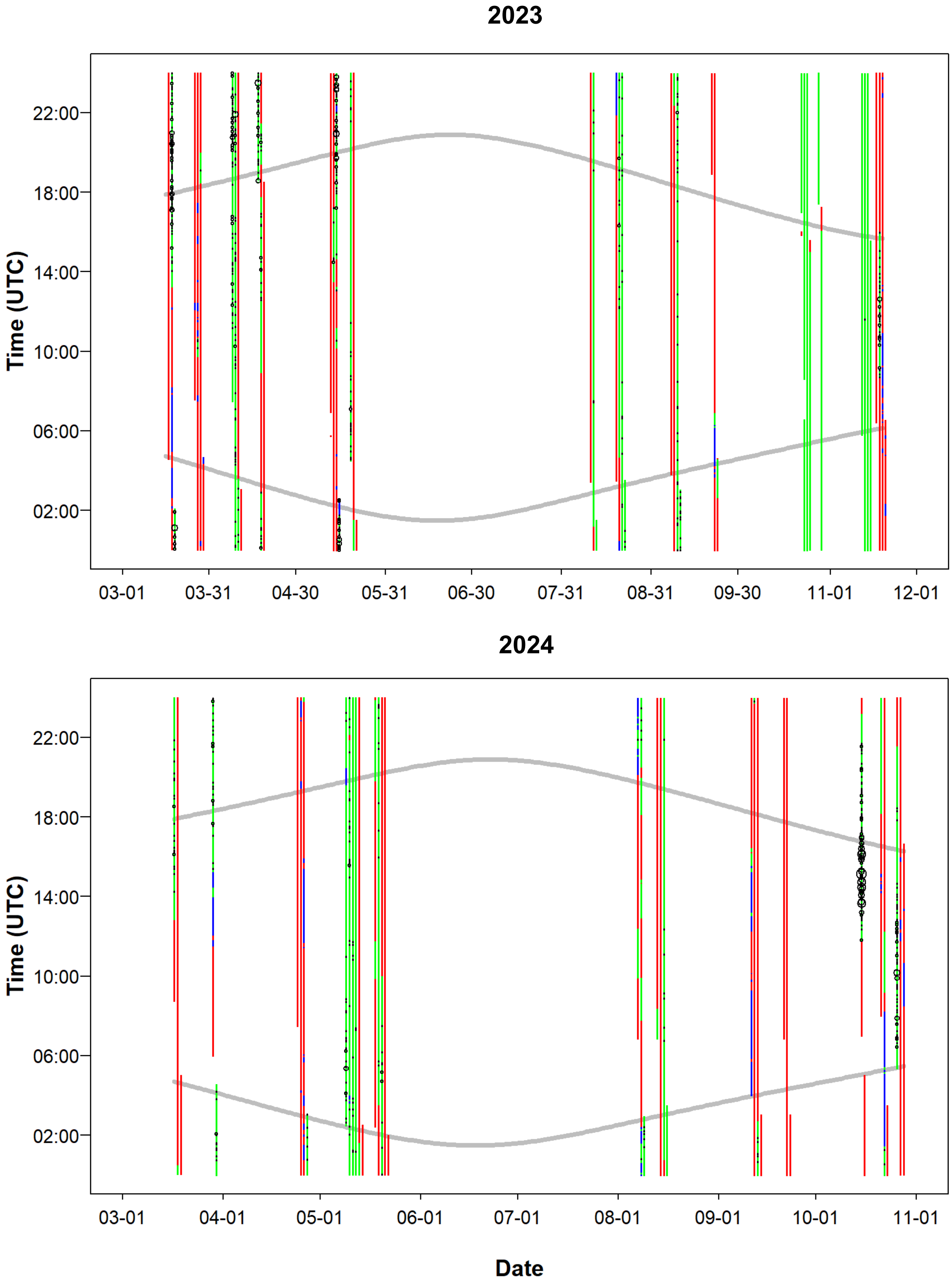
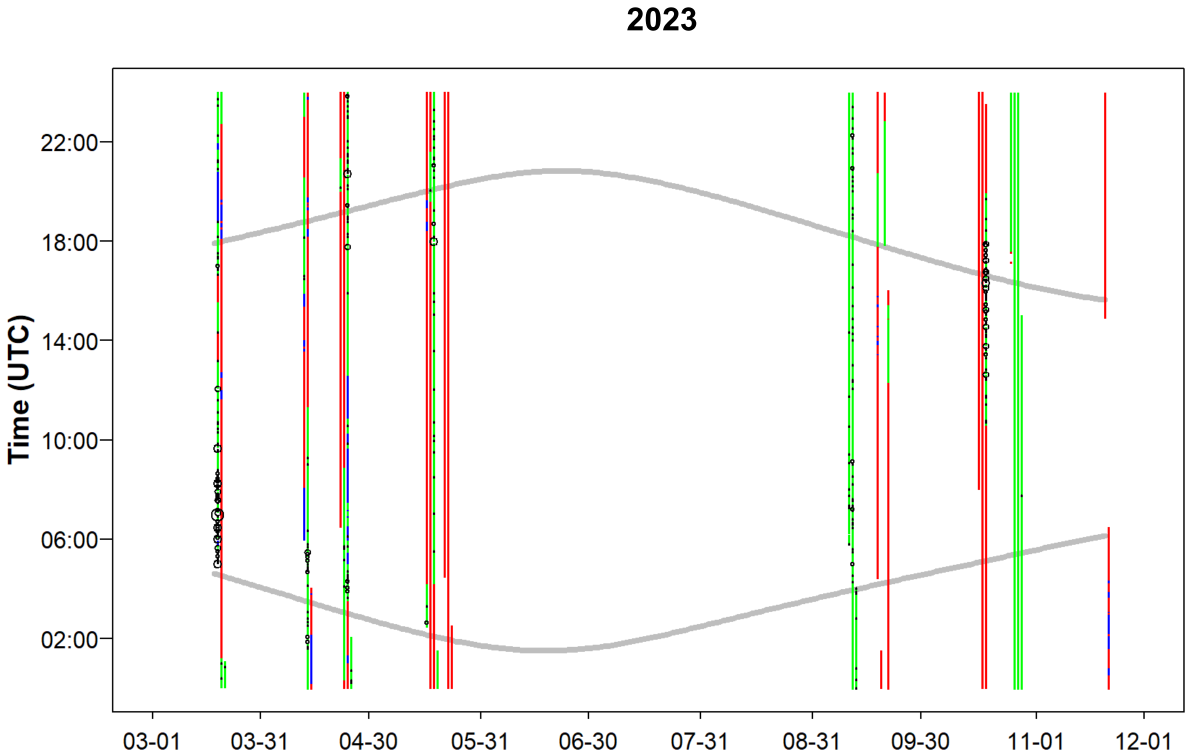


Figure 4.8 Effort of horizontal radar at the KF II OWF N in 2023 (top) and 2024 (bottom). Colours during the time of recording indicate the possibility to analyse the data: green indicate periods with analysable data, blue are periods not evaluable due to precipitation, red are periods not analysable due to other disturbances (mostly sea state). Black dots indicate the number of bird signals and grey lines mark the sunrise and sunset.



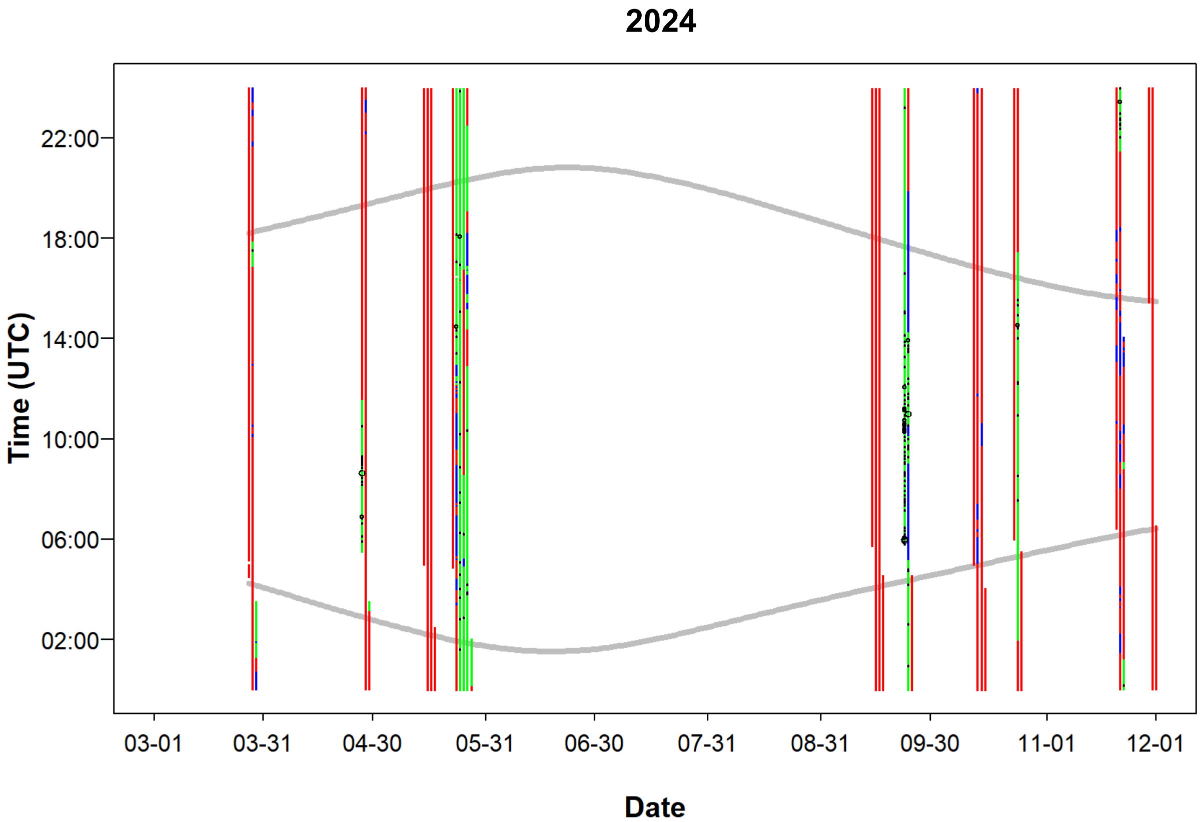


Figure 4.9 Effort of horizontal radar at the KF II OWF S in 2023 (top) and 2024 (bottom). See Figure 4.8 for details.

FLIGHT DIRECTION

The flight direction distribution was presented per season for both day and night migration. For plotting, flight directions were grouped into 20° increments. Using Rayleigh tests, it was tested whether directional migration could be assumed based on the respective directional distribution. When this was the case, the mean direction of flight was marked with an arrow in the diagrams.

All analysis described in this chapter were conducted using R 4.2.2.

5 DATA AND RESULTS

5.1 RESTING BIRDS

The following section presents the results obtained from the data analysis of six aerial surveys conducted during the second year of baseline monitoring between February and December 2024 in the planned OWF of Kriegers Flak II. Additionally, it combines the results obtained during the first year of monitoring, 2023, for comparisons purposes. When feasible, comparisons are given regarding proportion of specific species among resting birds or comparisons of absolute numbers found during the two years of baseline monitoring. Phenology of sightings is exemplified with raw counts and/or densities within the studied area.

Further description of the most abundant species is provided for those whose frequency of occurrence exceeded a threshold of 0.5% among detected resting birds. Species description is presented in ascending order according to Euring codes (EURING 2024).

The spatial distribution of the sightings is represented and grouped by season, according to the phenology described in the specific classification for each species by GARTHE ET AL. (2007b). The maps combine data from the two years of baseline monitoring, from January 2023 to December 2024. Additionally, specific results from the first year of monitoring can be found at Castillo et al. (2024).

5.1.1 ALL SPECIES

Table 5.1 depicts the total number of species observed during the six digital aerial surveys between February and December 2024.

Table 5.1 Bird counts and percentages of all resting bird species during the six digital aerial surveys between February and December 2024. Species representing at least 0.5% of total abundance are highlighted in bold.

Species groups	English name	Scientific name	All digital surveys	
			N ind.	Percentage
Divers	Red-throated diver	*Gavia stellata*	227	**1.35**
	Black-throated diver	*Gavia arctica*	55	0.33
	Great Northern diver	*Gavia immer*	1	0.01
	unidentified diver	*Gavia sp.*	50	0.3
Grebes	Great crested grebe	*Podiceps cristatus*	32	0.19
	Red-necked grebe	*Podiceps grisegena*	27	0.16
	Slavonian grebe	*Podiceps auritus*	53	0.31
	Red-necked/great crested grebe	*Podiceps grisegena/Podiceps cristatus*	36	0.21
	unidentified grebe	*Podicipedidae sp.*	36	0.21
Gannets	Northern gannet	*Morus bassanus*	4	0.02
Cormorants	Great cormorant	*Phalacrocorax carbo*	208	**1.24**
Sea ducks	Common eider	*Somateria mollissima*	4,665	**27.72**
	Long-tailed duck	*Clangula hyemalis*	994	**5.91**
	Common scoter	*Melanitta nigra*	6,233	**37.03**
	Common scoter / velvet scoter	*Melanitta sp.*	287	**1.71**
	Velvet scoter	*Melanitta fusca*	900	**5.35**

Species groups	English name	Scientific name	All digital surveys	
			N ind.	Percentage
Skuas	Arctic skua	*Stercorarius parasiticus*	2	0.01
Gulls	Little gull	*Hydrocoloeus minutus*	99	**0.59**
	Black-headed gull	*Chroicocephalus ridibundus*	259	**1.54**
	Common gull	*Larus canus*	586	**3.48**
	Lesser black-backed gull	*Larus fuscus*	33	0.2
	Herring gull	*Larus argentatus*	705	**4.19**
	Caspian gull	*Larus cachinnans*	1	0.01
	Great black-backed gull	*Larus marinus*	149	**0.89**
	Herring / common gull	*Larus argentatus/Larus canus*	41	0.24
	unidentified large gull	*Larus (magnus) sp.*	89	0.53
	Lesser black-backed gull / great black-backed gull	*Larus fuscus/Larus marinus*	8	0.05
	unidentified gull	*Larus sp.*	13	0.08
	Black-legged kittiwake	*Rissa tridactyla*	1	0.01
	unidentified small gull		66	0.39
Terns	Sandwich tern	*Thalasseus sandvicensis*	43	0.26
	common tern / arctic tern	*Sterna hirundo/Sterna paradisaea*	62	0.37
	Little tern	*Sternula albifrons*	13	0.08
	unidentified stern	*Sterna sp.*	26	0.15
Others	Tern / small gull	*Sterna spp / Larus spp.*	11	0.07
Auks	Common guillemot	*Uria aalge*	109	**0.65**
	Common guillemot / razorbill	*Uria aalge / Alca torda*	269	**1.6**
	Razorbill	*Alca torda*	375	**2.23**
	Black guillemot	*Cepphus grylle*	47	0.28
	unidentified auk	*Alcidae sp.*	16	0.1
Total			16,831	100

Table 5.2 includes monthly densities for each of the months at which digital aerial surveys were conducted. The phenology and spatial distribution of species, which represented at least 0.5% of the total abundance, are described in more details in the next sections.

Additionally, within the annexes, a complete list with all recorded species and/or species groups is presented along with the conservation status of each (Table A 1).

Table 5.2 Monthly mean densities (ind./km²) of selected species/species groups recorded in the pre-investigation area during digital aerial surveys from February to December 2024. The maximum value is also indicated and highlighted in bold. The number 0 means that no individual of this species/species group was found in that month.

Survey Method	Digital aerial surveys						
SPECIES/SPECIES-GROUP	FEBRUARY 2024	APRIL 2024	JUNE 2024	AUGUST 2024	OCTOBER 2024	DECEMBER 2024	MAX
Red-throated diver	0.182	0.072	0.009	0.002	0.034	**0.217**	0.217

SPECIES/SPECIES-GROUP	FEBRUARY 2024	APRIL 2024	JUNE 2024	AUGUST 2024	OCTOBER 2024	DECEMBER 2024	MAX
Black-throated diver	0.007	0.032	0	0	**0.049**	0.037	0.049
Great crested grebe	**0.045**	0	0.002	0.002	0.007	0.016	0.045
Northern gannet	0	0	0	0	**0.007**	0.002	0.007
Great cormorant	0.07	0.115	0.027	0.081	0.043	**0.136**	0.136
Common eider	2.579	0.569	0.354	0.739	**4.681**	1.609	4.681
Long-tailed duck	**0.877**	0.87	0	0	0	0.506	0.877
Common scoter	3.355	2.594	0.078	0.074	2.407	**5.674**	5.674
Velvet scoter	0.351	0.111	0	0.022	0.258	**1.318**	1.318
Little gull	0.002	0.045	0	0	0.052	**0.127**	0.127
Black-headed gull	0.016	0.025	**0.323**	0.081	0.092	0.046	0.323
Common gull	0.092	0.228	0.065	0.133	0.173	**0.645**	0.645
Lesser black-backed gull	0.002	0.011	**0.029**	0.027	0	0.005	0.029
Herring gull	0.146	0.163	0.065	0.124	**0.663**	0.437	0.663
Great black-backed gull	0.031	0.032	0.004	0.016	**0.135**	0.12	0.135
Black-legged kittiwake	0	0	0	0	0	**0.002**	0.002
Sandwich tern	0	0.038	0.009	**0.04**	0.009	0	0.04
Common guillemot	0.076	0.045	0.004	0	0.025	**0.097**	0.097
Razorbill	0.326	0.041	0	0	0.029	**0.46**	0.46
Black guillemot	0.04	0.02	0	0	0.002	**0.044**	0.044
Divers	0.193	0.12	0.009	0.002	0.124	**0.31**	0.31
Grebes	**0.29**	0.009	0.002	0.004	0.043	0.067	0.29
Ducks	0.803	0.133	0.029	0.038	**3.73**	0.987	3.73
Gulls	0.288	0.452	0.17	0.308	1.142	**1.299**	1.299
Terns	0	0.059	0.027	**0.229**	0.009	0	0.229
Auks	0.663	0.172	0.013	0	0.074	**0.939**	0.939
No. of surveys	**1**	**1**	**1**	**1**	**1**	**1**	

During the six digital aerial surveys carried out between February and December 2024 (see Table 5.1), a total of 25,263 birds were reported, from which 16,831 were classified as resting birds, belonging to 26 different species and 10 species groups (see Table 5.1). Of these, 6.0% (n=1,010) could not be identified to species level. The total number of all observed birds, together with their scientific names, Danish common names and conservation status are shown in Table A.1 in the appendix.

The most common species group was sea ducks (Figure 5.1), which represented 77.7% of all resting birds seen during the second year of monitoring, which was in a similar proportion as in 2023 (Figure 5.3), when 81.4% of resting birds belonged to this species group. The most abundant species were common scoters (n=6,233, 37.0%) followed by common eider (n=4,665, 27.7%), which combined represented 64.7% of all resting birds identified during the 2024 monitoring campaign. Gulls were the second largest identified species group, dominated by herring gulls (n=705, 4.2%) and common gulls (n=586, 3.5%). Auks and divers followed, mainly with razorbills (n=375, 2.2%) and red-throated divers (n=227, 1.3%), respectively. There were no substantial shifts in species composition and abundances with respect to the first year of monitoring (Figure 5.2).

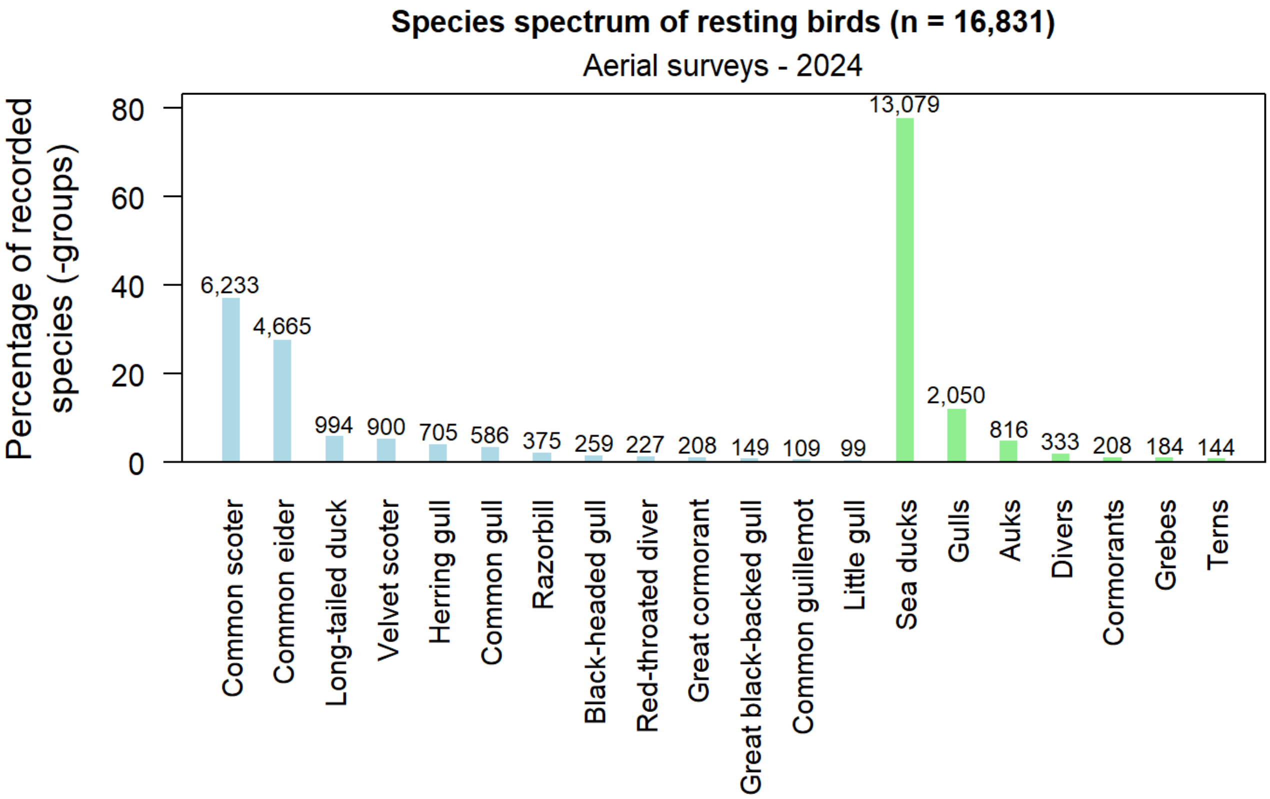


Figure 5.1 Percentage of the most common species or species groups representing at least 0.5% of the total number of resting birds recorded during aerial surveys in the pre-investigation area during the second survey year between February and December 2024 (number of individuals shown above each bar). The overall number of observed resting birds is given as n. Species are depicted in blue, species groups in green bars.

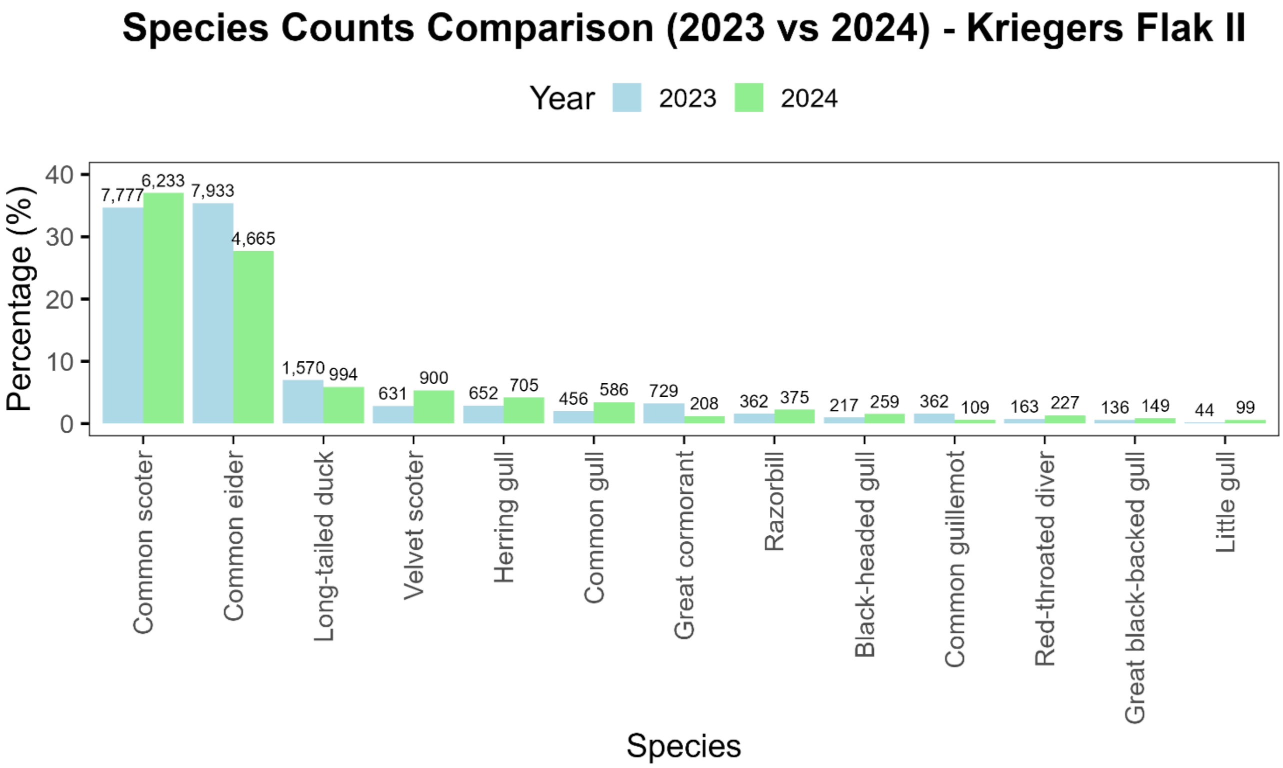


Figure 5.2 Percentage of the most common species representing at least 0.5% of the total number of resting birds recorded during aerial surveys in the pre-investigation area. Comparative between the first year of baseline monitoring, 2023 (blue), and the second, 2024 (green). Absolute values of reported sightings are included above bars for clarity.

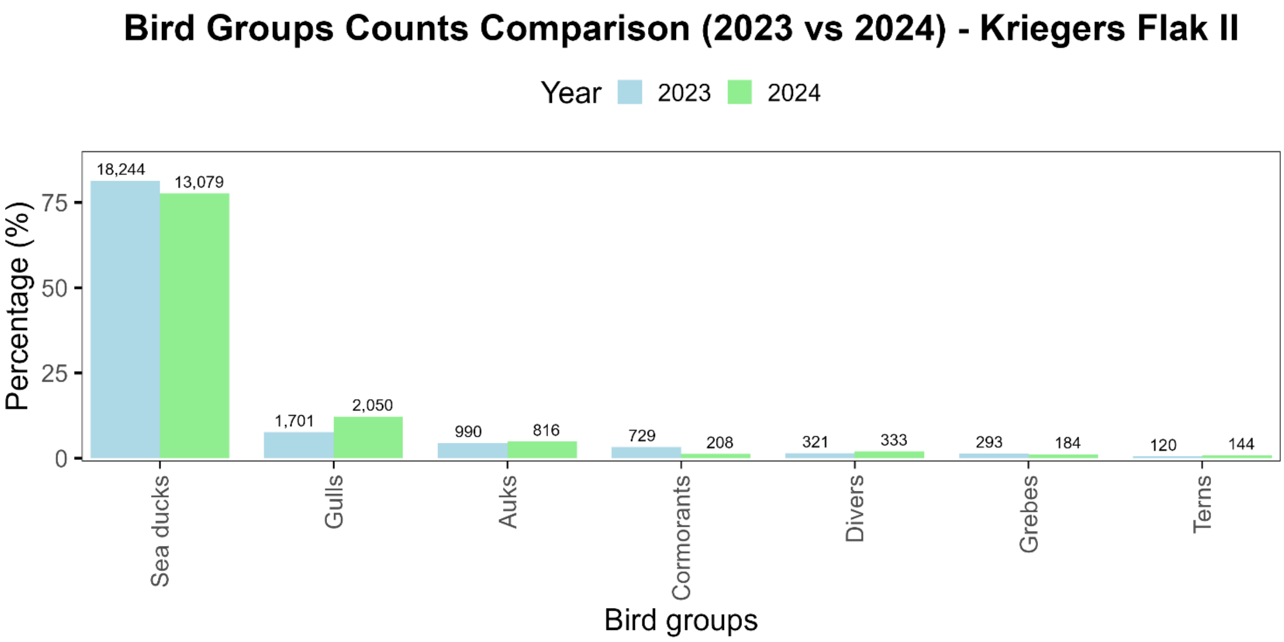


Figure 5.3 Percentage of the most common species groups of resting birds recorded during aerial surveys in the pre-investigation area. Comparative between the first year of baseline monitoring, 2023 (blue), and the second, 2024 (green). Absolute values of reported sightings are included above bars for clarity.

5.1.2 ABUNDANCE AND DISTRIBUTION OF THE MOST COMMONS SPECIES

DIVERS

Three species of divers were detected during the surveys conducted between February and December 2024: great northern diver, black-throated diver and red-throated diver. Red-throated diver was the most abundant diver and represented 80.2% of all diver species sighted and identified to species level, as in comparison with 2023 when they represented 64.9% of all identified diver species reported.

RED-THROATED DIVER

A total of 227 red-throated divers were reported in the investigated area during the six digital aerial surveys in 2024. This species represented 1.3% of all detected resting birds (Figure 5.1), and experienced an increase with respect to the previous year (n=163; 0.7%; Figure 5.2). Detections of this species were mainly found during the winter period, February and December being the months with highest detections and accounting for 77.1% of all sightings during 2024, a similar pattern as in the 2023 monitoring campaign.

The highest densities were also found during the winter period, with peak values registered in December (2023: 0.18 ind./km^2; 2024: 0.21 ind./km^2), while the lowest were registered in August. No individuals were detected during August in 2023 (Figure 5.4).
Red-throated diver was distributed throughout the investigated area but were most densely concentrated along the east coast of the Danish island of Møn, which is located west of the planned OWF (Figure 5.5). During the winter period, medium densities of this species were observed within the planned OWF area, particularly in the southern parts.

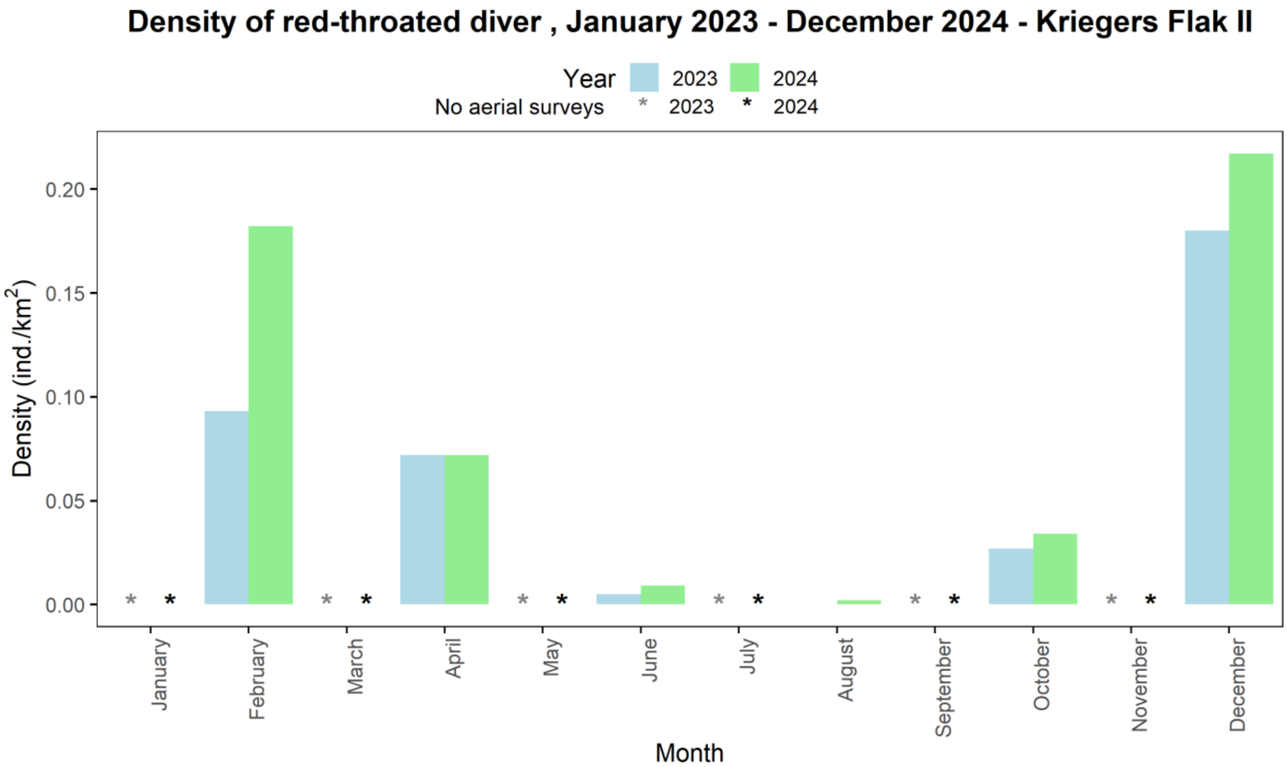


Figure 5.4 Monthly densities of red-throated diver during digital aerial surveys in the pre-investigation area between January 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

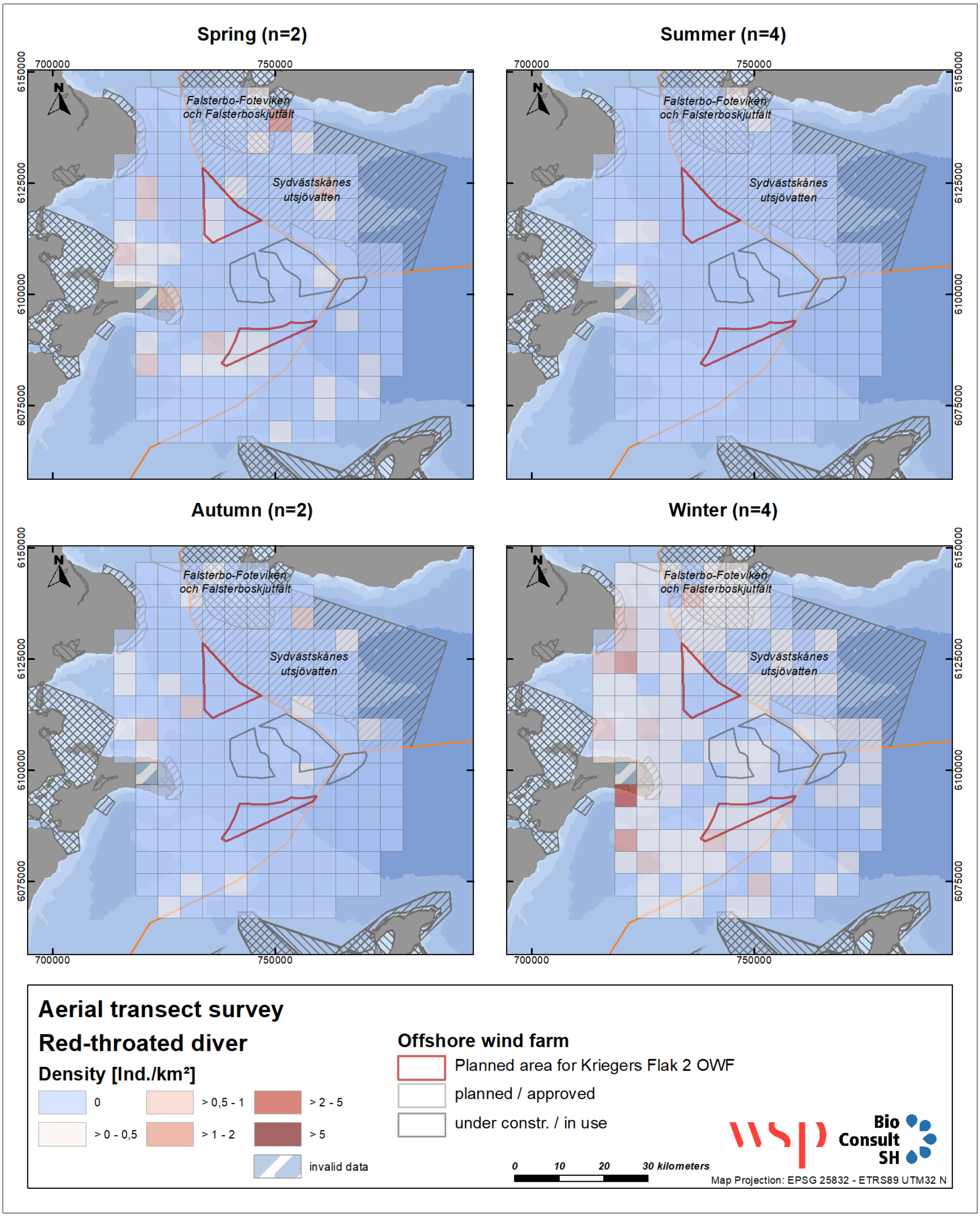


Figure 5.5 Distribution of red-throated diver in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

GREAT CORMORANT

Great Cormorant represented 1.2% (n=208) of all resting species identified (Figure 5.1), a considerable decrease in absolute and proportional numbers compared to 2023 (n=729; 3.2%; Figure 5.2). This species was registered throughout the entire period of observations and, although densities remained at low levels, there was a peak in its presence registered in October 2023, when large aggregations were found in the coastal waters of Møn and Falsterbo.

Lowest densities were registered during the summer months (2023: 0.04 ind./km^2; 2024: 0.03 ind./km^2; Figure 5.6). Spatially, sightings were registered in coastal waters westwards and northwards of the planned OWF. Also, large concentrations were spotted within the operating OWF of Kriegers Flak, located in between the two developmental areas of Kriegers Flak II (Figure 5.7).

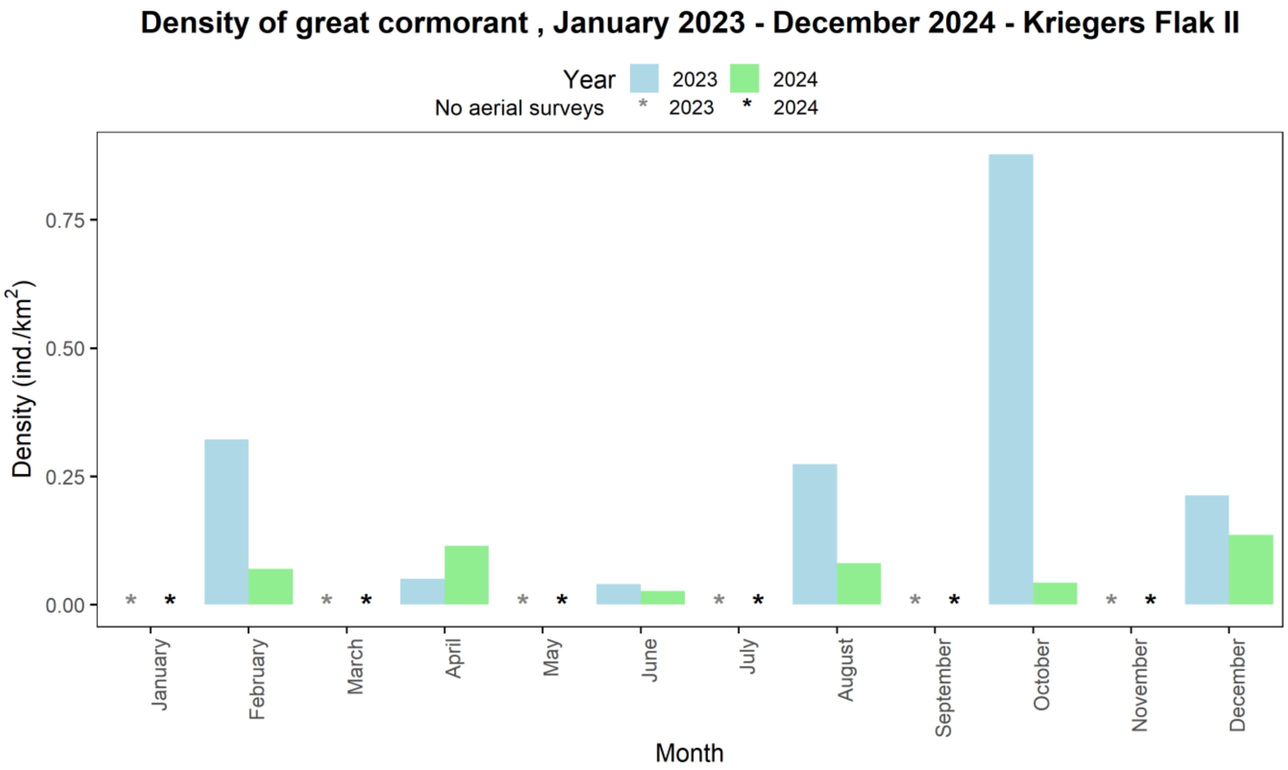


Figure 5.6 Monthly densities of great cormorant during digital aerial surveys in the pre-investigation area between January 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

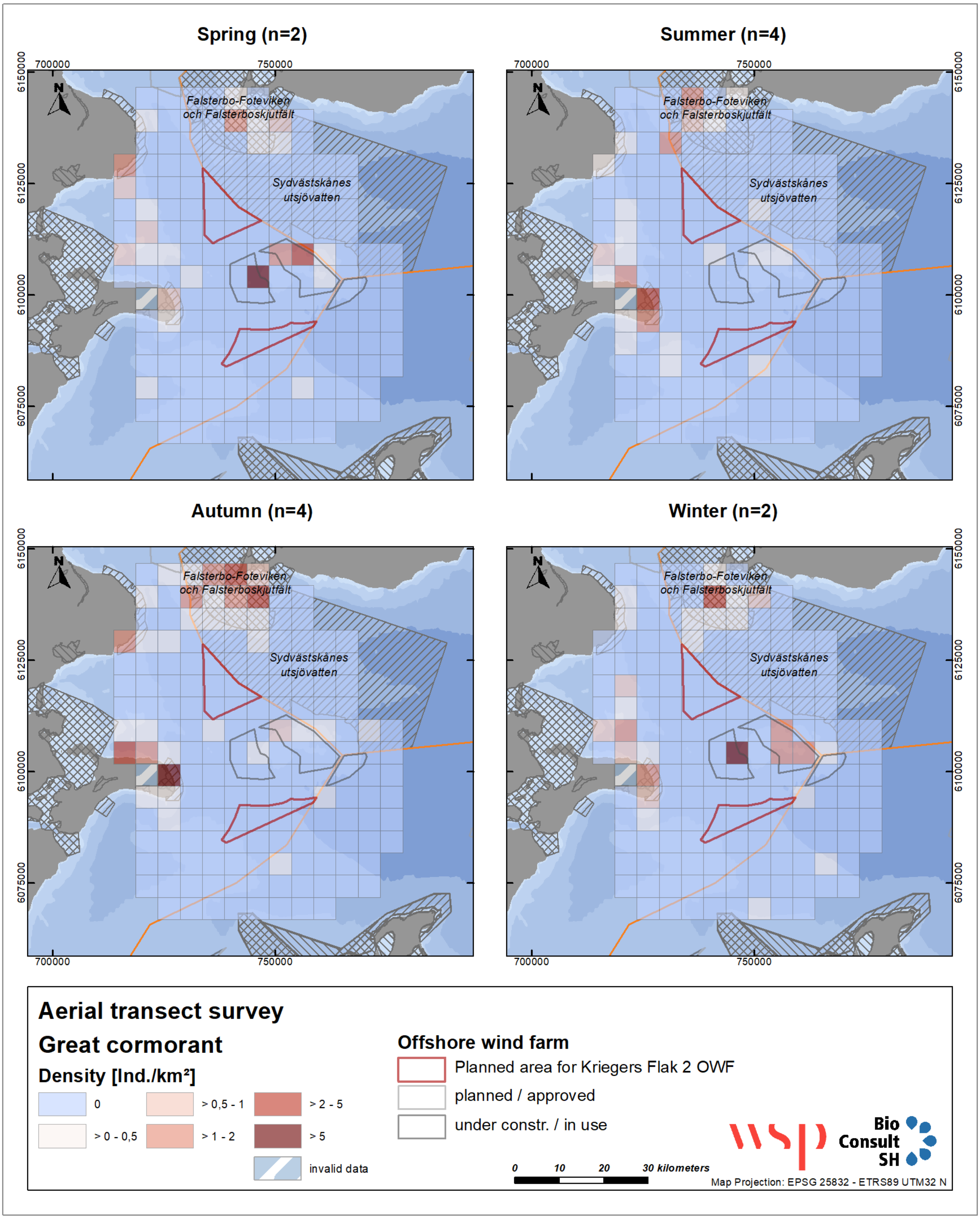


Figure 5.7 Distribution of great cormorant in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

DUCKS

Sea ducks represented the most abundant species group within the observation period February – December 2024. During this period, 13,079 individuals belonging to four different sea duck species were reported, accounting for 77.7% of all resting birds sighted, a similar ratio as in 2023 (n=18,244; 81.4%). Nonetheless, there was a considerable decrease in the absolute numbers of sea ducks seen (28.3% fewer sea ducks in 2024) which is reflected in the overall reduction of resting birds in the area. As the most numerous species group, they were present in every survey conducted between February 2023 and December 2024, but the highest densities were detected in October 2024, when up to 3.7 ind./km^2 were recorded, demonstrating a strong seasonality in their presence towards the winter period.

COMMON EIDER

Common eider was the second most common species observed during the monitoring carried out between February and December 2024, representing 27.7% (n=4,665) of all resting birds recorded (Figure 5.1). The presence of this species declined considerably in 2024 compared to 2023, when 7,933 individuals were reported representing 35.4% of all resting birds recorded (Figure 5.2).

The temporal distribution of this species was highly marked in two periods: winter and spring. The highest densities were recorded in April and October 2023 (6.10 ind./km^2 and 7.40 ind./km^2, respectively) and during the 2024 baseline monitoring period, the highest value was registered in October, with 4.70 ind./km^2 (Figure 5.8).

Spatially, common eider was widely distributed across the investigated area, especially during spring when the species was recorded at high densities ubiquitously, including within the boundaries of the planned OWF Kriegers Flak II and the currently operational OWF Kriegers Flak (Figure 5.9). Summer, autumn and winter showed a more coastal distribution pattern for this species, which concentrated in higher densities in the northern area of the upper developmental footprint of the proposed OWF Kriegers Flak II, in between the area of Falsterbo (Sweden) and Sjælland (Denmark). Common eiders were detected at variable densities within the boundaries of the proposed OWF during the entire period of observation.

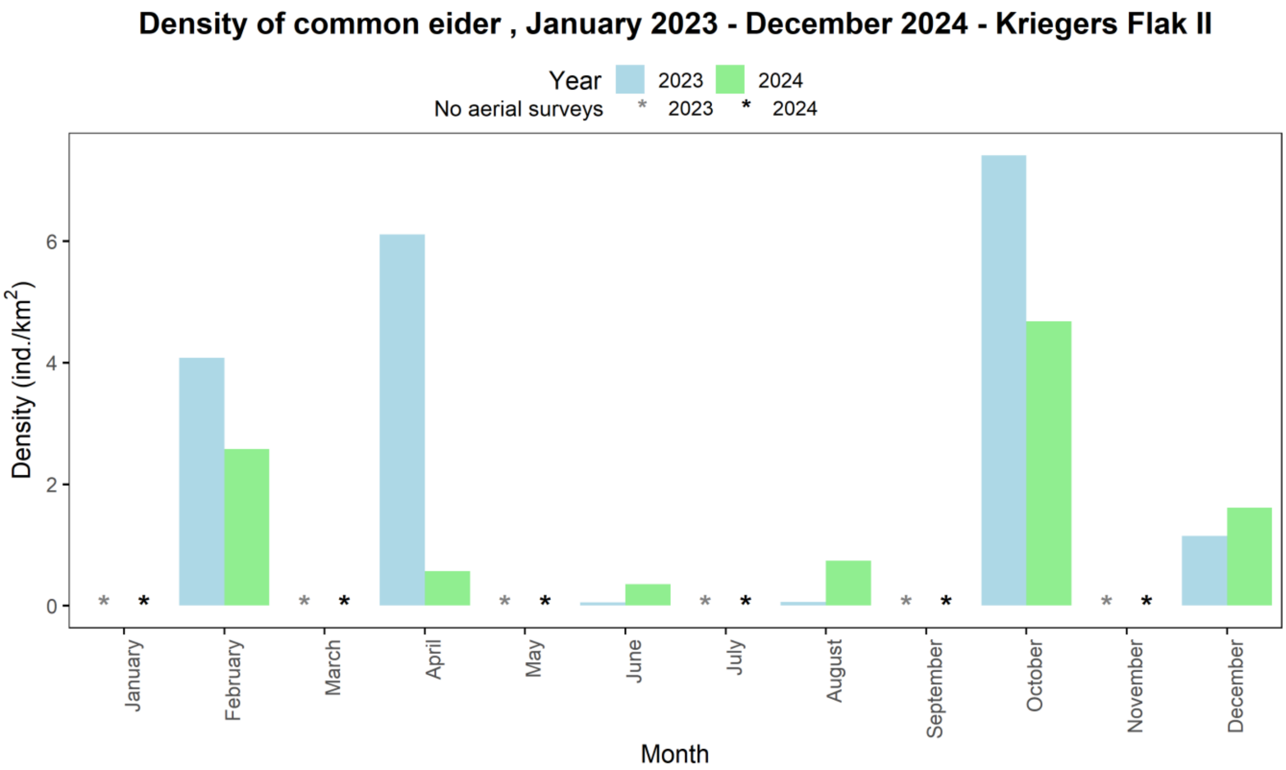


Figure 5.8 Monthly densities of common eider during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

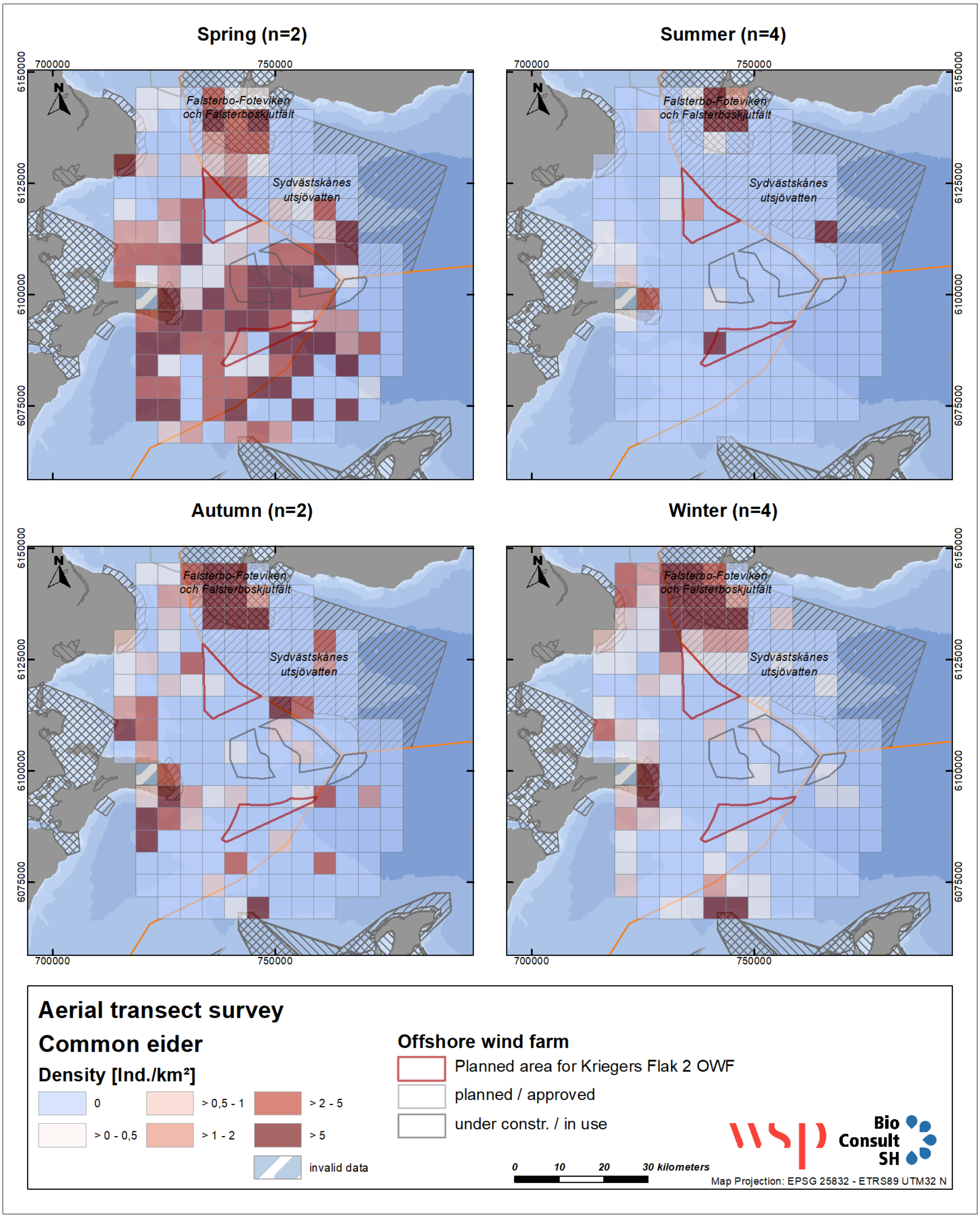


Figure 5.9 Distribution of common eider in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

LONG-TAILED DUCK

Long-tailed duck was the third most common species during the investigation period in 2024 (Figure 5.1), with 994 individuals recorded (5.9% of all registered resting birds). Compared to 2023, when 1,570 individuals representing 7.0% of all resting birds were recorded, their numbers decreased during the second survey year (Figure 5.2).

Winter and spring were the seasons with highest densities with peaks observed in April (2023, 1.71 ind./km^2; 2024, 0.87 ind./km^2), while no long-tailed ducks were registered during June, August or October surveys in 2024(Figure 5.10).

Spatially, birds were ubiquitous, especially during winter. At the same time, their presence was detected at higher rates near the north and east coasts of Møn (Denmark) during spring. This species was found within the boundaries of the planned OWF areas as well as within the operational OWF of Kriegers Flak (Figure 5.11).

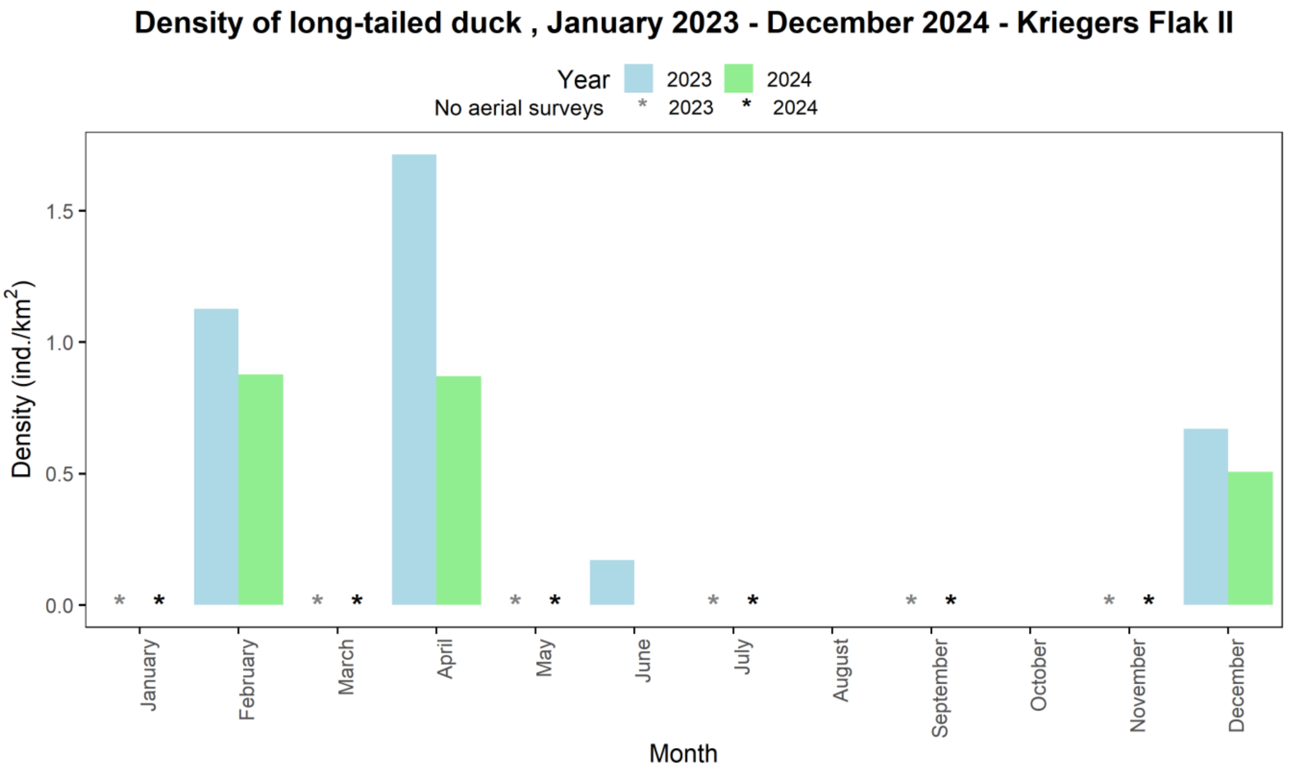


Figure 5.10 Monthly densities of long-tailed duck during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

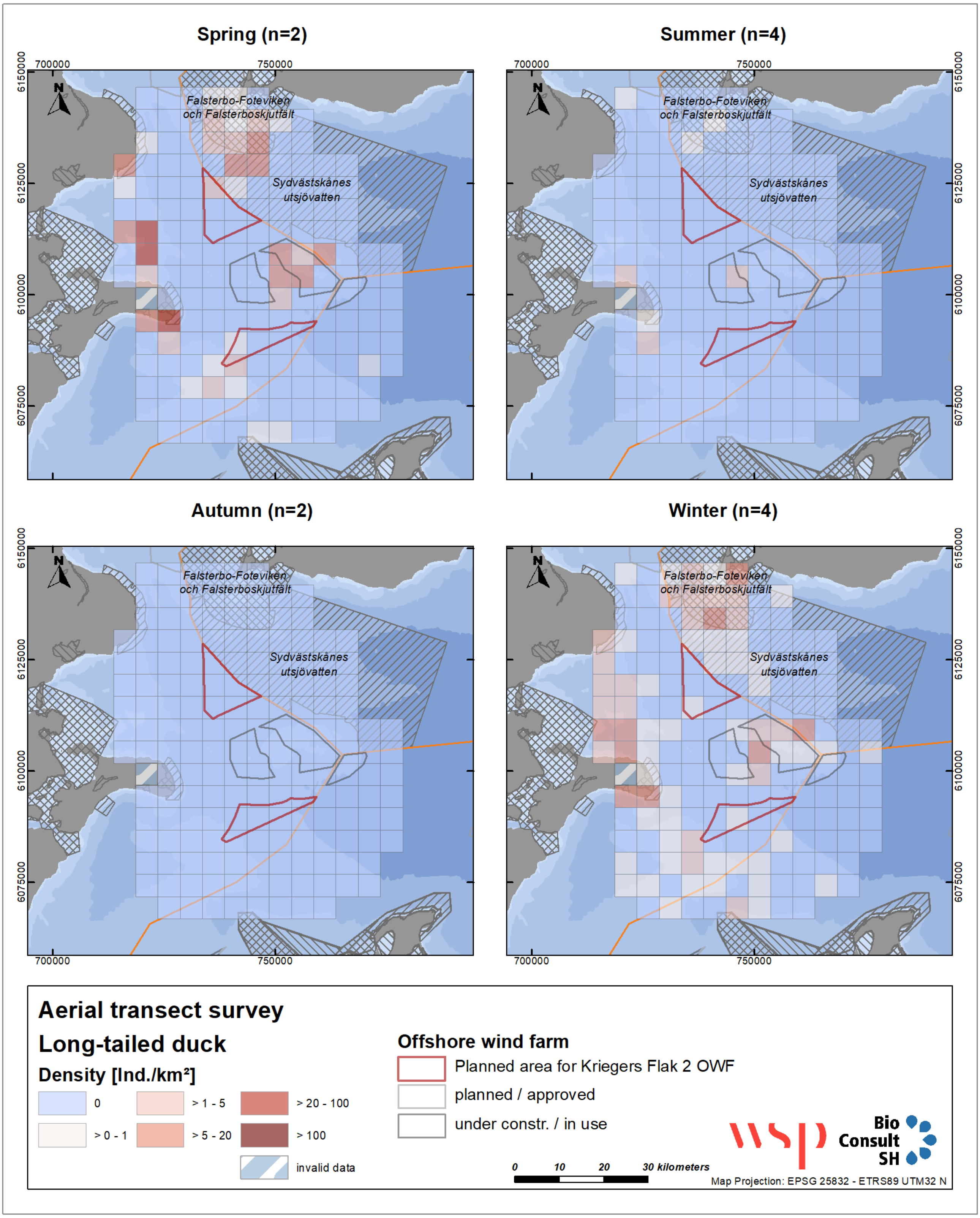


Figure 5.11 Distribution of long-tailed duck in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

COMMON SCOTER

Common scoter was the most common sea duck species sighted between February and December 2024, accounting for 37.0% (n=6,233) of all resting birds detected (Figure 5.1). Although >1,500 common scoters more were observed in 2023 (n=7,777), they made up a slightly smaller proportion, accounting for 34.7% of all recorded resting birds in the first year (Figure 5.2). The temporal distribution of sightings was skewed towards winter and spring, when the highest densities were detected, with the highest values registered in December (2023, 5.55 ind./km^2; 2024, 5.70 ind.km^2), while summer months recorded the lowest values (2023, no sightings; 2024, 0.07 ind.km^2; **Fejl! Henvisningskilde ikke fundet.**).

The spatial distribution of common scoter in the study area exhibited a distinct pattern, with the highest densities observed between the island of Møn (Denmark) and the island of Rügen (Germany), particularly during winter and spring (**Fejl! Henvisningskilde ikke fundet.**). Another key area of high presence was Falsterbo (Sweden), where the species was frequently recorded not only in winter and spring but also in autumn. Within the boundaries of the proposed OWF, common scoter was primarily detected in the southern sub-area, particularly near the southwest tip of the area, with higher densities occurring in spring and winter. Additionally, relatively high densities of this species were recorded near the operational OWF Kriegers Flak, situated between the two planned areas for the Kriegers Flak II offshore windfarm.

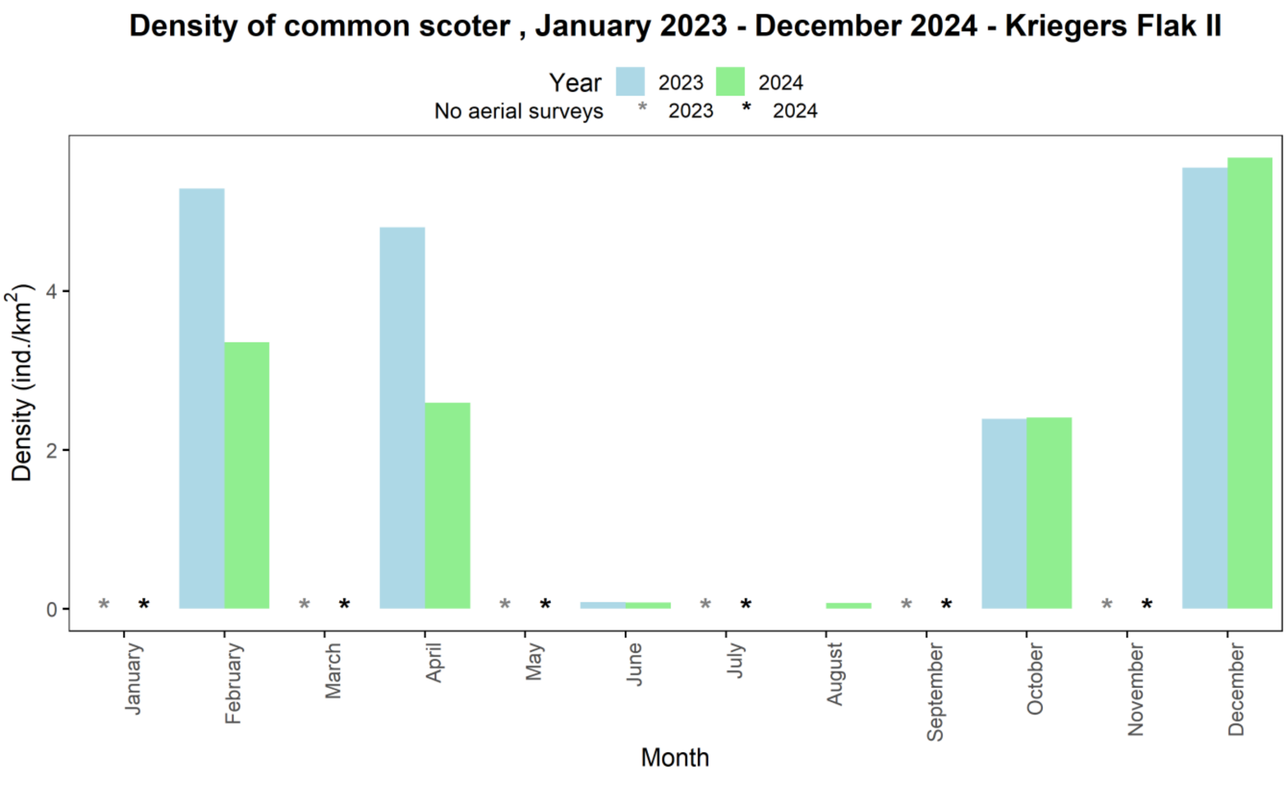


Figure 5.12 Monthly densities of common scoter- during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

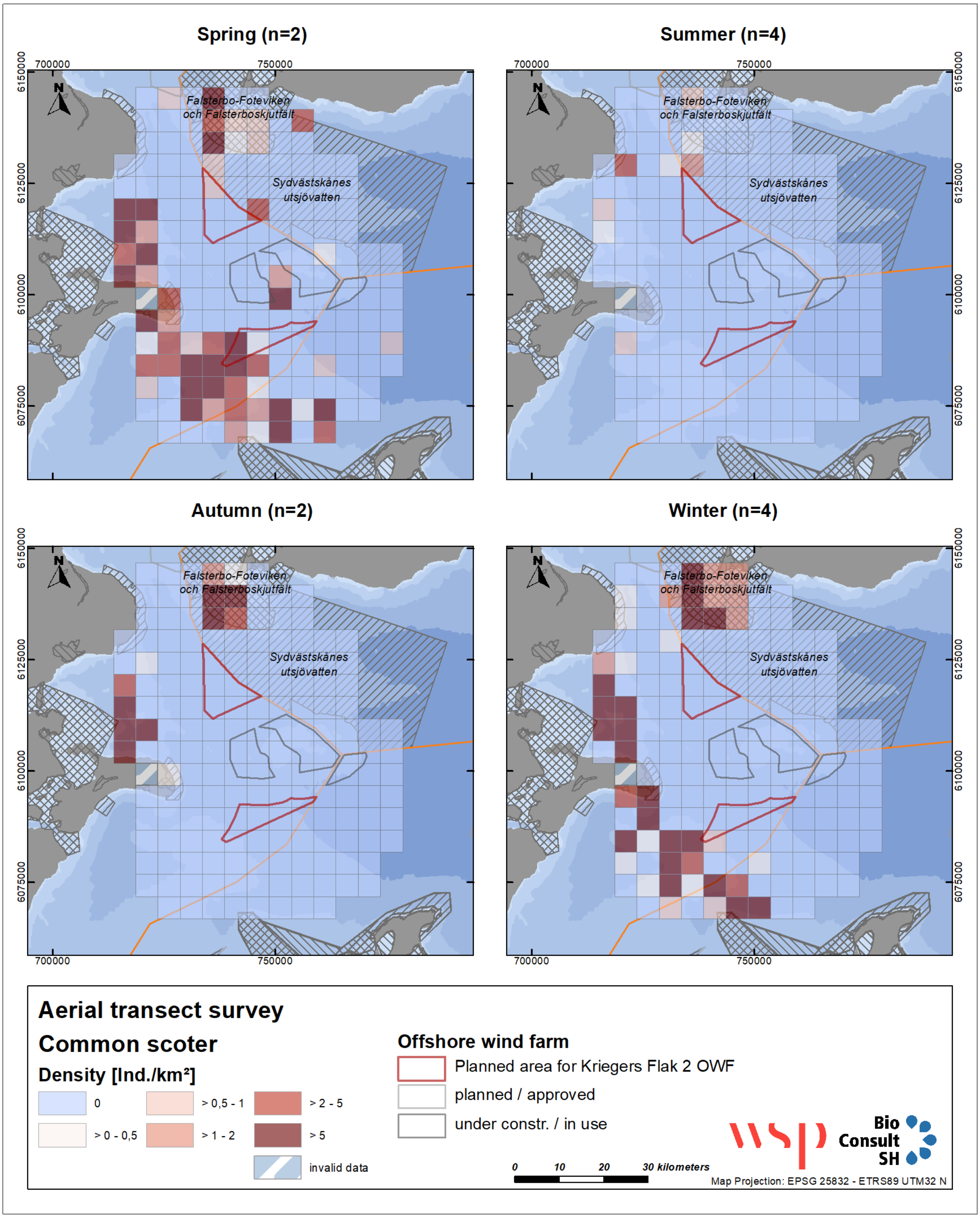


Figure 5.13 Distribution of common scoter in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

VELVET SCOTER

With 900 individuals registered, representing 5.3% of all registered resting birds, velvet scoter was the 4th most common species reported during the 2024 monitoring period (Figure 5.1). With respect to the previous year, there was an increase in the number of velvet scoters within the investigated area, when 631 individuals (2.82% of all resting birds) were recorded during 2023 (Figure 5.2).

Velvet scoter was mainly present in the survey area between October and April (end of autumn towards spring), reaching the highest densities in December 2024, when the peak of abundance was registered at 1.32 ind./km^2 (Figure 5.14).

Velvet scoter distribution was mainly close to the coast (Figure 5.15), and the largest concentrations of this species were found north of the island of Møn (Denmark) and south of the peninsula of Falsterbo (Sweden), with special emphasis on the winter period. This species was registered within the proposed OWF limits of Kriegers Flak II-N.

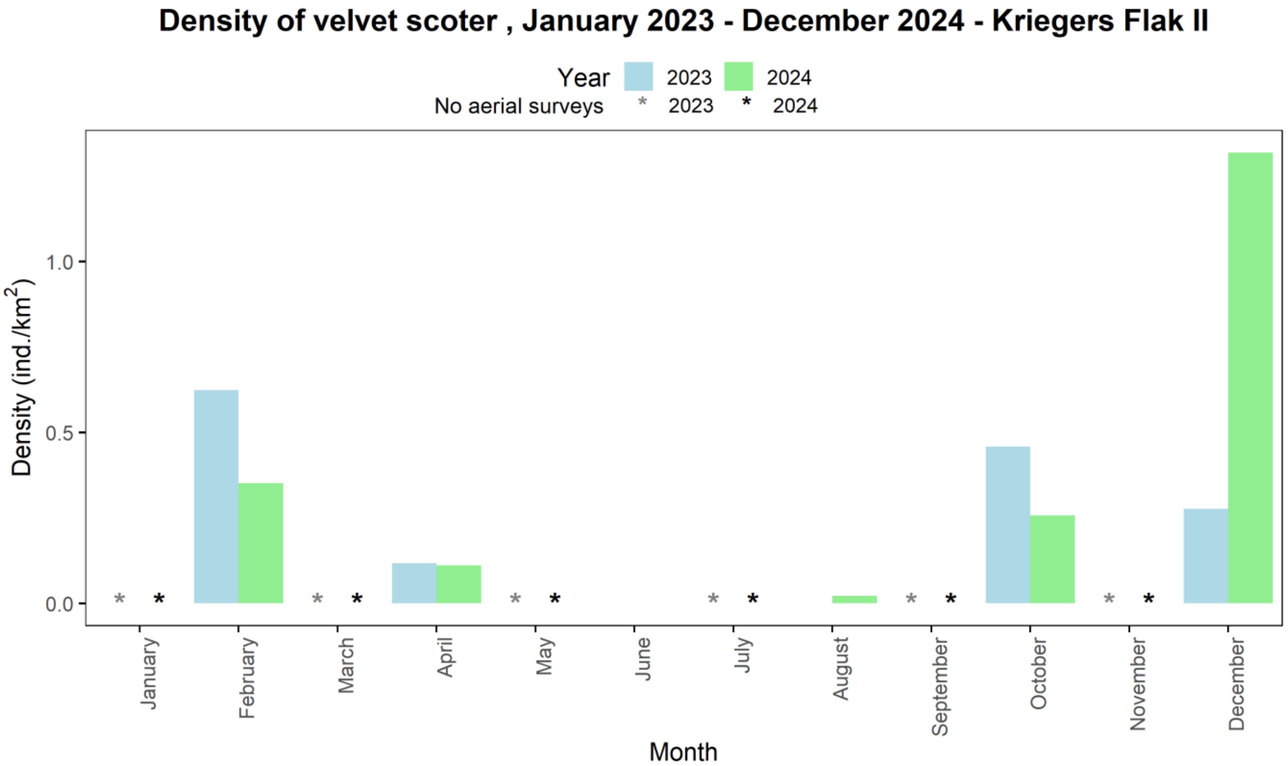


Figure 5.14 Monthly densities of velvet scoter during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

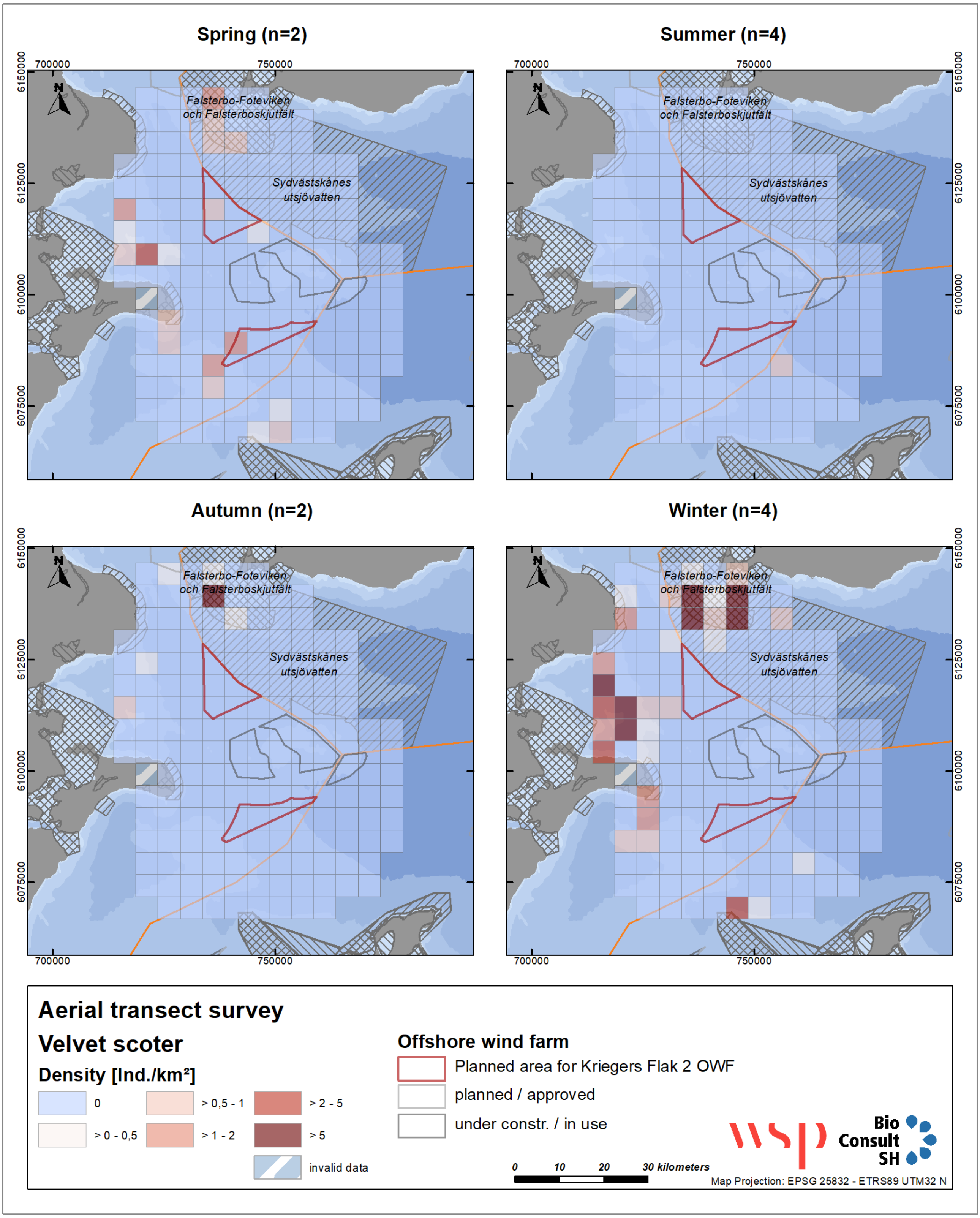


Figure 5.15 Distribution of velvet scoter the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

GULLS

Gulls were the second largest group of birds, with a total of 2,050 individuals recorded during 2024 and representing 12.2% of all resting birds (Figure 5.1). Compared to 2023, their numbers increased by 20.5% (n 2023 = 1,701, Figure 5.3). In total, nine different species were identified within this species group. However, only four of them surpassed the threshold of 0.5% of representation among resting birds. The most abundant species were, in ascending order, little gull, great black-backed gull, black-headed gull, common gull and herring gull. This group was represented in every survey conducted from February 2023 to December 2024. The highest densities were reached in October 2023 and December 2024 (1.23 ind./km^2 and 1.30 ind./km^2, respectively). There was a strong presence of this species group during the autumn and winter months. In the following section, their abundance, temporal and spatial distribution is described.

LITTLE GULL

There were 99 recorded sightings of little gull in 2024 (Table 5.1), representing 0.6% of all resting birds. In 2023, only 44 individuals were detected, representing 0.2% of all resting birds (Figure 5.2).

This species was registered from October to April, with no sightings during the summer months. The density peak was during October 2023 and December 2024, with 0.10 ind./km^2 and 0.13 ind./km^2, respectively (Figure 5.16).

Spatially, they were spread across the surveyed area, especially during autumn. However, the highest densities were found north of the island of Rügen (Germany) in spring (Figure 5.17). Little gulls were recorded occasionally within the limits of the planned OWF in Kriegers Flak II-N and II-S.

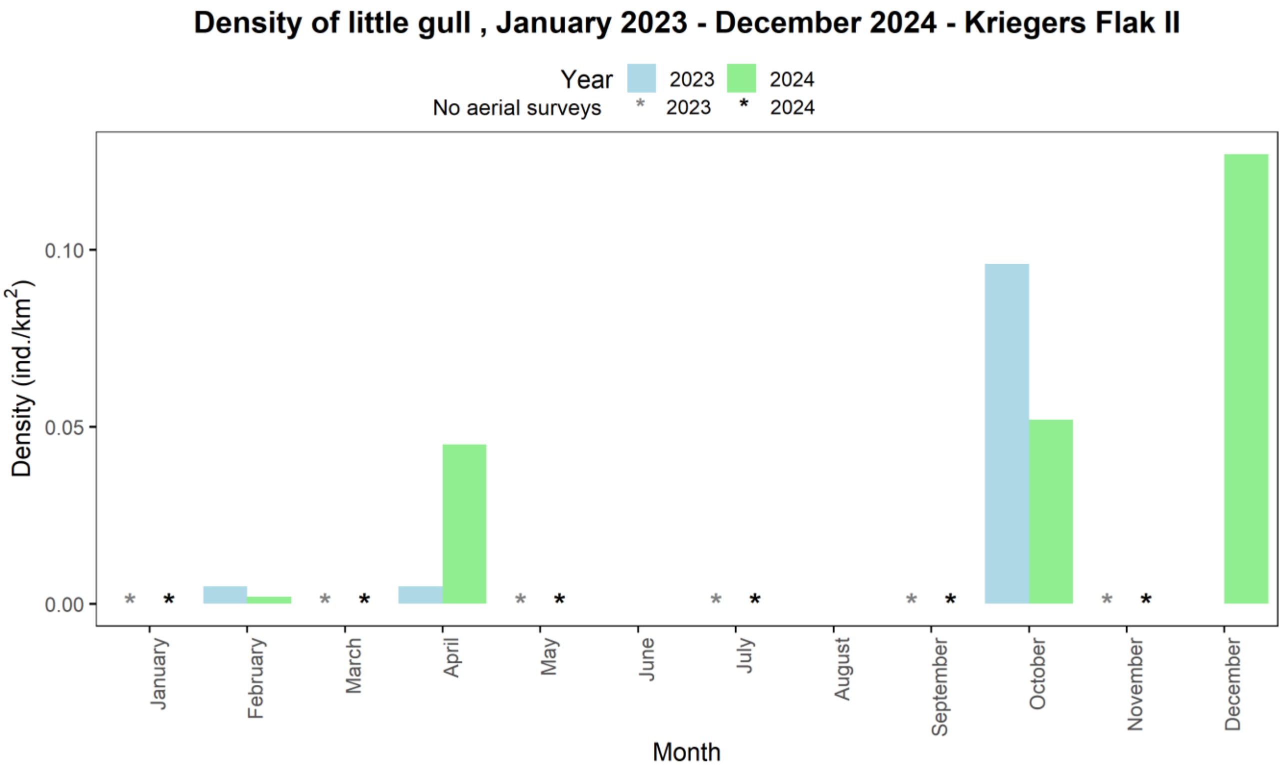


Figure 5.16 Monthly densities of little gull during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

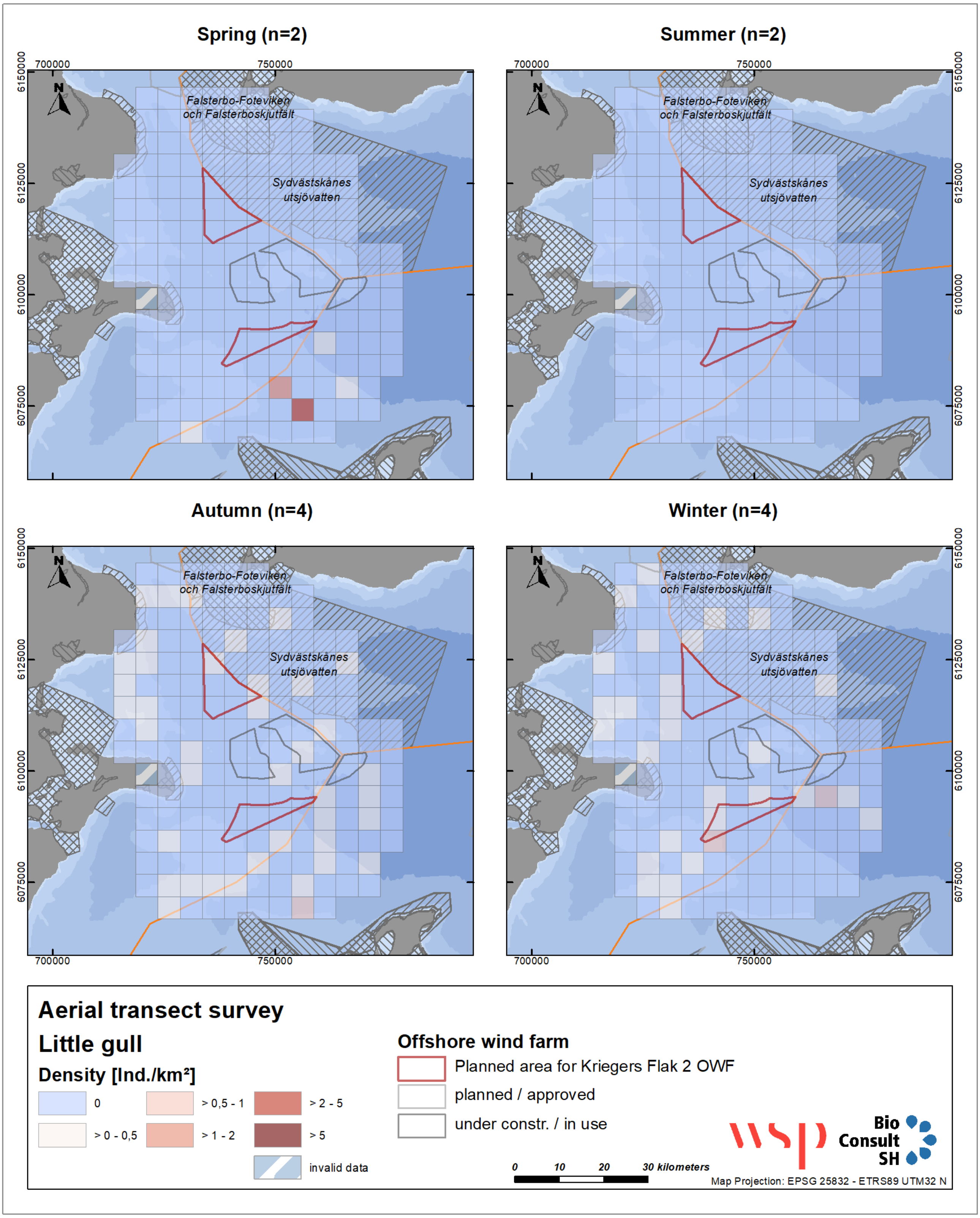


Figure 5.17 Distribution of little gull in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

BLACK-HEADED GULL

Black-headed gulls were the third most common gull species detected during the 2024 surveys, with 259 individuals representing 1.5% of the resting bird community (Figure 5.1). Compared to the 2023 campaign, there was a slight increase in numbers (n=217; 1.0% of detected resting birds in 2023, Figure 5.2).

This species was present in all surveys conducted between February 2023 and December 2024, but its presence was higher during the summer months, being June 2024 the month with the highest density in the surveyed area (0.32 ind./km^2; Figure 5.18).

The coastal areas were the main locations where this species was found. Highest concentrations of individuals were located near Falsterbo (Sweden) or the eastern tip of the island of Møn (Denmark). Black-headed gulls were barely seen in the vicinity or within the proposed OWF, but sometimes low densities were recorded (Figure 5.19).

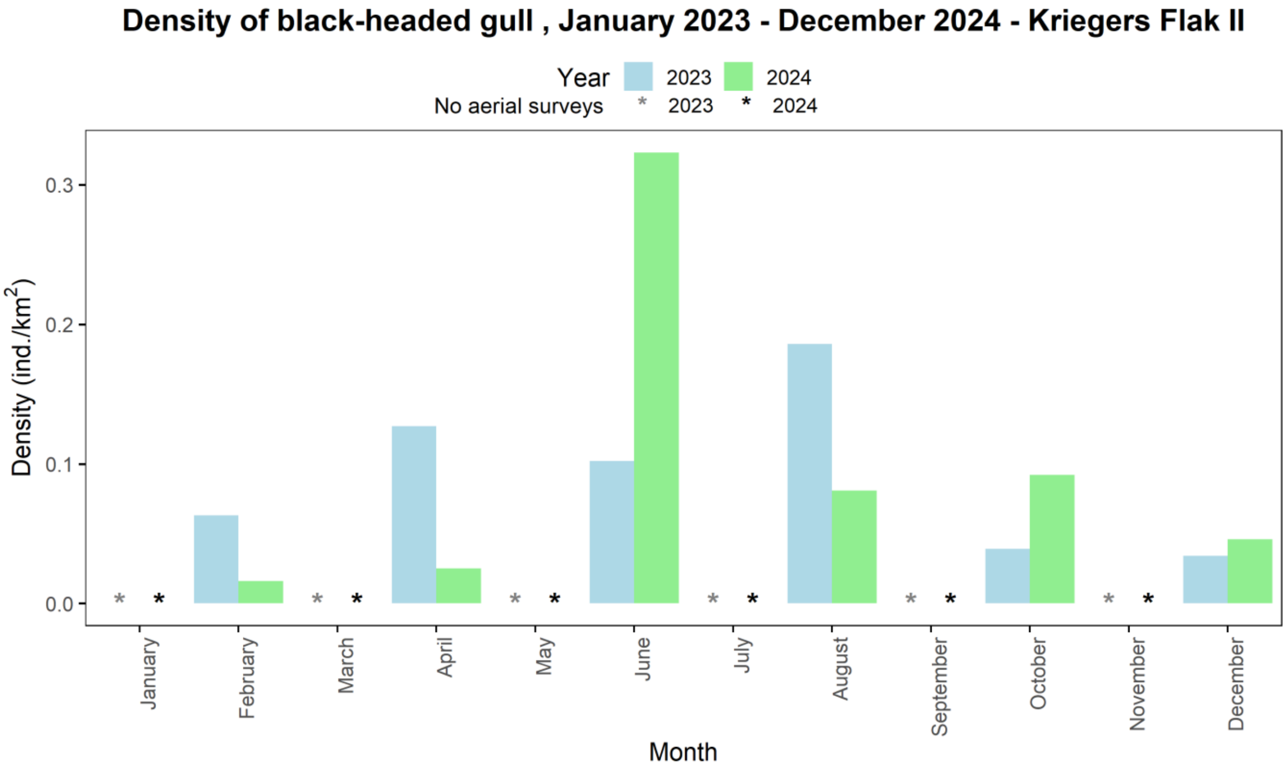


Figure 5.18 Monthly densities of black-headed gull during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

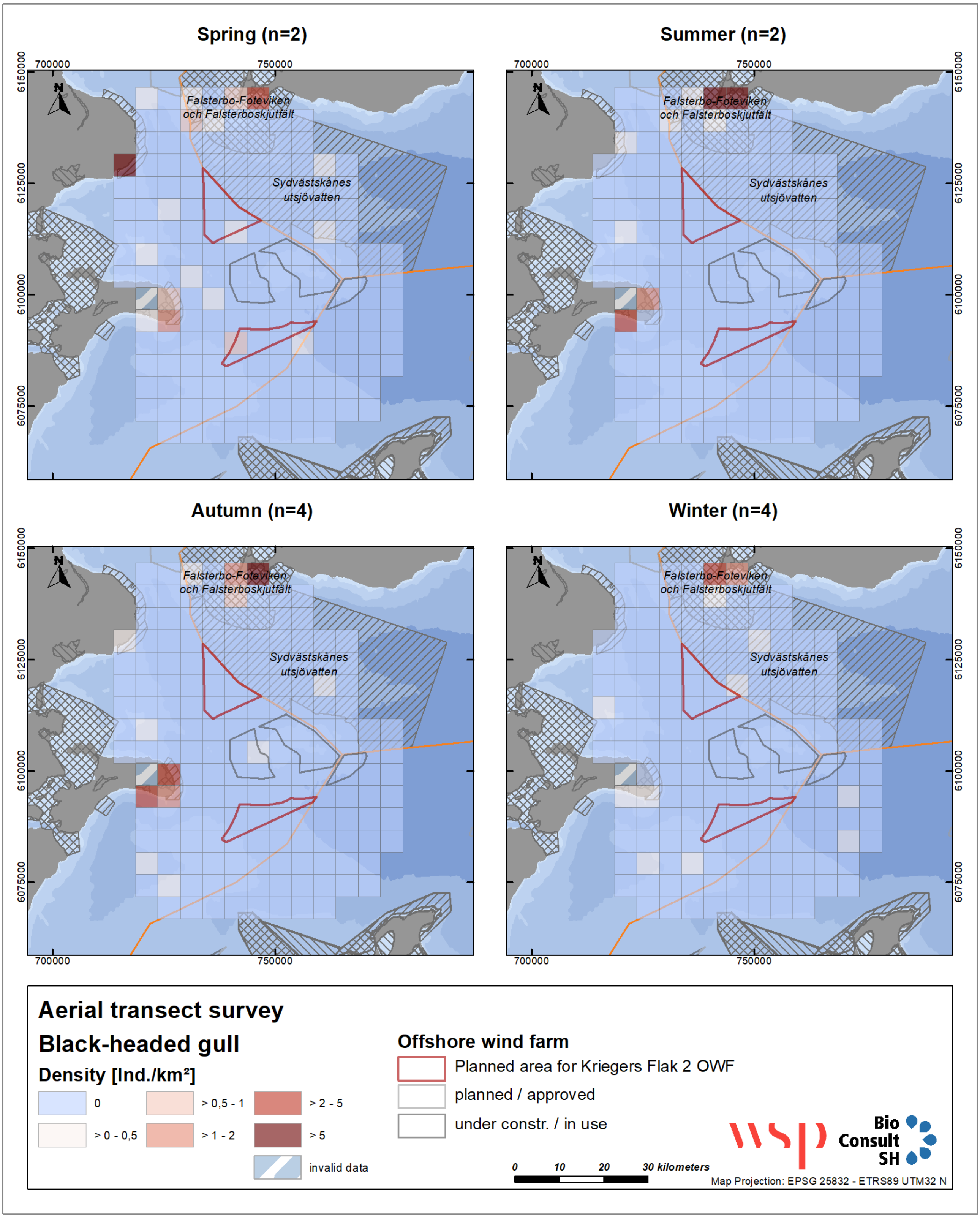


Figure 5.19 Distribution of black-headed gull in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

COMMON GULL

Common gull was the second most abundant gull species registered during 2024, with 586 individuals representing 3.5% of all detected resting birds (Figure 5.1). Fewer gulls of this species were detected in 2023 (n=456, 2.0% of all resting birds in 2023, Figure 5.2). This species was observed in each survey conducted between February 2023 and December 2024. However, the highest densities were detected during October and December (2023, 0.35 ind./km^2; 2024, 0.65 ind./km^2 respectively, Figure 5.20), while the lowest were detected during the summer months.

Spatially, common gulls were dispersed across the surveyed area, especially during the winter period. The highest densities were observed in coastal areas, eastwards of the island of Møn (Denmark) and southwards of the peninsula of Falsterbo (Sweden). This species was present within the proposed OWF Kriegers Flak II and was detected as well in the current operational OWF of Kriegers Flak (Figure 5.21).

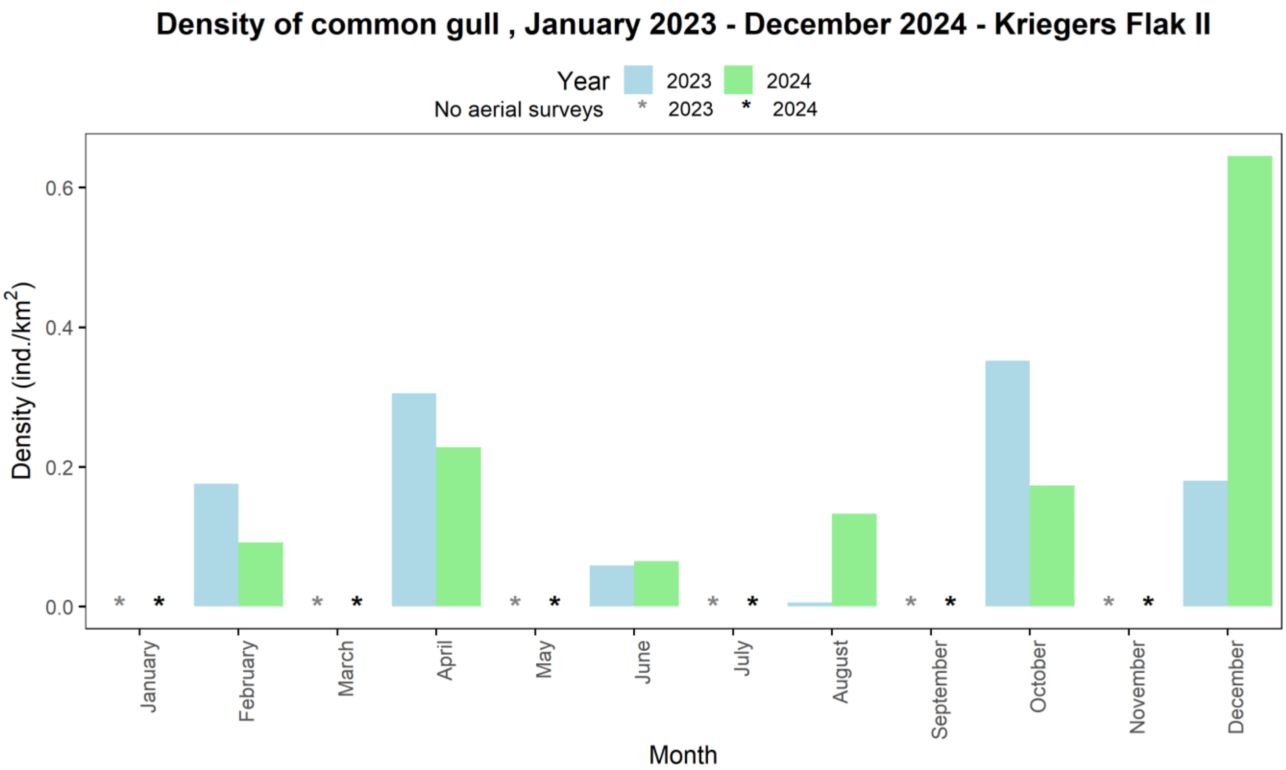


Figure 5.20 Monthly densities of common gull during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

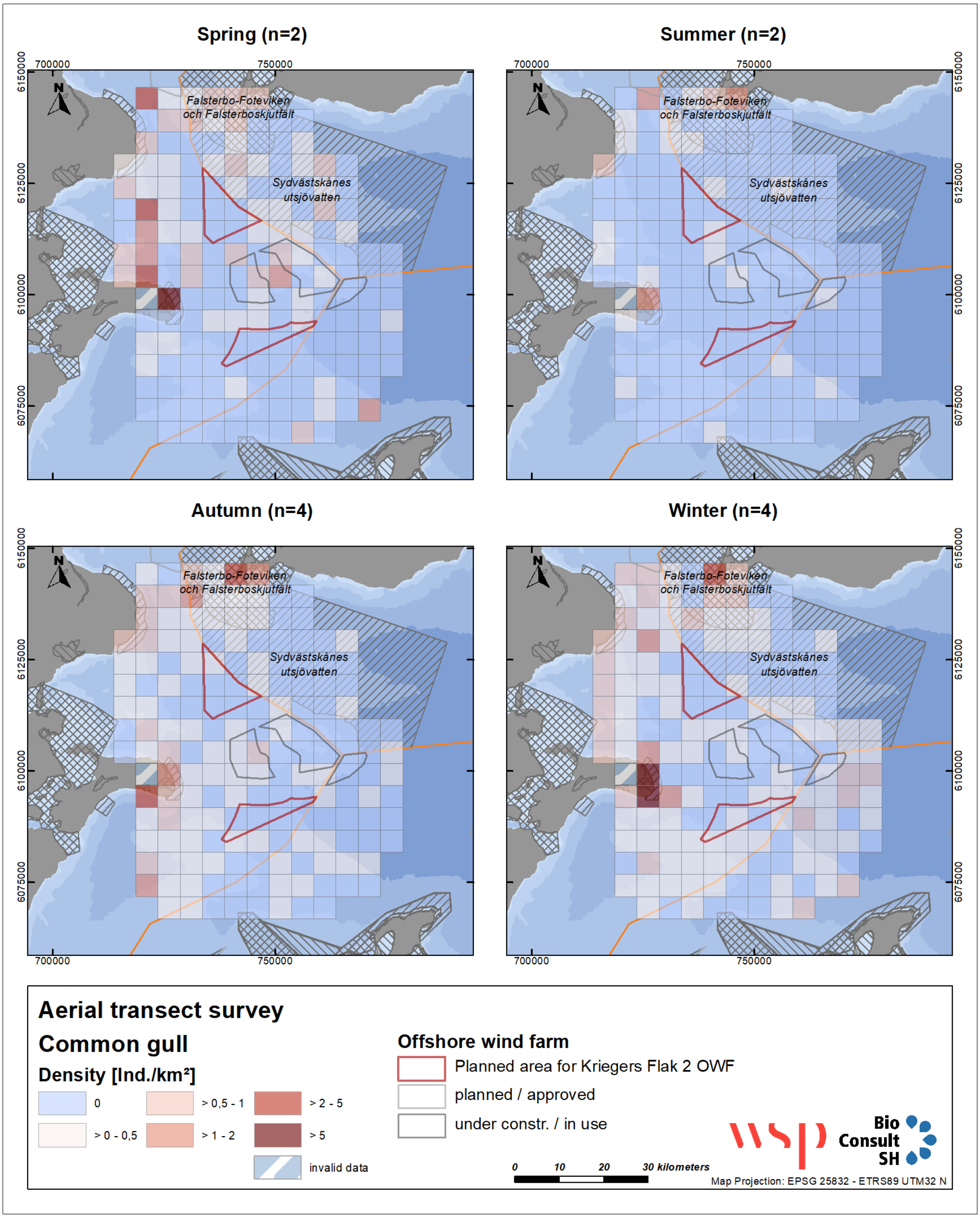


Figure 5.21 Distribution of common gull in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

HERRING GULL

Herring gulls were the fifth most common bird and the first most common gull species among all detected resting birds (Figure 5.1). They represented 4.2% of all resting birds (n=705) during the 2024 surveying campaign slightly increasing in numbers with respect to the 2023 monitoring (n=652, Figure 5.2). Despite being present in the investigated area during the entire observation period, the highest densities were reached in October (2023, ind./km^2; 2024, ind./km^2 respectively, Figure 5.22), while the lowest were detected during summer with 0.06 ind./km^2.

Herring gulls were spread across the surveyed area and found in large densities south of Falsterbo (Sweden), but also within the proposed and developed OWF areas´ limits (Figure 5.23).

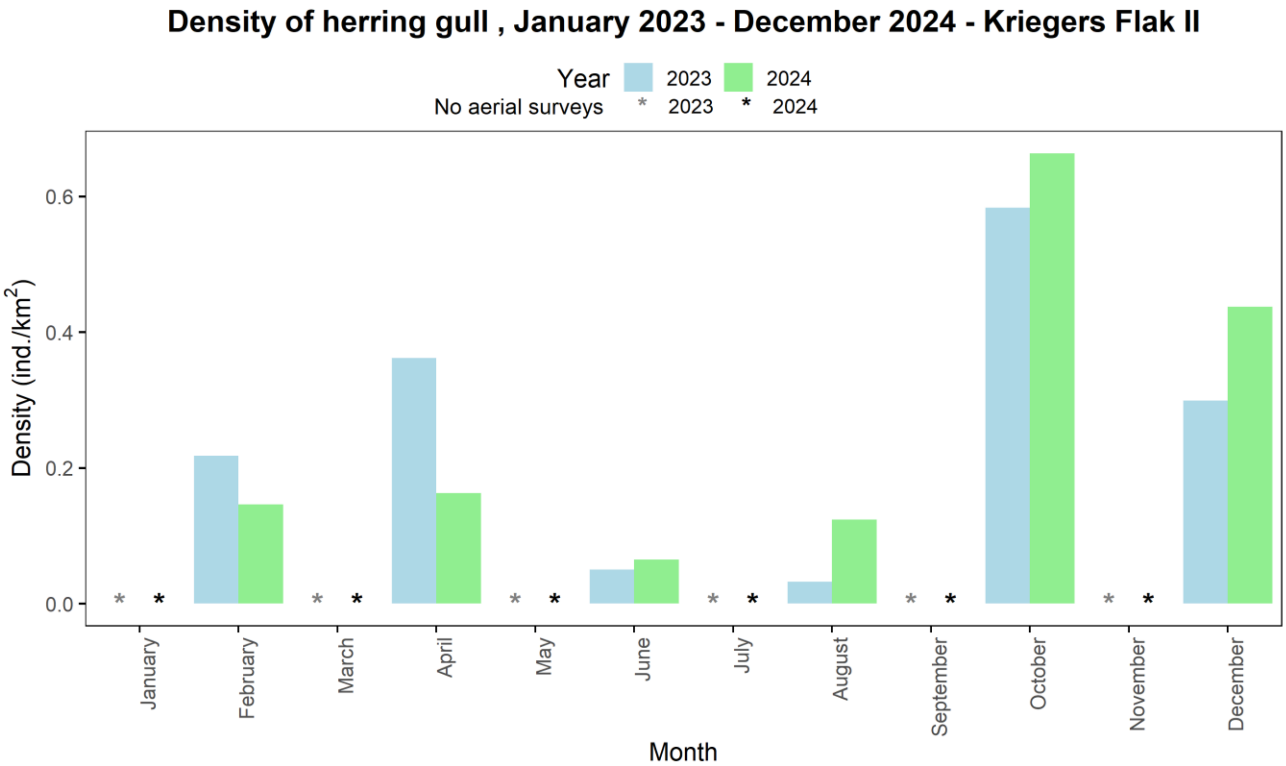


Figure 5.22 Monthly densities of herring gull during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

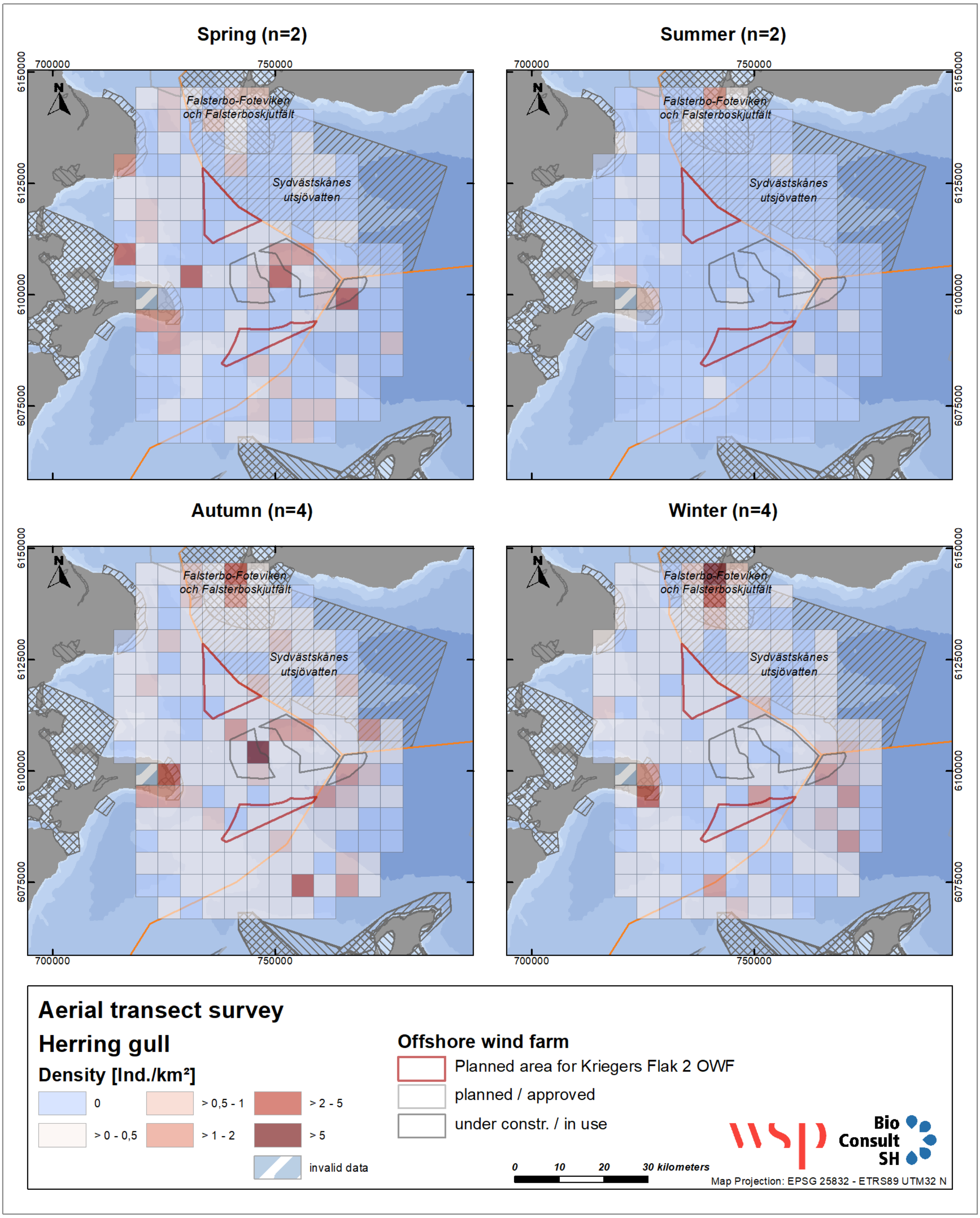


Figure 5.23 Distribution of herring gull in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

GREAT BLACK-BACKED GULL

Great black-backed gull was the fourth most abundant gull species in 2024, with 149 individuals registered within the surveyed area, representing 0.9% of all resting birds. It showed a similar result from the 2023 monitoring campaign, when 136 individuals were detected in the area, accounting for 0.6% of all resting birds (Figure 5.2).

Throughout the observation period, this species was consistently recorded, except in June 2023. Similarly, in June 2024 there was a decline in detections, with only two sightings reported. This makes the summer months the period with the lowest recorded densities and number of observations. The highest densities for both years were recorded in October (2023, 0.20 ind./km^2; 2024, 0.14 ind./km^2 respectively, Figure 5.24).

The spatial distribution of great black-backed gull was widespread across the entire observation area. However, a high-density grid cell was detected in the centre of the operational OWF Kriegers Flak, and the presence of this species was noted within the limits of the proposed OWF (Figure 5.25).

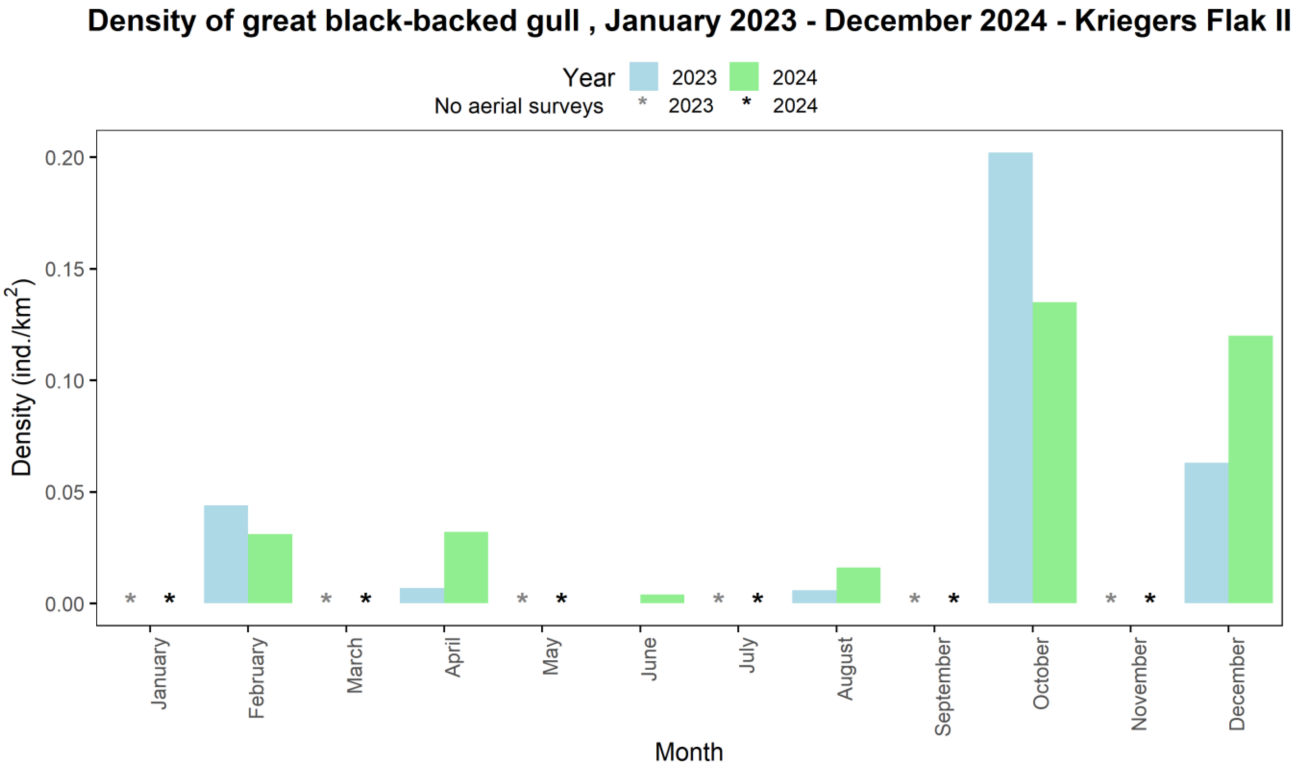


Figure 5.24 Monthly densities of great black-backed gull during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

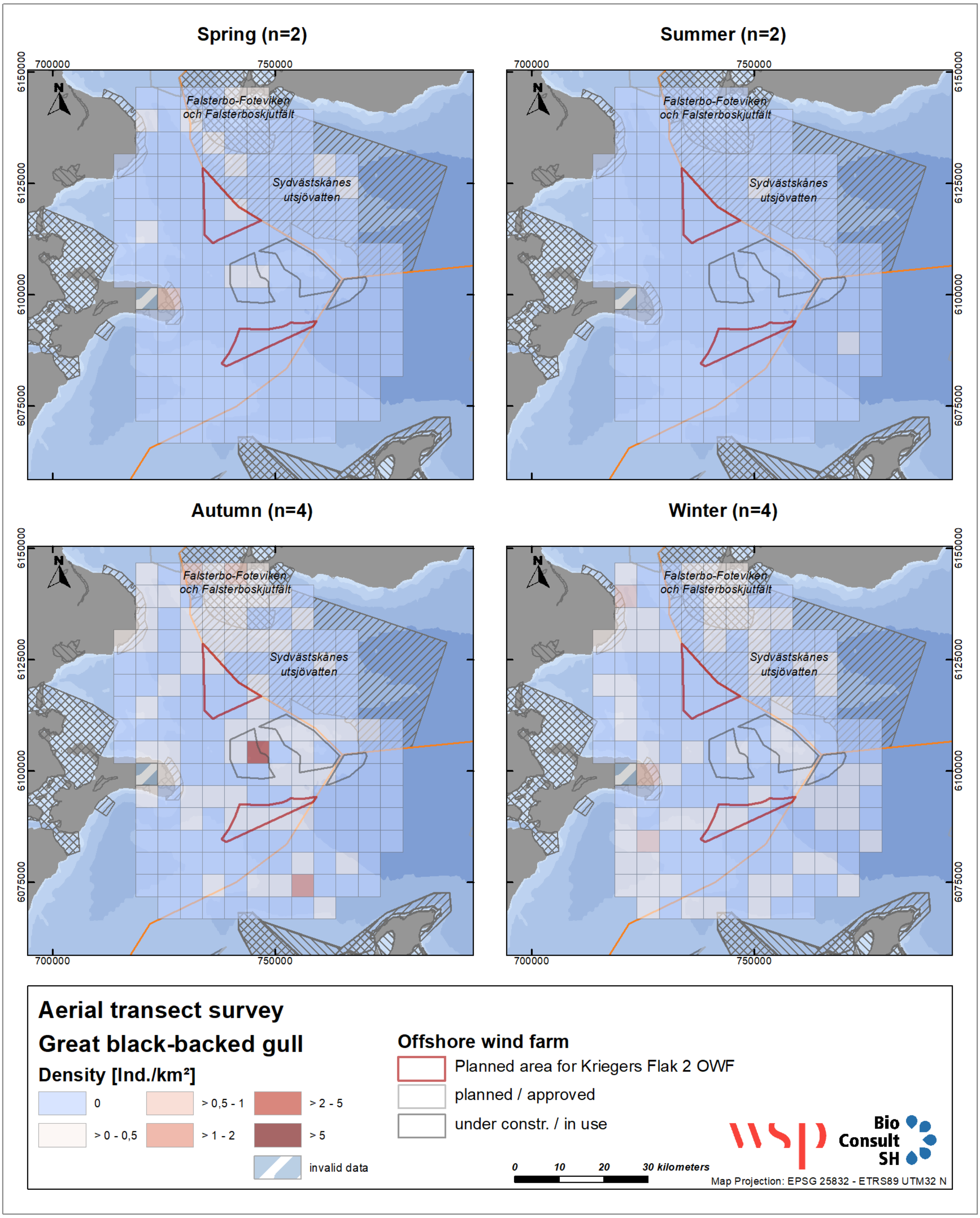


Figure 5.25 Distribution of great black-backed gull in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

AUKS

Auks were the third largest group of birds recorded in the surveyed area, with a total of 816 individuals representing 4.8% of resting birds during 2024 (Figure 5.1). A similar proportion was recorded during the 2023 monitoring, when 990 auks were registered, accounting for 4.4% of all resting birds (Figure 5.3).

In total, three species of auks were identified in the surveyed area: black guillemot, common guillemot and razorbill. Only the latter two surpassed the threshold of 0.5% of representation among resting birds and will therefore be described in more detail. The most abundant auk species during 2024 was the razorbill, however common guillemots and razorbills were equally common during the 2023 monitoring (n=362 and 1.6%).

Auks were present in the area during the entire observation period, apart from August 2024, and the highest densities were reached during the winter season, with February 2023 and December 2024 being the months with highest densities (1.31 ind./km^2 and 0.94 ind./km^2 respectively). Thus, auks were generally more common during the winter months.

COMMON GUILLEMOT

Common guillemot was the second most common species of auks in the investigated area during 2024, with 109 individuals detected representing 0.6% of all resting birds. However, their numbers decreased considerably compared to 2023, when up to 362 individuals (1.6% of all resting birds in 2023, Figure 5.2) were detected. The highest numbers of individuals were observed during the winter period, with a peak in densities detected in February 2023 (0.58 ind./km^2). In contrast, August was the month with the lowest recorded sightings (Figure 5.26). Common guillemot was widely distributed across the monitored area, and no high-density grid cells were detected. However, medium densities were found within the operational and planned OWF areas (Figure 5.27).

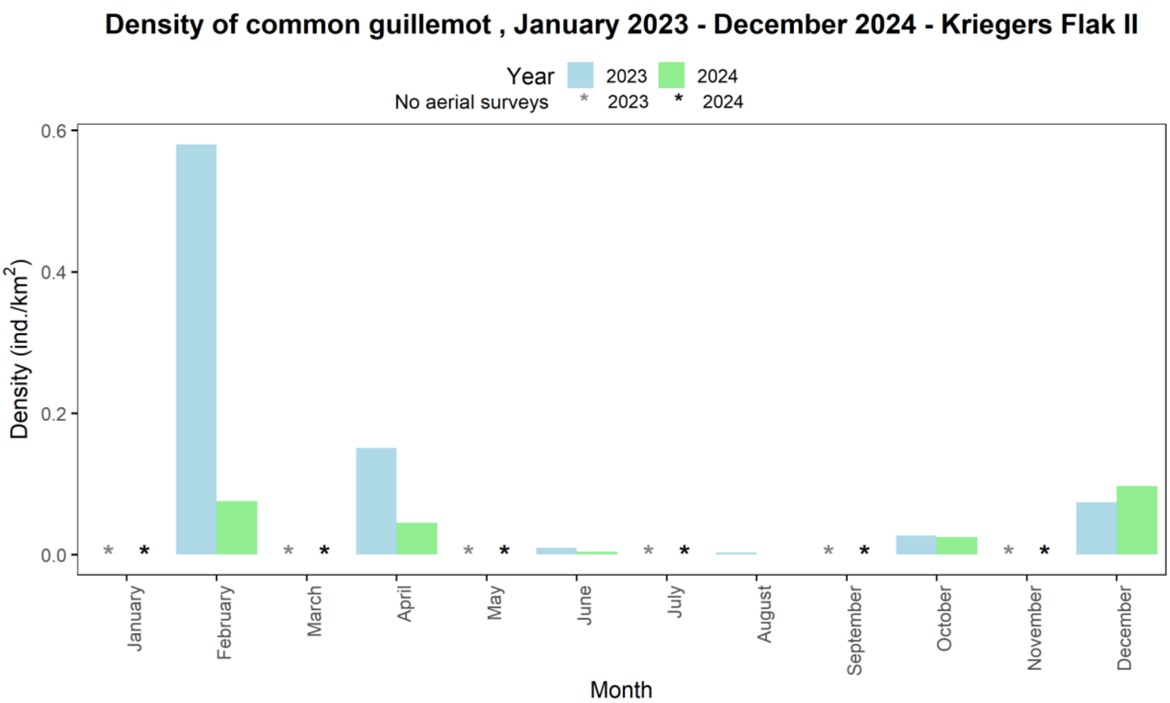


Figure 5.26 Monthly densities of common guillemot during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

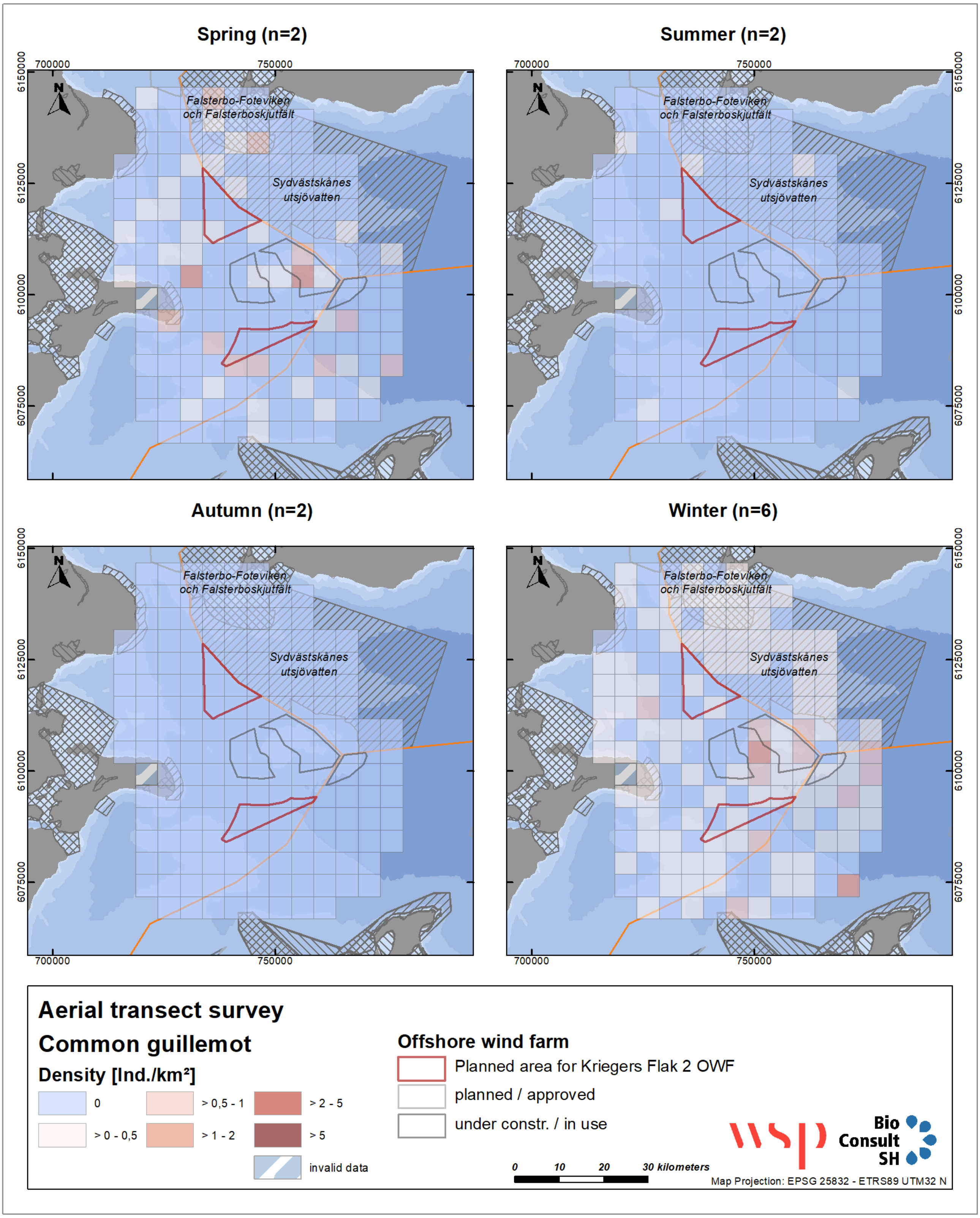


Figure 5.27 Distribution of common guillemot in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

RAZORBILL

Razorbill represented 2.2% of all resting birds, with 375 individuals detected (Figure 5.1). During the previous year of monitoring a similar number of individuals was detected (n=362, 1.6% of resting birds in 2023, Figure 5.2).

The temporality of this species, as in the other registered auk species, was marked by a contrasted presence during the winter and spring months and absence during the summer period. The highest densities were recorded in February 2023 and December 2024 (0.46 ind./km^2 and 0.46 ind./km^2, respectively), while no sightings were recorded in June and August (Figure 5.28).

Spatially, the razorbills were highly concentrated during spring in between the two planned areas for the Kriegers Flak II offshore windfarm, were an active and operational OWF is currently operating. In the winter months, their presence was more widespread and diffuse, and this species was also reported within the boundaries of the two planned areas for the OWF (Figure 5.29).

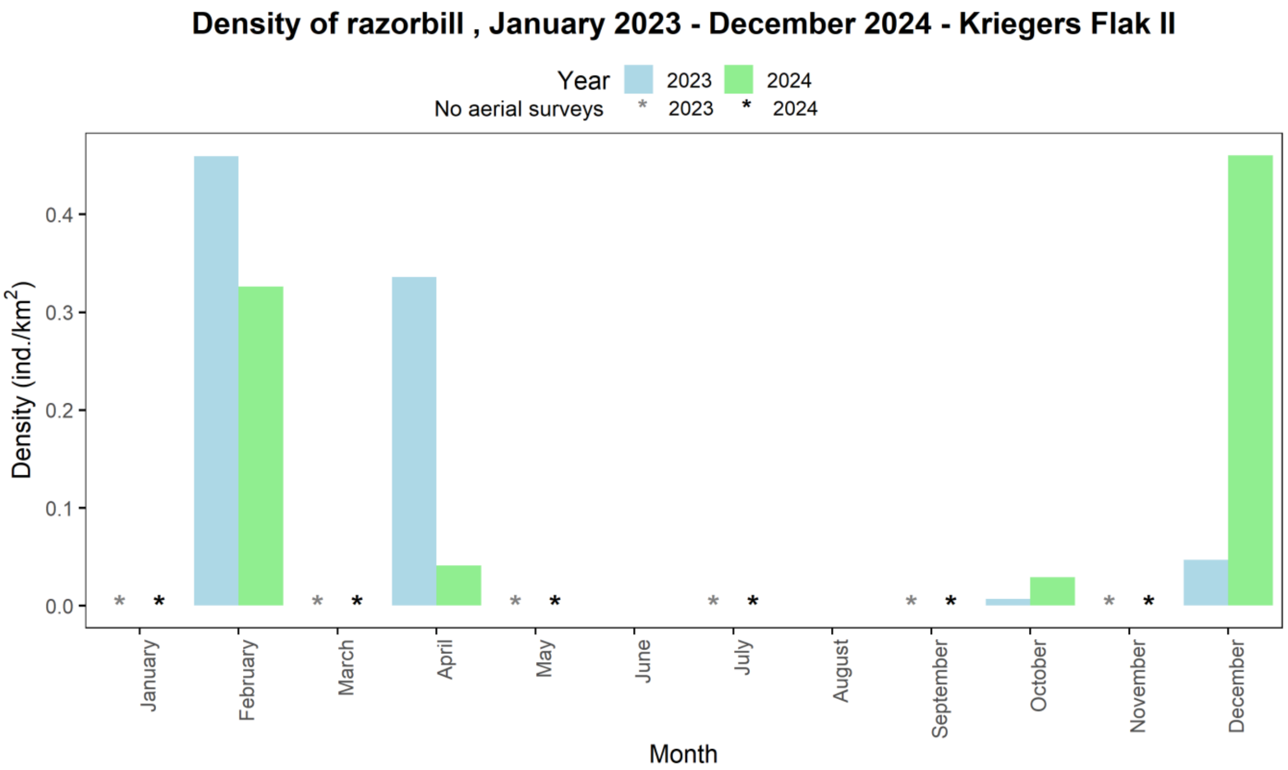


Figure 5.28 Monthly densities of razorbill during digital aerial surveys in the pre-investigation area between February 2023 and December 2024. Months in which aerial surveys were not conducted are represented by an asterisk *, both for 2023 (grey) and 2024 (black).

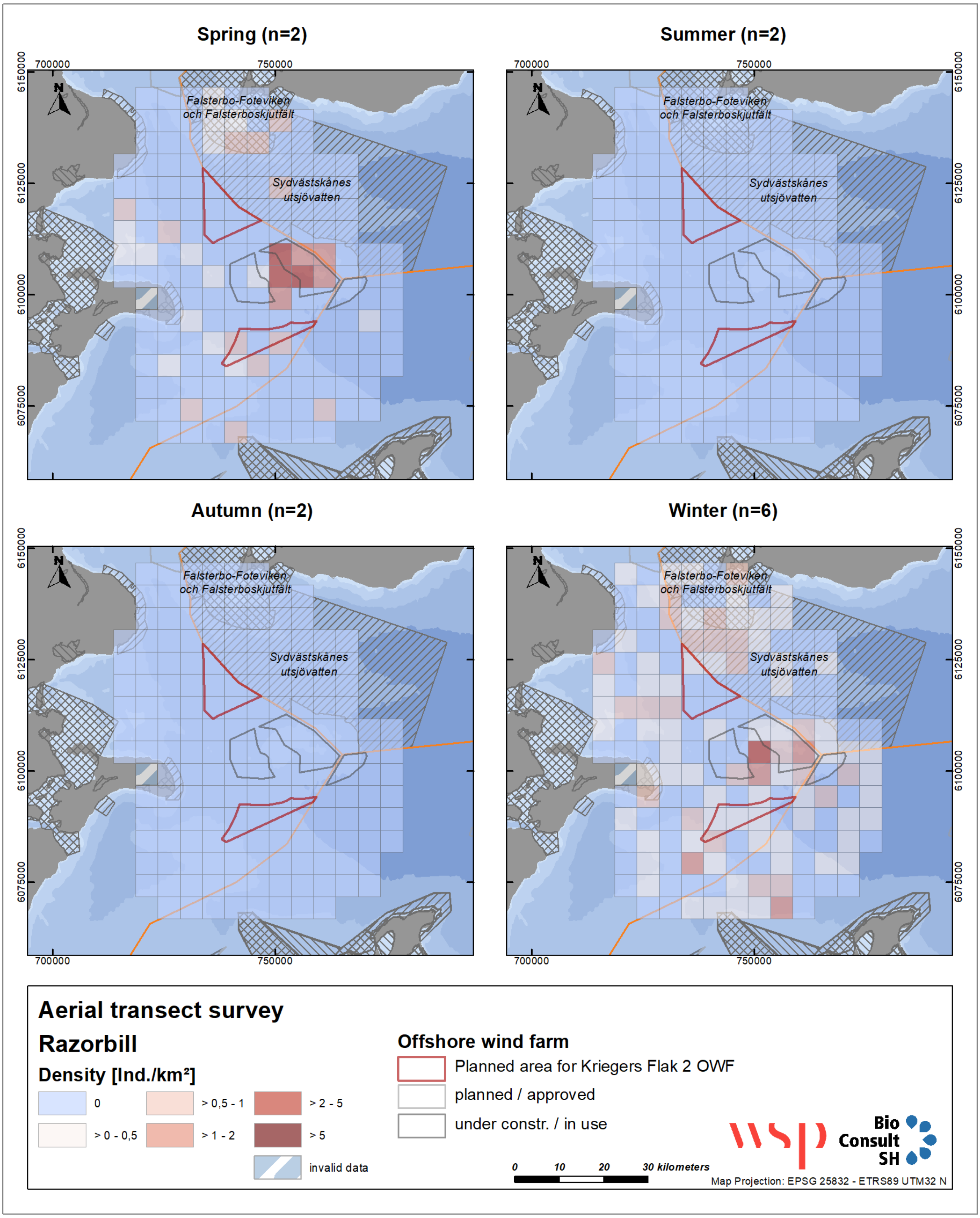


Figure 5.29 Distribution of common guillemot in the pre-investigation area per species specific season during the digital aerial surveys between February 2023 and December 2024. Classification of species-specific season according to GARTHE ET AL. (2007a). The number of surveys per season is given as n.

5.2 MIGRATING BIRDS

In this chapter, bird migration data such as observer-based information (visual sightings, nocturnal flight calls) and radar measurements (vertical and horizontal) are presented. Migration intensity is quantified as migration traffic rate (MTR) defined as the (extrapolated) number of birds (or radar echoes) transiting one square kilometre of airspace within one hour. Analysed observer-based data are presented first for all migrating birds (i.e., all species together) and then for different species groups (i.e., taxonomical groups). Species groups that were considered relevant (either because they are abundant, or the most common species of these species groups are listed under conservation categories) are presented in more detail. Data for both subareas OWF KF II North and South are presented separately but years have been pooled when the patterns were similar. The appendix (Table A-2 and Table A-3) includes species lists with information on numbers of all individuals observed, taxonomical information and species conservation status.

5.2.1 OBSERVER-BASED DATA

ALL SPECIES

DIURNAL MIGRATION (VISUAL OBSERVATIONS)

MIGRATION INTENSITY

KF II OWF N

In 2023, 33 days of surveys produced analysable data: 5 dates for each month in spring and 18 days spread between August and November for autumn. Migration intensity was at similar ranges in both seasons with autumn being slightly higher (means: 72.7 vs. 82.8 ind./h; medians: 42.7 vs. 48.5 ind./h, Table 5.3). Migration intensity increased towards the end of both seasons. There was a peak migration event on the 14th of May with 339.9 birds/h. In autumn, the maximum migration occurred on the 13th of November with 200.6 ind./h (**Fejl! Henvisningskilde ikke fundet.**, Figure 5.30). This corresponded to migration events of geese (see next section).

In 2024, 14 dates were surveyed in spring, most of them in May and 16 days in autumn between August and October. No survey took place in November 2024. In 2024, the average migration was more intense in both seasons due to some very high-migration events in May (1355.6 ind./h on the 9th of May, and a second peak was also observed the next day: 1165.2 ind./h) as well as in October (1542.7 ind./h on the 15th of October, Table 5.3 and Figure 5.30). Mean migration intensity in spring and autumn of 2024 showed almost the same value (217.7 and 218 ind./h, respectively, Table 5.3), however, median values differed (29.4 vs. 90.1, Table 5.3).

When data of both years are pooled and migration intensities averaged over all survey dates of both years (63 dates), the mean intensity turned out to be similar in spring and autumn (142.7 vs. 146.4 ind./h in spring and autumn, respectively). The standard deviation was larger in spring than in autumn suggesting a larger variability in the spring data. Due to the influence of the intense migration events in May and October (see above), the mean intensities were also higher in these months. Median values are also presented in the table as they allow for better comparison of data influenced by outliers (i.e., high migration events). When comparing the medians of both seasons averaged for both years, migration intensity in spring was less than half of the one observed in autumn (31.4 vs. 69 ind./h, Table 5.3).

Table 5.3 Monthly and seasonal migration rates (ind./h) calculated from visual observations in 2023 and 2024 in the pre-investigation area KF II OWF N. Data of both years were pooled and averaged at the bottom of the table. SD = standard deviation.

Month/Season Year	Migration intensity (ind./h)			Number of individuals	Number of survey days [planned]
	Mean (± SD)	Median	Maximum value		
2023					
March 2023	50.8 (± 52.4)	27.6	140.4	1470	5
April 2023	83.2 (± 55)	59.0	148.0	2885	5
May 2023	84 (± 143.7)	13.2	339.9	3499	5
Spring 2023	**72.7 (± 88.3)**	**42.7**	**339.9**	**7854**	**15 [15]**
August 2023	32.2 (± 19.3)	35.1	50.8	991	4
September 2023	90.3 (± 48.4)	88.9	139.4	1,875	3
October 2023	93.7 (± 84.6)	85.5	184.5	1,771	4
November 2023	102.2 (± 77.5)	136.2	200.6	3,350	7
Autumn 2023	**82.8 (± 67.2)**	**48.5**	**200.6**	**7,987**	**18 [20]**
2024					
March 2024	57.2 (± 36.5)	57.2	83.0	702	2
April 2024	25.4 (± 15.5)	25.9	40.6	572	3
May 2024	317.5 (± 540.8)	27.4	1355.6	24,268	9
Spring 2024	**217.7 (± 446.7)**	**29.4**	**1355.6**	**25,542**	**14 [15]**
August 2024	81.3 (± 71.8)	54.5	203.7	2,836	5
September 2024	151.6 (± 143.6)	96.9	327.8	4,554	5
October 2024	387.3 (± 578.2)	193.8	1542.7	11,598	6
Autumn 2024	**218 (± 370.8)**	**90.1**	**1542.7**	**18,988**	**16 [15]**
Both years					
March combined	52.7 (± 45.4)	31.4	140.4	2,172	7
April combined	61.5 (± 51.8)	42.0	148.0	3,457	8
May combined	234.1 (± 447)	24.1	1355.6	27,767	14
Spring combined	**142.7 (± 313.8)**	**31.4**	**1355.6**	**33,396**	**29 [30]**
August combined	59.5 (± 58.2)	44.4	203.7	3,827	9
September combined	128.6 (± 116)	92.9	327.8	6,429	8
October combined	269.9 (± 459.5)	147.3	1542.7	13,369	10
November combined	102.2 (± 77.5)	136.2	200.6	3,350	7
Autumn combined	**146.4 (± 259.7)**	**69.0**	**1542.7**	**26,975**	**34 [35]**

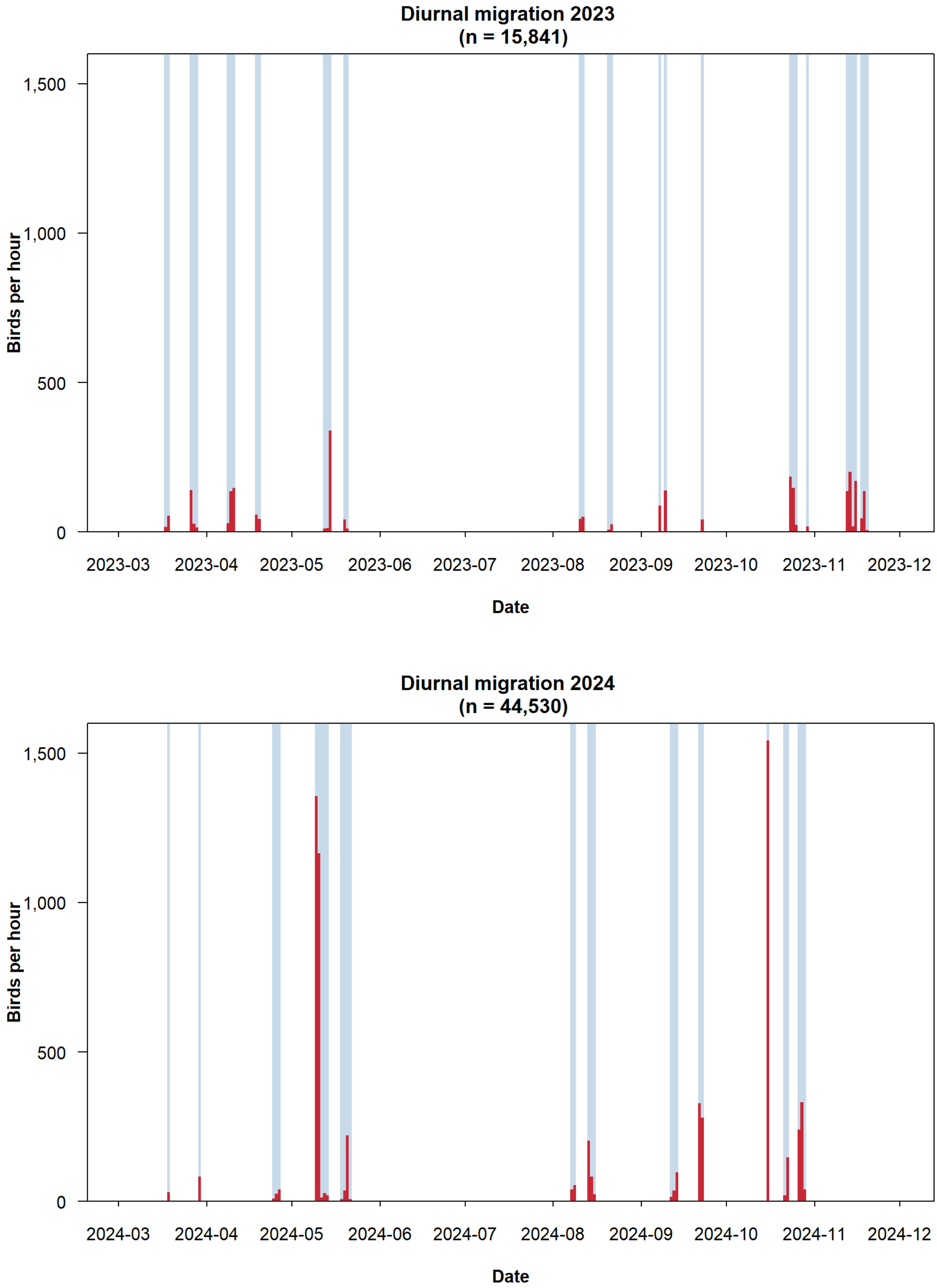


Figure 5.30 Diurnal migration intensity (red bars) derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Both Y-axes have been standardized for comparison. There was no survey in November 2024.

KF II OWF S

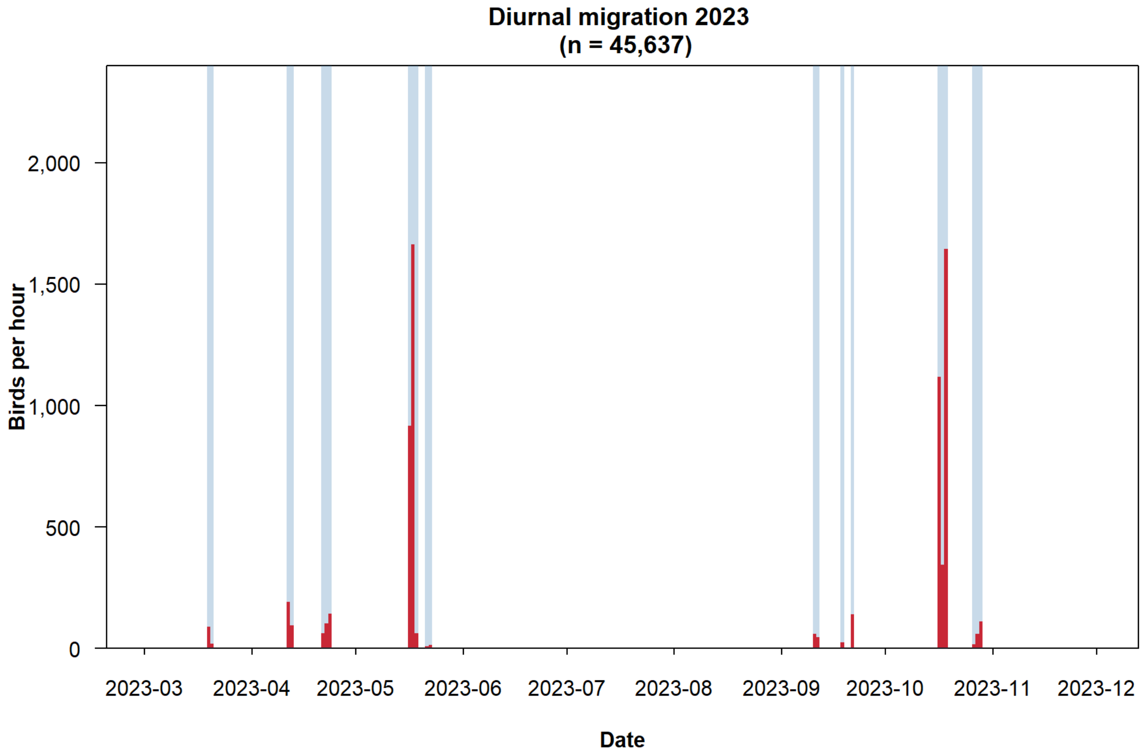
Surveys accomplished in the pre-investigation area KF II OWF S totalled 47 days of collection for 2023 and 2024 combined (see Table 5.4).

In 2023, the mean migration intensity was 281.1 ind./h in spring and 357 ind./h in autumn, and thus much higher than in the northern area KF II OWF N. Seasonal peak migration events had similar intensities with 1663.3 birds/h on the 17th of May 2023, and 1645.6 birds/h in autumn on the 18th of October 2023 (Table 5.4, Figure 5.31). These peak migration events corresponded with the migration of geese and, in autumn, some ducks (see next section). No data were collected in August or in November 2023 and despite only 22 survey days, many birds were observed in the KF II OWF S. In 2024, mean migration rates were lower than in the first year (211.8 ind./h in spring and 179.3 ind./h in autumn). Nonetheless, May and October were also the months with most observed migration with peak migration events having occurred in these months as well (2,308.4 ind./h on the 23rd of May 2024 and 555 ind./h on the 12th of October 2024, Table 5.4, Figure 5.31).

The pooling of migration intensities of both years results in similar mean intensities for spring and autumn (246.7 vs 256.6 ind./h, respectively). Variability is again larger in spring. When comparing medians however, values are larger in autumn by a much greater difference (40.7 vs. 142.1). In any case, mean and median values were larger in the KF II OWF S than in the KF II OWF N, with fewer collection dates available for the southern area.

Table 5.4 Monthly and seasonal migration rates (ind./h) in 2023 and 2024 in the pre-investigation area KF II OWF S.

Month/Season Year	Migration intensity (ind./h)			Number of individuals	Number of survey days [planned]
	Mean (± SD)	Median	Maximum value		
2023					
March 2023	54.4 (± 50)	54.4	89.7	635	2
April 2023	119.8 (± 50.3)	104.5	193	4,061	5
May 2023	533.2 (± 739.9)	62.1	1663.2	22,659	5
Spring 2023	**281.1 (± 500.3)**	**92.4**	**1663.2**	**27,355**	**12 [12]**
September 2023	68.6 (± 50.9)	52.8	142.1	1,653	4
October 2023	549.3 (± 675.4)	227.6	1645.6	16,629	6
Autumn 2023	**357 (± 562.1)**	**86**	**1645.6**	**18,282**	**10 [10]**
2024					
March 2024	74.9 (± 25)	74.9	92.6	1,011	2
April 2024	22.7 (± 2.3)	22.7	24.3	321	2
May 2024	293.3 (± 814.2)	6.0	2308.4	19,916	8
Spring 2024	**211.8 (± 660.8)**	**8.3**	**2308.4**	**21,248**	**12 [12]**
September 2024	176.7 (± 76.1)	197.0	258.3	5,700	5
October 2024	331.3 (± 150.1)	266.2	555	7,564	4
November 2024	30.6 (± 27)	19.9	70	531	4
Autumn 2024	**179.3 (± 151)**	**197.0**	**555**	**13,795**	**13 [15]**
Both years					
March combined	64.6 (± 34.4)	73.5	92.6	1,646	4
April combined	92 (± 62.7)	95.1	193	4,382	7
May combined	385.6 (± 764.2)	9.3	2308.4	42,575	13
Spring combined	**246.7 (± 562.2)**	**40.7**	**2308.4**	**48,603**	**24 [24]**
September combined	128.6 (± 84.3)	142.1	258.3	7,353	9
October combined	462.1 (± 523.1)	266.2	1645.6	24,193	10
November combined	30.6 (± 27)	19.9	70	531	4
Autumn combined	**256.6 (± 378.6)**	**142.1**	**1645.6**	**32,077**	**23 [25]**



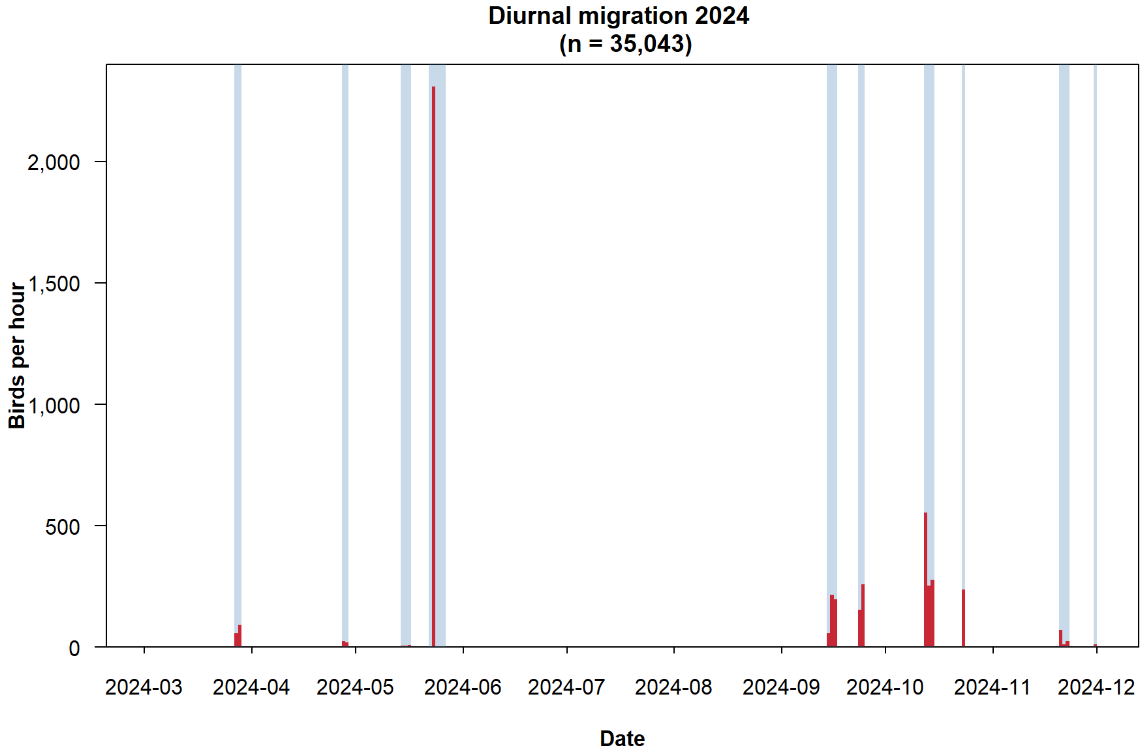


Figure 5.31 Diurnal migration intensity (red bars) derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (22 dates in 2023 and 25 in 2024). Both Y-axes have been standardized for comparison.

In this section, data of both years were combined since their patterns are similar. Differences between the areas will be highlighted.

KF II OWF N

A similar altitudinal distribution is observed when data of both years is combined for both seasons. Over half of all migrating birds were registered in the lowest altitudinal category flying close to the water surface (0-5 m) in spring and autumn (55% and 52%, respectively, Figure 5.32). About 68% and 74% of all migrating birds were registered flying at altitudes up to 20 m above sea level in spring and autumn, respectively. In spring, almost a third of all migrating birds counted during both years (32%) were flying at an altitude potentially at risk (turbine height, 20-200 m). This proportion was about 25% in autumn. In addition, there were only few birds (~1.5%) observed flying above 200 m of altitude.

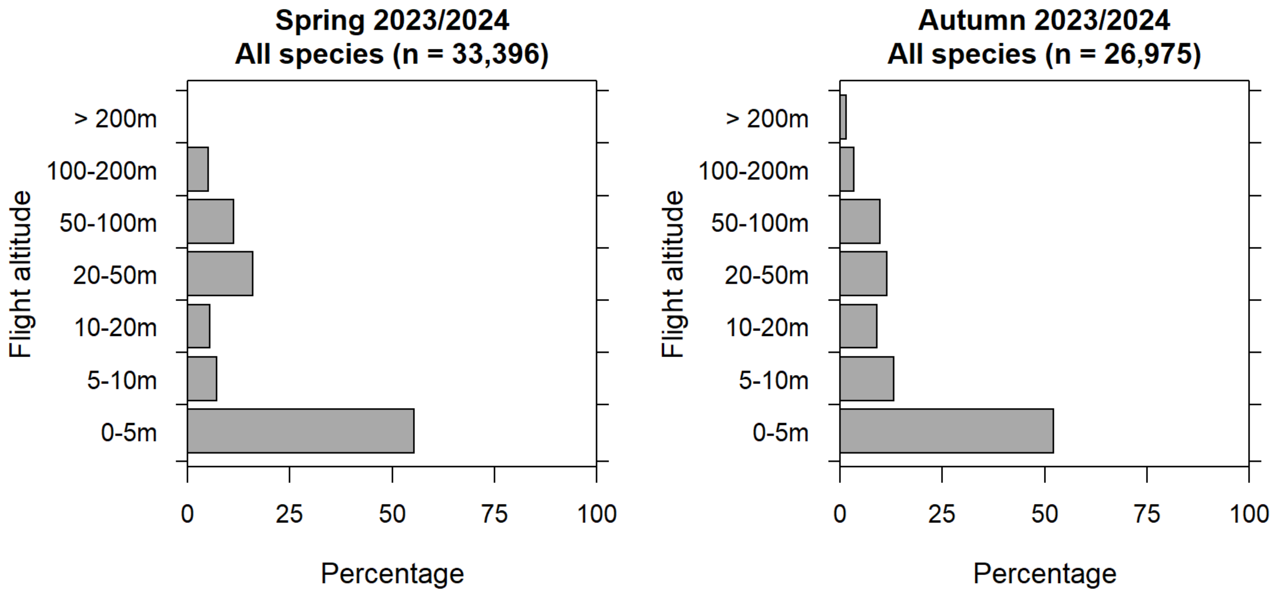


Figure 5.32 Flight altitude distribution of all observed birds during visual observations in spring (left) and autumn (right) 2023/2024 (data of both years pooled) in the pre-investigation area KF II OWF N.

KF II OWF S

Different patterns of flight altitude distribution were observed in the southern area between spring and autumn. In spring, about 29% of all migrating birds flew at the lowest layer (0-5 m), and at the layer between 20-50 m of altitude. In general, less than half of the birds were observed flying at altitudes below 20 m (49%, Figure 5.33), about 43% flew between 20 and 200 m of altitude. In addition, almost 8% of all birds flew at higher altitudes (> 200 m).

In autumn, more than half of the migrating birds were flying close to the surface (0-50 m), with the next layers containing a similar proportion of birds observed flying at all other altitude layers: about 5% of all migrating birds were observed flying above 200 m of altitude and 11% between 20 and 50 m Figure 5.33).

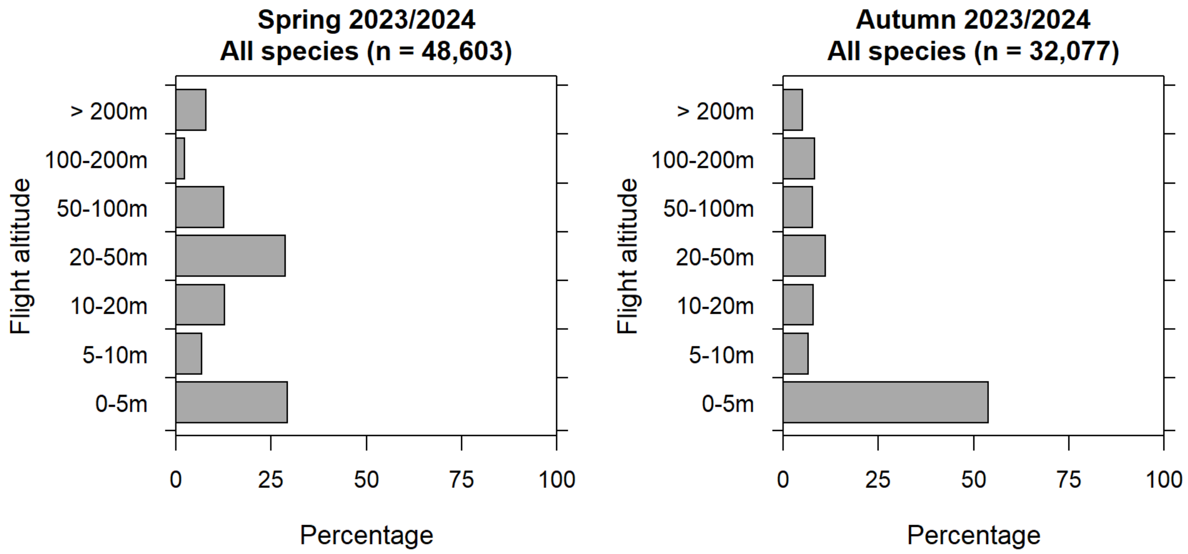


Figure 5.33 Flight altitude distribution of all observed birds during visual observations in spring (left) and autumn (right) 2023/2024 (data of both years pooled) in the pre-investigation area KF II OWF S.

Differences in flight altitude distribution between the subareas

The main difference between both areas remains in the altitudinal distribution of observed birds in spring. In the northern area, more than half of the birds were seen flying in the lowest layer (0-5 m) whereas less than 30% were seen flying at the same altitude layer in the southern area, and many more birds were seen in the layer between 20 and 50 m. In addition, more birds were seen flying at high altitudes (> 200 m) in the KF II OWF S than in the KF II OWF N.

FLIGHT DIRECTIONS

KF II OWF N

In the northern area, 78% of all migrating birds were seen flying in a NE direction, almost 6% and 8% were flying in a N and E direction in spring, respectively whereas in autumn, 52% of all birds flew in a SW and almost 32% flew in a W direction (**Figure 5.34**).

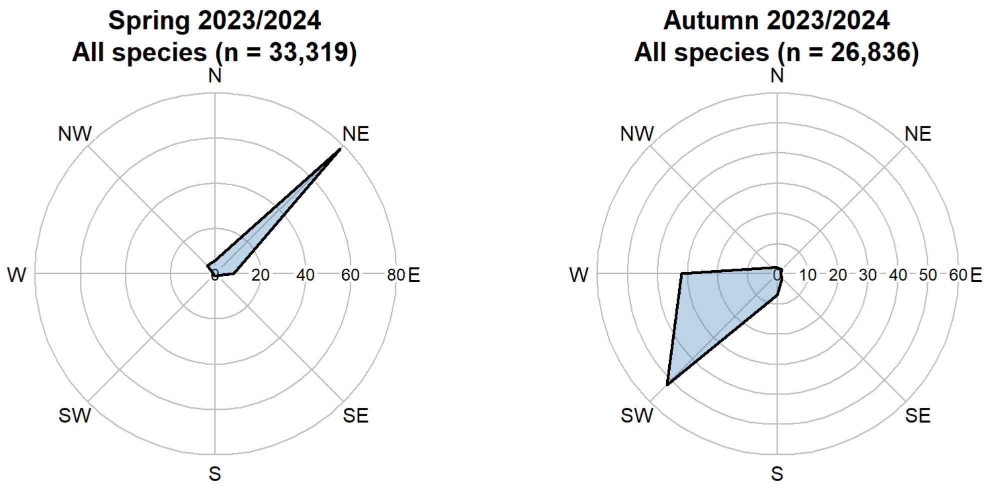


Figure 5.34 Flight directions of all observed birds during visual observations in spring and autumn of 2023/2024 (data of both years pooled) in the pre-investigation area KF II OWF N. Observers estimated the flying direction in 45° increments: N = North, NE = Northeast, E = East, SE = Southeast, S = South, SW = Southwest, W =West, NW = Northwest. Numbers on the axis represent percentages.

KF II OWF S

In the southern area, the NE direction was clearly observed for most migrating birds (90%). During autumn, more than half of all birds migrated to the SW (57%) but almost a quarter of the birds migrated to the W (24%) and 15% to the S. Other directions were less preferred. Only 4% of all observed birds flew in a direction that was not the W, SW or S direction (Figure 5.35).

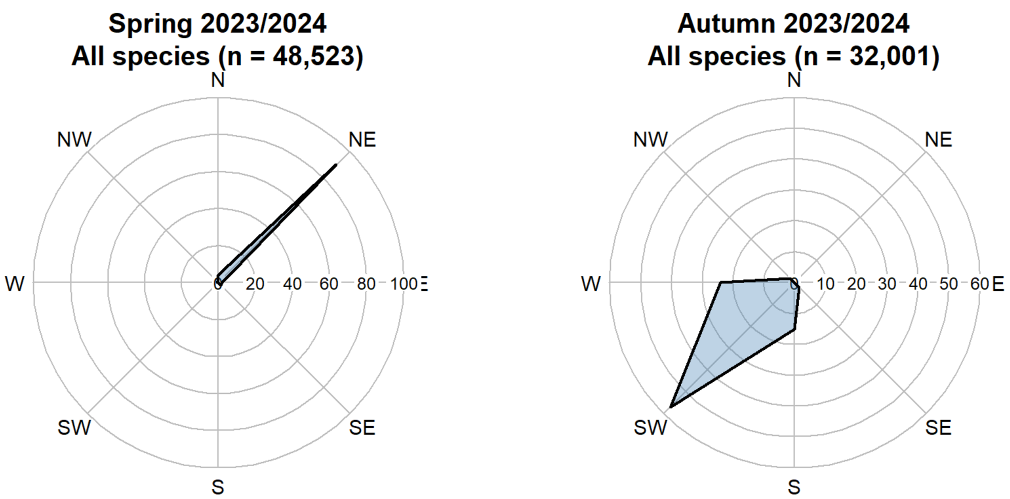


Figure 5.35 Flight directions of all observed birds during visual observations in spring and autumn of 2023/2024 (data of both years pooled) in the pre-investigation area KF II OWF S. See Figure 5.34 for details.

Differences in flight directions between the two subareas

In general, birds of both areas flew in a NE direction in spring and in a SW direction in autumn, but the direction was less variable in spring than in autumn. Westerly as well as southerly directions were chosen in both areas in autumn, but more birds were observed flying to the south in the KF II OWF S compared to the KF II OWF N.

TEMPORAL PATTERNS

KF II OWF N

During spring, over half of the observed birds (55%) flew during the first four hours after civil morning twilight with the largest number of observations taking place during the fourth hour (18%). The number of observed birds progressively decreased with about 31% of all birds being observed between the 5th and 8th hour and the remaining 15% of birds were observed in the last hours of the day before sunset (Figure 5.36).

Furthermore, in autumn, more birds observed during the first half of the day than in the next 6 hours (67%) with most birds being observed at the middle of the day (6th hour after civil morning twilight (Figure 5.36).

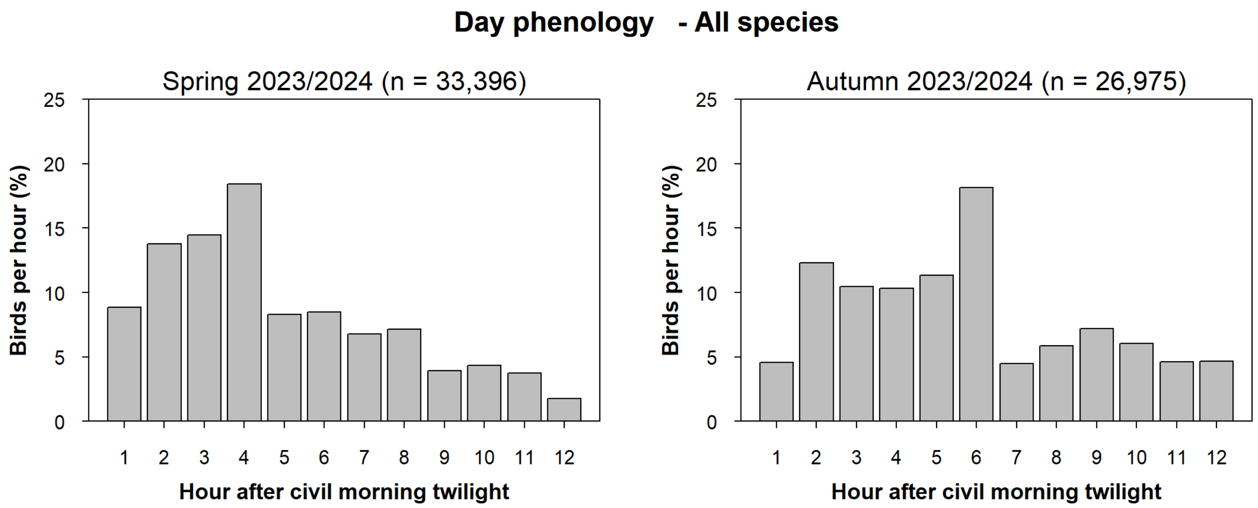


Figure 5.36 Diurnal phenology of all observed birds in 2023 and 2024 in the pre-investigation area KF II OWF N. Observations were pooled for each season of both years, and hours were standardized to a 12 hour day length, irrespective of the date.

KF II OWF S

In the southern area, the number of observed birds was higher towards the middle of the day with 76% of all birds observed flying between the 4th and the 9th hour after civil morning twilight (Figure 5.37). The largest number of birds were observed during the 9th hour (20.5%) with two additional peaks during the 5th and 6th hour (16-17%, each). In autumn, there was no peak hour for birds observed migrating. A constant flow of birds was observed flying between the 2nd and the 6th hour after civil morning twilight as well as before the setting of civil evening twilight (9th, 11th and 12th hour, Figure 5.37).

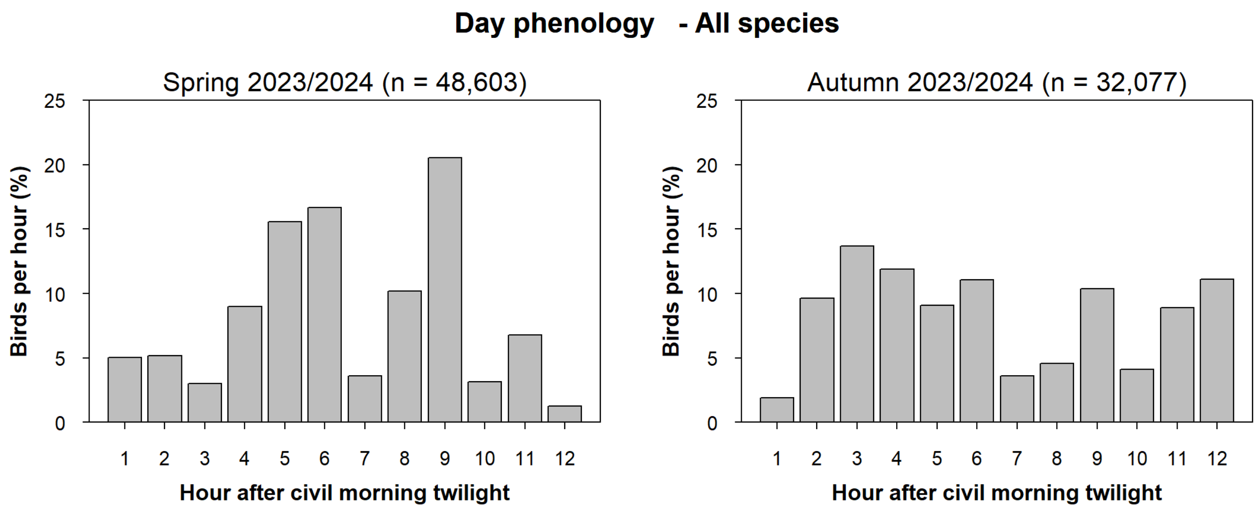


Figure 5.37 Diurnal phenology of all observed birds in 2023 and 2024 in the pre-investigation area KF II OWF S. See Figure 5.36 for details.

<u>Differences in temporal patterns between the subareas</u>

In the northern area, most birds flew in the first hours after civil morning twilight in spring whereas in the southern area, most birds were observed flying at the middle of the day. In autumn, there was not a strong difference in temporal patterns between both areas. Nonetheless, more birds were observed flying during the first half of the day than in the second half of the day in the northern area. This was not as obvious in the southern area (Figure 5.37).

NOCTURNAL MIGRATION (FLIGHT CALLS)

MIGRATION INTENSITY

KF II OWF N

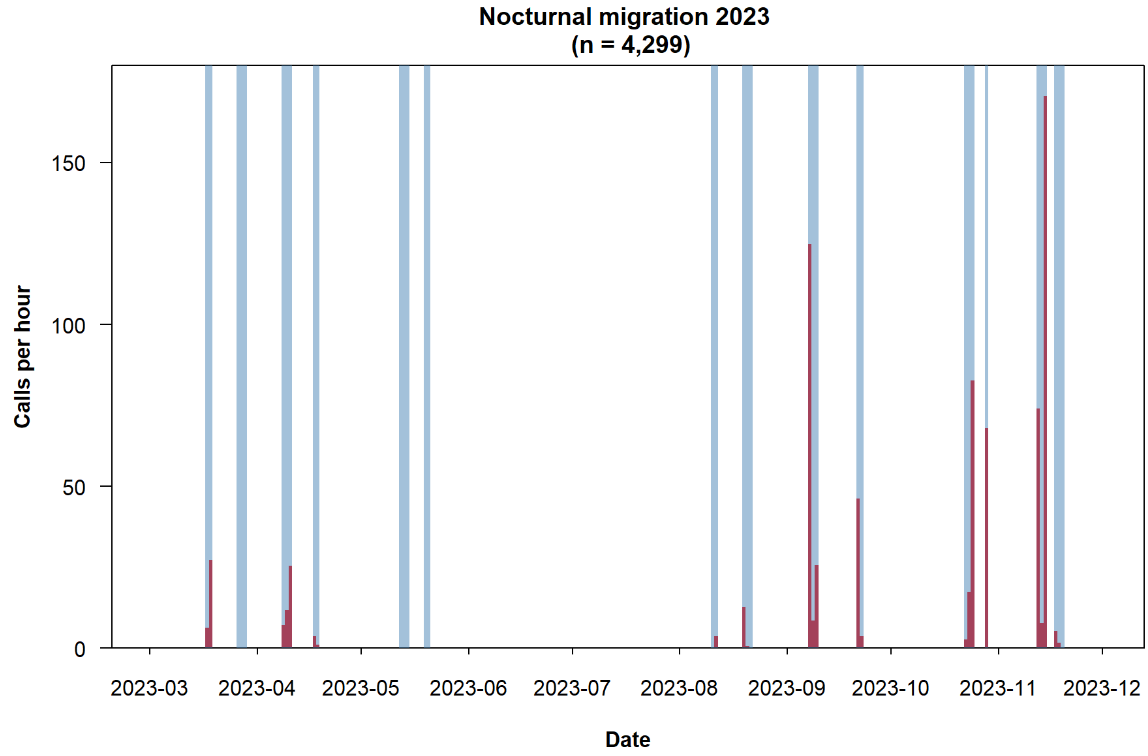
In general, fewer bird calls were heard during the second year of surveys than in the first year (less than half of the calls, see Table 5.5 and Figure 5.38) and in both years nocturnal migration was heard less than in spring than in autumn. In part, this difference between years can be attributed to fewer collection days in the second year. In fact, almost half of all nocturnal calls in autumn were heard in November 2023, a month not surveyed in 2024.

During the first year, there were five dates with migration intensities higher than 64 calls/h (the maximum calling intensity in the second year), the highest value was 170.4 calls/h on 14th November 2023 (Table 5.5). Calls were not much heard or registered in May. No calls were heard in any of the five survey nights in 2023, and calls were heard only in the first three out of the nine nights surveyed in May 2024.

When averaging the data of both years, migration intensity was similar in all three months of spring and similar to the overall mean of the season (6.5 calls/h), whereas in autumn, mean migration intensity during nights was low in August and increased with time to an overall mean of 25.7 calls/h.

Table 5.5 Monthly and seasonal migration rates (calls/h) calculated from acoustic observations in 2023 and 2024 in the pre-investigation area KF II OWF N. Data of both years were averaged together at the end of the table. SD = standard deviation.

Month/Season Year	Migration intensity (calls/h)			Number of calls	Number of survey nights [planned]
	Mean (± SD)	Median	Maximum value		
2023					
March 2023	6.7 (± 11.8)	0	27.2	144	5
April 2023	9.9 (± 9.6)	7.2	25.4	216	5
May 2023	0 (± 0)	0	0	0	5
Spring 2023	**5.5 (± 9.2)**	**0**	**27.2**	**360**	**15 [15]**
August 2023	3.4 (± 5.4)	0.8	12.8	64	5
September 2023	41.8 (± 49.3)	25.6	124.8	983	5
October 2023	42.7 (± 38.6)	42.7	82.6	1,076	4
November 2023	43.2 (± 68.4)	6.5	170.4	1,816	6
Autumn 2023	**32.8 (± 47.8)**	**8.2**	**170.4**	**3,939**	**20 [20]**
2024					
March 2024	12.6 (± 0)	12.6	12.6	63	1
April 2024	0.2 (± 0.2)	0.3	0.3	2	3
May 2024	9.7 (± 19.1)	0	47.0	571	9
Spring 2024	**7.7 (± 16.2)**	**0**	**47.0**	**636**	**13 [15]**
August 2024	5.2 (± 5.8)	3.1	11.7	96	5
September 2024	18.2 (± 18)	18.9	43.8	435	5
October 2024	25.2 (± 23.5)	18.9	64.0	801	5
Autumn 2024	**16.2 (± 18.3)**	**11.7**	**64.0**	**1,332**	**15 [15]**
Both years					
March combined	7.7 (± 10.8)	3.2	27.2	207	6
April combined	6.2 (± 8.8)	2.5	25.4	218	8
May combined	6.2 (± 15.7)	0	47.0	571	14
Spring combined	**6.5 (±12.5)**	**0**	**47.0**	**996**	**28 [30]**
August combined	4.3 (± 5.4)	1.9	12.8	160	10
September combined	30 (± 37.1)	22.3	124.8	1,418	10
October combined	33 (± 30.3)	18.9	82.6	1,877	9
November combined	43.2 (± 68.4)	6.5	170.4	1,816	6
Autumn combined	**25.7 (± 38.0)**	**11.0**	**170.4**	**5,271**	**35 [35]**



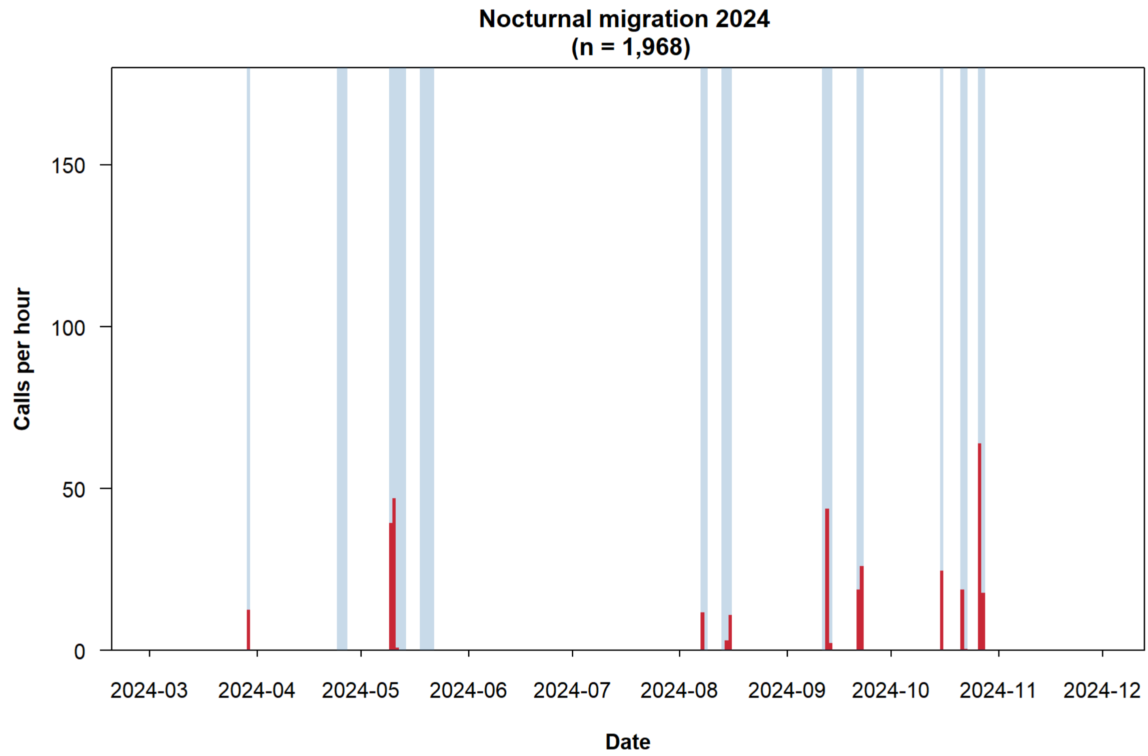


Figure 5.38 Nocturnal migration intensity (red bars) derived from acoustic observations of flight calls in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (35 dates in 2023 and 28 dates in 2024). Y-axes have been standardized for ease of comparison.

KF II OWF S

Similar to the northern area, nocturnal migration intensity was higher in the first year than in the second year, despite five more nights surveyed during the second year. In general, there were also fewer calls in spring than in autumn in both years, but particularly few calls were heard in spring of 2024 (only 44 calls in total). As in the northern area, May was the month with comparatively fewer calls, and in the case of the southern area, no calls were heard in a total of 14 survey nights during May (both years combined). In particular, the large number of calls registered in autumn of 2023 were mainly heard during a single night (10th September 2023, with over 75% of all calls of the season registered, 773.7 calls/h). In comparison, the maximum intensity in autumn of 2024 was 18 times lower than that of the previous year: 42.7 calls/h (13th October 2024, see Table 5.6 and Figure 5.39).

When pooling the data of both years, nocturnal calling intensity was high in March and further on, with no calls being registered during May. Mean nocturnal calling intensity for spring was then 7.0 calls/h. Similarly, there was a decrease of nocturnal intensity with time in autumn with most calls being registered in September and nocturnal calling intensity being lowest in November. Overall, 45.8 calls/h were heard on average during autumn in the southern area.

Table 5.6 Monthly and seasonal migration rates (calls/h) calculated from nocturnal flight calls (acoustic observations) in 2023 and 2024 in the pre-investigation area KF II OWF S.

Month/Season Year	Migration intensity (calls/h)			Number of individuals	Number of survey nights [planned]
	Mean (± SD)	Median	Maximum value		
			2023		
March 2023	58.9 (± 9.8)	58.9	65.8	544	2
April 2023	9.5 (± 5.8)	12.0	16.2	192	5
May 2023	0 (± 0)	0	0	0	5
Spring 2023	**13.8 (± 22)**	**3.4**	**65.8**	**736**	**12**
September 2023	213 (± 375.0)	37.5	773.7	4,047	4
October 2023	25 (± 22.1)	25.4	58.5	776	5
November 2023	0.3 (± 0)	0.3	0.3	2	1
Autumn 2023	**97.7 (± 238.7)**	**18.4**	**773.7**	**4,825**	**10**
			2024		
March 2024	4.3 (± 2.1)	4.3	5.8	42	2
April 2024	0.3 (± 0.4)	0.3	0.5	2	2
May 2024	0 (± 0)	0	0	0	9
Spring 2024	**0.7 (± 1.7)**	**0**	**5.8**	**44**	**13**
September 2024	8.5 (± 8.4)	8.0	22.1	218	5
October 2024	14.6 (± 18.1)	3.8	42.7	431	5
November 2024	1.3 (± 0.6)	1.2	2.1	39	4
Autumn 2024	**8.7 (± 12.4)**	**3.5**	**42.7**	**688**	**14**
			Both years		
March combined	31.6 (± 32.0)	28.9	65.8	586	4
April combined	6.9 (± 6.5)	3.7	16.2	194	7
May combined	0 (± 0)	0	0	0	14
Spring combined	**7.0 (± 16.1)**	**0**	**65.8**	**780**	**25**
September combined	99.4 (± 253.7)	8.0	773.7	4,265	9
October combined	19.8 (± 19.8)	17.3	58.5	1,207	10
November combined	1.1 (± 0.7)	1.1	2.1	41	5
Autumn combined	**45.8 (± 152.9)**	**5.0**	**773.7**	**5,513**	**24**

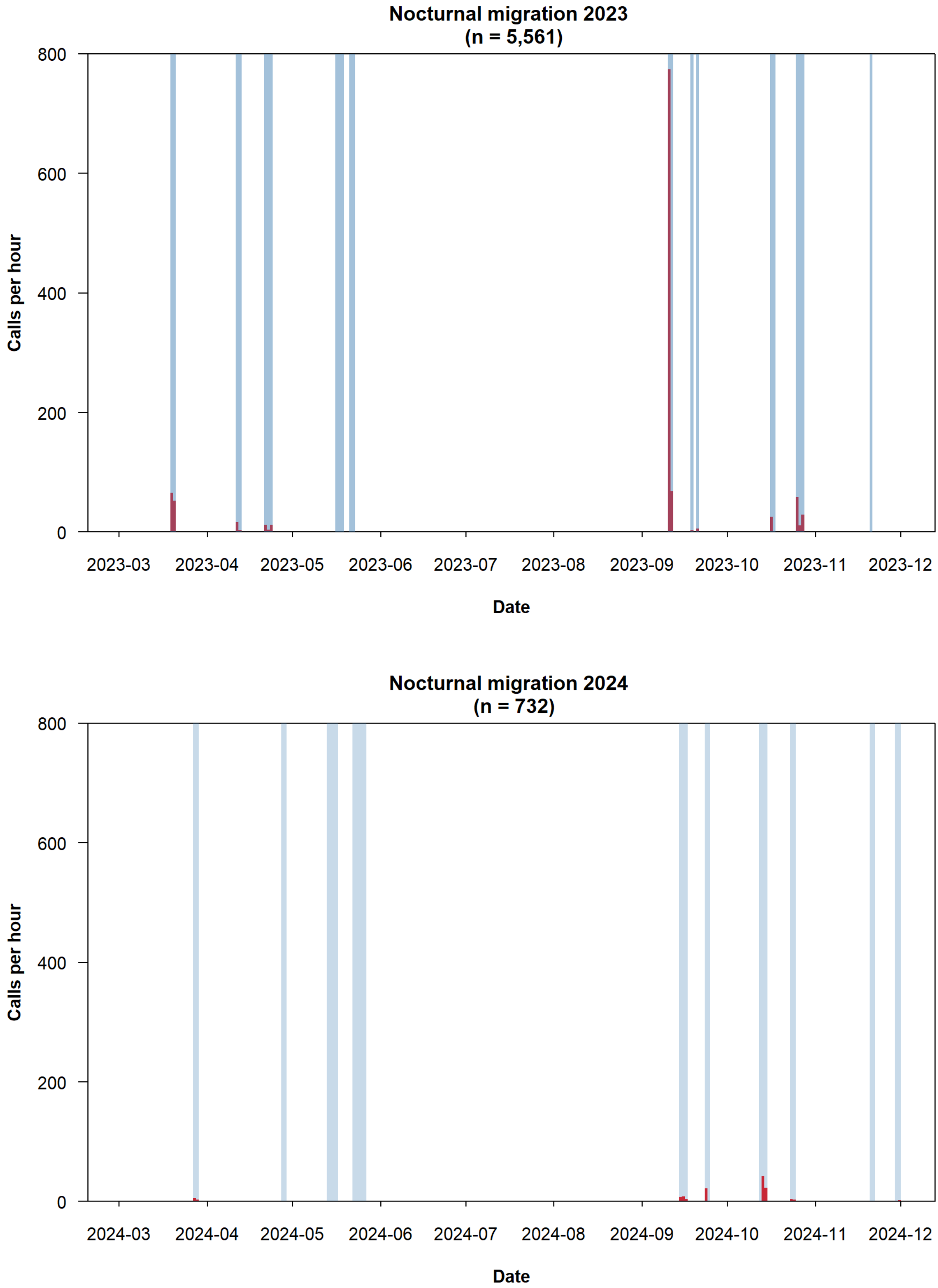


Figure 5.39 Nocturnal migration intensity (red bars) derived from acoustic observations (flight calls) in 2023 and 2024 in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (22 dates in 2023 and 27 dates in 2024). Y-axes have been standardized for ease of comparison.

Differences in nocturnal migration intensity between the subareas

In general, similar number of calls were heard in both areas when the data of both years were pooled (6,267 calls in KF II OWF N and 6,293 calls in KF II OWF S, see Table 5.5 and Table 5.6), with many more calls being registered in autumn than in spring. The calling intensities in both areas were at a similar level during spring, but there were some differences in the migration patterns. In KF II OWF N, a similar migration intensity was registered in every month in spring with little variation across months (except for many nights without calls in May), whereas in KF II OWF S, there was a higher calling intensity in March, which declined strongly with the season to no calls being heard in any of the 14 nights surveyed during May (resulting in a larger variability in the data). In autumn, nocturnal calling intensity increased with the season in the northern area, whereas in the southern area the opposite was true with November being the month with least calls registered. However, this was the month with more nocturnal calls in the northern area. Calling intensity was higher in the southern area (when comparing means), but it also registered a much larger variability due to the peak migration event in September.

TEMPORAL PATTERNS

KF II OWF N

In spring, most calls were heard during the third hour after civil evening twilight (33%), with fewer calls heard during the subsequent hours (two other peaks during the 5th and 6th hour, 73% of all nocturnal calls were heard during the first six hours of the night), but almost no calls heard during the first two hours after civil evening twilight. In autumn, most calls were heard between the 3rd and the 6th hour after civil evening twilight (55%, Figure 5.40) with a small but relatively constant number of calls heard during the remaining hours of the night (Figure 5.40).

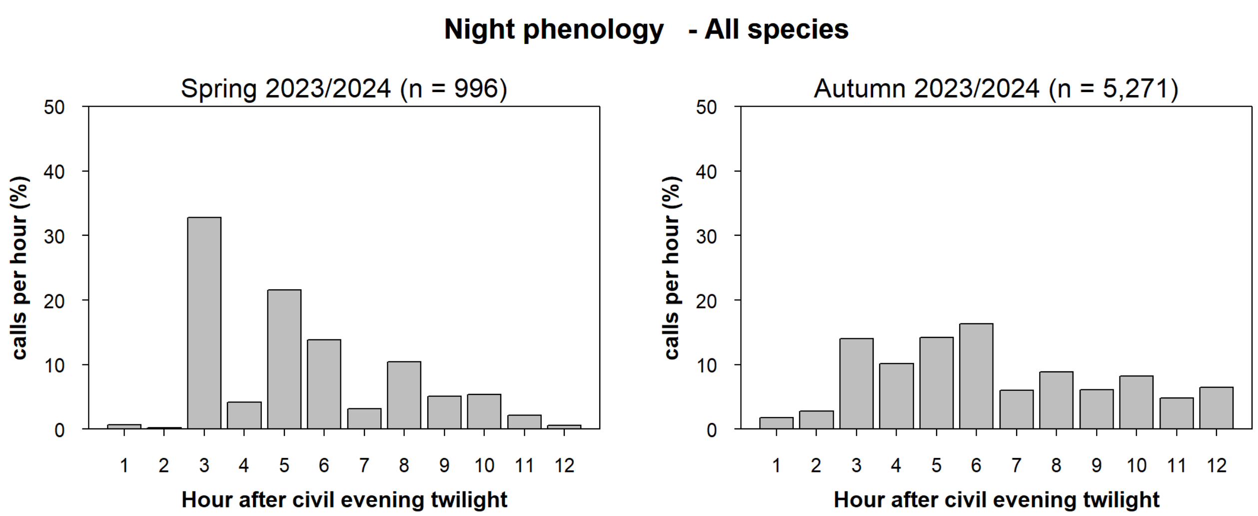


Figure 5.40 Nocturnal phenology of all registered bird calls in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF N (data pooled). See Figure 5.37 for details.

KF II OWF S

In spring, the number of calls increased progressively until the middle of the night, but most calls were heard at two peaks during the 6th (37%) and the 8th (32%, Figure 5.41) hours after civil evening twilight to progressively decrease afterwards. In autumn, nocturnal calls progressively increased and 75% of all calls were registered in the second half of the night with the largest number of calls being heard at the very last hour (one hour before civil morning twilight, Figure 5.41)

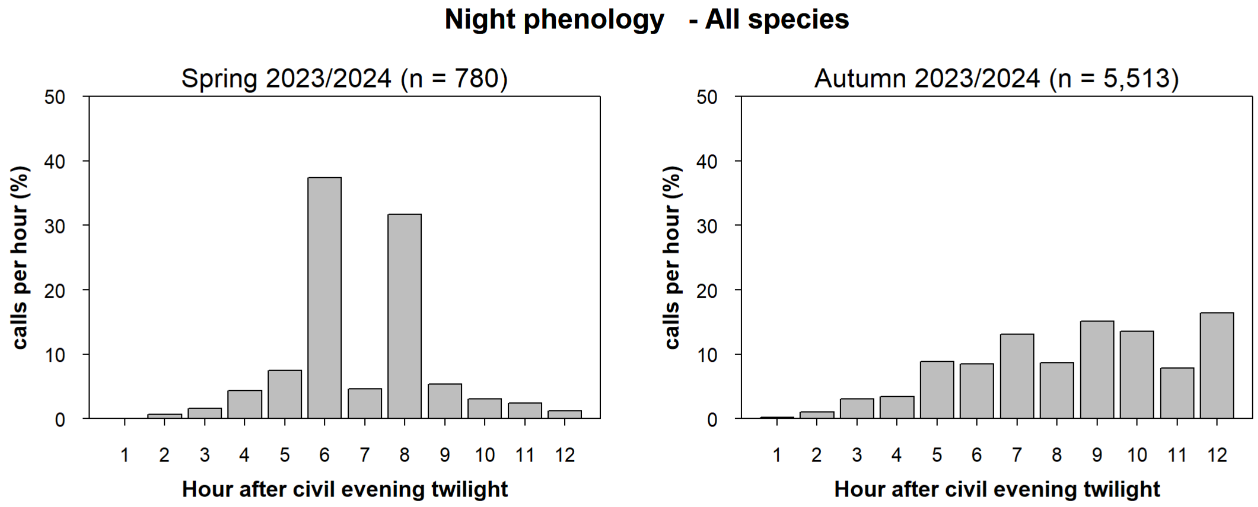


Figure 5.41 Nocturnal phenology of all registered bird calls in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF S. See Figure 5.37 for details.

Differences between the OWFs in temporal patterns

In the northern area, most calls were heard during the 3rd and 5th hour after civil evening twilight in spring, whereas the peaks in the southern area occurred three hours later (during the 6th and 8th hour). In autumn, nocturnal migration in terms of calls was more homogeneous without distinct peaks. Most calls were heard at the beginning of the night in the KF II OWF N (during the 3rd to 6th hour, 55%), whereas more calls were heard towards the end of the night in the southern area (between the 9th to 12th hour, 53%)

PER SPECIES GROUPS

In this section, a more detailed description of the most important migration patterns is presented for some species groups considered relevant in terms of abundance (at least 1% of abundance in any season), or because it includes many species considered endangered and under some category of protection (see Table 5.8 and Table 5.10).

DIURNAL MIGRATION (VISUAL OBSERVATIONS)

SPECIES COMPOSITION

OWF KF II N

Similar numbers of migrating birds were registered in KF II OWF N for both seasons of 2023. In spring, 7,854 birds were identified to 62 species during the 15 days of surveys. In autumn, a total of 7,987 birds belonging to 93 species were observed during 18 days of surveys (Table 5.7). In spring, 562 birds (7.2% of all birds registered during daytime) could not be identified to species level. In autumn, this number was almost three times larger with almost 20% (1,567 birds) of all birds not identified to species level.

Table 5.7 Total number of birds and species observed during spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF N.

Season/Year	Number of survey days	Number of individuals	Number of species	Number of species > 250 individuals	Number of species < 10 individuals	Number of species under conservation category (Appendix)
Spring 2023	15	7,854	62	6	32	27
Autumn 2023	18	7,987	93	5	51	47
All year2023	**33**	**15,841**	**106**	**8**	**53**	**52**
Spring 2024	14	25,542	54	5	35	25
Autumn 2024	16	18,988	73	9	30	36
All year 2024	**30**	**44,530**	**83**	**9**	**33**	**39**
Spring	29	33,396	80	7	43	35
Autumn	34	26,975	102	11	44	49
Both years	**63**	**60,371**	**116**	**14**	**48**	**54**

The species composition was similar between seasons, with geese and ducks being the most abundant groups. Geese represented half of all migrating birds seen during spring (50.6%), and 36.9% of all migrating birds in autumn. The barnacle goose was the most commonly occurring species in both seasons. Ducks represented roughly 30% of all migrating birds observed in both seasons, with two species being most abundant: common scoter and common eider. The latter was especially abundant in spring (Figure 5.42).

A high number of species (and individuals) of songbirds were registered in autumn, so that songbirds represented the third most common group of migrating birds observed during autumn (12.4%). Relatively abundant species were the sky lark, barn swallow and Eurasian siskin. Cormorants represented about 5% of migrating birds during both seasons. Other groups occurred at much lower proportions but still represented at least 1% of all migrating birds in one of the seasons and thus are presented in more detail in the next section (Figure 5.42).

Despite a similar number of survey days conducted in 2024, almost three times as many birds were observed in the KF II OWF N compared to the previous year. In spring of 2024, during the 14 days of surveys a total of 25,542 birds were counted that could be identified to 54 species. A total of 6,119 individuals could not be identified to species level. In autumn, there were a total of 18,988 birds registered during the 16 days of observations. These belonged to 73 species (Table 5.7). In this season, 4,631 individuals could not be identified. Both in spring and in autumn, the number of individuals not identified account for about 24% of all migrating birds in each season.

The species composition of both seasons in the second year of data collection was also different. In general, there were fewer species observed and there was a strong dominance of geese. In spring, geese accounted for 93% of all observed migrating birds (n = 23,722, Table 5.8, Figure 5.42), with barnacle goose being most numerous (61% of all migrating birds). Brent geese were also very common (7.8%). Besides these two species, only common eiders and common scoters were common enough to be mentioned as they represented 2% and 1% of all migrating birds observed, respectively. No other species group was observed in high numbers (Figure 5.42). There was a higher diversity in autumn, but still not comparable to the one of previous year (73 identified species). The two species of geese that were common in spring were also common in autumn, and in total, geese made up 50% of all birds. Other groups that were commonly observed were ducks especially common scoters (12.5%) and common eiders (5%), cormorants (3.8%), pigeons (8.4%) and songbirds (6.7%, Figure 5.42).

Table 5.8 Number of individuals and species of diurnally migrating birds observed in the pre-investigation area OWF KF II N. Numbers in parenthesis in the headings represent the number of survey dates of each season and year. Species groups that will be further described in detail are highlighted in bold.

Species groups	Spring			Autumn			Total	N species (sp. conserv.)
	2023 (15)	2024 (14)	Total (29)	2023 (18)	2024 (16)	Total (32)		
Divers	**28**	**26**	**54**	**155**	**55**	**210**	**264**	**2 (2)**
Grebes	9	0	9	0	2	2	11	2 (1)
Gannets	1	1	2	5	4	9	11	1 (0)
Cormorants	**403**	**147**	**550**	**422**	**719**	**1141**	**1,691**	**1 (0)**
Herons	0	1	1	6	32	38	39	2 (1)
Swans	28	19	47	93	0	93	140	3 (2)
Geese	**3,977**	**23,722**	**27,699**	**2,948**	**9,437**	**12,385**	**40,084**	**8 (3)**
Ducks	**2,347**	**1,010**	**3,357**	**2,430**	**4,850**	**7,280**	**10,637**	**16 (10)**
Birds of prey	**6**	**14**	**20**	**89**	**97**	**186**	**206**	**9 (7)**
Cranes	47	23	70	0	9	9	79	1 (1)
Waders	**149**	**6**	**155**	**269**	**154**	**423**	**578**	**13 (8)**
Skuas	0	3	3	16	12	28	31	1 (1)
Gulls	**396**	**84**	**480**	**232**	**442**	**674**	**1,154**	**8 (6)**
Terns	**55**	**182**	**237**	**251**	**298**	**549**	**786**	**5 (5)**
Auks	**144**	**78**	**222**	**75**	**15**	**90**	**312**	**3 (0)**
Pigeons	**1**	**1**	**2**	**0**	**1,586**	**1,586**	**1,588**	**2 (0)**
Owls	0	0	0	3	1	4	4	2 (1)
Swifts	0	1	1	1	3	4	5	1 (1)
Songbirds	**256**	**224**	**480**	**992**	**1,272**	**2,264**	**2,751**	**36 (4)**
All	**7,854**	**25,542**	**33,396**	**7,987**	**18,988**	**26,975**	**60,371**	**116 (54)**

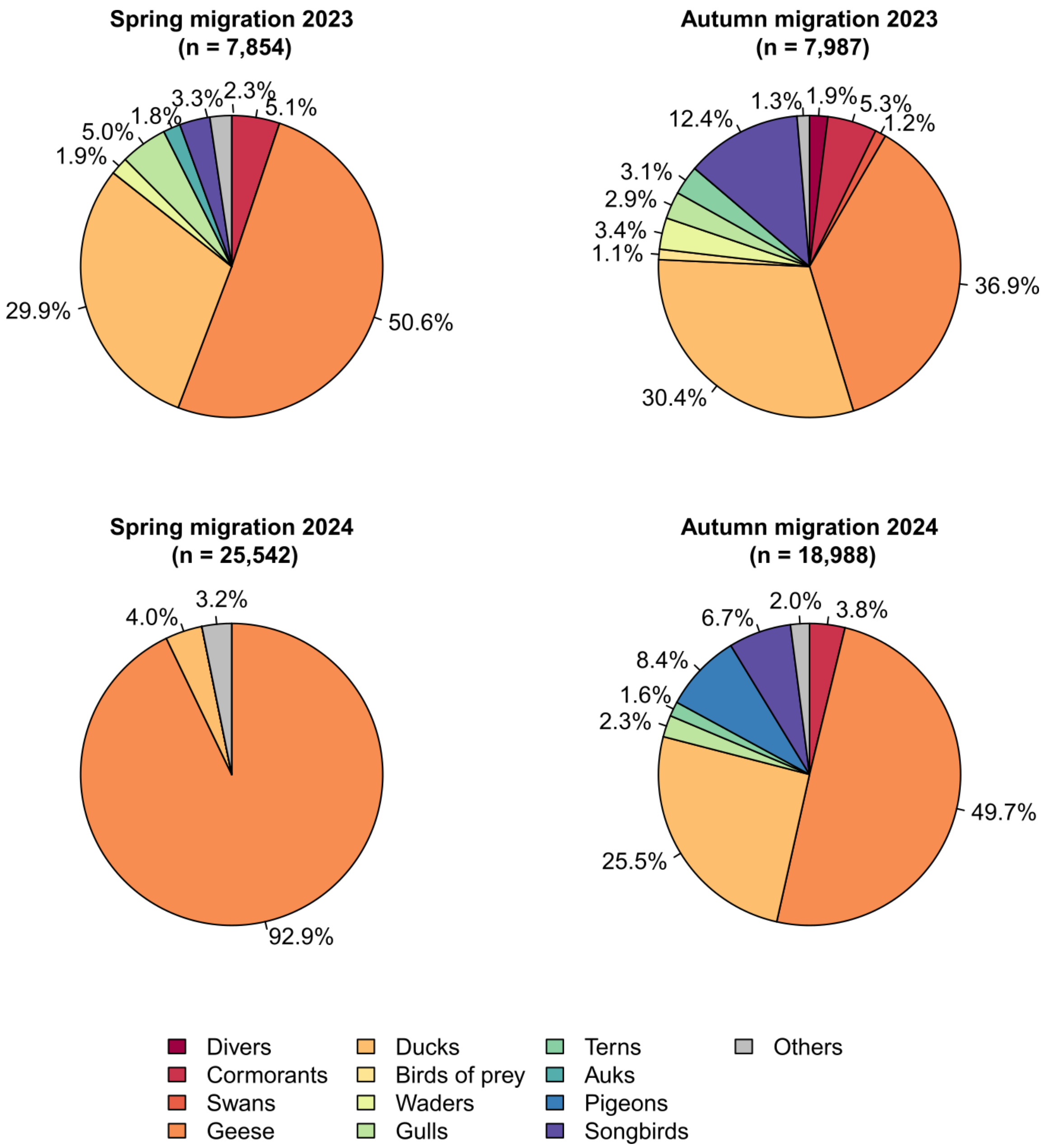


Figure 5.42 Proportion of observed diurnally migratory species in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N, grouped into high-category taxa. All species groups with an abundance of at least 1% of the total are presented according to their taxonomic order (starting at the top, in a clockwise order, thus songbirds appear last). The category "Others" (grey) includes all other bird taxa with a proportion of < 1%. Survey days for spring of 2023 and 2024 were 15 and 14, respectively, whereas in autumn of 2023 and 2024, 18 and 16 days were conducted, respectively.

OWF KF II S

The species group composition in the southern area, KF II OWF S looked rather different from the one in the northern area, KF II OWF N. In 2023, there were more birds observed migrating through this area, despite fewer survey days: three times as many birds spotted at the southern pre-investigation area (45,637 vs. 15,841, Table

5.7 and Table 5.9). In terms of species diversity, 65 species were identified in spring, although 14,571 birds (more than half of all birds) could not be identified to species level. In autumn, 73 species were identified, but 4,476 individuals (24.5%) remained unidentified to species level. In both seasons, most unidentified birds were geese. During spring, there was a larger number of migrating birds (27,355) than during autumn (18,282, Table 5.9). Again, geese and ducks were the most common species groups, but they were observed at much higher numbers than in the KF II OWF N area. Thus, other species groups apart from songbirds and gulls, occurred in comparatively lower numbers and are not shown in Figure 5.43.

Table 5.9 Total number of birds and species observed during spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF S.

Season/Year	Number of survey days	Number of individuals	Number of species	Number of species > 250 individuals	Number of species < 10 individuals	Number of species under conservation category (Appendix)
Spring 2023	12	27,355	65	5	38	24
Autumn 2023	10	18,282	73	9	40	28
All year2023	**22**	**45,637**	**89**	**11**	**48**	**35**
Spring 2024	12	21,248	55	3	38	22
Autumn 2024	13	13,795	74	10	36	32
All year 2024	**25**	**35,043**	**88**	**12**	**41**	**38**
Spring	24	48,603	76	**7**	38	30
Autumn	23	32,077	92	13	45	38
Both years	**47**	**80,680**	**108**	**16**	**52**	**46**

In spring, geese represented 82.8% of all migrating birds observed, of which a third were barnacle geese (Figure 5.43). Most of the remaining geese were unidentified black geese (14,203 individuals). In autumn, the proportion of geese was lower (59.1%), and most of them were barnacle geese again. About a third of the geese were not identified to species level (3,513 individuals). Another species that occurred frequently was the greater white-fronted goose (see next section). In spring, ducks represented 12.8% of all migrating birds, whereas they made up for a quarter of all migrating birds observed in autumn. In spring, the most commonly occurring duck species was the common scoter (7.3%), followed by the common eider (4.5%). During autumn migration, ducks were mainly dominated by common eiders (18%). Songbirds were the third most common group of diurnally migrating birds in autumn, comprising 12.4% of the total (Figure 5.43). In spring, they were occurring in comparatively lower numbers. The most commonly observed species of songbirds were starlings, Eurasian siskins and sky larks (which represented 3.1%, 2.5% and 1.7% of all autumn migrants, respectively).

In 2024, far fewer birds were observed than in the previous year and fewer than in the northern area. In spring, 21,248 birds belonging to 55 species were registered (Table 5.9). Almost all migrants (98.3$) were identified to species level. In autumn, a total of 74 species were identified from the 13,795 birds observed in this season (Table 5.9). Over a third of the observed birds (4,930 individuals, mainly songbirds) could not be identified to species level. Overall, geese were dominant among observed migrants with 93% of all birds seen in autumn (n=19,734, Table 5.10) having been geese. The most frequently observed species was the brent goose (91% of all migrating birds). Barnacle geese were hardly seen in comparison. Ducks represented just about 3% of all migrating birds with common scoters being the most common species (~2% of all migrating birds) and observed at similar numbers as cormorants. No other species group was seen in large numbers (Figure 5.43).

In the autumn of 2024, the most common species group was that of songbirds that represented 41% of all migrating birds seen in that season. Most individuals remained unidentified to species level, and the most commonly identified species were meadow pipits (8.5% of all migrating birds in the season), chaffinches, Eurasian siskins, bramblings and sky larks (2.6%, 1.9%, 1.7% and 1.6% of all migrating birds, respectively). Ducks were the second most common group of species observed in autumn of 2024, representing 22.3% of all migrating birds. The most common species of ducks seen were common eiders (8.5%), common scoters (4.4%) and Eurasian wigeons (3.5%). Over 15% of all migrating birds seen were geese of which more than half of all remained unidentified. Of the identified geese species, the most common ones were greater white-fronted goose (2.9%), barnacle goose (2.3%) and greylag goose (1.2%). The fourth group in abundance were cranes which were very commonly seen in this season: a total of 1,738 cranes were observed representing 12.6% of all migrating birds. Cormorants represented 3.9% of all migrating birds and gulls were the last of the commonly observed species groups (2.4% of all migrating birds). Two of the gull species were seen commonly: little gulls and common gulls (1.1% and 0.6%, respectively, Figure 5.43).

Table 5.10 Number of individuals and species of diurnally migrating birds observed in the pre-investigation area OWF KF II S. Numbers in parenthesis in the headings represent the number of survey dates of each season and year. Species groups that are discussed in more detail are highlighted in bold.

Species groups	Spring			Autumn			Total (47)	N species (sp. conserv.)
	2023 (12)	2024 (12)	Total (24)	2023 (10)	2024 (13)	Total (23)		
Divers	49	37	86	16	37	53	139	3 (3)
Grebes	6	0	6	0	3	3	9	1 (1)
Gannets	0	1	1	2	3	5	6	1 (0)
Cormorants	**262**	**430**	**692**	**174**	**540**	**714**	**1,406**	**1 (0)**
Herons	2	17	19	3	33	36	55	2 (1)
Swans	21	9	30	2	29	31	61	2 (1)
Geese	**22,643**	**19,734**	**42,377**	**10,799**	**2,129**	**12,928**	**55,305**	**8 (3)**
Ducks	**3,495**	**629**	**4,124**	**4,591**	**3,079**	**7,670**	**11,794**	**15 (9)**
Birds of prey	**14**	**12**	**26**	**105**	**112**	**217**	**243**	**13 (8)**
Cranes	**64**	**38**	**102**	**0**	**1,738**	**1,738**	**1,840**	**1 (1)**
Waders	90	0	90	33	59	92	182	6 (4)
Skuas	1	0	1	0	1	1	2	1 (1)
Gulls	**201**	**94**	**295**	**236**	**325**	**561**	**856**	**9 (7)**
Terns	5	79	84	0	4	4	88	1 (1)
Auks	72	30	102	49	40	89	191	2 (0)
Pigeons	4	1	5	3	4	7	12	3 (0)
Owls	0		0	1		1	1	1 (1)
Swifts	1		1	0		0	1	1 (1)
Songbirds	**416**	**137**	**553**	**2,268**	**5,659**	**7,927**	**8,480**	**37 (4)**
All	**27,355**	**21,248**	**48,603**	**18,282**	**13,795**	**32,077**	**80,680**	**108 (46)**

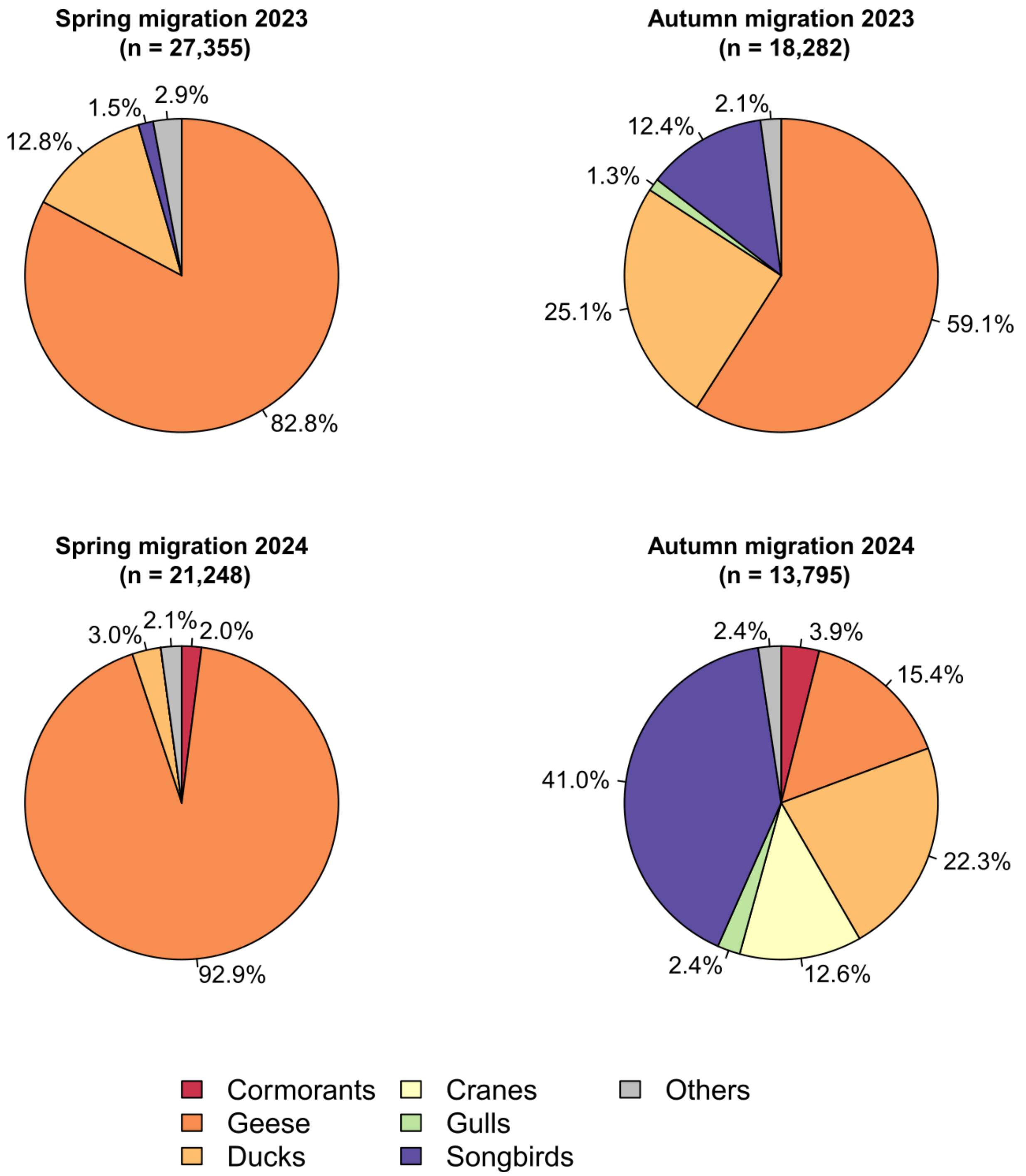


Figure 5.43 Proportions of observed diurnal migratory species in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S, grouped into high-category taxa. See Figure 5.42 for more details. Survey days for each spring was identical: 14, whereas in autumn of 2023 and 2024, 18 and 20 days of observation were conducted, respectively.

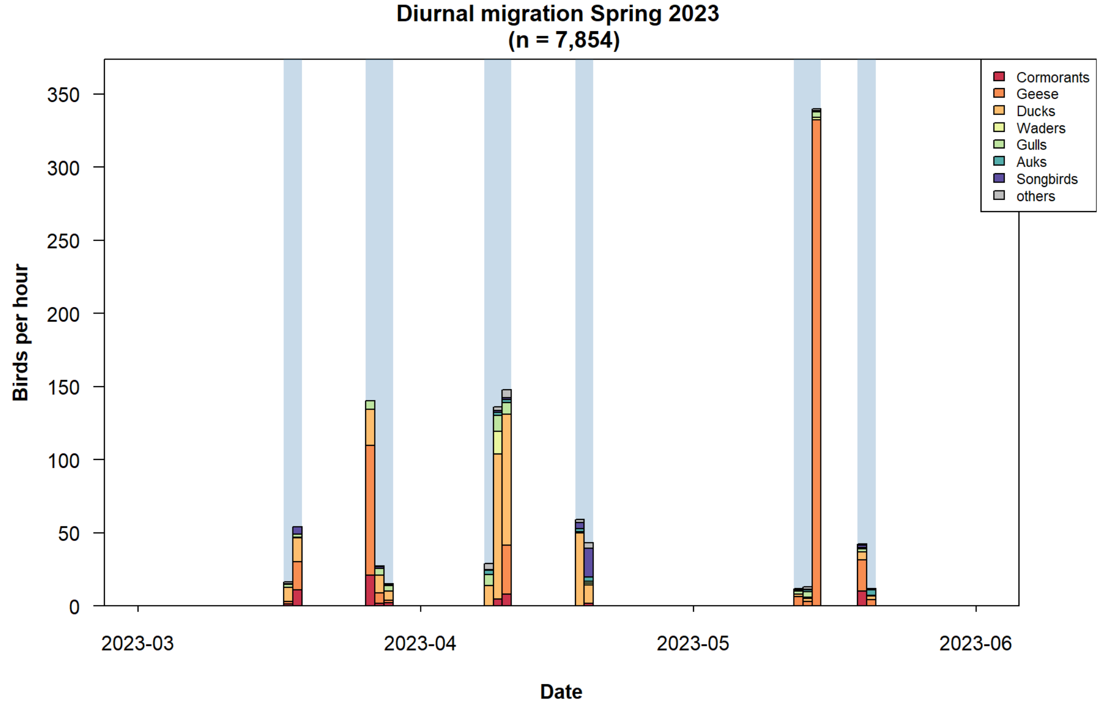
MIGRATION INTENSITY

The following tables and graphs summarize the diurnal migration intensities observed during each season and year by species group. See the section for descriptions of each species group for more details.

KF II OWF N

Table 5.11 Migration intensity for the species groups found in the pre-investigation area KF II OWF N in spring of 2023 and 2024 during visual observations. Mean (± SD), median and maximum migration intensity (ind./h) as well as the date of maximum migration intensity and the total number of dates with records for the species groups is provided. SD = standard deviation.

Species groups	Migration intensity (ind./h) in 2023 (15 days)			Migration intensity (ind./h) in 2024 (14 days)			Both years (29 days)	
	Mean (± SD)	Maximum (date)	Freq of observ.	Mean (± SD)	Maximum (date)	Freq of observ.	Mean (± SD)	Median
Divers	0.29 (± 0.47)	1.38 (19.04.)	7/15	0.27 (± 0.45)	1.33 (29.03)	8/14	0.28 (± 0.45)	0.11
Grebes	0.1 (± 0.22)	0.76 (08.04.)	3/15				0.05 (± 0.17)	0
Gannets	0.01 (± 0.04)	0.14 (18.04.)	1/15	0.01 (± 0.03)	0.13 (26.04.)	1/14	0.01 (± 0.03)	0
Cormorants	4.24 (± 6.06)	21.14 (26.03.)	11/15	1.57 (± 2.83)	8.33 (29.03.)	9/14	2.95 (± 4.89)	0.29
Herons				0.01 (± 0.03)	0.13 (26.04)	1/14	0 (± 0.02)	0
Swans	0.25 (± 0.39)	1.12 (12.05.)	6/15	0.19 (± 0.35)	1.17 (29.03.)	5/14	0.22 (± 0.37)	0
Geese	34.61 (± 85.5)	332.24 (14.05.)	12/15	199.34 (± 450.45)	1345.06 (10.05)	11/14	114.14 (± 323.85)	4.8
Ducks	22.99 (± 31.48)	99.0 (10.04.)	14/15	10.58 (± 17.31)	66.0 (29.03.)	14/14	17 (± 25.97)	6.09
Birds of prey	0.06 (± 0.1)	0.29 (10.04.)	4/15	0.13 (± 0.13)	0.39 (25.04.)	8/14	0.09 (± 0.12)	0
Cranes	0.46 (± 1.13)	4.29 (10.04.)	4/15	0.2 (± 0.57)	2.06 (20.05)	2/14	0.33 (± 0.9)	0
Waders	1.38 (± 3.93)	15.43 (09.04.)	8/15	0.06 (± 0.21)	0.77 (26.04.)	1/14	0.74 (± 2.86)	0
Skuas				0.03 (± 0.06)	0.14 (11.05)	3/14	0.01 (± 0.04)	0
Gulls	3.93 (± 2.91)	10.86 (09.04.)	15/15	0.83 (± 0.65)	2.0 (18.03.)	11/14	2.43 (± 2.63)	1.55
Terns	0.49(± 0.73)	2.34 (19.04.)	8/15	1.73 (± 2.94)	9.57 (12.05.)	10/14	1.09 (± 2.16)	0.29
Auks	1.33 (± 1.23)	3.53 (20.05.)	11/15	0.75 (± 0.57)	2.0 (29.03)	12/14	1.05 (± 1)	0.82
Pigeons	0.01 (± 0.04)	0.16 (17.03.)	1/15	0.01 (± 0.04)	0.14 (11.05.)	1/14	0.01 (± 0.04)	0
Swifts				0.01 (± 0.03)	0.11 (19.05.)	1/14	0 (± 0.02)	0
Songbirds	2.41 (± 4.93)	19.45 (19.04.)	13/15	2.03 (± 2.93)	10.19 (25.04.)	13/14	2.24 (± 4.02)	0.83



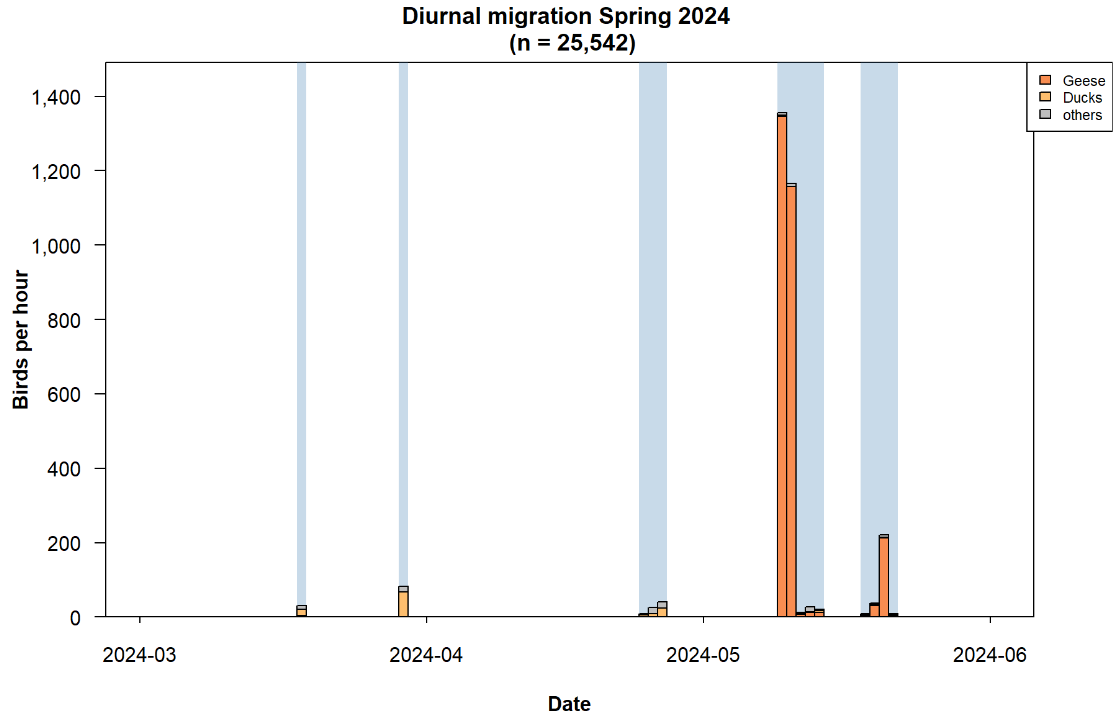
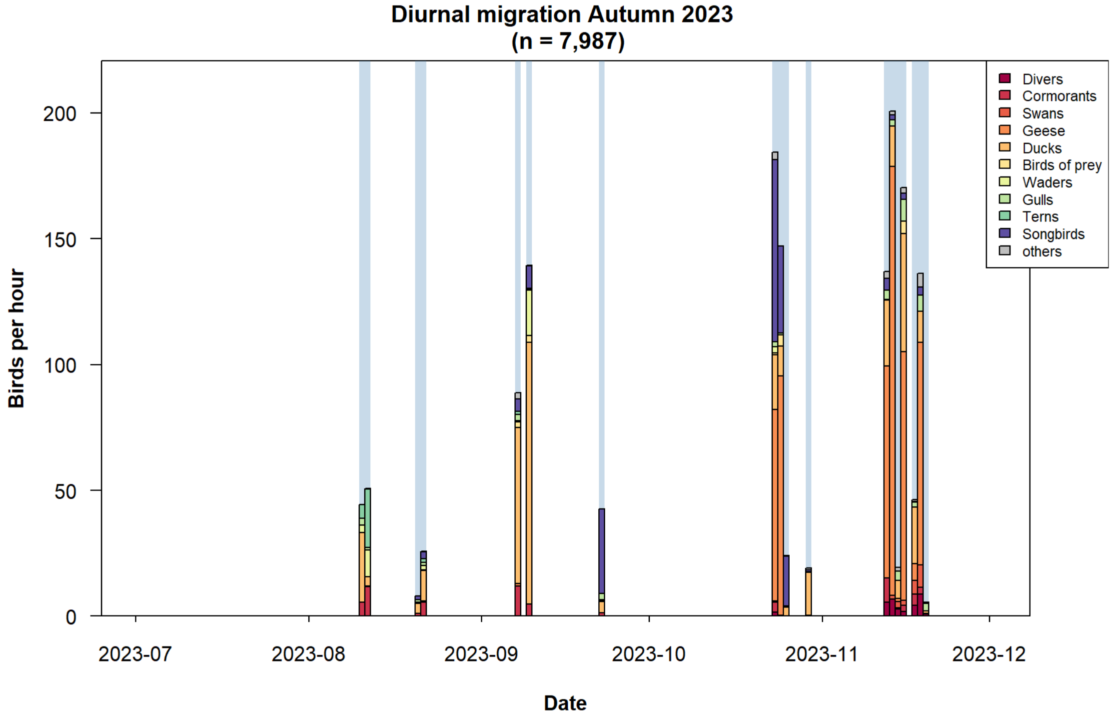


Figure 5.44 Diurnal migration intensity (coloured by taxonomical groups) derived from visual observations in spring of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (15 days in 2023 and 14 in 2024). Same colours and groups used as in Figure 5.42. Different y-axes are shown.

Table 5.12 Migration intensity for the species groups found in the pre-investigation area KF II OWF N in autumn of 2023 and 2024 during visual observations. See Table 5.11 for details.

Species groups	Migration intensity (ind./h) in 2023 (18 days)			Migration intensity (ind./h) in 2024 (16 days)			Both years (34 days)	
	Mean (± SD)	Maximum (date)	Freq. of observ.	Mean (± SD)	Maximum (date)	Freq. of observ.	Mean (± SD)	Median
Divers	1.85 (± 2.69)	8.67 (18.11.)	12/18	0.66 (± 1.44)	5.89 (15.10.)	9/16	1.29 (± 2.24)	0.25
Grebes				0.02 (± 0.09)	0.36 (22.10.)	1/16	0.01 (± 0.06)	0
Gannets	0.06 (± 0.12)	0.42 (12.11)	4/18	0.04 (± 0.14)	0.55 (22.10.)	3/16	0.05 (± 0.13)	0
Cormorants	3.69 (± 3.92)	11.71 (07.09.)	15/18	7.01 (± 8.8)	32.15 (22.09.)	14/16	5.25 (± 6.78)	2.68
Herons	0.05 (± 0.14)	0.57 (07.09.)	3/18	0.28 (± 0.41)	1.33 (13.09)	7/16	0.16 (± 0.32)	0
Swans	1.13 (± 2.37)	8.89 (18.11.)	6/18				0.6 (± 1.8)	0
Geese	34.59 (± 52.61)	170.53 (13.11.)	11/18	117.94 (± 313.74)	1255.58 (15.10.)	12/16	73.81 (± 218.98)	1.34
Ducks	22.46 (± 25.84)	104.14 (09.09.)	18/18	48.8 (± 50.33)	173.12 (13.08.)	16/16	34.85 (± 40.91)	21.78
Birds of prey	0.88 (± 1.63)	5.05 (15.11.)	8/18	1.08 (± 1.95)	6.95 (15.10.)	13/16	0.98 (± 1.76)	0.24
Cranes				0.09 (± 0.35)	1.38 (22.09)	1/16	0.04 (± 0.24)	0
Waders	2.09 (± 4.69)	17.86 (09.09.)	8/18	1.3 (± 2.38)	8.12 (15.08.)	6/16	1.72 (± 3.75)	0
Skuas	0.13 (± 0.44)	1.86 (07.09.)	4/18	0.1 (± 0.17)	0.62 (14.08.)	6/16	0.12 (± 0.33)	0
Gulls	2.44 (± 2.13)	8.42 (15.11.)	18/18	4.83 (± 6.65)	28.84 (15.10.)	16/16	3.57 (± 4.89)	2.48
Terns	1.77 (± 5.55)	23.38 (11.08.)	5/18	2.56 (± 4.75)	16.48 (08.08.)	10/16	2.14 (± 5.13)	0
Auks	0.91 (± 1.42)	5.33 (18.11.)	10/18	0.18 (± 0.37)	1.47 (15.10.)	7/16	0.57 (± 1.11)	0.07
Pigeons				18.02 (± 72.04)	288.18 (27.10)	2/16	8.48 (± 49.42)	0
Owls	0.03 (± 0.1)	0.38 (29.10.)	2/18	0.01 (± 0.05)	0.21 (15.10.)	1/16	0.02 (± 0.08)	0
Swifts	0.01 (± 0.03)	0.12 (11.08.)	1/18	0.02 (± 0.05)	0.12 (14.-15.08)	3/16	0.01 (± 0.04)	0
Songbirds	10.67 (± 18.93)	72.47 (23.10.)	14/18	15.05 (± 32.49)	130.11 (15.10.)	13/16	12.73 (± 25.87)	2.68



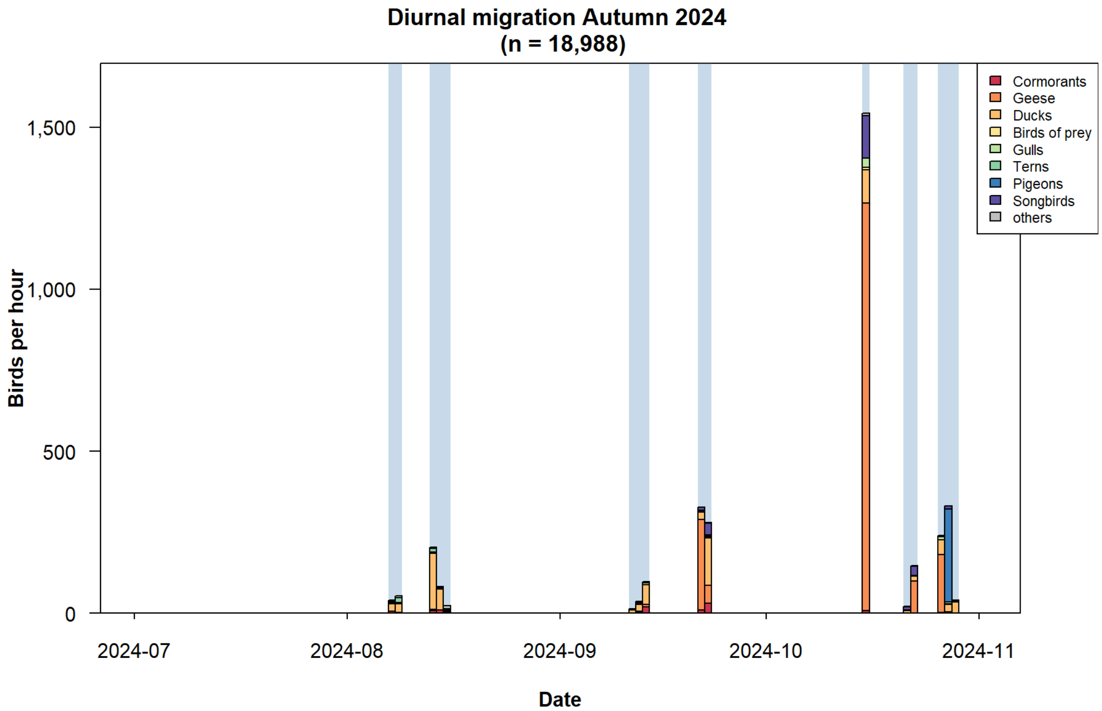
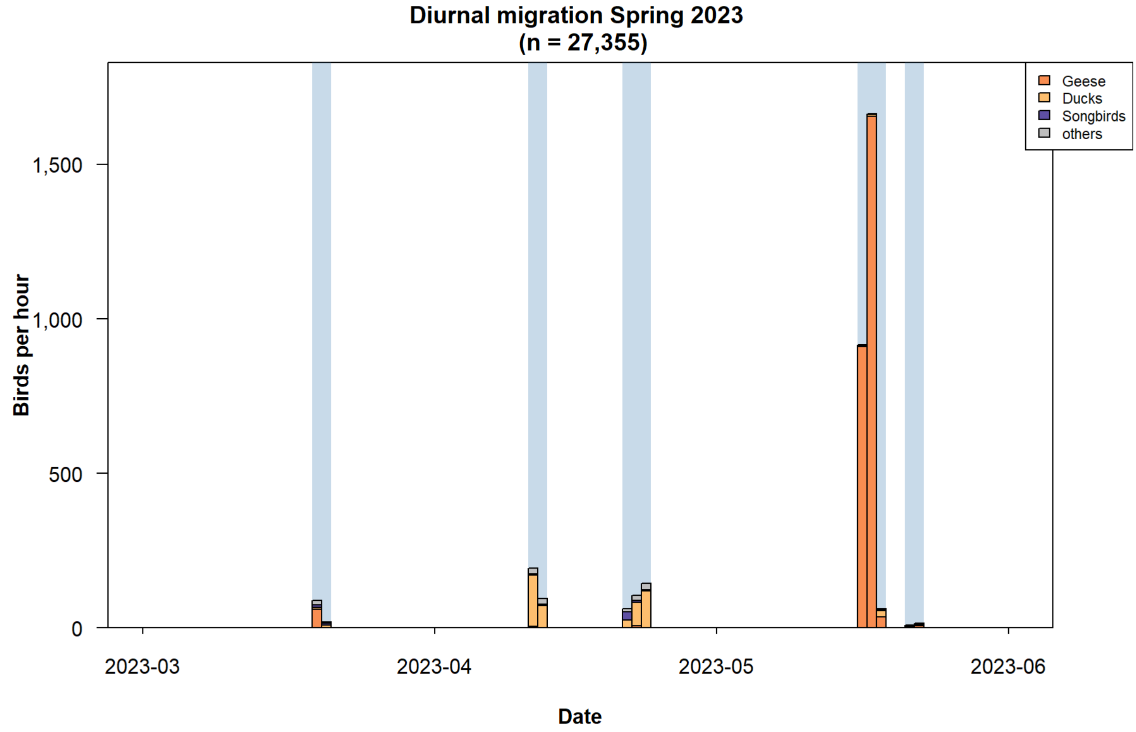


Figure 5.45 Diurnal migration intensity (coloured by taxonomical groups) derived from visual observations in autumn of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (18 days in 2023 and 16 in 2024). Same colours and groups used as in Figure 5.42. Different y-axes are shown.

KF II OWF S

Table 5.13 Migration intensity for the species groups found in the pre-investigation area KF II OWF S in spring of 2023 and 2024 during visual observations. See Table 5.11 for details.

Species groups	Migration intensity (ind./h) in 2023 (12 days)			Migration intensity (ind./h) in 2024 (12 days)			Both years (24 days)	
	Mean (± SD)	Maximum (date).	Freq. of observ.	Mean (± SD)	Maximum (date)	Freq. of observ.	Mean (± SD)	Median
Divers	0.59 (± 0.77)	2.5 (11.04.)	8/12	0.46 (± 1.31)	4.62 (27.04)	6/12	0.53 (± 1.05)	0.12
Grebes	0.08 (± 0.2)	0.67 (11.04.)	2/12	0 (± 0)			0.04 (± 0.14)	0
Gannets			0	0.01 (± 0.04)	0.13 (28.04)	1/12	0.01 (± 0.03)	0
Cormorants	3.17 (± 3.86)	10.29 (12.04)	9/12	5.29 (± 15.2)	53.19 (28.03)	5/12	4.23 (± 10.9)	0.5
Herons	0.03 (± 0.1)	0.33 (11.04.)	1/12	0.17 (± 0.51)	1.76 (23.05)	2/12	0.1 (± 0.37)	0
Swans	0.21 (± 0.53)	1.83 (22.05)	2/12	0.1 (± 0.14)	0.39 (28.04)	5/12	0.15 (± 0.38)	0
Geese	223.85 (± 519.71)	1655.41 (17.05)	10/12	193.7 (± 664.43)	2303.53 (23.05)	8/12	208.77 (± 583.57)	2.89
Ducks	42.29 (± 54.55)	166.33 (11.04.)	11/12	7.56 (± 13.12)	40.59 (27.03)	9/12	24.93 (± 42.67)	5.72
Birds of prey	0.16 (± 0.24)	0.83 (21.04)	7/12	0.13 (± 0.2)	0.59 (23.05)	5/12	0.15 (± 0.21)	0.06
Cranes	0.84 (± 1.42)	4.0 (19.03)	5/12	0.46 (± 1.49)	5.19 (27.03)	2/12	0.65 (± 1.44)	0
Waders	1.09 (± 2.39)	8.0 (23.04)	3/12	0 (± 0)			0.55 (± 1.74)	0
Skuas	0.01 (± 0.05)	0.17 (21.04)	1/12	0 (± 0)			0.01 (± 0.03)	0
Gulls	2.41 (± 1.23)	5.0 (11.04.)	12/12	1.12 (± 1.33)	4.0 (27.03)	11/12	1.77 (± 1.42)	1.45
Terns	0.06 (± 0.16)	0.53 (23.04)	2/12	0.86 (± 1.9)	6.71 (28.04)	6/12	0.46 (± 1.38)	0
Auks	0.83 (± 1.1)	3.07 (23.04)	7/12	0.33 (± 0.22)	0.8 (22.05)	11/12	0.58 (± 0.82)	0.28
Pigeons	0.05 (± 0.14)	0.48 (20.03)	2/12	0.01 (± 0.04)	0.13 (28.04)	1/12	0.03 (± 0.1)	0
Swifts	0.01 (± 0.03)	0.12 (16.05)	1/12				0 (± 0.02)	0
Songbirds	5.35 (± 7.4)	27.67 (21.04)	12/12	1.61 (± 2.22)	6.52 (28.03)	10/12	3.48 (± 5.68)	0.97



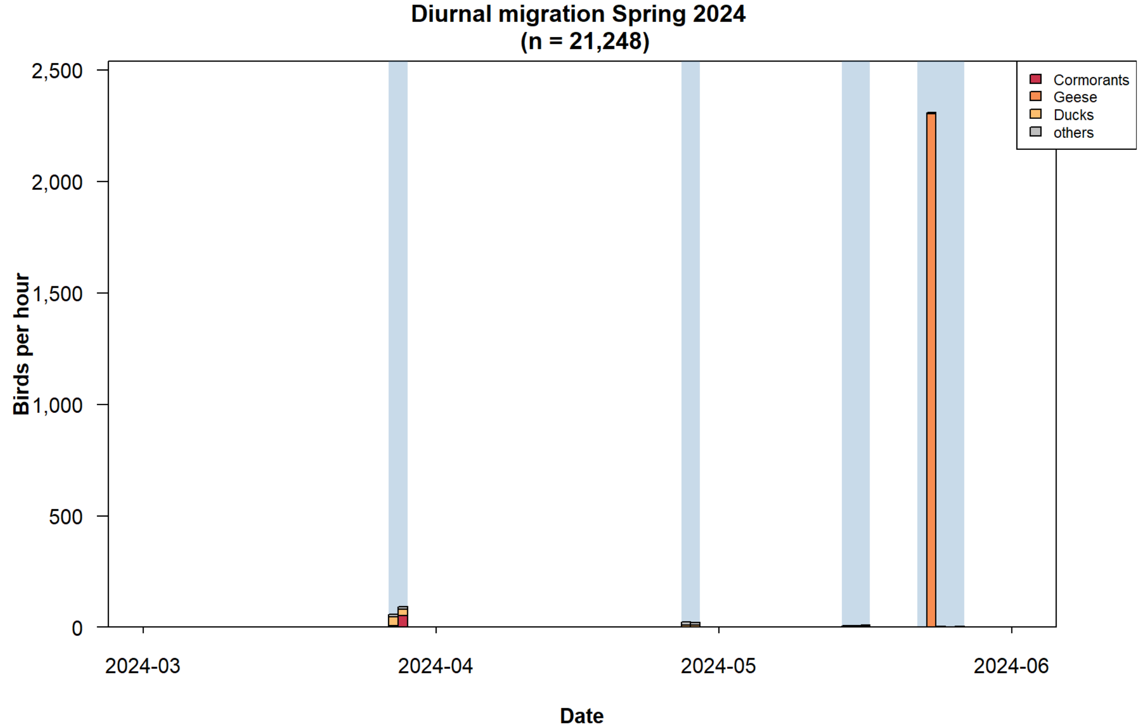


Figure 5.46 Diurnal migration intensity (coloured by taxonomical groups) derived from visual observations in spring of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (12 days in 2023 and 12 in 2024). Same colours and groups used as in Figure 5.43. Different y-axes are shown.

Table 5.14 Migration intensity for the species groups found in the pre-investigation area KF II OWF S in autumn of 2023 and 2024 during visual observations. See Table 5.11 for details

Species groups	Migration intensity (ind./h) in 2023 (10 days)			Migration intensity (ind./h) in 2024 (13 days)			Both years (23 days)	
	Mean (± SD)	Maximum (date)	Freq. of observ.	Mean (± SD)	Maximum (date)	Freq. of observ.	Mean (± SD)	Median
Divers	0.33 (± 0.53)	1.65 (16.10.)	5/10	0.54 (± 0.41)	1.33 (30.11)	10/13	0.45 (± 0.47)	0.52
Grebes				0.04 (± 0.14)	0.52 (23.09.)	1/13	0.02 (± 0.11)	0
Gannets	0.04 (± 0.08)	0.19 (27.10.)	2/10	0.05 (± 0.09)	0.22 (20.11.)	3/13	0.04 (± 0.08)	0
Cormorants	3.42 (± 3.92)	11.06 (16.10.)	10/10	6.97 (± 8.49)	28.3 (15.09.)	13/13	5.43 (± 6.99)	2.43
Herons	0.05 (± 0.17)	0.55 (18.10.)	1/10	0.42 (± 0.62)	1.57 (14.10.)	5/13	0.26 (± 0.5)	0
Swans	0.03 (± 0.11)	0.33 (10.09)	1/10	0.47 (± 1.09)	4.0 (20.11.)	6/13	0.28 (± 0.84)	0
Geese	215.45 (± 445)	1244.91 (18.10)	5/10	29.4 (± 40.42)	107.65 (12.10.)	9/13	110.29 (±	1.11
Ducks	85.55 (± 116.76)	357.64 (18.10)	10/10	38.54 (± 40)	137.19 (16.09)	13/13	58.98 (± 83.77)	30.77
Birds of prey	2.1 (± 3.13)	10.35 (16.10)	9/10	1.47 (± 1.74)	4.95 (23.10.)	9/13	1.74 (± 2.4)	0.89
Cranes				21.19 (± 37.37)	103.85 (15.09.)	5/13	11.98 (± 29.61)	0
Waders	0.54 (± 0.79)	1.69 (11.09)	4/10	0.74 (± 1.6)	4.46 (24.09.)	4/13	0.66 (± 1.29)	0
Skuas				0.01 (± 0.04)	0.15 (24.09.)	1/13	0.01 (± 0.03)	0
Gulls	4.48 (± 5.59)	15.45 (17.10.)	10/10	4.28 (± 4.39)	17.19 (16.09.)	13/13	4.37 (± 4.83)	2.22
Terns				0.05 (± 0.14)	0.5 (14.09.)	2/13	0.03 (± 0.11)	0
Auks	0.96 (± 0.93)	2.48 (27.10.)	8/10	0.6 (± 0.47)	1.33 (22.11,	10/13	0.75 (± 0.71)	0.67
Pigeons	0.07 (± 0.22)	0.71 (16.10.)	1/10	0.05 (± 0.11)	0.35 (14.10.)	3/13	0.06 (± 0.16)	0
Owls	0.02 (± 0.07)	0.21 (28.10.)	1/10				0.01 (± 0.04)	0
Songbirds	43.98 (± 45.16)	120.87 (21.09.)	10/10	74.48 (± 113.41)	364.7 (12.10.)	11/13	61.22 (± 89.94)	19.81

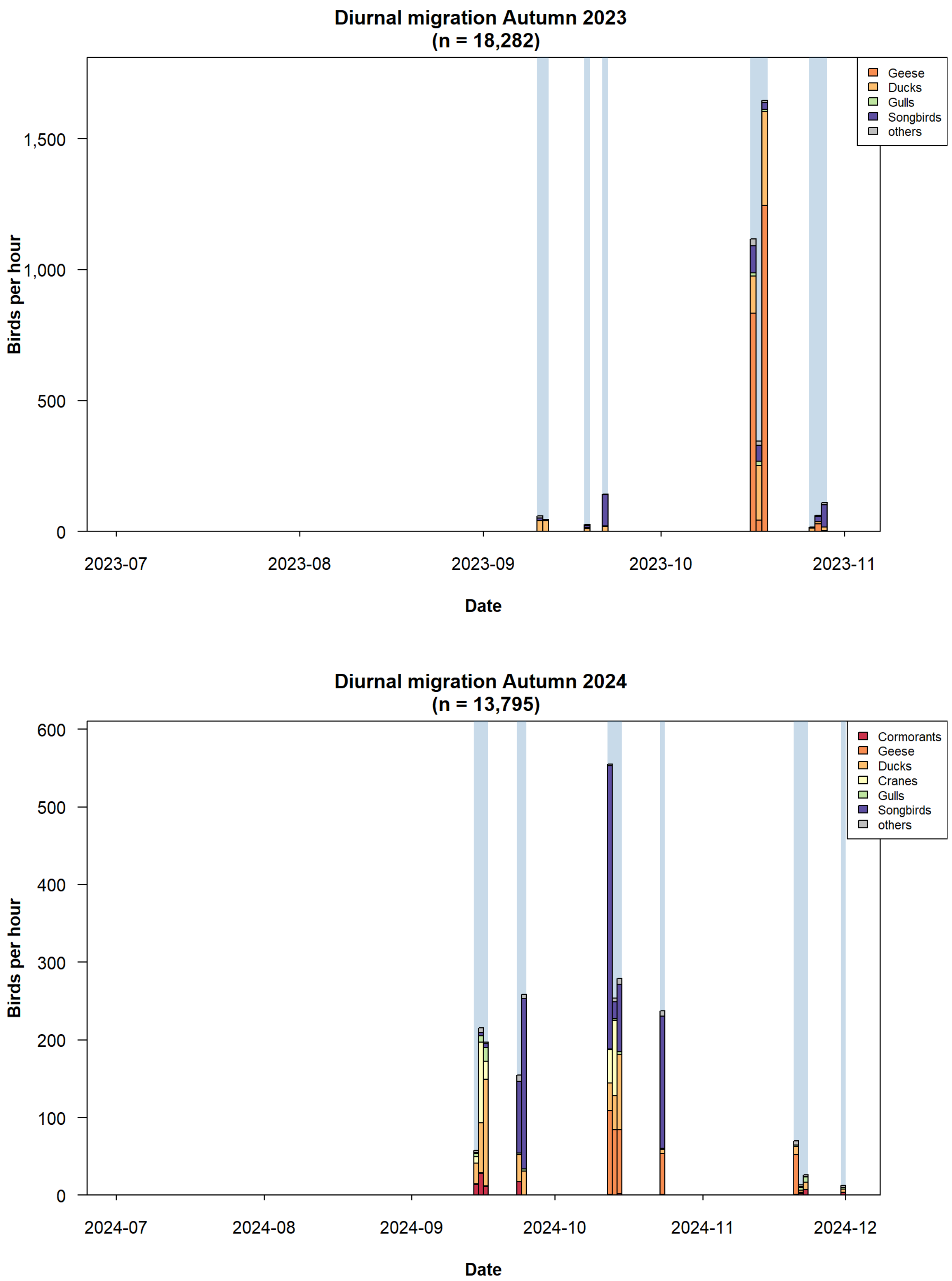


Figure 5.47 Diurnal migration intensity (coloured by taxonomical groups) derived from visual observations in autumn of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (10 days in 2023 and 13 in 2024). Same colours and groups used as in Figure 5.43. Different y-axes are shown.

KF II OWF N

Table 5.15 Proportion of individuals observed at three different altitudinal levels (0 – 20 m, 20 – 200 m, > 200 m) in spring and autumn (2023 and 2024 data pooled) in the pre-investigation area KF II OWF N. In addition, mean flight altitude and standard deviation are provided for each season.

Species groups	Altitude in spring					Altitude in autumn				
	N ind.	Percent (%)			Mean (± SD) in m.a.s.l.	N ind.	Percent (%)			Mean (± SD) in m.a.s.l.
		0-20	20-200	>200			0-20	20-200	>200	
Divers	**54**	56	44	0	18.4 (± 19.4)	**210**	57	43	0	23 (± 19.4)
Grebes	**9**	100	0	0	7.3 (± 11)	**2**	100	0	0	1
Gannets	**2**	100	0	0	1 (± 0)	**9**	89	11	0	28.9 (± 69.5)
Cormorants	**550**	66	34	0	12.9 (± 20.4)	**1,141**	66	34	<0.05	16.3 (± 39.2)
Herons	**1**	100	0	0	5	**38**	34	66	0	24.1 (± 28.5)
Swans	**47**	81	19	0	10.7 (± 20.9)	**93**	65	36	0	19.6 (± 17.8)
Geese	**27,699**	64	36	0	17.5 (± 28.5)	**12,385**	67	31	2	33.8 (± 50)
Ducks	**3,357**	93	7	0	7.5 (± 12.5)	**7,280**	79	21	0	13 (± 21.5)
Birds of prey	**20**	80	20	0	22.8 (± 47.6)	**186**	55	32	13	25 (± 44.6)
Cranes	**70**	76	24	0	46.7 (± 46)	**9**	0	100	0	
Waders	**155**	98	2	0	9.4 (± 13)	**423**	74	26	0	5.1 (± 12.5)
Skuas	**3**	100	0	0	8.3 (± 10.2)	**28**	50	50	0	29.4 (± 29.2)
Gulls	**480**	66	34	0	21.4 (± 21.5)	**674**	55	45	<0.05	26.4 (± 26.4)
Terns	**237**	96	4	0	11.4 (± 8.3)	**549**	92	8	0	9.7 (± 7.8)
Auks	**222**	100	0	0	1.3 (± 0.7)	**90**	100	0	0	1.8 (± 1.7)
Pigeons	**2**	100	0	0	7.5 (± 3.5)	**1,586**	97	0	3	121.3 (± 180)
Owls	**0**	0	0	0	-	**4**	50	50	0	33.8 (± 32.5)
Swifts	**1**	100	0	0	20	**4**	75	25	0	18 (± 9.1)
Songbirds	**480**	87	13	0	8.6 (± 11.7)	**2,264**	92	8	0	10.4 (± 13.1)

KF II OWF S

Table 5.16 Proportion of individuals observed at three different altitudinal levels (0 – 20 m, 20 – 200 m, > 200 m) in spring and autumn (2023 and 2024 data pooled) in the pre-investigation area KF II OWF S. In addition, mean flight altitude and standard deviation are provided for each season.

Species groups	Altitude in spring					Altitude in autumn				
	N ind.	Percent (%)			Mean (± SD) in m.a.s.l.	N ind.	Percent (%)			Mean (± SD) in m.a.s.l.
		0-20	20-200	>200 m			0-20	20-200	20-200	
Divers	**86**	73	27	0	19.5 (± 21.2)	**53**	66	34	0	18 (± 22)
Grebes	**6**	100	0	0	1.5 (± 0.7)	**3**	100		0	1
Gannets	**1**	100	0	0	1	**5**	40	60	0	33 (± 24.4)
Cormorants	**692**	89	11	0	12.6 (± 16.6)	**714**	47	53	0	29 (± 55.2)
Herons	**19**	0	100	0	75 (± 25)	**36**	81	0	19	67.8 (± 118.4)
Swans	**30**	100	0	0	6.3 (± 6.8)	**31**	87	13	0	8.2 (± 15.6)
Geese	**42,377**	43	48	9	33.4 (± 50.9)	**12,928**	53	38	9	32.7 (± 71.4)
Ducks	**4,124**	88	12	0	8.6 (± 14.2)	**7,670**	91	9	0	11 (± 19)
Birds of prey	**26**	54	46	0	30.3 (± 45.7)	**217**	75	16	9	40.1 (± 101.2)
Cranes	**102**	3	83	14	105.4 (± 127.2)	**1738**	0	78	22	283.3 (± 215.4)
Waders	**90**	1	99	0	46.5 (± 39.9)	**92**	97	3	0	3.1 (± 6.1)
Skuas	**1**	0	100	0	25	**1**	100	0	0	20
Gulls	**295**	73	27	0	18.8 (± 15.2)	**561**	69	31	0	25.1 (± 23.7)
Terns	**84**	93	7	0	13.8 (± 17.4)	**4**	100	0	0	7.5 (± 3.5)
Auks	**99**	100	0	0	1.8 (± 2.5)	**89**	100	0	0	3.1 (± 3)
Pigeons	**5**	100	0	0	10 (± 6.1)	**6**	43	57	0	19 (± 16.2)
Owls	**0**	0	0	0	-	**1**	100	0	0	20
Swifts	**1**	100	0	0	5	**0**	0	0	0	-
Songbirds	**553**	97	3	0	7.3 (± 7.7)	**7,927**	85	15	0	8.9 (± 12)

KF II OWF N

Table 5.17 Proportion of individuals flying towards the main flight directions in spring (N-NE-E) and autumn (S-SW-W) in the pre-investigation area KF II OWF N (both years pooled) during visual observations.

Species groups	Flight directions in spring					Flight directions in autumn				
	N ind.	N (%)	NE (%)	E (%)	Other directions	N ind.	S (%)	SW (%)	W (%)	Others
Divers	**54**	7	43	19	31%	**210**	3	16	43	21% (NW), N (10%)
Grebes	**9**	22	78	0		**2**	0	0	100	
Gannets	**2**	50	0	0	50%	**8**	0	0	0	NW (63%)
Cormorants	**549**	27	45	18	10%	**1,137**	12	52	17	19%
Herons	**1**	0	100	0		**38**	10.5	71	16	3%
Swans	**47**	21	13	19	34% (W), 13% (SW)	**93**	18	31	19	31%
Geese	**27,699**	3	86	7	< 5%	**12,380**	5	73	19	3
Ducks	**3,328**	15.5	42	14	29	**7,241**	4	30	48	17%
Birds of prey	**18**	44	39	0	17	**183**	27	40	24	8
Cranes	**70**	69	14	0	27	**9**	100	0	0	
Waders	**155**	3	12	81	5	**423**	1	39	59	1
Skuas	**3**	0	100	0		**28**	7	57	18	18
Gulls	**457**	12.5	45	12.5	30%	**645**	9	33	16	42
Terns	**237**	8	65	7	21	**549**	3.5	36	48	12
Auks	**219**	9	12	12	67% (19% SW, 19% NW)	**90**	8	6	24	54%
Pigeons	**1**	100	0	0		**1,586**	0	5	95	
Owls	**0**					**8**	0	50	25	25
Swifts	**1**	0	0	0	100 (NW)	**4**	0	100	0	
Songbirds	**462**	42	26	3.5	20% (NW)	**2,206**	28	61	3.5	7

KF II OWF S

Table 5.18 Proportion of individuals flying towards the main flight directions in spring (N-NE-E) and autumn (S-SW-W) in the pre-investigation area KF II OWF S (both years pooled) during visual observations.

Species groups	Flight directions in spring					Flight directions in autumn				
	N ind.	N	NE	E	Others	N ind.	S	SW	W	Others
Divers	**86**	2	26	51	21%	**53**	4	21	38	38%
Grebes	**6**	0	100	0	0	**3**	100	0	0	0
Gannets	**0**					**5**	20	20	20	40
Cormorants	**692**	19	69	2	10	**709**	20	49	10	21%
Herons	**19**	89	11	0	0	**36**	22	58	19	0
Swans	**30**	3	3	0	W (60%), NW (23%)	**31**	32	32	10	26
Geese	**42,377**	3	95	0	2	**12,928**	3	60	35	1
Ducks	**4,095**	6	58	14	21	**7,669**	13	55	26	6
Birds of prey	**26**	27	54	4	15	**217**	17	57	24	2
Cranes	**102**	33	39	3	NW (22%)	**1,738**	67	28	1	4
Waders	**90**	14	84	0	1	**92**	4	57	39	0
Skuas	**1**	0	0	100		**1**	0	100	0	0
Gulls	**275**	12	23	24	40	**522**	10	36	27	26
Terns	**84**	20	21	58		**4**	0	75	25	0
Auks	**102**	18	25	16	41	**88**	3	17	23	NW (22%), NE (19%)
Pigeons	**4**	25	0	0	75	**6**	0	67	33	0
Owls	**0**					**1**	0	0	100	0
Swifts	**1**	100	0	0		**0**				
Songbirds	**524**	15	53	5	27	**7,898**	25	63	9	3

NOCTURNAL MIGRATION (FLIGHT CALLS)

The analysis of nocturnal calls is presented separately for each area. Flight calls are often dominated by calls of songbirds, especially of thrushes. In general, more calls were heard in autumn than in spring in both years and areas. It must be kept in mind, however, that the number of calls does not necessarily correlate with the number of individuals migrating.

SPECIES COMPOSITION

OWF KF II N

In the spring of 2023, a total of 360 calls of 12 species were registered by observers during the 15 survey nights (Table 5.19). Songbirds made up 67.5% of all calls in the pre-investigation area KF II OWF N, whereas gulls represented 25.6% of all calls and waders 6.1% (Figure 5.48). The most common songbird species heard were redwings (27.2% of all calls), European robins (17.2%), blackbirds (15.6%) and song thrushes (6.9%). Common gull represented almost a quarter of all calls heard in the season (24.2%) and of waders the most common calls were of snipes (3.1%), wood sandpipers and (1.4%) and European golden plovers (1.1%).

In the autumn of 2023, many more calls were heard (3,939 during the 20 survey nights of that season). These calls were assigned to 30 species (Table 5.19). Songbird calls made up 92.1% of all calls in the northern area and waders emitted 7.7% of all calls. In autumn, songbirds constituted a large number of the species identified: calls of 19 species were heard. In terms of number, most calls belonged to the same species as in spring, but these were heard more often: redwings (40.7%), blackbirds (25.6%), European robins (10.7%) and song thrushes (7.4%). Dunlins represented the most frequently heard species of waders (5.9% of all calls).

Table 5.19 Total number of bird calls and species heard during nocturnal migration in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF N.

Season/Year	Number of survey nights	Number of individuals	Number of species	Number of species > 250 individuals	Number of species < 10 individuals	Number of species under conservation category (Appendix)
Spring 2023	15	360	12	0	6	5
Autumn 2023	20	3,939	30	4	16	5
All year2023	**35**	**4,299**	**36**	**4**	**21**	**9**
Spring 2024	13	636	15	1	10	**5**
Autumn 2024	15	1,332	27	1	13	8
All year 2024	**28**	**1,968**	**34**	**3**	**17**	**12**
Spring	28	996	21	1	11	**10**
Autumn	35	5,271	38	4	17	**11**
Both years	**63**	**6,267**	**46**	**5**	**21**	**17**

In the spring of 2024, a total of 636 nocturnal calls were heard over the 13 survey nights. These belonged to 14 species and most calls were of barnacle geese (85.7% of all calls). Songbirds (thrushes and non-thrushes) and waders represented 5.7% of all calls heard in the season. The only songbird species commonly heard was the redwing (3.6% of all calls). Of waders, two species were relatively common: Eurasian oystercatchers and whimbrels (2.4% and 2.2% of all calls, respectively). In the autumn of 2024, twice as many calls were heard than in spring, and these were identified to represent 27 species (Table 5.19). Songbirds emitted 93.7% of all calls heard in this season and a total of 16 species of songbirds were identified. The most frequently heard species were the European robin (43.8%) as well as redwings (18.8%) and song thrushes (17%). Calls of waders represented 2.6% of all calls with the most commonly heard species being the common redshank (1.7%). Geese were not frequently registered, and barnacle geese calls made up for 1.7% of all calls. Another group not commonly heard was that of terns (Figure 5.48).

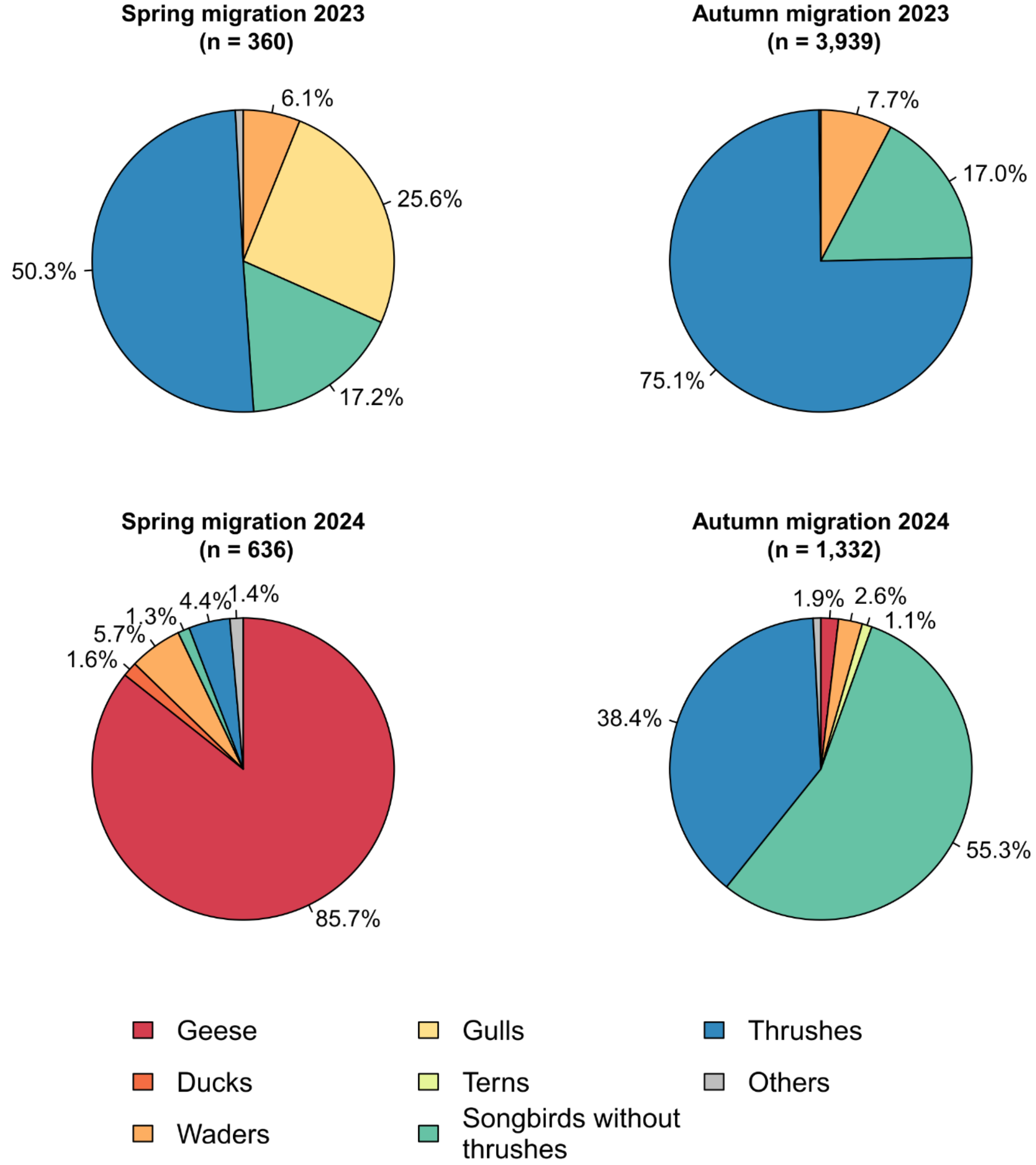


Figure 5.48 Proportion of nocturnal migratory species (based on acoustic observations) grouped into high-category taxa in spring and autumn of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. See Figure 5.42 for more details.

Table 5.20 Number of nocturnal calls of migrating birds heard in the OWF KF II N. Numbers in parenthesis in the headings represent the number of survey nights for each season and year. Species groups that are discussed in detail later in the text are highlighted in bold.

Species groups	Spring			Autumn			Total
	2023 (15)	2024 (13)	Total (28)	2023 (20)	2024 (15)	Total (35)	
Herons	0	0	0	2	0	2	2
Geese	**0**	**545**	**545**	**6**	**25**	**31**	**576**
Ducks	3	10	13	0	11	11	24
Waders	**22**	**36**	**58**	**302**	**34**	**336**	**394**
Gulls	92	3	95	0	0	0	95
Terns		1	1		14	14	15
Songbirds without thrushes	**62**	**8**	**70**	**669**	**736**	**1,405**	**1,475**
Thrushes	**181**	**28**	**209**	**2,960**	**512**	**3,472**	**3,681**
Birds not determined		5	5		25	25	30
All	**360**	**636**	**996**	**3,939**	**1,332**	**5,271**	**6,267**

OWF KF II S

In the pre-investigation area KF II OWF S, a total of 736 calls were identified to 14 species during spring of 2023 (Table 5.21). Calls of songbirds made up almost 95% of all calls heard, and gulls and ducks contributed to less than 5% of all calls in that same season (Figure 5.49). Most common songbird calls were from song thrushes, common blackbirds, European robins and redwings (30.4%, 23.9%, 17.9% and 16.8% of all calls, respectively). Duck calls were mainly by common scoters (2.3%) and the most frequently heard gull was the black-headed gull (1.4% of all calls).

Table 5.21 Total number of bird calls and species heard during nocturnal migration in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF S.

Season/Year	Number of survey nights	Number of individuals	Number of species	Number of species > 250 individuals	Number of species < 10 individuals	Number of species under conservation category (Appendix)
Spring 2023	12	736	14	0	7	2
Autumn 2023	10	4,825	19	2	9	2
All year2023	**22**	**5,561**	**26**	**4**	**14**	**4**
Spring 2024	13	44	6	0	3	**0**
Autumn 2024	14	688	9	1	5	1
All year 2024	**27**	**732**	**11**	**1**	**7**	**1**
Spring	25	780	16	0	9	**3**
Autumn	24	5,513	21	3	11	2
Both years	**49**	**6,293**	**29**	**4**	**16**	**5**

In autumn of 2023, many more calls were heard (4,825 calls) identified to 19 species (Table 5.21). Again, songbirds emitted the great majority of all calls (97%) but in this case, thrushes were not as commonly heard as other songbirds. The most commonly heard species was European robin (68.5%). Most common calls of thrushes were from redwings, song thrushes and blackbirds (9.4%, 4.2% and 2.6% respectively. Waders represented just 3% of all calls, most frequently by sandpipers (2.3%, Figure 5.49).

In 2024, generally fewer calls were heard during the 24 survey nights. These calls all belonged to waders and songbirds. In spring, only 44 calls of six species could be heard. Songbirds dominated the calls (81-8%) and most commonly heard songbirds were redwing (61.4%), song thrushes (13.6%) and European robins (4.5%). Two species of waders were heard: common redshanks (13.6%) and common sandpipers (4.5%).

In autumn of 2024, 688 calls of 9 species were registered during the 14 survey nights (Table 5.21, Figure 5.49). These calls all belonged to songbirds. The most commonly heard species was the European robin (54.4%). Other common species were redwings, blackbirds and song thrushes (19.0%, 14.1% and 9.4%, respectively).

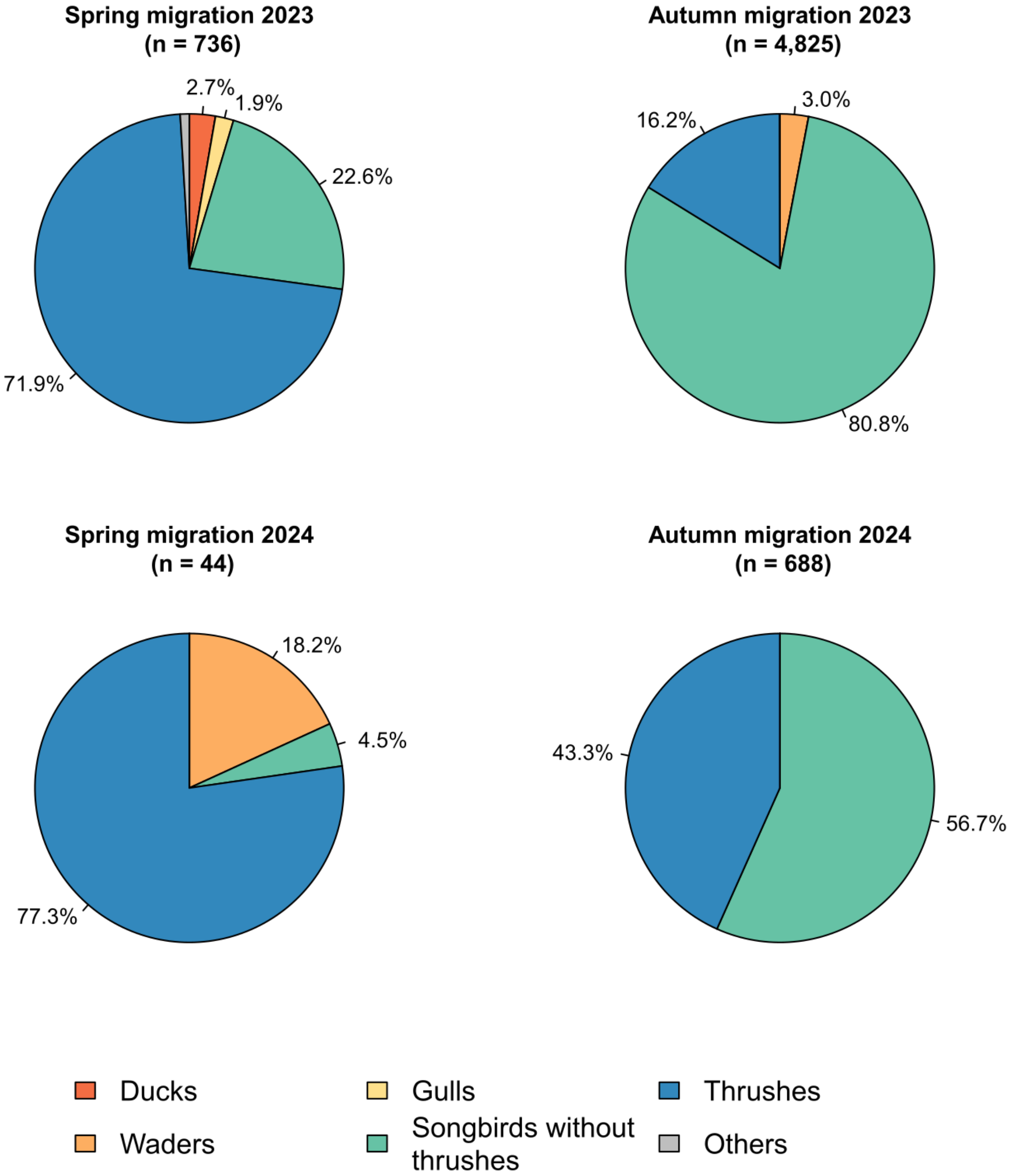


Figure 5.49 Proportion of nocturnal migratory species (based on acoustic observations) grouped into high-category taxa in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF S. See Figure 5.42 for more details.

Table 5.22 Number of nocturnal calls of migrating birds heard in the pre-investigation area KF II OWF S. Numbers in parenthesis in the headings represent the number of survey nights for each season and year. Species groups that are described in more detail later in the text are highlighted in bold.

Species groups	Spring			Autumn			Total (29)
	2023 (12)	2024 (13)	Total (25)	2023 (10)	2024 (14)	Total (24)	
Geese	5	0	5	0	0	0	5
Ducks	20	0	20	0	0	0	20
Waders	**1**	**8**	**9**	**144**	**0**	**144**	**153**
Gulls	14	0	14	0	0	0	14
Pigeons	0	0	0	1	0	1	1
Owls	1	0	1	0	0	0	1
Songbirds without thrushes	**166**	**2**	**168**	**3,899**	**390**	**4,289**	**4,457**
Thrushes	**529**	**34**	**563**	**781**	**298**	**1079**	**1642**
All	736	44	780	4,825	688	5,513	6,293

MIGRATION INTENSITY

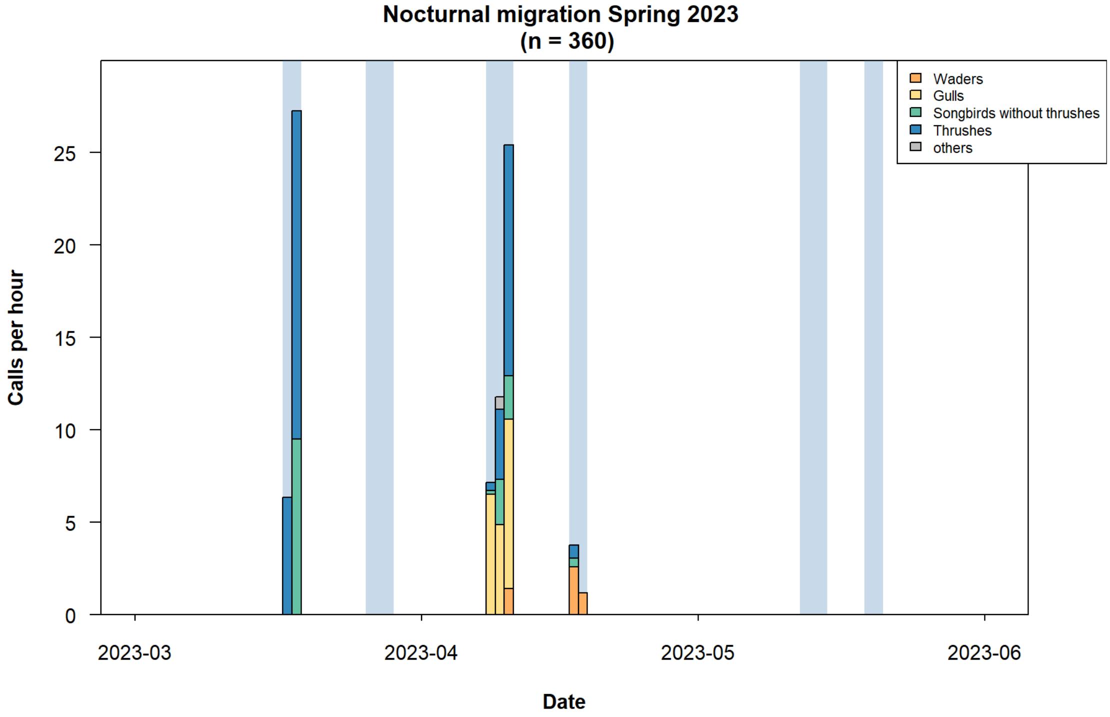
KF II OWF N

Table 5.23 Migration intensity of species groups acoustically recorded in the pre-investigation area KF II OWF N in spring of 2023 and 2024 during nocturnal migration. Mean, maximum and peak date of migration intensity is provided (calls/h).

Species groups	Migration intensity (calls/h) in 2023 (15 nights)			Migration intensity (calls/h)in 2024 (13 nights)			Both years (28 nights)	
	Mean (± SD)	Maximum (date)	Freq of observ.	Mean (± SD)	Maximum (date)	Freq of observ.	Mean (± SD)	Median
Geese				6.41 (± 15.78)	46.72 (10.05.)	2/13	2.98 (± 11.02)	0
Ducks	0.04 (± 0.17)	0.67 (09.04.)	1/15	0.15 (± 0.55)	2.0 (29.03)	1/13	0.1 (± 0.39)	0
Waders	0.35 (± 0.77)	2.59 (17.04.)	3/15	0.5 (± 1.12)	3.6 (29.03)	4/13	0.42 (± 0.93)	0
Gulls	1.37 (± 2.96)	9.18 (10.04.)	3/15	0.05 (± 0.13)	0.4 (29.03)	1/13	0.76 (± 2.23)	0
Terns				0.01 (± 0.04)	0.16 (11.05.)	1/13	0.01 (± 0.03)	0
Songbirds without thrushes	1 (± 2.49)	9.5 (18.03.)	5/15	0.11 (± 0.3)	1.0 (29.03)	1/13	0.59 (± 1.86)	0
Thrushes	2.77 (± 5.42)	17.75 (18.03.)	6/15	0.43 (± 1.55)	5.6 (29.03)	1/13	1.68 (± 4.21)	0

Table 5.24 Migration intensity of species groups acoustically recorded in the pre-investigation area KF II OWF N in autumn of 2023 and 2024 during nocturnal migration. Mean, maximum and peak date of migration intensity is provided (calls/h).

Species groups	Migration intensity (calls/h) in 2023 (20 nights)			Migration intensity (calls/h) in 2024 (14 days)			Both years (34 nights)	
	Mean (± SD)	Maximum (date)	Freq of observ	Mean (± SD)	Maximum (date)	Freq of observ.	Mean (± (SD)	Median
Herons	0.02 (± 0.09)	0.42 (07.09.)	1/20				0.01 (± 0.07)	0
Geese	0.05 (± 0.22)	1.0 (28.10.)	1/20	0.28 (± 0.99)	3.83 (15.10.)	2/14	0.15 (± 0.66)	0
Ducks				0.13 (± 0.43)	1.67 (15.10.)	2/14	0.05 (± 0.28)	0
Waders	3.26 (± 12.26)	55.16 (07.09.)	7/20	0.64 (± 1.99)	7.71 (07.08.)	3/14	2.14 (± 9.34)	0
Terns				0.27 (± 1.03)	4.0 (07.08.)	1/14	0.11 (± 0.68)	0
Songbirds without thrushes	6.92 (± 12.47)	45.47 (07.09.)	15/20	9.48 (± 12.96)	43.79 (12.09.)	12/14	8.02 (± 12.56)	1.86
Thrushes	22.57 (± 42.62)	168.57 (14.11)	14/20	5.4 (± 10.40)	37.54 (26.10.)	7/14	15.21 (± 33.67)	1.14



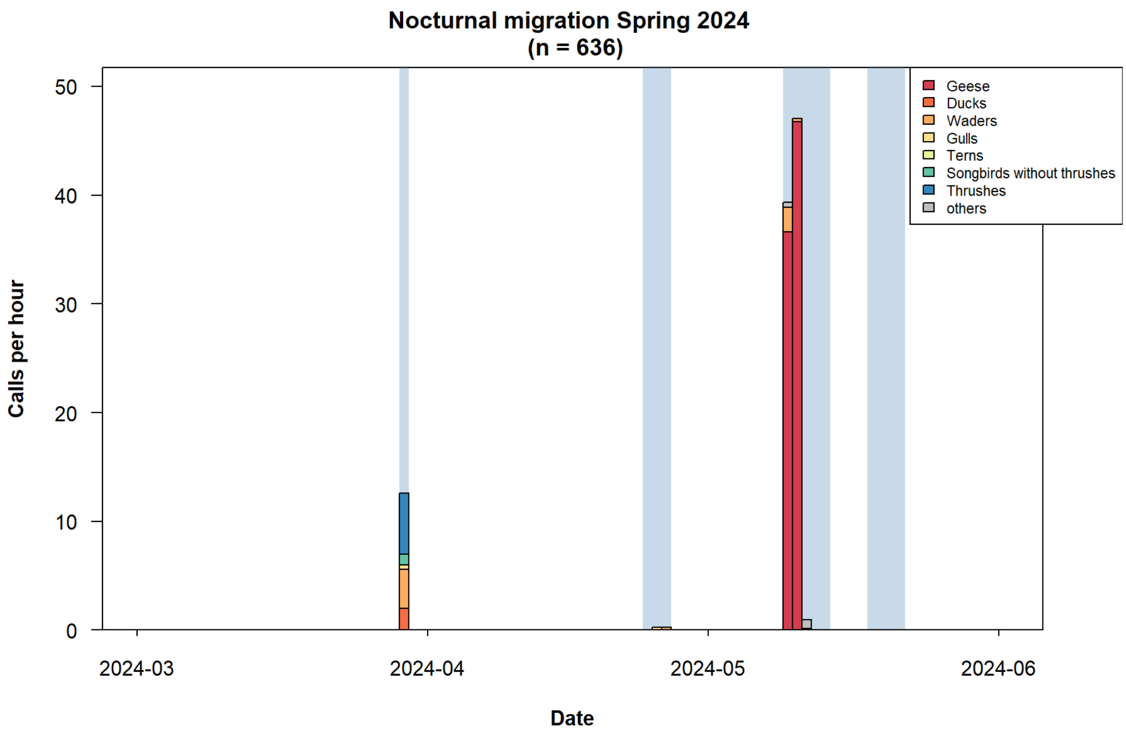
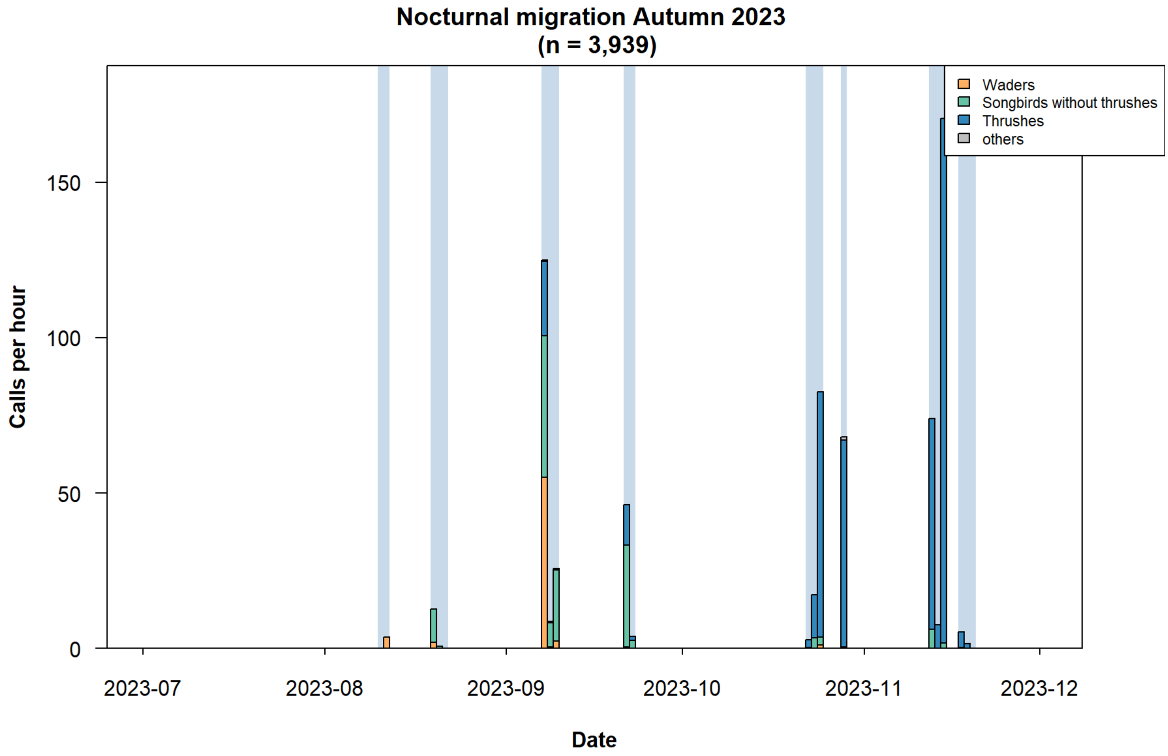


Figure 5.50 Nocturnal migration intensity (coloured by taxonomical groups) derived from acoustic observations (flight calls) in spring of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (15 nights in 2023 and 13 nights in 2024). Same colours and groups used as in Figure 5.48. Different y-axes are shown.



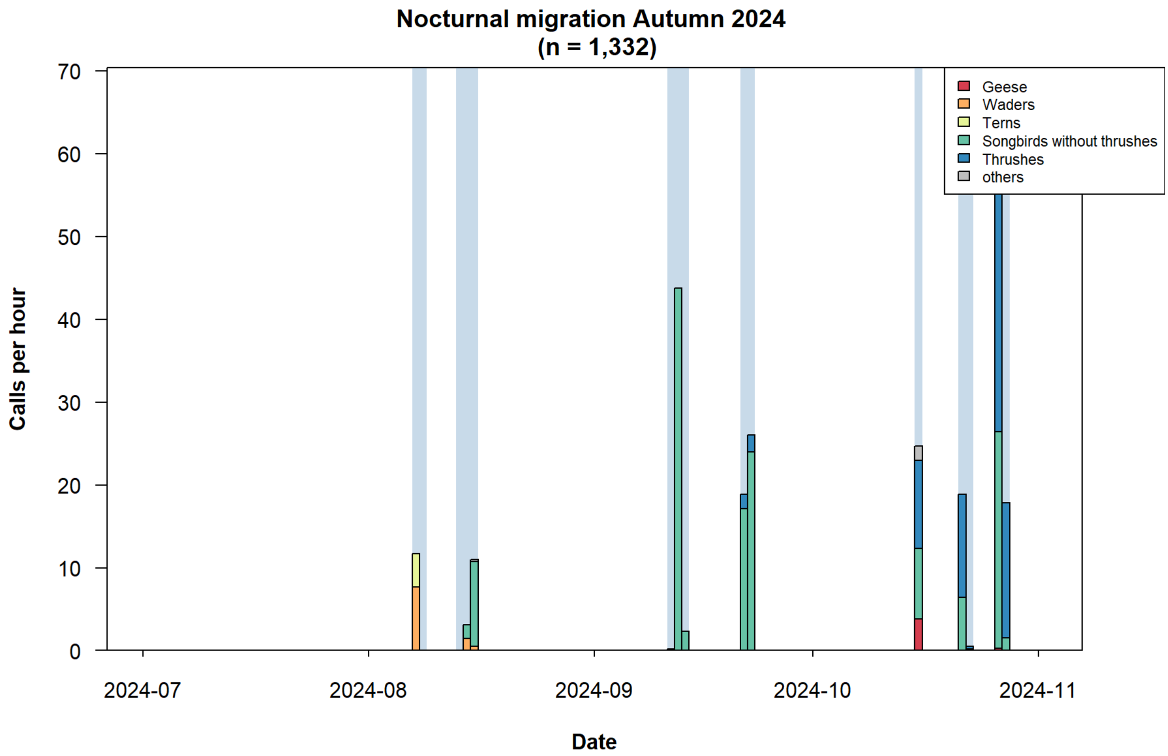


Figure 5.51 Nocturnal migration intensity (coloured by taxonomical groups) derived from acoustic observations (flight calls) in autumn of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (20 nights in 2023 and 15 nights in 2024). Same colours and groups used as in Figure 5.48. Different y-axes are shown.

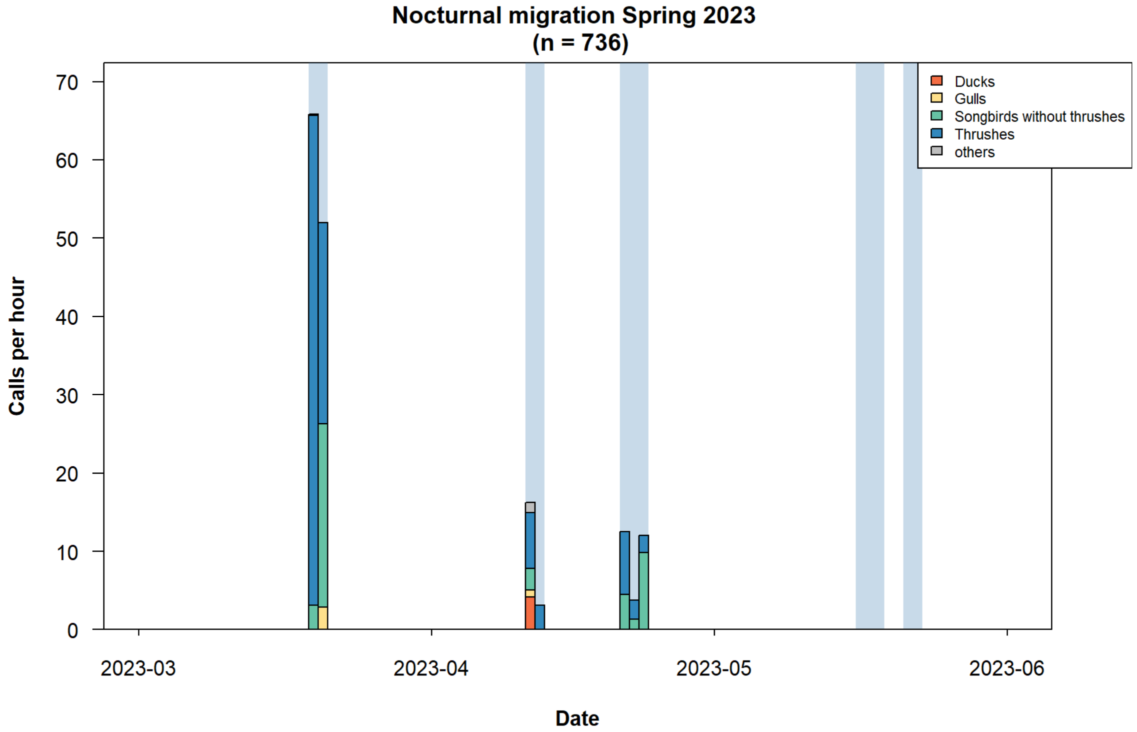
KF II OWF S

Table 5.25 Migration intensity of species groups acoustically recorded in the pre-investigation area KF II OWF S in spring of 2023 and 2024 during nocturnal migration. Mean, maximum and peak date of migration intensity is provided (calls/h).

Species groups	Migration intensity (calls/h) in 2023 (12 nights)			Migration intensity (calls/h) in 2024 (13 nights)			Both years	
	Mean (± SD)	Maximum value (date)	Freq of observ.	Mean (± SD)	Maximum value (date)	Freq of observ.	Mean (± SD)	Median
Geese	0.09 (± 0.3)	1.05 (11.04.)	1/12				0.05 (± 0.23)	0
Ducks	0.35 (± 1.22)	4.21 (11.04.)	1/12				0.2 (± 0.92)	0
Waders	0.02 (± 0.06)	0.21 (11.04.)	1/12	0.13 (± 0.35)	1.2 (27.03.)	2/13	0.09 (± 0.28)	0
Gulls	0.31 (± 0.84)	2.86 (20.03.)	2/12				0.18 (± 0.64)	0
Owls	0.02 (± 0.05)	0.18 (19.03)	1/12				0.01 (± 0.04)	0
Songbirds without thrushes	3.75 (± 6.85)	23.43 (20.03.)	6/12	0.03 (± 0.12)	0.44 (28.03.)	1/13	2.16 (± 5.42)	0
Thrushes	9.26 (± 18.29)	62.55 (19.03.)	7/12	0.54 (± 1.39)	4.6 (27.03.)	2/13	5.63 (± 14.27)	0

Table 5.26 Migration intensity of species groups acoustically recorded in the pre-investigation area KF II OWF S in autumn of 2023 and 2024 during nocturnal migration. Mean, maximum and peak date of migration intensity is provided (calls/h).

Species groups	Migration intensity (calls/h) in 2023 (10 nights)			Migration intensity (calls/h) in 2024 (14 nights)			Both years	
	Mean (± SD)	Maximum value (date)	Freq of observ.	Mean (± SD)	Maximum value (date)	Freq of observ.	Mean (± (SD)	Media n
Waders	3.09 (± 8.87)	28.21 (10.09)	2/10				1.29 (± 5.76)	0
Pigeons	0.02 (± 0.07)	0.21 (10.09)	1/10				0.01 (± 0.04)	0
Songbirds without thrushes	81.67 (± 228.74)	729.89 (10.09)	8/10	5.12 (± 7.51)	21.83 (13.10.)	9/14	37.02 (± 148.29)	0.78
Thrushes	12.94 (± 18.51)	58.0 (25.10.)	6/10	3.54 (± 6.4)	20.83 (13.10.)	9/14	7.45 (± 13.4)	1.17



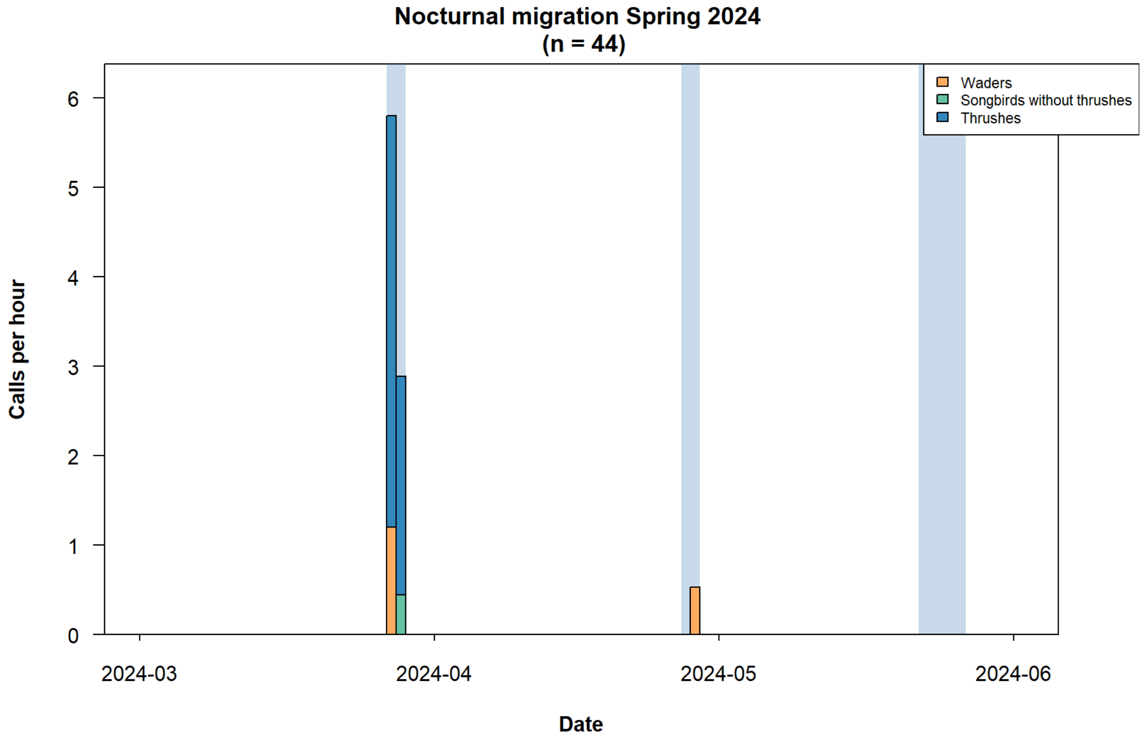
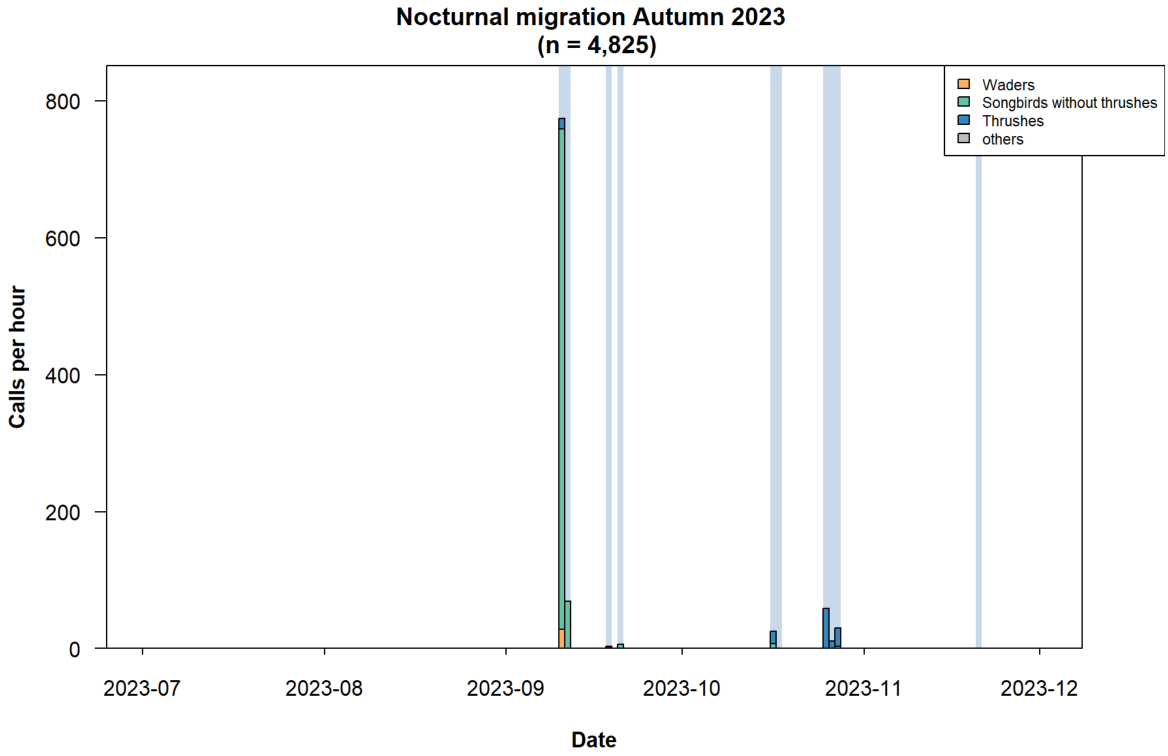


Figure 5.52 Nocturnal migration intensity (coloured by taxonomical groups) derived from acoustic observations (flight calls) in spring of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (12 nights in 2023 and 13 nights in 2024). Same colours and groups used as in Figure 5.49. Different y-axes are shown.



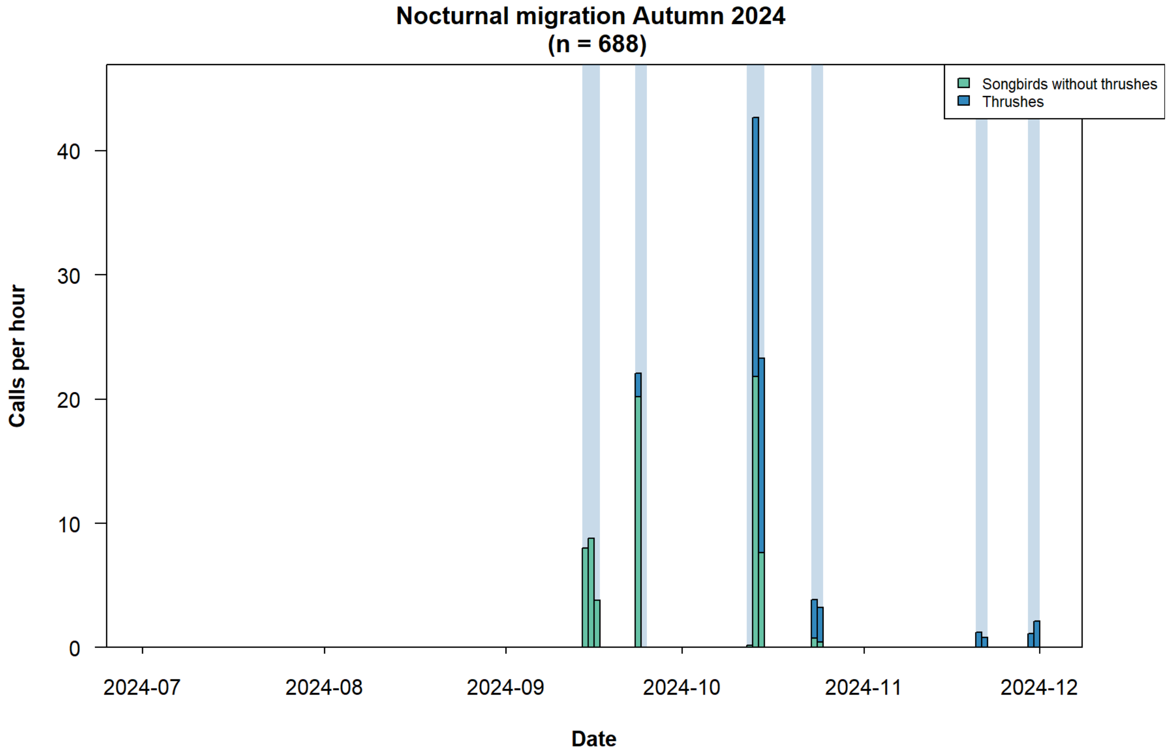


Figure 5.53 Nocturnal migration intensity (coloured by taxonomical groups) derived from acoustic observations (flight calls) in spring of 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (10 nights in 2023 and 14 nights in 2024). Same colours and groups used as in Figure 5.49. Different y-axes are shown.

DIVERS

In general, divers were neither abundant nor very frequent in both areas, but all diver species are considered to be threatened, are sensitive to shipping and show avoidance behaviour towards offshore wind farms. They are included in many categories of conservation and thus are included here. The species represented > 1% of all individuals seen only in autumn of 2023 in the northern area (see Figure 5.42). Divers were not heard during nights in any of the areas.

Table 5.27 Number of individuals per species of divers in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Red-throated diver	x	16	154	170	25	18	43
Black-throated diver	x	10	25	35	8	16	24
Great Northern diver	x	0	0	0	1	0	1
Unidentified diver		28	31	59	52	19	71
All divers		**54**	**210**	**264**	**86**	**53**	**139**

<u>KF II OWF N</u>

Two species of divers were detected in the two survey years: the red-throated diver (*Gavia stellata*) and the black-throated diver (*Gavia arctica*). Red-throated divers accounted for 64% of all divers seen in the KF II OWF North area (n=264, Table 5.27). The species was more common in 2023 (it represented 79% of all divers seen) than in 2024 (when it represented only about a third of all divers, 32%). The species was also more common in autumn than in spring (91% of all individuals seen over the two years occurred during autumn and only and > 10% of all divers were seen in spring. Black-throated divers represented only 13% of all divers seen. The species was also more common in autumn than in spring (71% individuals of the species were observed during autumn) but was more often seen in the second year (69% of all individuals were seen in this year). Altogether, 22% of all divers could not be identified to species level (n = 59, Table 5.27).

Since more individuals were observed in autumn than in spring, migration intensities in spring were lower with a mean of 0.28 (± 0.45) and a median of 0.11 ind./h. Maximum values in both years were similar (1.3 – 1.4 ind./h, Table 5.11). Overall, divers were more often seen in April and fewer individuals in May (Figure 5.54). In autumn, the overall migration intensity of divers was higher (1.29 ± 2.24 ind./h) with a median of 0.25 ind./h. The maximum value of autumn was reached in November of 2023 (8.7 ind./h, Table 5.12). Monthly intensities of divers in autumn increased throughout the season with most divers being observed in November (Figure 5.54).

The altitudinal distribution of divers in spring and autumn was similar with similar proportions of individuals observed flying in the various altitude categories. No diver was seen to fly above 100 m. Overall, 26.5% of all divers seen in the KF II OWF N were flying between 0-5 m whereas ~36% were flying between 20 and 50 m and 43% of all divers flew above 20 m (Table 5.15, Figure 5.55).

In spring, most divers flew to the NE (43%) whereas 19% flew to the E. About 31% flew in other directions. In autumn, most divers flew to the west (43%), NW (21%), SW (16%) or N (10%, Table 5.17).

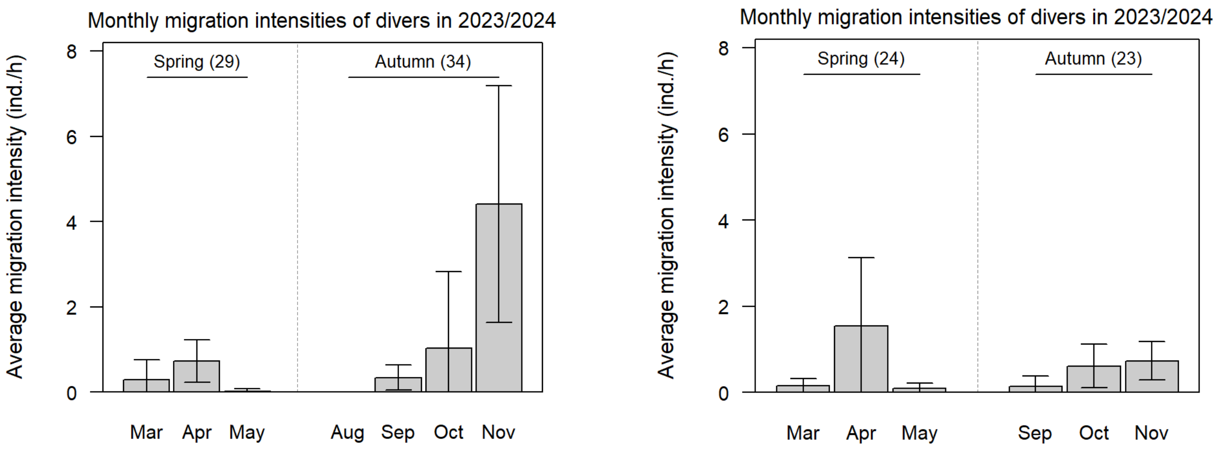


Figure 5.54 Mean monthly diurnal migration intensity of divers in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

KF II OWF S

Fewer survey days were available in the southern area than in the northern area, especially in autumn (Table 5.27). Hence, fewer divers were observed in the southern area than in the northern area (139 vs. 264, **Fejl! Henvisningskilde ikke fundet.**), and in this area more divers were observed in spring than in autumn (62% vs. 38%). About 51% of all divers could not be identified to species level (n=71) and red-throated divers represented 31% of all divers whereas black-throated divers represented 17% of all divers (**Fejl! Henvisningskilde ikke fundet.**). Furthermore, one individual of great northern diver was seen in spring in addition to the two common diver species Divers were occurring at similar frequencies (14/24 and 15/23 survey days in spring and autumn respectively).

Migration intensities in spring and autumn were similar, but variability was larger in spring (0.53 ± 1.05 in spring and 0.45 ± 0.47 ind./h in autumn, Table 5.13 and Table 5.14). Median values were lower in spring than in autumn. The maximum value of daily intensity was 4.6 ind./h in April 2024 (Table 5.13) whereas in autumn the maximum value reached 1.7 ind./h in October 2023 (Table 5.14). In spring, divers were most common in April, whereas in autumn, there was also a slight increase of migration intensities with the season. Nonetheless, the November average migration intensity was much lower than that in November in the northern area (Figure 5.54).

The overall altitudinal distribution of divers in the southern area was somewhat different from the one in the northern area with a higher proportion of individuals observed flying very close to the surface (0-5 m, 47.5%, Figure 5.55). No divers were seen flying above 100 m of altitude. There was a slight difference in the distribution between spring and autumn with about three out of four divers observed flying between 0-20 m of altitude in spring and about two out of three divers observed at these altitudes in autumn (Table 5.16). Overall, about 29.5% of all divers flew above 20 m of altitude in both seasons (Figure 5.55).

In the southern area, most divers flew to the east (51%) and a quarter flew to the NE (26%). Other directions were less frequent. In autumn, most divers flew directly to the West (38%) and SW (21%, Table 5.18).

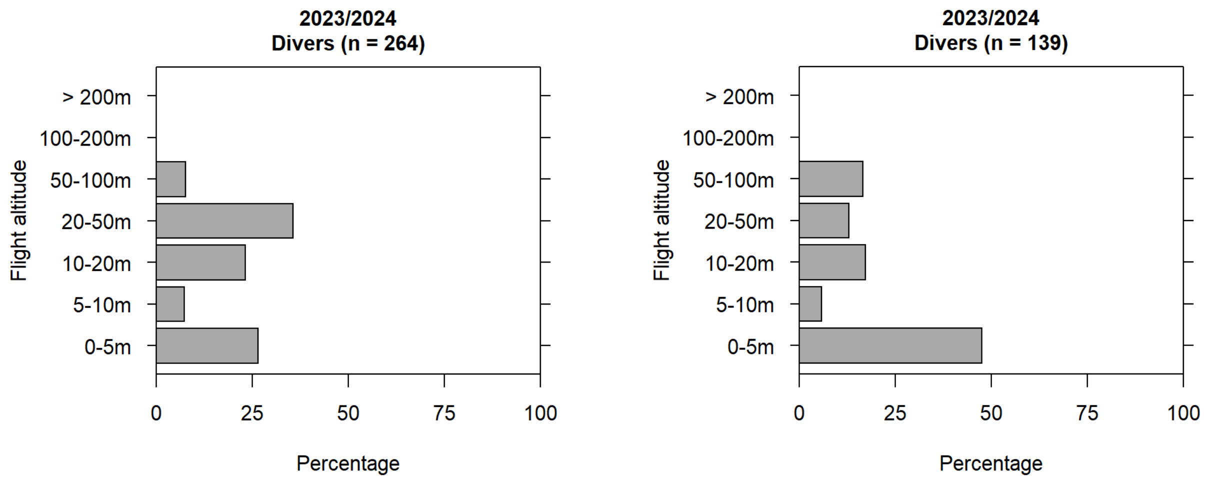


Figure 5.55 Flight altitude distribution of divers during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

CORMORANTS

Cormorants are represented by one single species, the great cormorant (*Phalacrocorax carbo*). The species is not under any category of conservation, but it is often observed and may be attracted to man-made structures such as OWF. It also represented over 1% of the total number of migrating birds in more than one season in both areas (Figure 5.42 and Figure 5.43).

<u>KF II OWF N</u>

Almost twice as many cormorants were seen in autumn than in spring (Table 5.8) over the two years. Cormorants were seen in similar numbers in both years (n 2023 = 825, n 2024 = 866). Cormorants represented about 5.1% and 5.3% of all birds seen in spring and autumn of 2023 respectively (Figure 5.42). In 2024, there were many more migrating birds seen and they just represented about 0.6% of all birds in spring and 3.8% of all migrating birds in spring and autumn of 2024, respectively (Figure 5.42).

Cormorants were frequently observed. In spring they were observed on 20 out of 29 survey dates, whereas in autumn they were seen on 29 out of the 34 survey dates over the two years (Table 5.11, Table 5.12). Mean migration intensity in spring was 3.0 (± 4.9) and due to the skewed distribution, the median was 0.3 ind./h, whereas the autumn mean was 5.3 ± 6.8 ind./h and the median was higher 2.7 (Table 5.11). The maximum value in spring was 21.1 ind./h (at the end of March 2023), whereas in autumn it was 32.1 ind./h and occurred in September 2024 (Table 5.12).

Monthly migration intensities were high in March and decreased progressively throughout the season, whereas in autumn the highest migration intensities were observed in September followed by August (Figure 5.56).

Similar flying behaviour was observed in spring and autumn with few birds observed flying at altitudes above 50 m. In general, about 66% of all cormorants flew below 20 m of altitude with about 43% of all birds being seen in the near-surface layer (0-5 m). About 26% were flying between 20 and 50 m and 6% between 50 and 100 m. Only < 2,5% were flying above 100 m of altitude (Figure 5.57).

Cormorants flew in the expected migration directions in spring and autumn. About 45% of all cormorants flying in spring flew directly to the NE, whereas 27% and 18% flew to the N and to the E, respectively. In autumn, most cormorants flew to the SW (52%), whereas 12% an 17% flew to the S and W, respectively (Table 5.17).

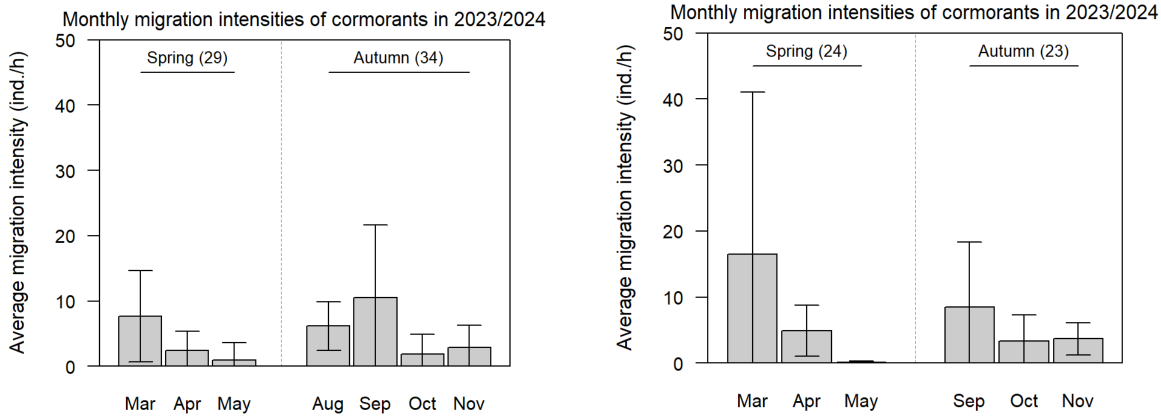


Figure 5.56 Mean monthly diurnal migration intensity of cormorants in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

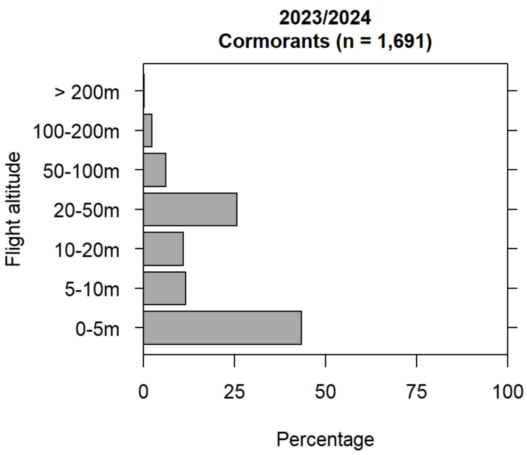
KF II OWF S

Similar numbers of individuals were observed in spring and autumn in the southern area (Table 5.10), but there were more than twice as many cormorants observed in 2024 than in 2023 (n 2023 = 436, n 2024 = 970). Cormorants represented almost 0.95% of all migrating birds in spring and autumn of 2023 (thus are not shown as species group in Figure 5.43). In 2024, however, they represented 2.0% and 3.9% of all migrating birds seen in spring and autumn respectively (Figure 5.43).

They were also relatively frequent in spring with observations on 14 out of the 24 survey dates in spring (Table 5.13) and on each of the survey dates in autumn (23/23, Table 5.14). Mean migration intensities were at similar levels (4.2 ind./h in spring and 5.4 ind./h in autumn, Table 5.13, Table 5.14), but the median values were larger in autumn (0.5 ind./h vs. 2,4 ind./h), since the variability was larger in spring, too. The maximum value occurred in spring with 53.2 ind./h at the end of March 2024, whereas in mid-September 2024, the maximum value of the autumn was registered and was half the maximum of spring (28.3 ind./h, Table 5.13, Table 5.14). Like the northern area, the maximum monthly intensity was observed in March with the subsequent months registering fewer cormorants. In autumn, the maximum monthly intensity occurred in September with fewer cormorants being observed in October and November (Figure 5.56). Overall, however, there were comparable monthly migration intensities in the two areas.

In comparison to the northern area, the distribution of flying altitudes of cormorants in spring and autumn in the southern area differed somewhat. In spring, almost 74% of all cormorants flew in the near-surface layer (0-5 m), and about 89% of all birds flew below 20 m of altitude with only 11% flying between 20 and 100 m of altitude (Table 5.16). In autumn, only 47% of all birds were observed flying below 20 m of altitude and the rest flew between 20 and 200 m of altitude (Table 5.16). Only one individual flew above 200 m of altitude. This also resulted in a slightly higher mean flying altitude in autumn compared to spring (Table 5.16). When combining both seasons (of both years), about 54% of all birds flew close to the surface (0-5 m) whereas 13% flew between 5 and 20 m and a third (~33%) flew above 20 m of altitude (Figure 5.57).

Cormorants flew mainly in the expected migration directions. In spring, most birds flew directly to the NE (69%) with another 19% flying to the north. In autumn, most cormorants flew to the SW (49%) with another 20% flying to the south and 10% to the west. Other directions were less common, but another 11% flew even to the SE (**Fejl! Henvisningskilde ikke fundet.**).



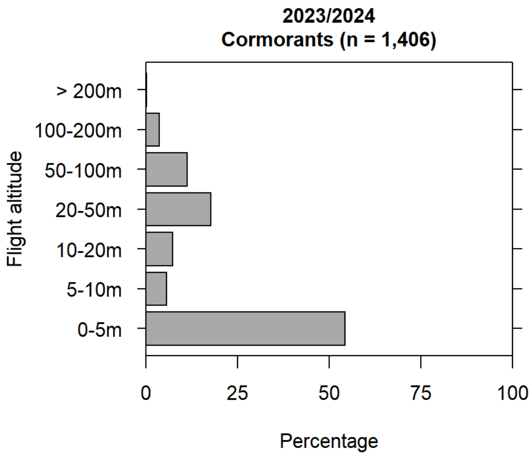


Figure 5.57 Flight altitudinal distribution of cormorants during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

SWANS

Swans were neither abundant nor frequent. Nonetheless they represented > 1% of all migrating birds in autumn of 2023 in the northern pre-investigation area (Figure 5.42).

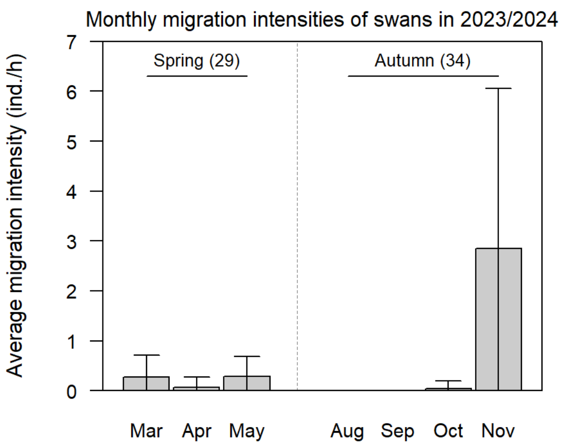
Table 5.28 Number of individuals per species of swan in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Mute Swan		14	16	30	6	10	16
Bewick´s Swan	x	4	0	4	0	0	0
Whooper Swan	x	4	69	73	0	17	17
unidentified swan		25	8	33	24	4	28
All swans		**47**	**93**	**140**	**30**	**31**	**61**

KF II OWF N

Twice as many swans were registered in autumn than in spring in the northern pre-investigation area (Table 5.28), with many more individuals registered in the first year of surveys than in the second year (n 2023 = 121, n 2024 = 19). In fact, swans observed in autumn correspond all to individuals that were observed in the first year. In autumn of 2024, no swans were seen. In the northern pre-investigation area, three species were identified, the most common one was the whooper swan that were mainly observed in autumn, when the species represented 74% of all swans seen. The two other species seen were the mute swan and the Bewick's swan. Of this species, only four individuals were seen in spring of the first year.

Swans were not very common and were seen in 11 out of 29 survey dates during spring and in 6 out of 18 dates (survey dates in autumn of 2023, Table 5.11, Table 5.12). The mean spring migration intensity was similar in both years, and when both years data were pooled, it was 0.2 ind./h (Table 5.11). In autumn of 2023, the mean migration intensity was higher (0.6 ind./h, Table 5.12). Maximum migration intensities in spring ranged between 1.1 and 1.2 ind./h, whereas the maximum migration intensity in autumn was 8.9 ind./h (Table 5.11 and Table 5.12). The monthly migration intensities of swans were in general low in spring and were lower in April. In autumn, swans were seen only by the end of the season, with many more birds occurring in November (Figure 5.58).



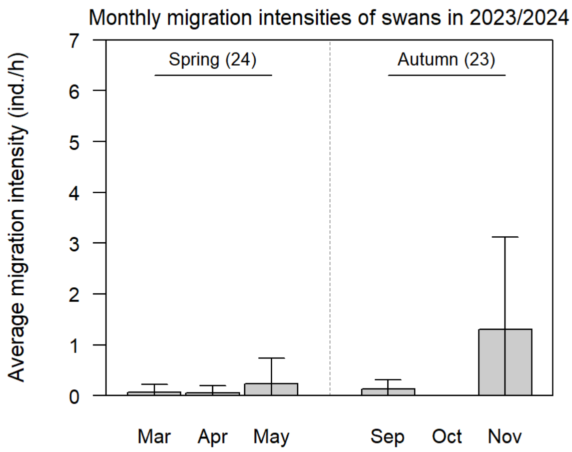


Figure 5.58 Mean monthly diurnal migration intensity of swans in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented as standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

The altitudinal distribution of swans differed slightly between spring and autumn with a larger proportion of individuals flying close to the sea surface in spring than in autumn (~75% of all birds seen in spring were flying between 0-5 m whereas this proportion was about 43% in autumn, Table 5.15). In general, 19% of all migrating swans were flying above 20 m of altitude in spring, but about 36% flew above this altitude layer in autumn). No swan was observed flying above 100 m of altitude (Table 5.15, Figure 5.59).

In spring, about half of the observed swans flew to any of the three directions more often chosen in spring (N-NE, E), whereas 34% of swans (the preferred direction) flew to the west and another 13% to the SW. In autumn, a similar pattern was observed with 31% flying to the SW and similar proportions (18 and 19%) flying to the west or to the S). However, about 19% of swans flew directly to the NE during autumn (Table 5.17).

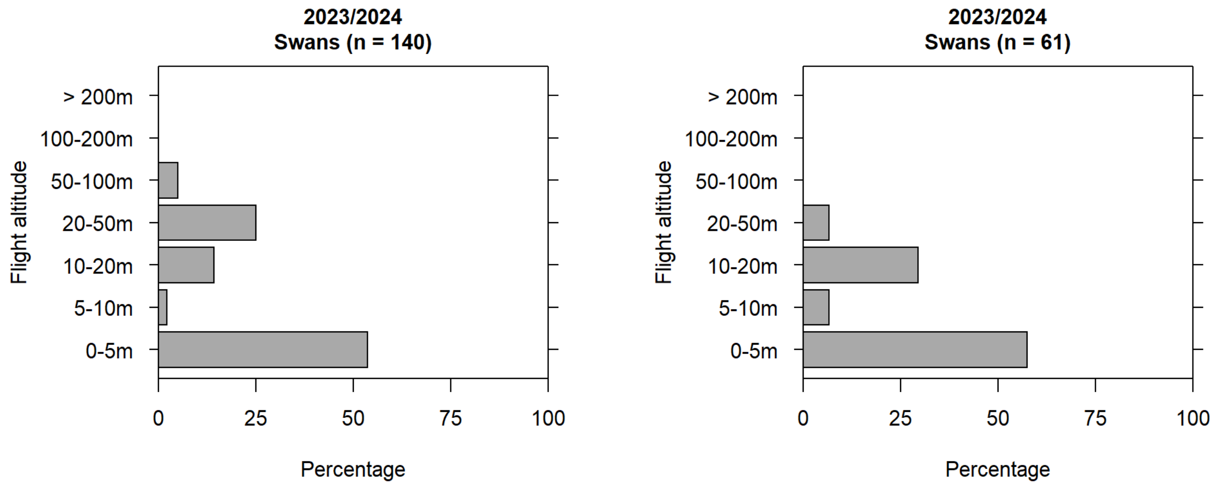


Figure 5.59 Flight altitudinal distribution of swans during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

There were fewer swans observed in the southern pre-investigation area than in the northern area, but when data of both years is pooled similar number of swans were registered in each season (Table 5.28). There were however more swans observed in the second year of surveys than in the first year of surveys (n 2023 = 23, n = 2024 = 38). In contrast to the pattern observed in the northern pre-investigation area, in autumn of 2023 only two swans were observed with most of the individuals registered in autumn of 2024. Only two species were identified: whooper swan and mute swan and both were seen at similar proportions (Table 5.28).

The mean migration intensity was lower in spring than in autumn (0.15 ind./h vs. 0.28 ind./h, respectively, Table 5.13, Table 5.14). The maximum migration intensity value in spring was observed in May of 2023 (1.8 ind./h) and the maximum value in autumn was 4.0 (November 2024, Table 5.13, Table 5.14). The monthly migration intensities of March and April were at a similarly low level, and migration intensity increased slightly in May. In autumn, swans were seen in September and November, with most individuals being observed in November (also the month with the highest migration intensity, Figure 5.58).

The overall flight altitudinal distribution of swans in the southern pre-investigation area was very similar to the one in the northern pre-investigation area when the data of both years and seasons were pooled. There were certain differences between seasons too (Table 5.16). All swans were seen flying below 20 m of altitude in spring with most of them (>50%) flying between 10 and 20 m. In autumn, most swans (87%) flew close to the sea surface and the rest flew between 20 and 50 m. The resulting pattern is shown in **Fejl! Henvisningskilde ikke fundet.**.

Swans did not fly in the expected spring direction. Over 60% of all swans flew to the west with another 23% of the birds flying to the NW. In autumn, the preferred directions were the SW and the S (32% of individuals flew to each of these directions. Another 10% flew to the west and almost 18% flew to the NE in autumn (Table 5.18).

GEESE

Geese were the most common group of birds seen during all seasons at both areas (except in the southern area in autumn of 2024). Taken together, geese made up for at least two thirds of all migrating birds seen in any of the areas over the two years (Figure 5.42 and Figure 5.43).

Table 5.29 Number of individuals per species of goose in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Bean goose	x	10	135	145	0	1	1
Tundra bean goose		0	23	23	0	2	2
Pink-footed goose		0	0	0	0	5	5
Greater white-fronted goose	x	519	166	685	350	953	1,303
Greylag goose		599	350	949	344	206	550
Canada goose		96	2	98	0	8	8
Barnacle goose	x	18,511	6,176	24,687	7,838	6,689	14,527
Brent goose		2,037	1,708	3,745	19,452	272	19,724
Common shelduck		3	5	8	0	0	0
Unidentified black goose		0	526	526	14,203	129	14,332
Unidentified grey goose		0	131	131	0	521	521
Unidentified goose		5,924	3,163	9,087	190	4,142	4,332
All geese		**27,699**	**12,385**	**40,084**	**42,377**	**12,928**	**55,305**

KF II OWF N

Most geese (69%, n = 27,699, Table 5.29) were observed in spring and in the second year of surveys (n 2023 = 6,925, n 2024 = 33,159). A total of eight species were identified in the northern area during both years and seasons. About 24% of all geese observed in the northern area remained unidentified to species level (**Fejl! Henvisningskilde ikke fundet.**). The most common species in both seasons was the barnacle goose (Branta leucopsis), which represented 67% and 50% of all geese observed in spring and autumn, respectively (**Fejl! Henvisningskilde ikke fundet.**). The second most common species was the brent goose (Branta bernicla) which represented 7% and 14% of all geese observed in spring and autumn, respectively (**Fejl! Henvisningskilde ikke fundet.**), mostly observed in 2024. Other relatively common species were the greylag goose (Anser anser) and the greater white-fronted goose (Anser albifrons) which accounted for about 2.4% and 1.7%, respectively, of all geese observed in the northern area over the two seasons. Other species were less common and showed some seasonality (e.g., bean geese were more common in autumn and Canada geese were more common in spring).

Altogether, geese were very common and represented between 36.9% (autumn of 2023) and 92.9% (spring of 2024) of all migrating birds observed in each season and year in the northern area (Figure 5.42).

Geese were also frequently occurring and were seen on 23 survey dates in spring and 23 survey dates in autumn. Average migration intensities in spring varied between the years but the overall mean migration intensity in spring was 114.1 ind./h with a median value of 4.8 ind./h. Maximum daily value was 1345.1 ind./h on the 9th of May 2024 (Table 5.11). In autumn, mean migration intensity was 73.8 with a median of 1.3 ind./h. The maximum value was at a similar level (1255.6 ind./h) and occurred in mid-October 2024 (Table 5.12).

In spring, geese (mainly barnacle geese) were mostly seen in May whereas in autumn most geese were seen in October (Figure 5.60).

Geese displayed a similar altitudinal distribution in spring and autumn with the largest number of geese being observed flying close to the surface (54% in spring and 57% in autumn) and about a third of all geese flying below 20 m of altitude (64% in spring and 67% in autumn). In spring, the rest of birds were flying between 20 and 200 m whereas in autumn 2% of birds flew over 200 m of altitude and 31% between 20 and 200 m. Mean flying altitude was also higher in autumn than in spring (Table 5.15). Taken together, about 55% of all geese flew close to the surface over the two years and two seasons. About 14% flew between 20 and 50 m and another 14% between 50 and 100 m and only 6% in the layer between 100-200 m. Less than 1% flew above this altitude layer (Figure 5.61).

Geese flew in a NE direction in spring (86% of all migrating geese) and in a SW direction in autumn (73% of all migrating geese). In autumn, another 19% of all geese migrated also to the west (Table 5.17).

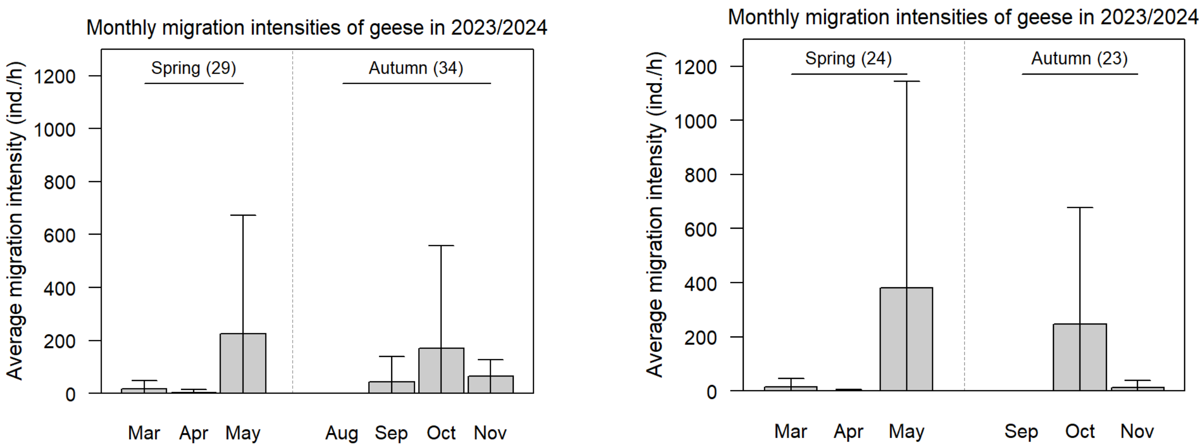


Figure 5.60 Mean monthly diurnal migration intensity of geese in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented as standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

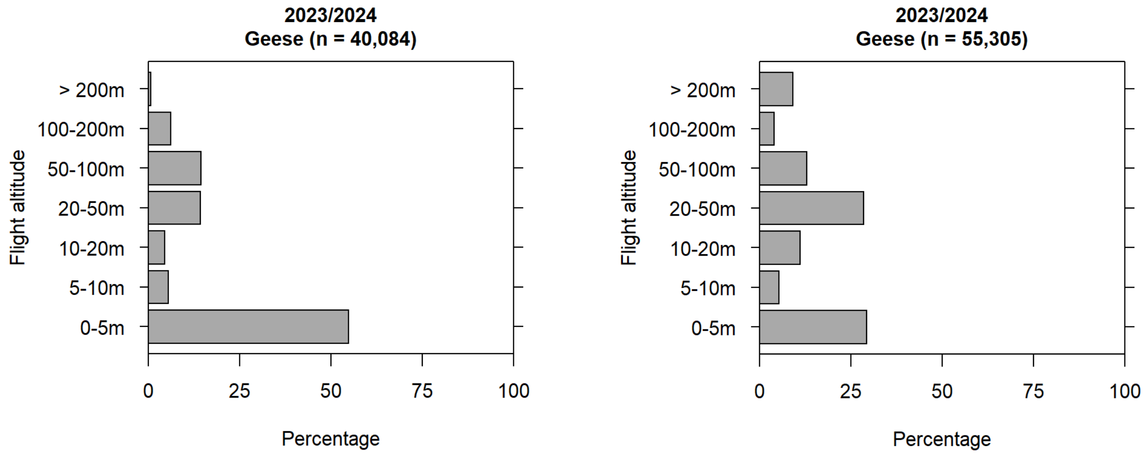


Figure 5.61 Flight altitudinal distribution of geese during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

Geese were also registered during nights. Calls of geese were heard repeatedly in spring of 2024 when 545 calls of barnacle geese were heard. In autumn, a total of 31 calls were heard over the two years of surveys, including two nocturnal calls of greater white-fronted goose. Geese represented the most commonly heard group of birds during nights in spring of 2024 (85.7%, Figure 5.48), which was an unexpected result since geese are often considered diurnal migrants. Overall, the mean nocturnal migration intensity of geese in spring was 3.0 calls/h with a maximum migration intensity of 46.7 calls/h on the night of 10th of May 2024. There was also a second peak on the night before with 36.9 calls/h (Figure 5.50). In autumn, the mean migration intensity was 0.15 calls/h and the maximum intensity was in mid-October 2024 (3.8 calls/h).

KF II OWF S

Geese were even more common in the southern area than in the northern area despite fewer survey dates available. In spring (both years pooled), a total of 42,377 were observed and these represented 77% of all geese observed in both seasons. More geese were registered in 2023 than in 2024 (n 2023 = 33,442; n 2024 = 21,863). Eight species were identified. In comparison to the northern area, no Canada goose was registered but five individuals of pink-footed goose were observed instead. About 34% and 37% of all geese observed in spring and autumn, respectively, could not be identified to species level.

In spring, geese represented between 82.8% (2023) and 92.9% (2024) of all migrating birds observed during daytime, whereas in autumn they represented 59.1% and 15.4% of all migrating birds in each year (Figure 5.43).

The most common species in 2023 was the barnacle goose which represented 34% and 59% of all migrating geese in spring and autumn, respectively. In 2024, barnacle geese were not as common and represented just 1.6% of all geese observed in that year. In turn, brent geese were very common representing 89% of all geese observed in 2024 in the southern area, almost all of them registered in spring. Other species that were common in the southern area and occurred in both years were the greater white-fronted goose and the greylag goose which represented 2.4% and 0.9%, respectively, of all geese observed in the southern area over the two years and seasons.

Geese were also frequently observed in the southern area. They were registered on 18 (out of 24) survey dates in spring and 14 (out of 23) survey dates in autumn (Table 5.13 and Table 5.14). Mean migration intensity in spring was 208.8 ind./h with a median of 2.9 ind./h, whereas in autumn the mean migration intensity (110.3

ind./h) and the median (1.1 ind./h) were lower (Table 5.13 and Table 5.14). Maximum daily migration intensity in spring was 2303.5 ind./h and occurred in May 2024 (Table 5.13), whereas in autumn the maximum value was 1244.9 ind./h and was in mid-October 2023 (Table 5.14). As in the northern area most geese were observed in May and in October (Figure 5.60).

The distribution of flying altitudes of geese in spring and autumn was similar and differed only in the proportion of birds flying in the lowest layer. In spring, about 25% of all geese were flying just above the sea surface (0-5 m), whereas in autumn this proportion was 44%. Furthermore, almost 48% of all geese in spring were flying between 20 and 200 m of altitude whereas 38% of all geese in autumn were flying at this altitude range (Table 5.16). Mean flying altitudes were similar. When pooling data of both seasons, some differences in the altitude distribution of flight behaviour were detected with respect to the northern area: 29% of all geese flew between 0 and 5 m of altitude, and a similar percentage flew between 20 and 50 m of altitude. About 9% of all geese in the southern area flew above 200 m of altitude (Figure 5.61).

Geese flew mainly to the NE in spring (95% of all geese). In autumn, most flew to the SW and 35% of all geese flew to the west (**Fejl! Henvisningskilde ikke fundet.**).

Geese were also heard at night in the southern area but at a low rate: only 5 calls of brent goose were registered in spring of 2023 with a maximum value of 1.1 calls/h. Migration intensity was < 0.1 calls/h.

DUCKS

Ducks were the second most abundant group of migrating birds in both areas during both seasons (Figure 5.42 and Figure 5.43). They also occurred very frequently being observed on almost all survey dates in spring (28 out of 29, Table 5.11) and on all survey dates in autumn (34 survey dates, Table 5.12).

Table 5.30 Number of individuals per species of ducks in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Eurasian wigeon	x	16	619	635	26	866	892
Gadwall		2	0	2	0	3	3
Eurasian teal		0	263	263	16	134	150
Mallard		2	9	11	4	37	41
Northern pintail	x	8	23	31	1	34	35
Northern Shoveler	x	0	41	41	8	5	13
unidentified swimming duck		3	75	78	8	73	81
Common pochard	x	0	1	1	0	0	0
Tufted duck	x	8	16	24	0	67	67
Greater scaup	x	0	28	28	0	7	7
Common eider	x	1,587	1,361	2,948	1,353	4,483	5,836
Long-tailed duck	x	84	18	102	45	8	53
Common scoter		1,171	3,277	4,448	2,422	926	3,348
Common scoter / velvet scoter		25	41	66	0	33	33
Velvet scoter	x	56	176	232	70	127	197
Common goldeneye		0	4	4	0	1	1

Red-breasted merganser	x	238	82	320	87	67	154
Goosander		26	38	64	9	140	149
unidentified merganser / goosander		22	27	49	4	5	9
unidentified duck		109	1,181	1,290	71	654	725
All ducks		**3,357**	**7,280**	**10,637**	**4,124**	**7,670**	**11,794**

KF II OWF N

There were twice as many ducks seen in autumn than in spring. The number of species seen in autumn was higher than the number of species seen in spring over the two years (15 species in autumn, 11 in spring, Table 5.30). Ducks were somewhat more numerous in 2024 than in 2023 but there was not such a large difference between the years (n 2023 = 4,777; n 2024 = 5,860). The number of ducks that could not be identified to species level was also larger in autumn than in spring (156 and 1,324 ducks could not be identified in spring and autumn, respectively), and these represented 4.7% and 18.2% of all ducks in each season in the northern area, respectively (Table 5.30).

In spring, the most common species observed over the two years was the common eider which represented almost half of all migrating ducks in the northern area (47.3%), followed by common scoters that represented 34.9% of all ducks in that season. Red-breasted mergansers were also common (7.1%). In autumn, the most common species were common scoters, common eiders and to a lesser extent Eurasian wigeons that represented 45%, 18.7% and 8.5% of all ducks seen in autumn, respectively. Other less frequently observed ducks were the Eurasian teal (only seen in autumn and represented 3.6% of all ducks in autumn), velvet scoters (1.7% in spring and 2.4% in autumn) and long-tailed ducks (2.5% in spring, 0.2% in autumn, Table 5.30).

Mean migration intensity in spring was 17.0 ind./h with a median value of 6.1 ind./h. The maximum value in spring was 99 ind./h and took place in April 2023 (Table 5.11). In autumn, the mean migration intensity over the two years was higher than that of spring: 34.9 ind./h with a higher median value as well (21.8 ind./h). The maximum value of autumn occurred in August 2024 and was 173.1 ind./h (Table 5.12). Most ducks were seen flying in April with the mean of March being about half of that of April. In May, very few ducks were seen. In autumn, relatively many ducks were seen in August, with the maximum number of ducks occurring in September and then the number of ducks progressively reduced throughout the rest of the season (Figure 5.62). Nevertheless, ducks were, as mentioned before, seen during all survey dates.

Ducks were mostly seen flying very close to the surface: 59% of all ducks flying in the northern area were flying between 0 and 5 m of altitude (Figure 5.63). Approximately the same number of ducks were seen flying in the next three altitude layers above the surface (5-10, 10-20 and 20-50 m), representing between 12-13% of all ducks. In comparison, less than 4% of all ducks were observed flying above 50 m (Figure 5.63). There was a small difference in the altitudinal distribution between seasons, with many more ducks flying in near-surface category (0-5 m) in spring (70%) than in autumn (54%) and fewer ducks flying between 20-200 m in spring than in autumn (7% vs. 21%, Table 5.15).

In spring, most ducks flew in the expected NE direction (42%) but another 15.5% flew directly to the north and 14% to the east, with almost 30% flying in other directions. In autumn, most ducks flew to the west (48%) with about 30% flying to the SW and 8% flying to the NW (Table 5.17).

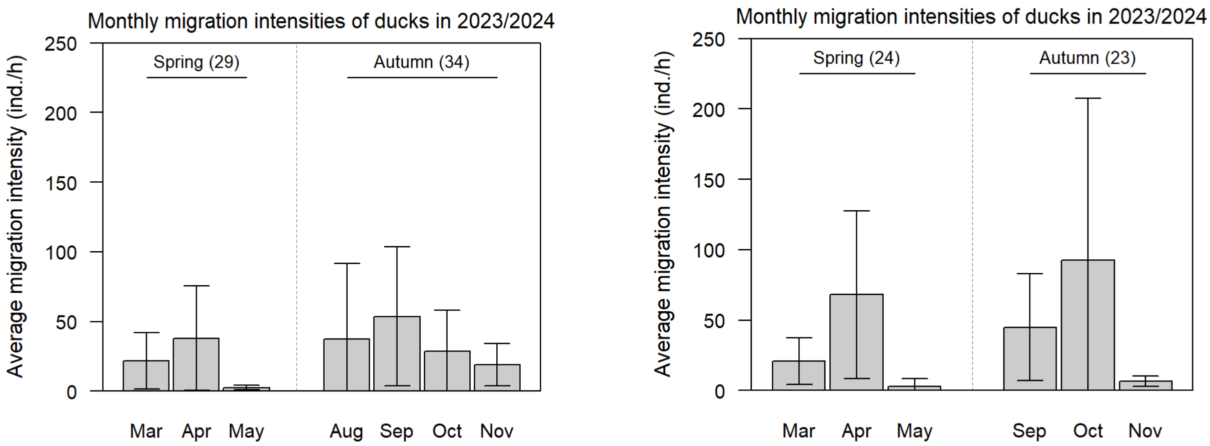


Figure 5.62 Mean monthly diurnal migration intensity of ducks in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

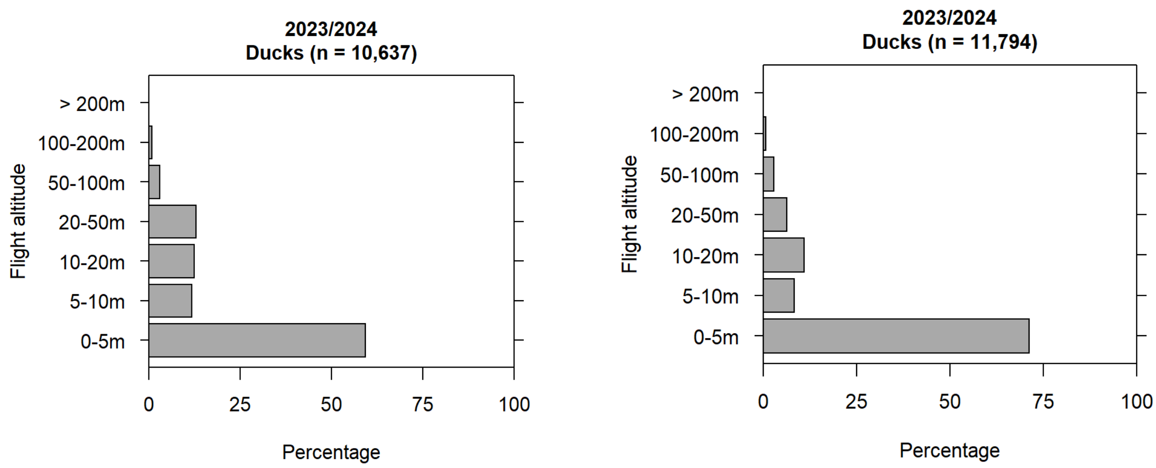


Figure 5.63 Flight altitudinal distribution of ducks during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

During nights, ducks were rarely heard. In the first year only calls of common scoter were registered, whereas in the second year, calls of common eiders, tufted ducks and common teals were heard.

KF II OWF S

Similar to the northern area, there were almost twice as many ducks observed in autumn than in spring (4124 vs. 7670 ducks, Table 5.30) with 15 species occurring in autumn and 13 species in spring. More ducks remained unidentified to species level in autumn than in spring (83 and 765 individuals, in spring and autumn, respectively, Table 5.30) which represented 2.0% and 10.0% of all ducks in each season, respectively. In contrast to the northern area, many more ducks were observed in 2023 than in 2024 (n 2023 = 8,086, n 2024 = 3,708).

In terms of species composition, the most common species observed in spring was the common scoter which accounted for 58.7% of all ducks seen in spring. The second most common species in spring was the common eider (32.8%). Other less frequently encountered species were the red-breasted merganser (2.1%), the velvet scoter (1.7%) and the long-tailed duck (1.1%). In autumn, the most common species was the common eider that represented 58.4% of all ducks seen in the area, whereas common scoters and Eurasian wigeons were less common (12.1% and 11.3%, respectively). Other species that occurred less frequently were the goosander (1.8%) and the Eurasian teal and velvet scoter (each representing 1.7% of all ducks seen in autumn, Table 5.30).

Ducks were also seen frequently in this area (20/24 survey dates in spring, Table 5.13) and in all survey dates in autumn (23 survey dates, Table 5.14). Mean migration intensity in spring was 24.9 ind./h with a mean of 5.7 ind./h whereas the maximum daily migration intensity was 166.3 ind./h registered in mid-April 2023 (Table 5.13). In autumn, the mean migration intensity was 59.0 ind./h with a larger median value (30.8 ind./h) and a higher maximum intensity (357.6 ind./h) which took place in mid-October 2023 (Table 5.14). The monthly mean migration intensities followed a similar pattern in spring with most ducks being observed in April and very few in May. In autumn, the highest migration intensity was observed in October, however and and not in September (Figure 5.62).

In comparison to the northern area, a larger proportion of ducks were flying close to the sea surface in the southern area (71%), another 19% flew between 5 and 20 m of altitude and < 10% of all ducks flew above 20 m of altitude (Figure 5.63). When looking at the flight altitude distribution of ducks in each season, more ducks were flying in the lowest altitude layer in autumn than in spring (76% vs. 63% respectively), while more ducks flew above the 20 m altitude layer in spring than in autumn (12% vs. 9%, Table 5.16).

Ducks flew in the expected directions in spring (58% flew to the NE, 14% to the E and 6% to the N) and in autumn (55% flew directly to the SW, 26% to the west and 13% to the south, **Fejl! Henvisningskilde ikke fundet.**).

Ducks were also heard during nights, but at low intensities and only in spring of the first year of surveys. Calls of two species were heard (common teal and common scoter).

BIRDS OF PREY

Table 5.31 Number of individuals per species of birds of prey in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
European honey-buzzard	x	0	15	15	4	12	16
Red kite	x	0	59	59	0	9	9
White-tailed eagle	x	2	0	2	2	0	2
Eurasian marsh harrier	x	0	15	15	0	2	2
Hen harrier	x	1	2	3	1	8	9
unidentified harrier		1	2	3	2	2	4
Northern goshawk		0	0	0	0	2	2
Eurasian sparrowhawk		10	75	85	11	136	147

Common buzzard		0	0	0	0	2	2
unidentified *Buteo* buzzard		1	0	1	0	0	0
unidentified bird of prey		0	0	0	4	7	11
Osprey	x	1	8	9	0	7	7
Common kestrel		1	5	6	1	14	15
Merlin	x	3	5	8	0	14	14
Eurasian hobby		0	0	0	1	0	1
Peregrine falcon	x	0	0	0	0	2	2
All birds of prey		**20**	**186**	**206**	**26**	**217**	**243**

KF II OWF N

A total of nine species of birds of prey were identified over the two years of surveys in the northern area. Birds of prey were more common in autumn than in spring (20 individuals vs. 186 individuals in spring, and autumn, respectively, Table 5.31). Similar number of birds were seen in each year of survey (n 2023 = 95, n 2024 = 111).

Only in autumn of 2023, were birds of prey common enough to represent >1% of all migrating birds (Figure 5.42). In the rest of the seasons, they represented < 1% of all migrating birds. Of the 20 birds of prey seen during spring migration, half of them were Eurasian sparrowhawks. In autumn, the most commonly occurring species were also Eurasian sparrowhawks (40.3% of all birds of prey), followed by red kites (31.7%) and similar numbers of European honey buzzards and Eurasian marsh harriers (8.1% each, Table 5.31).

Birds of prey were not frequently occurring in spring (they were seen in 12/29 survey dates in spring) at very low migration intensities (mean: <0.1 ind./h, median = 0, Table 5.11). The maximum migration intensity in spring was 0.4 ind./h and occurred in late April 2024. In autumn, they were more frequently seen (21/34 survey dates) with higher migration intensities (mean = 1.0 ind./h, median = 0.2 ind./h, Table 5.12). The maximum migration intensity of autumn was 7.0 ind./h and was in mid-October 2024. In spring, monthly migration intensities were low but most birds were registered in April. In autumn, migration intensities were at a similar range in September and October (Figure 5.64).

The altitudinal flight distribution of birds of prey slightly differed between spring and autumn. In spring, most birds flew close to the sea surface (0-5 m, 65%), 20% flew between 20-200 m and no birds flew above 200 m. In autumn (when most birds of prey were detected, Table 5.15), less than a third of all birds of prey flew in the first altitude layer (0-5 m), whereas about 32% flew between 20 and 200 m. and almost 13% of all birds of prey flew above 200 m of altitude (Table 5.15). Overall, mean flight altitude in each season was similar. Figure 5.65 shows the overall altitude distribution of birds of prey when data of both seasons was pooled.

In spring, birds of prey were mostly observed flying to the N and NE (44% and 39%, respectively). In autumn, the preferred direction of flight was SW (40%) with 27% flying to the south and another 24% flying to the west (Table 5.17).

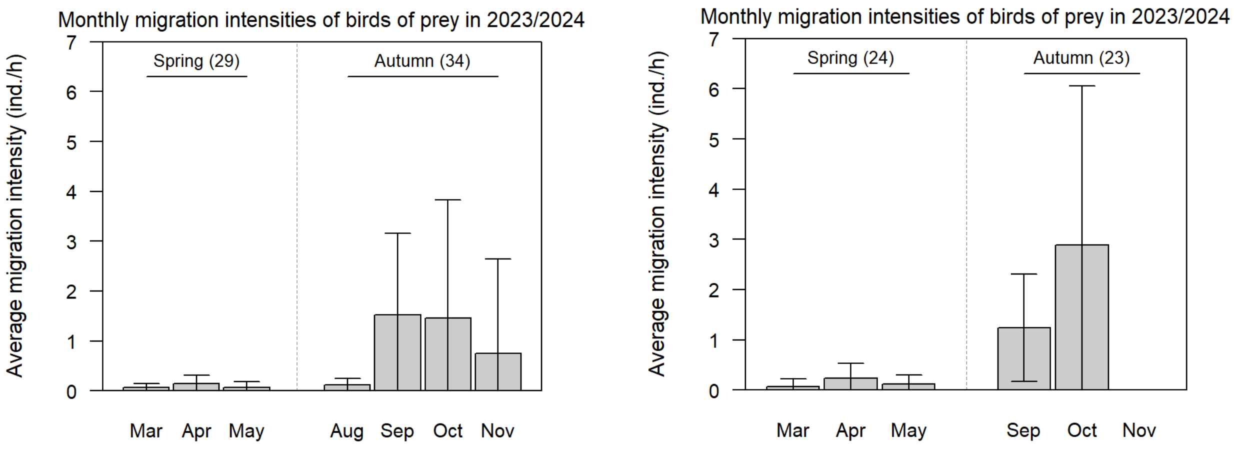


Figure 5.64 Mean monthly diurnal migration intensity of birds of prey in both years (data pooled in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

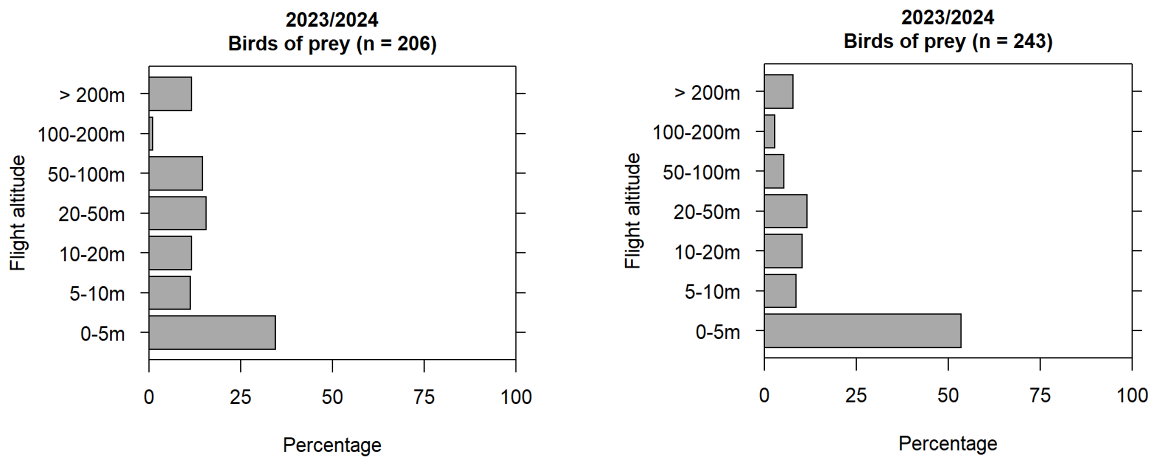


Figure 5.65 Flight altitudinal distribution of birds of prey during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

Migration patterns of birds of prey in the southern area were similar to those of the northern area. A similar number of birds of prey was seen in both years (n 2023 = 119, n 2024 = 124) and many more birds of prey were registered in autumn than in spring (217 vs. 26, Table 5.31).

The most common species was again the Eurasian sparrowhawk which represented 42% and 63% of all birds of prey observed in each season. Other species relatively common were the European honey-buzzard in spring (15%) and autumn (~6%) and common kestrel, merlin and red kite (that represented ~6%, ~6% and 4% of all birds of prey in autumn, respectively (Table 5.31).

Birds of prey were also seen on about half of the survey dates in spring (12/24, Table 5.13). Mean migration intensities in spring were low (0.15 ind./h). Median was 0.06 ind./h, and the maximum migration rate was 0.8 ind./h and was registered in April 2023 (Table 5.13). In autumn, birds of prey were more frequently observed (18/23 survey dates, Table 5.14) and the mean migration intensity (1.7 ind./h) and the median (0.9 ind./h) were higher than in spring. The maximum intensity was 10.4 ind./h and occurred in mid-October 2024 (Table 5.14). The migration pattern in spring resembled the migration pattern observed in the northern area. In autumn, birds of prey only occurred in September and October (no survey date in August) with the maximum monthly intensity being observed in October (Figure 5.64).

In comparison to the northern area, a larger proportion of birds of prey flew in the very lowest altitude category (0-5m) when pooling data of both seasons (and both years, Figure 5.65). About 53.5% of all birds of prey flew in this lowest layer. Almost 20% flew between 20 and 200 m and about 8% flew above 200 m. Small differences in the altitudinal distribution can be, however, seen between seasons, with a larger proportion of individuals flying between 20 and 200 m in spring (46%) than in autumn (16%) and a smaller proportion of individuals flying between 0-5 m in spring than in autumn too (38% vs. 55%). In addition, all birds flying above 200 m were observed only in autumn (Table 5.16).

Birds of prey flew in the expected directions in spring (54% to the NE, 27% to the N) and autumn (57% to the SW, 24% to the west and 17% to the south, Table 5.18).

CRANES

Cranes are represented by one single species (*Grus grus*). The species was only common in the southern area during autumn of 2024 when it represented 12.6% of all migrating birds of that season.

KF II OWF N

A few individuals of this species were seen in both seasons, most of them during spring (70 individuals) whereas only 9 individuals were seen in autumn (all of them in 2024, Table 5.8).

Cranes were not frequently seen in spring (6 out of 29 survey dates). Mean migration intensity was 0.3 ind./h, and the maximum migration intensity was 4.3 ind./h (April 2023, Table 5.11). In autumn, migration intensity was much lower with a mean migration intensity of 0.04 ind./h and a maximum value registered in September (which was also the only date of occurrence of cranes in the northern area, 1/34, Table 5.12). Monthly migration intensities were higher in April (Figure 5.66).

Most cranes flew between 10 and 20 m of altitude (38%) and about 33% flew between 20 and 200 m of altitude. Another 23% flew between 0 and 5 m. The altitude distribution of both seasons (Figure 5.67) is almost very similar to that of spring (since only 9 individuals were seen in autumn, all of them flying between 50 and 100 m of altitude, Table 5.15).

In spring, most cranes flew to the north (69%) and only 14% flew to the NE. In autumn, all individuals flew to the south (Table 5.17).

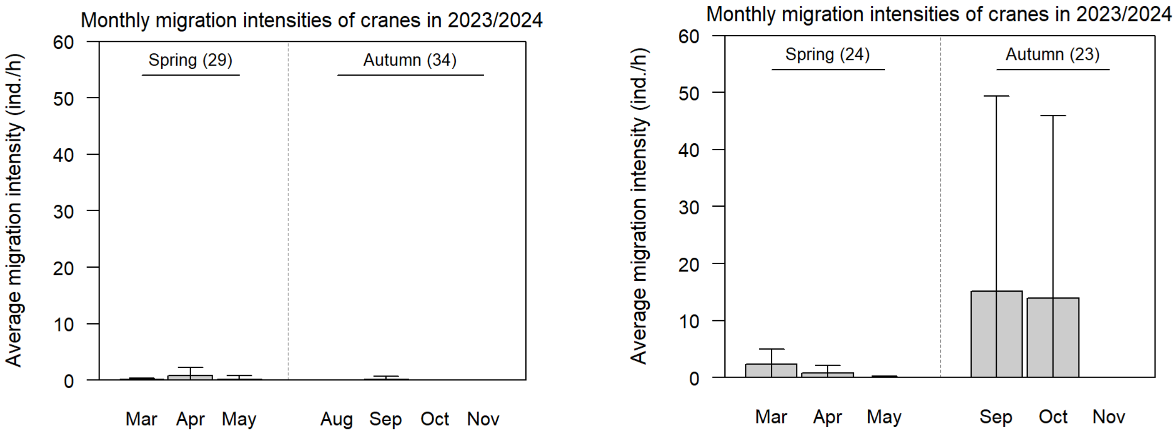


Figure 5.66 Mean monthly diurnal migration intensity of cranes in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

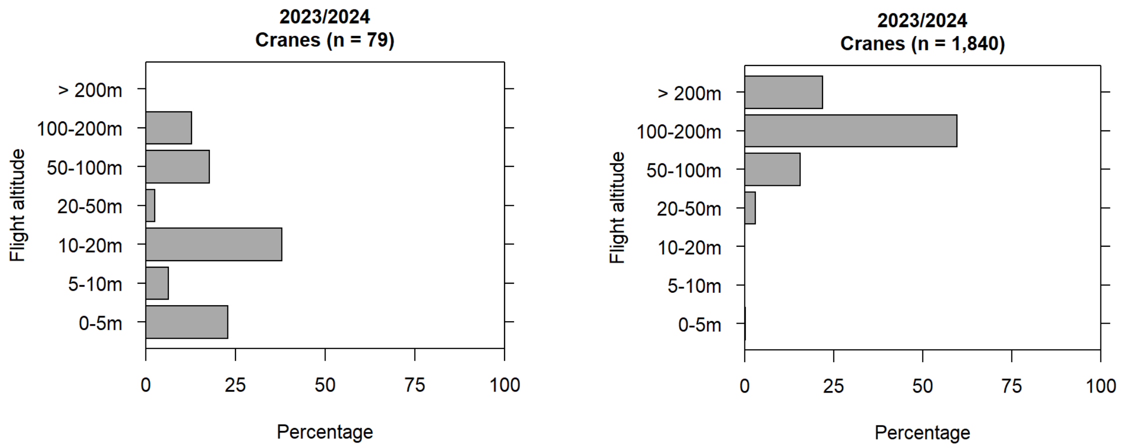


Figure 5.67 Flight altitudinal distribution of cranes during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

<u>KF II OWF S</u>

Cranes were far more abundant in the southern area, especially in autumn of 2024. In 2023, only 64 individuals were seen in spring. In 2024, a total of 1,840 were observed, most of them in autumn (1,738 individuals, Table 5.10).

Cranes were not frequently seen neither in spring (7/24 survey dates) nor in autumn (5/34 survey dates). The mean migration intensity was at a similar low level in spring (0.65 ind./h) with maximum daily migration rates of 5.2 ind./h registered by the end of March 2024. In autumn of 2024, however, high migration rates were registered. The maximum daily migration rate reached 103.9 ind./h in mid-September and mean intensities over the two years reached 12.0 ind./h. Monthly migration intensities are shown in Figure 5.66.

In spring, most cranes were seen flying between 20 and 50 m of altitude (53%) with a large proportion of individuals flying above 100 m (38%). In autumn, most cranes flew between 100 and 200 m of altitude (62%), and all flew above 50 m of altitude. Thus, the mean flight altitude was higher in autumn than in spring. When combining the data of both seasons, patterns of autumn dominate and 78% of all cranes flew between 20 and 200 m of altitude and still 22% flew above 200 m of altitude.

In spring, most cranes flew to the NE (39%) but a considerable number of individuals flew also to the N (33%) and NW (22%). In autumn, most cranes flew directly to the south (67%) with 28% flying to the SE (Table 5.18).

Table 5.32 Number of individuals per species of waders in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Eurasian oystercatcher	x	0	74	74	0	0	0
Little ringed plover		1	0	1	0	0	0
Ringed plover		1	20	21	0	0	0
European golden plover	x	2	39	41	1	6	7
Grey plover		0	10	10	0	0	0
Sanderling		0	0	0	0	2	2
Dunlin	x	0	207	207	0	19	19
unidentified sandpiper		0	0	0	0	23	23
Ruff	x	0	1	1	0	0	0
Snipe	x	0	5	5	0	1	1
Black-tailed godwit	x	0	4	4	0	0	0
Bar-tailed godwit	x	0	15	15	0	0	0
Whimbrel		0	6	6	0	0	0
Eurasian curlew	x	121	8	129	89	3	92
Green sandpiper		0	0	0	0	1	1
Common redshank	x	0	3	3	0	0	0
unidentified wader		30	31	61	0	37	37
All waders		**155**	**423**	**578**	**90**	**92**	**182**

Table 5.33 Number of individuals per species of waders in spring and autumn (2023 and 2024 data pooled) registered during nocturnal acoustic observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Eurasian oystercatcher	x	15	0	15	1	0	1
Pied avocet	x	0	2	2	0	0	0
Little ringed plover		0	2	2	0	0	0
Common ringed plover		3	15	18	0	0	0
Eurasian golden plover	x	4	3	7	0	7	7
Dunlin	x	2	234	236	0	24	24
Jack snipe		0	8	8	0	0	0
Common snipe	x	11	24	35	0	0	0
Bar-tailed godwit	x	2	0	2	0	0	0
Eurasian whimbrel		14	4	18	0	3	3
Spotted redshank	x	0	2	2	0	0	0
Common redshank	x	0	23	23	6	0	6
Wood sandpiper	x	5	0	5	0	0	0
Common sandpiper		2	19	21	2	110	112
All waders		**58**	**336**	**394**	**9**	**144**	**153**

KF II OWF N

A total of 13 species of waders were seen during diurnal migrations in the northern area, and most of them were observed in autumn (only 4 species were registered in spring, Table 5.32). Waders were also more common in 2023 and 2024 (n 2023 = 418, n 2024 = 160). In fact, in 2023, they represented 1.9% and 3.4% of all migrating birds seen in spring and autumn, respectively (Figure 5.42). In 2024, they made up for < 1% of all migrating birds in each season. About the same number of waders could not be identified to species level in each season (19% and 7% of all waders in spring and autumn, respectively, Table 5.32).

In spring the most commonly occurring species was the Eurasian curlew (that only occurred in 2023) and represented 78% of all waders seen in spring. In autumn, the most commonly occurring species was the dunlin (49% of all waders seen in autumn). Other common species in autumn were the Eurasian oystercatcher (18%) and European golden plover (9%, Table 5.32).

Waders were not that frequent in spring (9 out 29 surveys) or autumn (14 out of 34 surveys). The mean spring intensity was 0.74 ind./h, and the maximum value was registered in April 2023 (15.4 ind./h, Table 5.11). In autumn, the mean migration intensity was higher than that of spring (1.7 ind./h), but the maximum migration value was at a similar level (17.9 ind./h) and occurred in September 2023 (Table 5.12). Monthly migration intensities in spring were higher in April, whereas in autumn, the monthly migration intensity was on average higher in August and decreased progressively until October with no waders being observed in November (Figure 5.68).

The altitude flying distribution of waders differed slightly between spring and autumn, especially in the proportions of birds flying above 20 m of altitude. In spring, most birds flew below 20 m of altitude (98%) whereas in autumn, a large proportion flew close to the surface (0-5 m, 70%) but still 26% few between 20 and 100 m of altitude (Table 5.15). Combining data of both seasons results in the altitude distribution shown in Figure 5.69.

In spring, most waders flew directly to the east (81%) whereas only 12% flew to the NE. In autumn, 59% flew to the west and 39% to the SW (Table 5.17).

During nocturnal migration a total of 14 species of waders were registered during both years of surveys in the northern area. Most species and the largest number of calls were registered during autumn (11 species, 85% of all waders' calls heard, Table 5.33). In spring, most calls belonged to three species: Eurasian oystercatcher (26% of all 58 calls in spring), Eurasian whimbrel (24%) and common snipe (19%). In autumn, 69% of all calls belonged to dunlins, whereas calls of snipes and common redshanks were less common (7% each).

KF II OWF S

Waders were more numerous and diverse in the northern area than in the southern area. In the southern area there were less than half of the species (6 species) and half of the total number of individuals seen (Table 5.32). In the southern area, waders represented < 0.5% of all migrating birds registered in each season and no waders were seen in spring of 2024. About the same number of individuals were registered in spring and autumn. Of all waders seen in the southern area (182), about a third of them could not be identified to species level (Table 5.32).

In spring, the most commonly occurring species was the Eurasian curlew (99% of all waders in spring, seen only in 2023). In autumn, most waders were unidentified (65%), and the most commonly observed species were the dunlin (21%) and the European golden plover (7%).

Waders were not commonly encountered. In spring of 2023 they occurred in only 3 out of 12 survey dates. The mean migration intensity of spring over the two seasons was 0.6 ind./h, with the maximum migration intensity registered in April 2023 (8 ind./h, Table 5.13). In autumn, the mean intensity was at a similarly low level 0.7 ind./h with the maximum value reaching 4.5 ind./h in September 2024. In autumn, waders were slightly more frequent (8 out of 23 surveys, , Table 5.14). The same monthly migration patterns were seen as in the northern area with more waders observed in April and September and none in November (there was no survey in August in the southern area, Figure 5.68).

The flight altitudinal distribution of waders in spring and autumn was rather different and is determined by the dominant species of each season. In spring, most waders (99%, all Eurasian curlews) flew between 20 and 100 m of altitude, whereas in autumn, most waders (97%) flew between 0 and 5 m of altitude and only 3% flew between 20 and 50 m (Table 5.16). Figure 5.69 shows the flight altitudinal distribution of waders when both seasons are pooled (the lowest part of the graph corresponds to the altitude distribution during autumn, while the animals flying between 20 and 100 m reflect the birds seen in spring).

In spring, most waders flew to the NE (99%), whereas in autumn, most waders flew to the SW (57%) and the west (39%, Table 5.18).

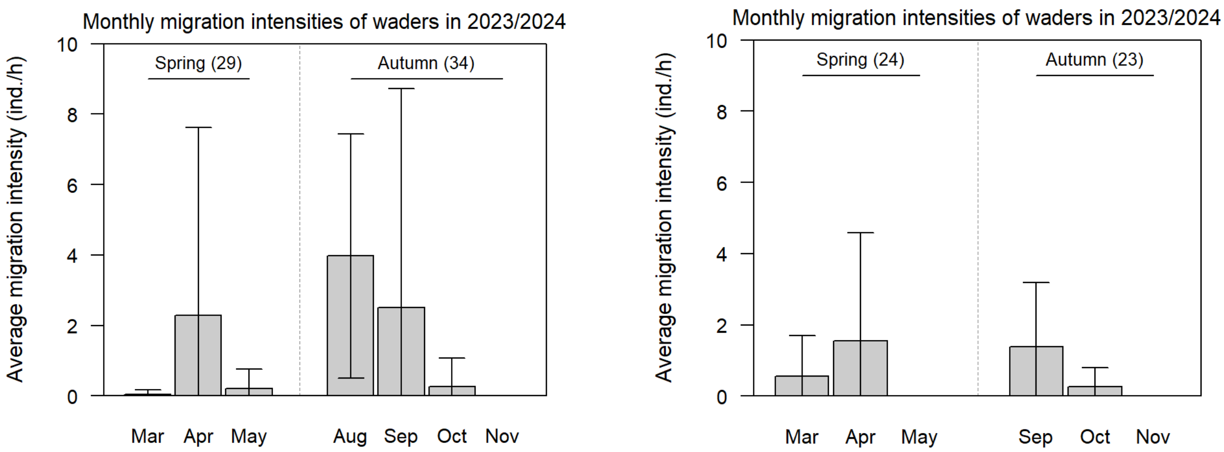


Figure 5.68 Mean monthly diurnal migration intensity of waders in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

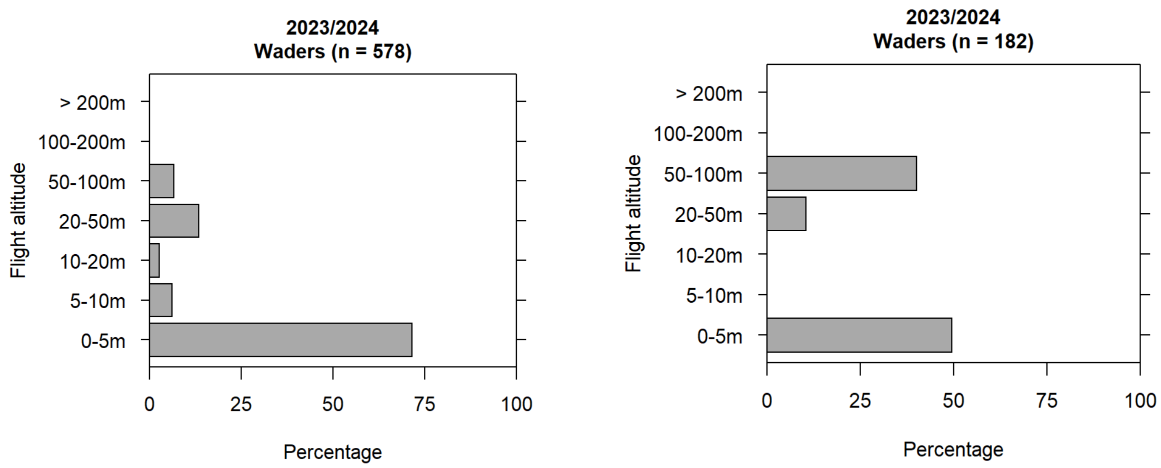


Figure 5.69 Flight altitudinal distribution of waders during visual observations in 2023 and 2024 (both years and seasons pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

Calls of waders were less common in terms of species and in terms of number of calls in the southern area. Less than half of the calls belonging to only six species of waders were heard during the two years of surveys. Waders were much more common in autumn (94% of all calls of waders). In this season, the most commonly heard species of wader was the common sandpiper (76%). Dunlins were the second most commonly heard wader species (17%, Table 5.33). In spring, monthly migration intensities were low with fewer (or none) calls heard in May. In autumn, calls of waders were more common in September in both areas (Figure 5.70).

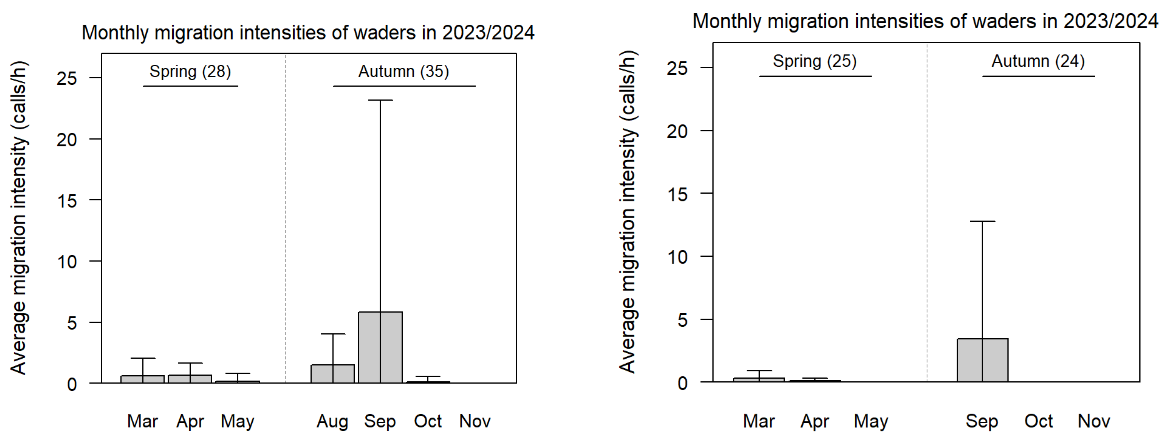


Figure 5.70 Mean monthly nocturnal migration intensity of waders in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey nights in each season and area.

GULLS

Gulls were a frequently occurring group during diurnal migration in both areas and both seasons

Table 5.34 Number of individuals per species of gulls in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Mediterranean gull	x	0	0	0	2	0	2
Little gull	x	32	90	122	19	188	207
Black-headed gull	x	40	90	130	12	31	43
Common gull		242	170	412	96	141	237
unidentified small gull		0	29	29	0	0	0
Lesser black-backed gull	x	37	21	58	25	12	37
Herring gull	x	97	97	194	96	54	150
Caspian gull		1	28	29	11	16	27
Common/herring gull		1	0	1	0	0	0
Great black-backed gull	x	9	55	64	7	44	51
unidentified large gull		18	81	99	23	67	90
Great black-backed gull / lesser black-backed gull	x	1	2	3	0	0	0
Black-legged kittiwake	x	2	3	5	1	0	1
unidentified gull		0	8	8	3	8	11
All gulls		**480**	**674**	**1,154**	**295**	**561**	**856**

Table 5.35 Number of individuals per species of gulls in spring and autumn (2023 and 2024 data pooled) registered during diurnal observations in the pre-investigation areas KF II OWF N and KF II OWF S.

Species		KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Black-headed gull		0	0	0	10	0	10
Common gull		89	0	89	4	0	4
Herring gull		5	0	5	0	0	0
unidentified gull		1	0	1	0	0	0
All gulls		**95**	**0**	**95**	**14**	**0**	**14**

KF II OWF N

Gulls were commonly occurring. They were seen in 26 out 29 survey dates in spring and in all survey dates of autumn. A total of 8 species were identified in the northern area during both seasons and years. About 12% of all gulls seen in the area remained unidentified to species level (140 gulls, Table 5.34). Almost 100 more individuals more were registered in the first survey year (n 2023 = 628, n 2024 = 526).

In the northern area, gulls made up 5% of all migrating birds in spring of 2023, whereas in spring of 2024, they made up for < 0.5% of all migrating birds in the season. In autumn, they made up for 2.9% and 2.3% of all migrating birds in each year, respectively (2023 and 2024, Figure 5.42).

In terms of species, common gull and herring gull were the most common species in spring (50% and 20% of all gulls seen in spring, respectively). Black-headed gulls, lesser black-backed gulls and little gulls were less common (8%, 8% and 7%, respectively). In autumn, common gulls represented a quarter of all gulls in the season (25%) while herring gulls, black-headed gulls and little gulls represented 14%, 13% and 13% of all gulls, respectively. Great black-backed gulls were less frequently observed (8%, Table 5.34).

In spring, the mean migration intensity was 2.4 ind./h with a median value of 1.6 ind./h. The maximum daily migration rate was 10.9 ind./h registered in April 2023 (Table 5.11). In autumn, the mean and median migration rate were slightly higher (3.6 ind./h and 2.5 ind./h). The maximum intensity was 28.8 ind./h and was registered in mid-October 2024 (Table 5.12). Monthly migration intensity rates were high in March and even higher in April and low in May. In autumn, monthly migration intensities increased from August to a maximum monthly average in October, whereas they slightly decreased towards November (Figure 5.71).

The altitudinal flight distribution in both seasons was similar with slightly larger proportions of birds flying between 20 and 100 m in autumn than in spring (45% vs 34%, Table 5.15). In general, about 59% of all gulls flew below 20 m whereas a third of the gulls flew between 20 and 50 m and another 7% flew between 50 and 100 m (Figure 5.72).

In spring, gulls flew mainly towards the NE (45%) with about the same number of individuals flying directly to the north or the east (12.5%). In autumn, a third of the gulls flew to the SW, 16% to the west and 9% to the south. Still, more than 40% of all gulls flew in other directions (Table 5.17).

In the northern area, gulls were only heard during nights in the spring season. A total of 95 calls identified to two species were registered. The most commonly heard species was the common gull (89 calls out of 95 calls, Table 5.35).

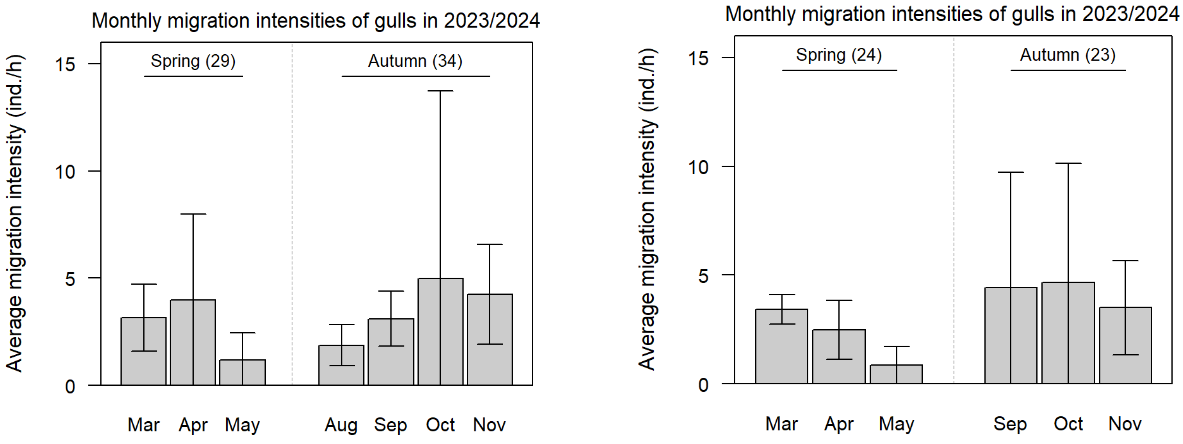


Figure 5.71 Average (mean) monthly diurnal migration intensity of gulls in both years (data combined) in the KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

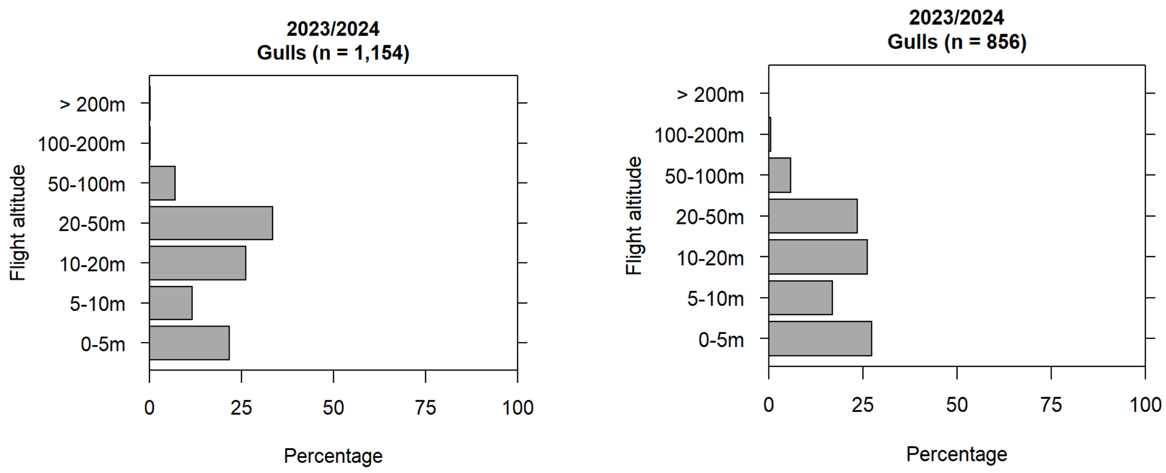


Figure 5.72 Flight altitude distribution of gulls during visual observations in 2023 and 2024 (both years and seasons combined) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

Gulls were also common in the southern area. A total of nine species were registered during both seasons. Almost twice as many gulls were registered in autumn than in season (n spring = 295, n autumn = 561). A similar number of gulls were registered in both years (n 2023 = 437, n 2024 = 419). A similar proportion of all gulls in the southern area could not be identified to species level (12%, Table 5.34). In spring, gulls did not make up > 0.5% of all migrating birds. However, in autumn they made up for 1.3% and 2.4% of all migrating birds in each year, respectively (2023 and 2024).

In spring, the most commonly occurring species were the same as in the northern area: common gulls and herring gulls represented each 32.5% of all gulls seen in the season. Other less frequently occurring gulls were the lesser black-backed gulls (8.5%) and the little gulls (6.4%). In autumn, little gulls and common gulls were most frequently sighted (33.5% and 25% respectively). Other gulls that were still relatively common in this season were the herring gulls (10%) and the great black-backed gulls (8%, Table 5.34).

Gulls were also commonly seen in this area (23 out of 24 survey dates in spring, and all survey dates in autumn). The mean migration intensity in spring was 1.8 ind./h and median migration intensity was 1.45 ind./h. The maximum value in spring was 5.0 ind./h and was registered in April 2023 (Table 5.13). In autumn, the mean migration intensity was higher (4.4 ind./h) with a slightly larger median as well (2.2 ind./h). The maximum value was 17.2 ind./h and occurred in mid-September 2024 (Table 5.14). Monthly migration intensity rates decreased from March to May whereas in autumn, monthly migration intensities remained at the same levels in September and October and slightly decreased in November (Figure 5.71).

The flight altitudinal distribution of gulls in the southern area was similar between spring and autumn with slightly larger proportions of gulls flying above 20 m of altitude in autumn than in spring (31% vs. 27%, Table 5.16). Overall, combining both seasons, about 30% of all gulls flew above 20 m of altitude, and 27% flew between 0 and 5 m (Figure 5.72).

Gulls flew into different directions in spring. Similar proportions of gulls flew to the NE and east (23% and 24%), with all other directions occurring less frequently. In autumn, most birds flew to the SW (36%) and west (27%). NW and south were less commonly chosen flight directions (10% each) and all other directions were less frequent (Table 5.18).

In the southern area, calls of gulls were also only heard during spring during nocturnal migration (similar to the northern area). Then, a total of 14 calls of two species (black-headed gulls and common gulls) were heard (Table 5.35).

TERNS

Terns were much more common in the northern area, especially in autumn.

Table 5.36 Number of individuals per species of terns in spring and autumn (2023 and 2024 data combined) registered during diurnal observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Caspian tern	x	1	0	1			
Sandwich tern	x	39	13	52	11	0	11
Common tern	x	9	303	312			
Arctic tern	x	7	14	21			
Common tern / Arctic tern	x	148	141	289	70	3	73
Black tern	x	0	5	5			
unidentified tern		33	73	106	3	1	4
All terns		**237**	**549**	**786**	**84**	**4**	**88**

KF II OWF N

A total of 786 terns identified to five species were observed in the northern area during both seasons and both years. Of these, half of them could not be identified to species level (common and Arctic terns are morphologically very similar, and difficult to discern in the field). Terns were more common in autumn when more than twice of the terns were sighted (Table 5.36). Terns were more frequent also in the second year of surveys (n 2023 = 306, n 2024 = 480). Terns accounted for less than 1% of all individuals seen in spring but they represented 3.1% and 1.6% of all migrating birds in autumn of 2023 and 2024, respectively (Figure 5.42).

In spring, common terns/Arctic terns (morphologically similar species difficult to tell apart) were sighted as the most commonly occurring in the area (62%), followed by Sandwich terns (16.5%). In autumn, common terns (55%) were more common, followed by the group of common/Arctic terns (26%, Table 5.36).

Terns were sighted for about half of the survey dates in spring (18/29 survey dates) and autumn (15/34 survey dates). The mean migration intensity in spring was 1.1 ind./h and a median of 0.3 ind./h. The maximum daily migration rate in the season was 9.6 ind./h and was observed in May 2024 (Table 5.11). In autumn, the mean migration rate of both years was 2.1 ind./h, and the maximum daily migration rate was observed in August 2023 (23.4 ind./h, Table 5.12). Monthly migration intensities were low and at similar levels in April (slightly higher) and May and no terns were seen in March. In autumn, they were seen mainly in August with very few birds seen in September (Figure 5.73).

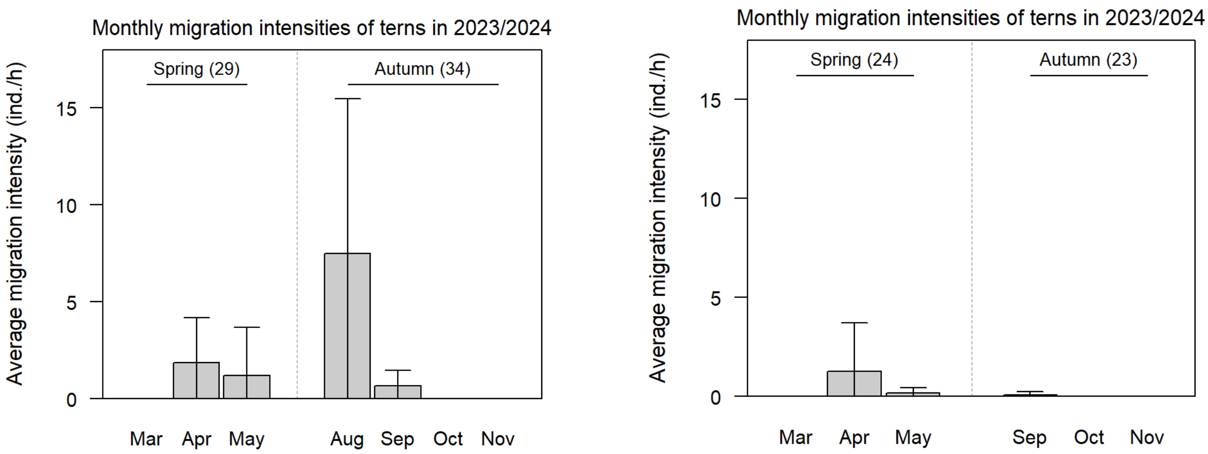


Figure 5.73 Average (mean) monthly diurnal migration intensity of terns in both years (data combined) in the KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

The flight altitudinal distribution of terns was similar between seasons. In autumn, there was a slightly larger number of birds flying above 20 m than in spring (8% vs. 4%, Table 5.15). Overall, no tern was seen flying above 50 m of altitudes, and there was a progressive decline of birds with increasing altitude. About 47% of all birds flew between 0 and 5 m, whereas 25% flew between 5 and 10 m and 7% between 20 and 50 m (Figure 5.74).

In spring, terns were migrating directly to the NE (65%) and 14% were flying to SE. In autumn, most terns flew to the west (48%) and 36% flew to the SW (Table 5.17).

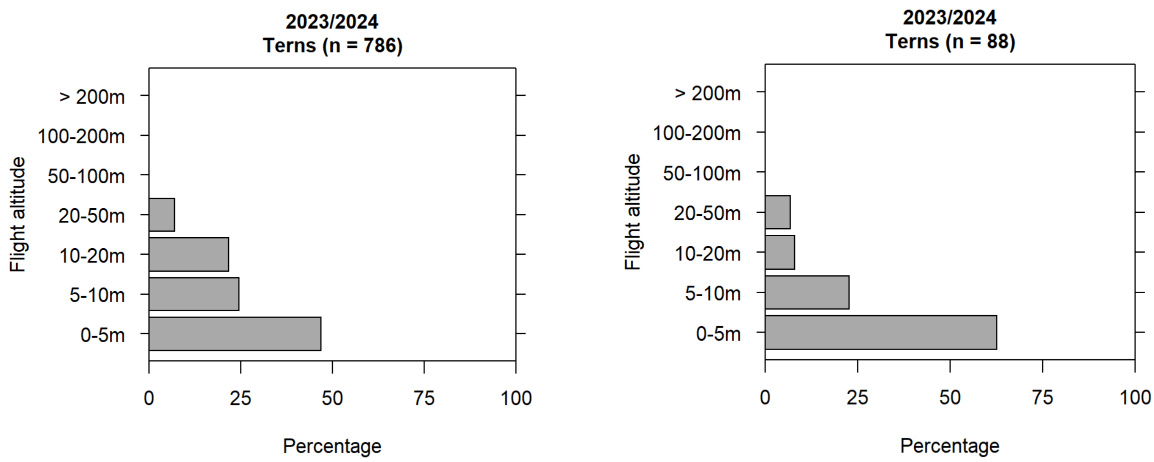


Figure 5.74 Flight altitude distribution of terns during visual observations in 2023 and 2024 (both years and seasons combined) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

Comparatively, very few terns were registered over the two seasons and years in the southern area (88 individuals), of which most of them were observed in spring. Also, most terns were seen in the second year of surveys, only 5 individuals were seen in spring of 2023. Of all terns seen in the southern area, most of them could not be identified to species level (77 individuals, Table 5.36).

In spring, the most commonly seen tern was the group of common terns/Arctic terns (83%), followed by Sandwich terns (13%). In autumn, only four individuals were seen (all of them not identifiable to species level, Table 5.36).

The mean migration intensity in spring was 0.5 ind./h with a maximum daily migration rate of 6.7 ind./h observed by the end of April 2024 (Table 5.13). In autumn, the mean migration intensity was very low < 0.1 ind./h with a maximum migration rate observed in mid-September 2024 (0.5 ind./h, Table 5.14).

The flight altitude distribution of terns is shown in Figure 5.74 and reflects the altitude distribution of terns in spring (since only four terns were observed in autumn, Table 5.16). Overall, most terns flew between 0 and 5 m (62.5%), 31% flew between 5 and 20 m and only 7% of all terns flew between 20 and 50 m of altitude.

In spring, terns flew to the east (58%) whereas similar proportions of birds flew to the NE and to the north (21% and 20%, respectively). In autumn, three birds flew to the SW (75%) and one to the west (25%, Table 5.18).

AUKS

Two species of auks are often present in the Baltic Sea: the common guillemot (*Uria aalge*) and the razorbill (*Alca torda*). These are similar in morphology and often difficult to tell apart so often species are classified as common guillemots/razorbills. In both areas, these species were dominant. In general, there were more auks in the northern area (almost twice as many) compared to the southern area.

Table 5.37 Number of individuals per species of auks in spring and autumn (2023 and 2024 data combined) registered during diurnal observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Common guillemot		54	17	71	18	24	42
Common guillemot / razorbill		97	38	135	48	47	95
Razorbill		45	30	75	35	18	53
Black guillemot		26	4	30	0	0	0
unidentified auk		0	1	1	1	0	1
All auks		**222**	**90**	**312**	**102**	**89**	**191**

KF II OWF N

Three species of auks were present in the northern area: common guillemots, razorbills and black guillemots. Most auks were seen in spring (71%, Table 5.37). More than twice the number of birds were seen in the first year of surveys than in the second year (n 2023 = 219, n 2024 = 93). Almost 44% of all auks observed in the northern area could not be identified to species level (n = 136). Auks were not very abundant, but they occurred often. They were observed at 23 out of 29 survey dates in spring and during half of the survey dates in autumn (17/34 survey dates, Table 5.11 and Table 5.12).

Auks represented 1.8% of all migrating birds in spring of 2023 and 0.9% of all migrating birds in autumn at the northern area. In 2024, they were less common and represented less than 0.5% of all migrating birds in each season (Figure 5.42). In addition, a third species was present in low numbers in the northern area: the black guillemot that represented 0.27% of all migrating birds in spring.

The most common species in spring were the common guillemots and razorbills. The group of common guillemot/razorbill (not species identification) made up for 44% of all auks in spring, whereas 24% of all auks were identified to common guillemots and 20% to razorbills. About 12% of all auks seen in spring were black guillemots. In autumn, the group of common guillemots/razorbills was also most common (42%), followed by razorbills (33%) and common guillemots (19%, Table 5.37).

The mean migration intensity of auks in spring was 1.1 ind./h and a median of 0.8 ind./h and a maximum value of 3.5 ind./h in May 2023 (Table 5.11). In autumn, mean migration rate (0.6 ind./h) and median migration rate (< 0.1 ind./h) were lower than in spring. The maximum daily migration rate was registered in mid-November 5.3 ind./h (Table 5.12). In spring, monthly migration rates were highest in April whereas in autumn monthly migration rates increased progressively towards the end of the season, being highest in November (Figure 5.75).

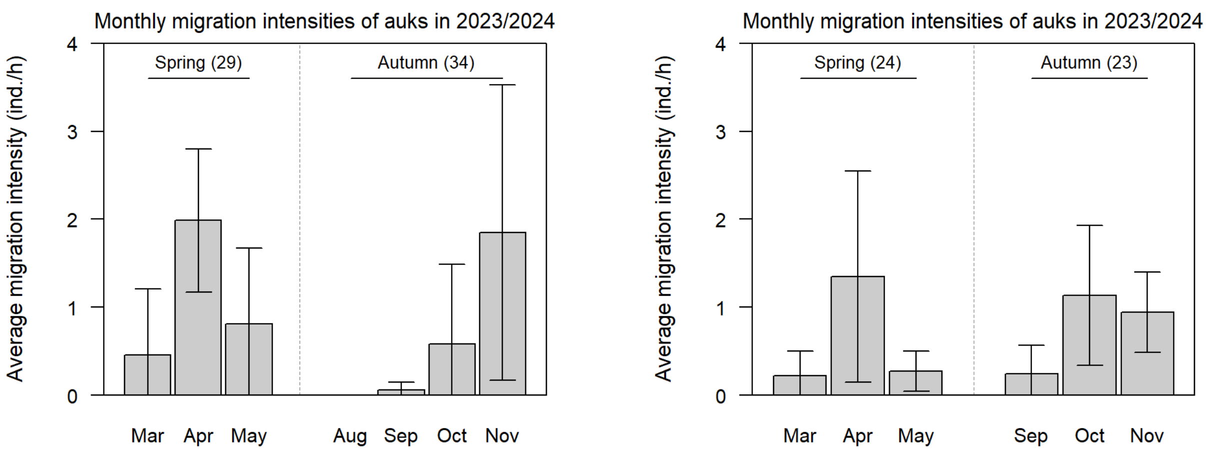


Figure 5.75 Average (mean) monthly diurnal migration intensity of auks in both years (data combined) in the KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

All auks flew between 0 and 5 m of altitude. Only one individual flew between 5 and 10 m of altitude (Figure 5.76).

In spring, auks flew into different directions. Only a third of the auks flew into the N-NE-E direction whereas many flew to the SW and NW (19% each). In autumn, also many directions were chosen: 24% flew to the west, but other directions were also relatively common (17% flew to the east, another 17% flew to the NW and 14% to the NE, Table 5.17).

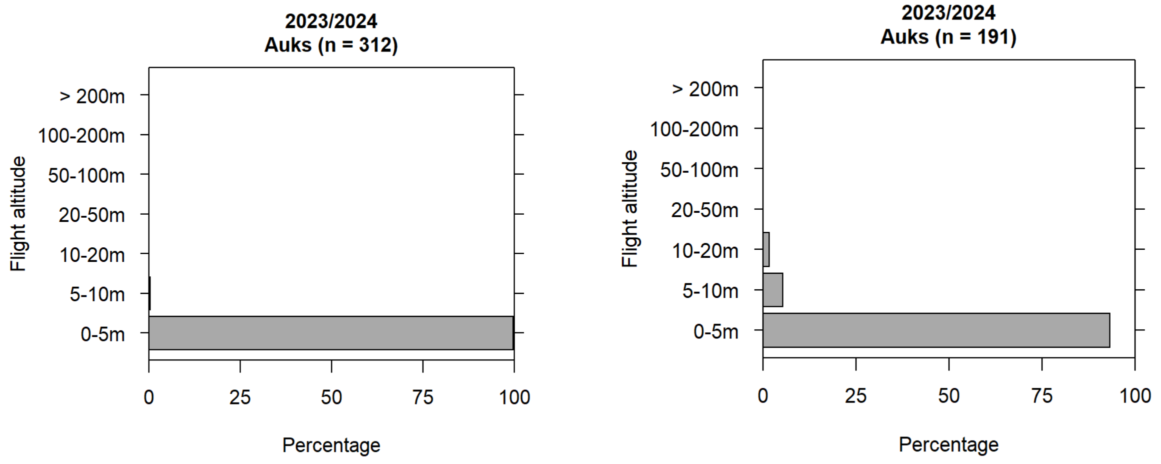


Figure 5.76 Flight altitude distribution of auks during visual observations in 2023 and 2024 (both years and seasons combined) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

Fewer auks were observed in the southern area and no black guillemots were seen in this area. Similar numbers were seen in spring and autumn (102 and 89 auks, respectively). A few more auks were registered in the first survey year than in the second year (n 2023 = 121, n 2024 = 70). About half of all auks seen in the southern area could not be identified to species level (n = 96, Table 5.37). Auks did not represent > 0.5% of all migrating birds seen in any season in the southern area (Figure 5.43).

The most common species in spring was the group formed by common guillemots/razorbills (47%) followed by razorbills (34%) and guillemots (18%) whereas in autumn, common guillemots/razorbills were seen at a similar frequency (53%), with guillemots being slightly more common than razorbills (27% and 20%, respectively, Table 5.37).

Mean migration intensity of auks in spring was 0.6 ind./h with a median of 0.3 ind./h. The maximum daily migration rate was 3.1 ind./h and was registered in April 2023 (Table 5.13). In autumn, the mean migration rate remained at the same level 0.75 ind./h with a median also slightly higher (0.7 ind./h). The maximum daily migration rate was at a similar level (2.5 ind./h) and was seen by the end of October 2023 (Table 5.14). In spring, monthly migration rates were highest also at the middle of the season (in April), and in autumn monthly migration rates were higher in October and were slightly lower in November (Figure 5.75).

The flight altitude distribution of auks was similar between spring and autumn (Table 5.16), so the figure Figure 5.76 reflects the pattern of flight of auks irrespective of season. All auks flew below 20 m of altitude.

Auks in the southern area also flew into different directions. In spring, a quarter of the auks flew to the NE, with 18% and 16% flying to the N and E, respectively, and another 41% flying into other directions. In autumn, similar percentages flew to the west and the NE (23% and 22%, respectively) whereas 19% and 17% flew to the NE and SW, respectively (Table 5.18).

PIGEONS

Pigeons were especially abundant only in autumn of 2024 in the northern area (Figure 5.42).

Table 5.38 Number of individuals per species of pigeons in spring and autumn (2023 and 2024 data combined) registered during diurnal observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Feral pigeon		1	0	1	0	1	1
Stock pigeon		0	0	0	1	4	5
Common wood pigeon		1	1,586	1,587	4	2	6
All pigeons		**2**	**1,586**	**1,588**	**5**	**7**	**12**

KF II OWF N

Pigeons were very rare in the northern area, except during autumn of 2024, when a large number of common wood pigeons were registered. In this season, they represented 8.4% of all migrating birds observed (Figure 5.42).

Only two individuals of two species of pigeons were seen in spring, so that the mean migration intensities were low and neglectable (Table 5.11). In autumn of 2024, pigeons were registered on two dates with the maximum migration rate seen on the 27th of October 2024 (288.2 ind./h). The mean migration rate of autumn was then 8.5 ind./h (Table 5.12). Pigeons were seen only sporadically and in autumn of 2024, only on two dates in October (Figure 5.77).

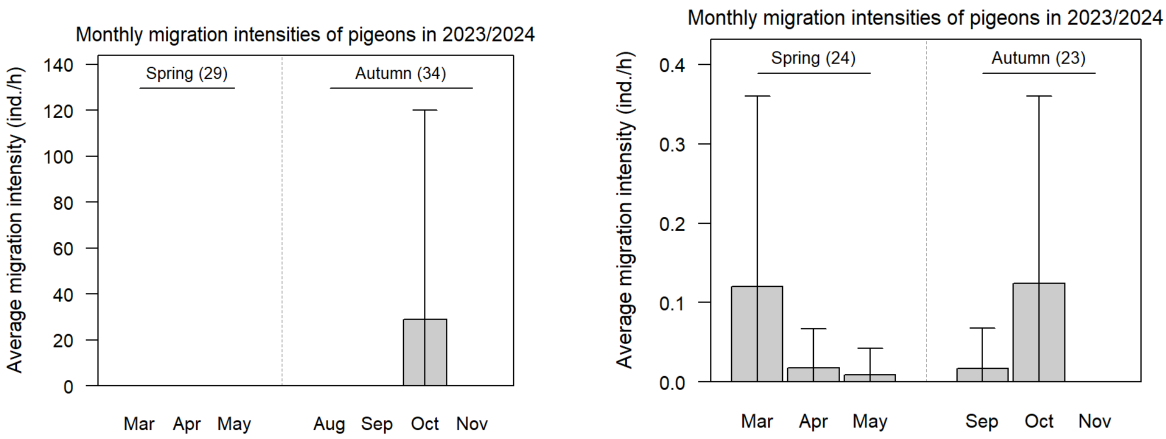


Figure 5.77 Average (mean) monthly diurnal migration intensity of birds of prey in both years (data combined) in the KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

Since only two individuals of pigeons were registered in spring, the flight altitude distribution shown in Figure 5.78 depicts the flight altitudinal distribution observed in autumn of 2024. Most pigeons flew between 5 and 10 m of altitude with about 3% flying above 200 m.

Almost all pigeons were seen flying to the west in autumn of 2024 (95%, Table 5.17).

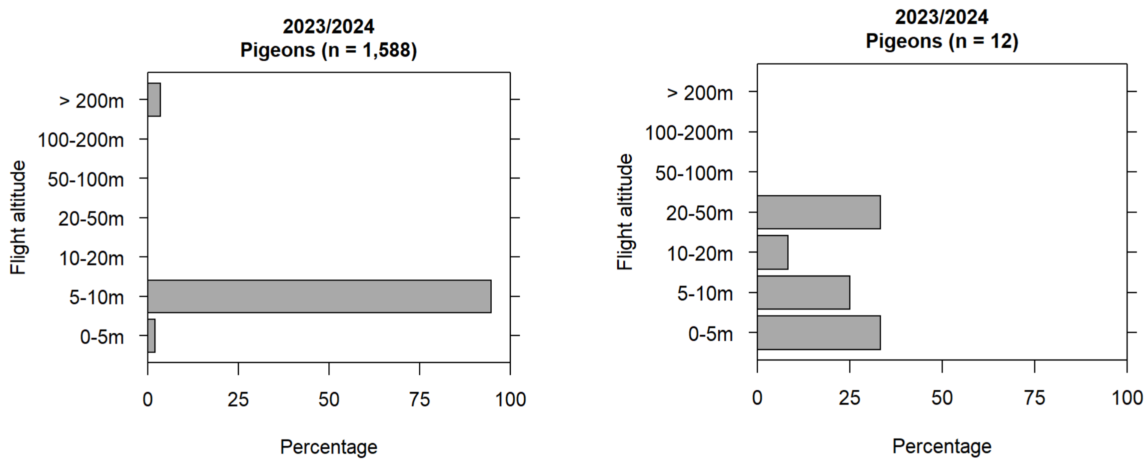


Figure 5.78 Flight altitude distribution of pigeons during visual observations in 2023 and 2024 (both years and seasons combined) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

KF II OWF S

In the southern area, pigeons were also very rarely seen. Twelve individuals of three species were seen with similar numbers in both seasons (5 in spring, 7 in autumn, Table 5.38).

They occurred rarely in both seasons (3 out of 24 survey dates in spring and 4 out of 23 dates in autumn). Migration intensities were low in spring and in autumn (< 0.1 ind./h in each season), with maximum daily migration rates of 0.5 ind./h (spring, March 2023) and 0.7 ind./h (autumn, mid-October 2023, Table 5.13 and Table 5.14).

With so few individuals seen it is difficult to interpret patterns of flight altitude or flight directions. Nonetheless, all five individuals flew below 20 m of altitude in spring whereas four individuals (out of 7) were seen flying between 20 and 50 m of altitude in autumn (the rest below 10 m). Overall, the flight distribution of the 12 individuals is shown in Figure 5.78.

Flight directions were only detected for four individuals in spring, and they all were flying into different directions (none to the NE). In autumn, four individuals flew to the SW and two to the west (Table 5.18).

SONGBIRDS

Table 5.39 Number of individuals per species of songbirds in spring and autumn (2023 and 2024 data combined) registered during diurnal observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Wood lark	x	0	8	8	0	1	1
Sky lark		19	921	940	26	533	559
Sand martin		1	8	9	2	1	3
Barn swallow		85	133	218	73	197	270
House martin		5	0	5	8	0	8

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
unidentified swallow / martin		9	0	9	4	2	6
Tree pipit		0	18	18	2	2	4
Meadow pipit		30	216	246	51	1,251	1,302
Rock pipit (eastern)		0	4	4	0	2	2
unidentified pipit		35	36	71	73	120	193
Yellow wagtail		17	23	40	1	1	2
Grey wagtail		0	8	8	0	6	6
White wagtail / pied wagtail		36	10	46	12	44	56
Winter wren		1	8	9	8	4	12
Hedge accentor		1	0	1	2	0	2
European robin		0	0	0	6	4	10
Redstart		0	0	0	1	0	1
Black redstart		0	3	3			
Northern wheatear	x	0	1	1	0	1	1
Common blackbird		1	1	2	5	0	5
Song Thrush		0	1	1	0	5	5
Redwing		0	0	0	8	5	13
unidentified thrush		0	1	1	3	78	81
Common chiffchaff		0	1	1	3	1	4
Willow warbler		2	0	2	0	1	1
unidentified leaf warbler		0	0	0	1	3	4
Goldcrest		1	6	7	4	5	9
Common firecrest		0	0	0	10	0	10
Spotted flycatcher		0	1	1			
Red-breasted flycatcher	x	0	0	0	1	0	1
Blue tit		0	1	1	2	2	4
Great tit		1	3	4	5	0	5
Rook	x	4	0	4			
Crow		0	0	0	7	0	7
Carrion crow		3	0	3	1	9	10
Hooded crow		0	0	0	12	0	12
Unidentified crow		0	0	0	4	4	8
Common starling		13	7	20	15	571	586
Chaffinch		1	49	50	14	424	438
Brambling		16	0	16	10	246	256
unidentified *Fringilla* finch		5	0	5	0	274	274
European greenfinch		8	6	14	3	0	3
European goldfinch		7	21	28	18	75	93
Eurasian siskin		19	153	172	17	708	725
Common linnet		2	4	6	12	142	154
Twite	x	0	41	41	0	6	6
Lesser redpoll		0	15	15	0	9	9
unidentified *Carduelis* finch		4	192	196	25	1,299	1,324
Snow bunting		0	1	1			
Reed bunting		0	4	4	0	27	27
unidentified songbird		154	359	513	104	1,864	1,968
All songbirds		**480**	**2,264**	**2,744**	**553**	**7,927**	**8,480**

KF II OWF N

During diurnal migrations, a total of 2,744 passerines of 37 species were observed in the northern area. Most songbirds were registered during autumn (480 in spring, 2264 in autumn, Table 5.39) and a few more songbirds were observed in the second year (n 2023 = 1,248, n 2024 = 1,496). Of all 2,744 songbirds seen, 29% remained unidentified to species level (this percentage was larger in spring than in autumn). The number of species was also higher in spring than in autumn (22 species in spring, 30 in autumn, Table 5.39). Songbirds were often surveyed in the northern area. In spring, they were seen in 26 out of the 29 survey dates whereas in autumn they occurred in 27 out of 34 survey dates (Table 5.11 and Table 5.12). In spring songbirds were less abundant but still made up for 3.3% and 0.9% of the total migrating birds in each season (2023 and 2024). In autumn, they made up for 12.4% and 6.7% of all migrating birds (2023 and 2024, respectively, Figure 5.42).

In spring, the most common species seen were the barn swallow (17.7% of all songbirds in spring)., pipits (meadow pipits and unidentified pipits made up for 13.5% of all songbirds) and wagtails (mainly white/pied wagtail and yellow wagtails made up for another 11% of all songbirds in the season. Almost a third of all songbirds could not be assigned to any family or larger group (32%, n =154). In autumn, the most common species was the sky lark (40.7%). Other common species were the meadow pipit (9.5%), Eurasian siskin (6.8%) and the barn swallow (5.9%). Almost 16% of all songbirds could not be identified to any family (n = 359, Table 5.39).

Mean migration intensity in spring was 2.2 ind./h with a median of 0.8 ind./h. The maximum value was registered in April 2023 (19.5 ind./h, Table 5.11). In autumn, mean migration intensity (12.7 ind./h) and median (2.7 ind./h) were larger. The maximum daily migration rate of autumn was also an order of magnitude larger and took place in mid-October 2024 (130.1 ind./h, Table 5.12). Monthly migration intensities were higher in the middle of the season, both for spring (April) and autumn (October, Figure 5.79).

Flight altitude distribution of songbirds was very similar between spring and autumn with most of them being detected flying below 50 m of altitude. The proportion of birds flying above 20 m of altitude was a bit higher in spring than in autumn (13% vs. 8%). Overall, 68.5% flew very close to the surface (0 – 5 m) whereas 8% flew between 20 and 50 m (Figure 5.80).

In spring, most songbirds flew to the north (42%) with similar proportions flying to the NW (20%) and the NE (26%). In autumn, most birds flew to the expected SW direction (61%), and 28% flew to the south (Table 5.17).

Nocturnal migration

Calls of passerines during nocturnal migration account for the most commonly heard calls. Mirroring songbird migration patterns during diurnal migration, most calls were heard in autumn than in spring in both areas (Table 5.40).

In the northern area, only 279 calls of songbirds identified to six species were heard in spring while in autumn 4,877 calls of 21 species were registered by the observers. Three times as many calls were heard in the first year of surveys than in the second year (n 2023 = 3,872, n 2024 = 1,284). Few calls remained unidentified to species level (81 calls, Table 5.40).

The most common species heard in spring were the redwing (43.4%), the European robin (24%), the common blackbird (20.1%) and song thrush (9.7%). In autumn, the same species were also common with similar percentages: redwings represented 38% of all calls, followed by blackbirds (21%) and robins (20.6%) and song thrushes (10.6%). Of these four species, all except robins were thrushes (Turdus spp., Table 5.40).

Nocturnal migration intensity of songbirds is often divided into calls emitted by thrushes and non-thrushes. Mean migration intensity of thrushes in spring was higher than that of non-thrushes (1.7 calls/h vs. 0.6 calls/h). The maximum migration rates of both types of songbirds coincides and the maximum overall migration rate for thrushes and non-thrushes was on the 18th of March 2023 (thrushes: 17.8 calls/h and non-thrushes: 9.5 calls/h). In autumn, mean migration intensity of thrushes was also higher than that of all other songbirds (15.2 calls/h vs. 8.0 calls/h). The maximum migration rate of thrushes took place in November 2023 (168.6 calls/h) whereas that for thrushes was 45.5 and was registered on the 7th of September 2023 (Table 5.23 and Table 5.24).

Calls of songbirds were more common in autumn than in spring. In spring, most nocturnal calls were heard in March (irrespective of the type of songbird) whereas in autumn, most calls of thrushes increased towards the end of the season, with the highest intensities in November whereas songbirds of non-thrushes were more often heard in September (Figure 5.81 and Figure 5.82).

<u>KF II OWF S</u>

Many more songbirds were seen in the southern area than in the southern area (8,480) during the two survey years. Most of them were seen in autumn (only 553 of the total number of songbirds were seen in both spring seasons). In the second year twice as many songbirds were registered (n 2023 = 2,684, n 2024 = 5,796). Also, more species of songbirds were registered in the southern area (39 species, and the same number of species were registered in spring and autumn: 30). Of all songbirds seen, almost half of them could not be identified to species level (3,858, 45.5%, Table 5.39).

Similar to what was observed in the northern area, songbirds were often a representative group in terms of abundance (especially in autumn). In spring of 2023, they represented 1.5% of all migrating birds but in spring of 2024 they hardly represented ~0.5% of all migrating birds (due to the massive dominance of geese). In autumn of 2023, they accounted for 12.4% of all migrating birds, becoming the third group of birds in terms of abundance in this season. In autumn of 2024, they were the most commonly occurring species, representing 41% of all migrating birds observed in this season (Figure 5.43).

The species composition of songbirds seen in spring in the southern area was very similar to that of the northern area. The most commonly occurring species in spring were the barn swallow (13.2% of all songbirds in the season) and pipits (meadow pipit represented 9.2% and unidentified pipits 13.2% of all songbirds). Songbirds that could not be assigned to any family represented 18.8% of all songbirds. Other species were less common. In autumn, the most commonly occurring species was the meadow pipit (15.8%), followed by the Eurasian siskin (8.9%), the starling (7.2%), the sky lark (6.7%) and the chaffinch (5.3%). About 23.5% of all songbirds could not be identified to any family (Table 5.39).

Songbirds were also frequently observed. In spring they occurred at 22 out of 24 survey dates whereas in autumn they were seen at 22 out of 23 survey dates (Table 5.13 and Table 5.14). Mean migration intensity of songbirds in spring was 3.5 ind./h with a median value of 1.0 ind./h. The maximum migration rate was observed in April 2023 and was 27.7 ind./h (Table 5.13). In autumn, mean migration intensity was an order of magnitude larger (61.2 ind./h) with a median of 19.8 ind./h. The maximum migration intensity was 120.9 and was seen in September 2023 (Table 5.14). Monthly migration rates were similar to those of the northern area with maximum monthly migration rates being observed in April and in October for spring and autumn, respectively (Figure 5.79).

Flight altitude distribution of songbirds in the southern area was similar to that of the northern area, but some birds were observed flying above 50 m of altitude (all of them in autumn). The difference between the altitude distribution of songbirds' flight in spring and autumn was that in autumn about 15% of the birds flew between 20 and 200 m, whereas this percentage was much lower in spring (only 3% of the birds flew between 20 and 50 m of altitude only, Table 5.16). Overall, 63% of all songbirds flew between 0 and 5 m of altitude, and 14% flew between 20 and 200 m of altitude. The remaining 23% flew between 5 and 20 m of altitude (Figure 5.80).

Most songbirds flew to the NE in spring (6´53%) with 15% flying also to the north. In autumn, most birds flew to the SW (63%) and 25% flew directly to the south (Table 5.18).

Nocturnal migration

Calls of songbirds were also much more common in autumn than in spring in the southern area as well. There were more calls registered, but less species (16 species). In spring, 731 calls of 7 species were heard whereas in autumn 5,368 calls of 16 species were identified (Table 5.40).

The most common songbirds heard in spring were the thrushes: song thrush (39% of all calls in spring), blackbird (24%) and the redwing (21%) whereas robins were the only species of non-thrushes that was common (18%). In autumn, however, robins were by far the most common species of songbirds heard (representing 69% of all nightcalls of songbirds). Thrushes were comparatively less common: redwings (11%), song thrushes (5%), blackbirds (4%, Table 5.40).

In spring, the mean migration rate of thrushes was 5.6 whereas the mean migration rate of all other songbirds was 2.2. The maximum migration rate were 62.6 calls/h and 23.4 calls/h for thrushes and non-thrushes respectively (Table 5.25) and occurred in the first year of surveys at the end of March. In autumn, mean migration intensity of thrushes was lower than that of all other songbirds (7.5 calls/h < 37.0 calls/h). The maximum migration rate in autumn of all other songbirds was much larger than that of spring (729.9) and took place on the 10th of September 2023 (Table 5.26). The maximum migration rate of thrushes was 58.0 calls/h and was registered by the end of October 2023. Migration rates of thrushes were highest in March whereas in autumn, their migration rates were higher in October. All other songbirds migrated at similar intensities in March and April with slightly higher rates in March, and in autumn, they were more commonly heard in September (Figure 5.81 and Figure 5.82).

Table 5.40 Number of individuals per species of songbirds in spring and autumn (2023 and 2024 data combined) registered during nocturnal acoustic observations in the pre-investigation area KF II OWF N and KF II OWF S.

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Eurasian skylark		0	40	40	31	168	199
Tree pipit		0	97	97	0	43	43
Meadow pipit		0	47	47	0	0	0
Red-throated pipit		0	3	3	0	0	0
unidentified pipit		0	0	0	0	1	1
Western yellow wagtail		0	20	20	0	0	0
White wagtail / pied wagtail		0	0	0	0	3	3
Eurasian wren		0	3	3	0	0	0
Dunnock		0	13	13	0	0	0
European robin		67	1,004	1,071	134	3,678	3,812
Common redstart		0	1	1	0	9	9
Common blackbird		56	1,024	1,080	177	223	400
Fieldfare		5	75	80	5	6	11

Species	Conservation category	KF II OWF N			KF II OWF S		
		Spring (29)	Autumn (34)	Total (63)	Spring (24)	Autumn (23)	Total (47)
Song thrush		27	518	545	230	266	496
Redwing		121	1,852	1,973	151	584	735
Mistle thrush		0	3	3	0	0	0
Lesser whitethroat		0	0	0	0	1	1
Common chiffchaff		0	0	0	0	1	1
unidentified leaf warbler		0	0	0	0	24	24
Goldcrest		0	28	28	0	15	15
Spotted flycatcher		2	5	7	0	4	4
Great tit		0	6	6	0	0	0
Common starling		0	4	4	0	5	5
Common chaffinch		0	3	3	0	0	0
Brambling		0	14	14	2	7	9
Reed bunting		0	37	37	0	42	42
unidentified songbird		1	80	81	1	288	289
All passerines		**279**	**4,877**	**5,156**	**731**	**5,368**	**6,099**

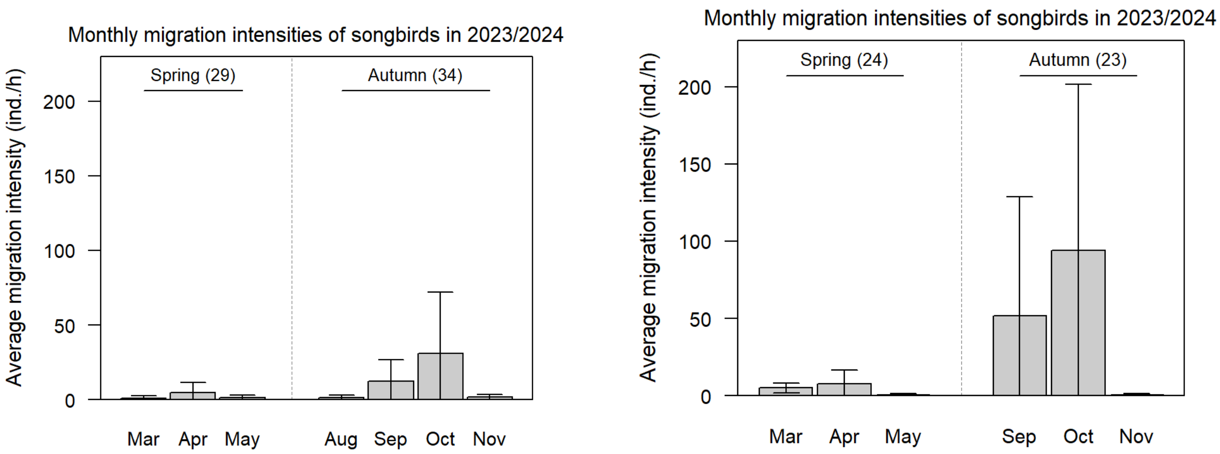


Figure 5.79 Average (mean) monthly diurnal migration intensity of songbirds in both years (data combined) in the KF II OWF N (left) and KF II OWF S (right). Variability is represented by standard deviations. Numbers in brackets indicate the number of survey days in each season and area.

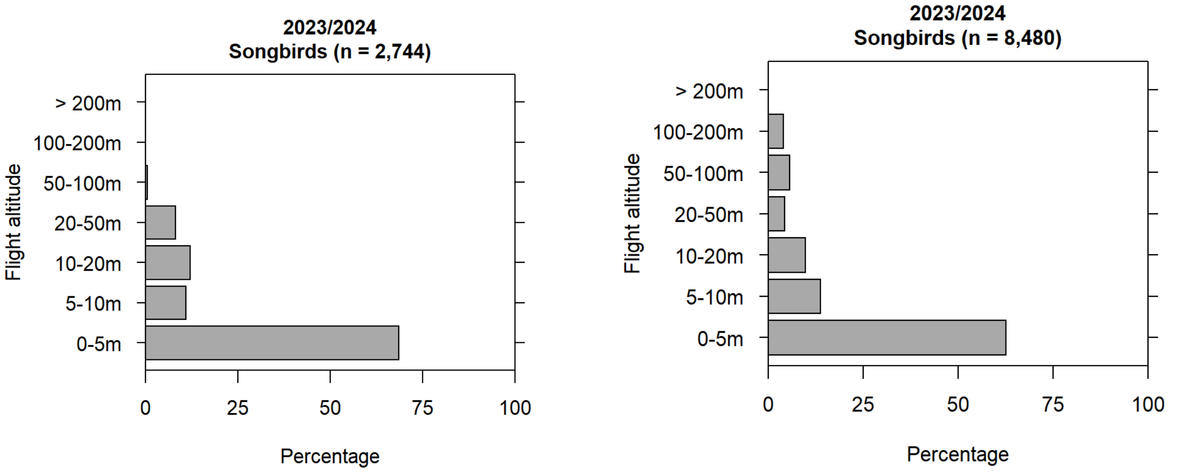


Figure 5.80 Flight altitude distribution of songbirds during visual observations in 2023 and 2024 (both years and seasons combined) in the pre-investigation area KF II OWF N (left) and KF II OWF S (right). See Figure 5.32 for details.

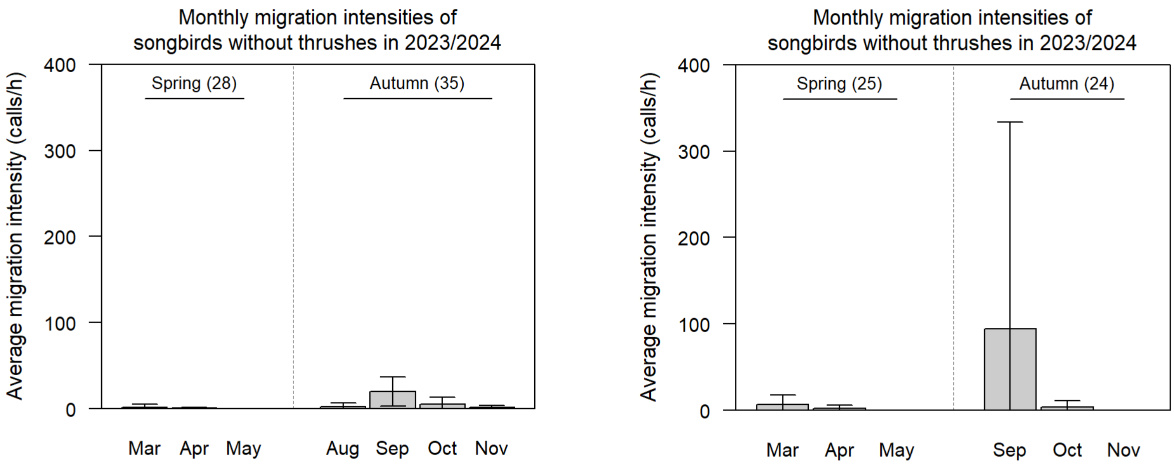


Figure 5.81 Mean monthly nocturnal migration intensity of songbirds (non-thrushes) in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey nights in each season and area.

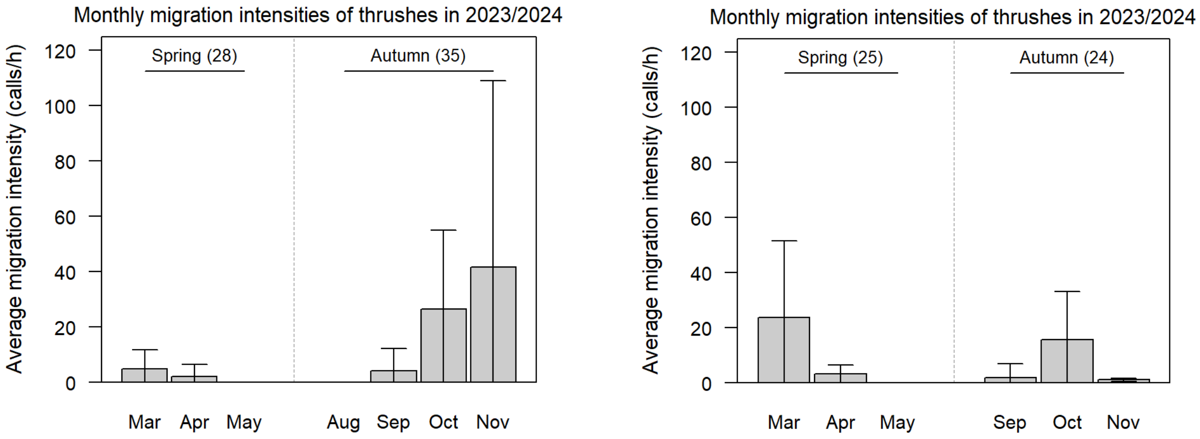


Figure 5.82 Mean monthly nocturnal migration intensity of thrushes in both years (data pooled) in the pre-investigation areas KF II OWF N (left) and KF II OWF S (right). Variability is presented by standard deviations. Numbers in brackets indicate the number of survey nights in each season and area.

5.2.2 HORIZONTAL AND VERTICAL RADAR

MIGRATION INTENSITY

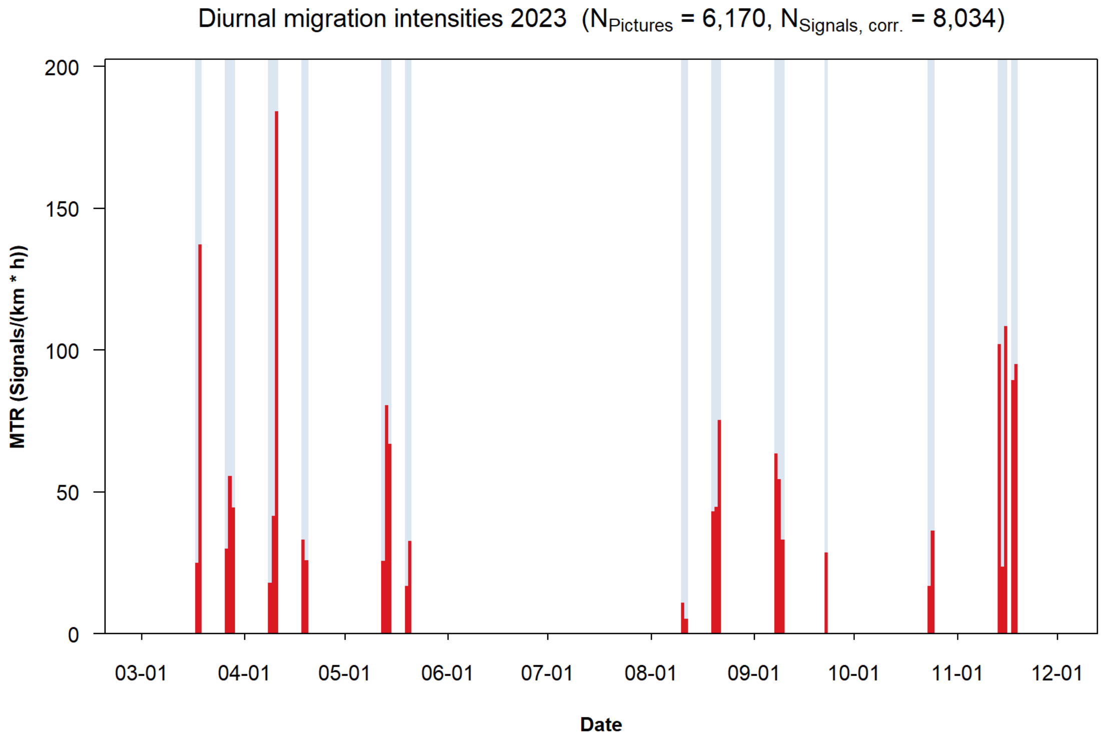
KF II OWF N

In the KF II OWF N pre-investigation area, 65 observation days were carried out in accordance with the planned scope over the two survey periods and seasons. A total of 60 days and 60 nights with analysable vertical radar signals (without interference from rain or excessive swell) could be used to calculate the average migration intensities (see Table 5.41), which corresponds to a proportion of >90% analysable data and is therefore above the expected 75% threshold (see also StUK 4, BSH 2013). In spring, mean migration intensity during daytime was 46.6 MTR (signals/(km*h) and 318.1 MTR during nights (**Fejl! Henvisningskilde ikke fundet.**). Median values were lower (40.1 MTR for days and 209.4 MTR for nights). Diurnal migration intensity was higher at the beginning of the spring season (mean = 55.8 MTR, median = 44.5 MTR) whereas nocturnal migration was highest at the end of the spring season (mean = 366.6 MTR, median = 264.0 MTR). Peak migration events took place however in the middle of the season. The highest migration rate during days and nights was detected on the same dat: 10th of April 2023 (184.1 MTR for days, Figure 5.83, and 1,102.9 MTR for nights, Figure 5.84). A second large peak (1,011.8 MTR) occurred just on the previous night (9th of April 2023, Figure 5.84).

In autumn, mean migration intensity during days was on a similar level as in spring (mean = 55.7 MTR, median = 44.7 MTR) with the maximum migration taking place in November (mean = 83.7 MTR, median = 95.0 MTR). However, the maximum migration rate was seen in October (22nd October, 2024, 129.1 MTR, Figure 5.83). Mean migration intensity during nights was also high, but not as high as during spring (mean = 200.2 MTR, median = 148.0 MTR). The highest migration intensity during nights in autumn occurred at the start of the season in August (mean = 316.6 MTR, median = 286.2) and the maximum peak migration event was 654.5 MTR which occurred on the night of the 20th of August 2023 (Figure 5.84).

Table 5.41 Monthly and seasonal diurnal and nocturnal migration rates (MTR) calculated from vertical radar in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF N.

Month Season Year	Diurnal migration (MTR)				Nocturnal migration (MTR)			
	Mean (± SD)	Median	Maximum	Number of days	Mean (± SD)	Median	Maximum	Number of nights [planned]
2023								
March	58.5 (± 45.6)	44.5	137.1	5	206.3 (± 276.3)	65.8	670.6	5
April	60.6 (± 69.6)	33.3	184.1	5	479.7 (± 528.3)	101.3	1102.9	5
May	44.5 (± 27.7)	32.6	80.5	5	358.7 (± 234.8)	259.1	753.2	5
Spring	**54.5 (± 47.4)**	**33.3**	**184.1**	**15 [15]**	**348.2 (± 361.5)**	**240.4**	**1102.9**	**15 [15]**
August	35.9 (± 28.4)	43.2	75.3	5	301.8 (± 237.9)	241.6	654.5	5
September	45 (± 16.7)	43.8	63.6	4	118.7 (± 48.9)	129.2	186.8	5
October	26.6 (± 13.7)	26.6	36.3	2	102.6 (± 39.8)	102.6	130.8	2
November	83.7 (± 34.4)	95.0	108.6	5	166.7 (± 121.5)	198.1	269.4	3
Autumn	**52.0 (± 33.4)**	**44.0**	**108.6**	**16 [20]**	**187.2 (± 162.9)**	**135.3**	**654.5**	**15 [20]**
2024								
March	49 (± 26.8)	49.0	68.0	2	289.5 (± 384.2)	73.7	733.0	3
April	8 (± 6.4)	6.8	14.9	3	37.4 (± 29.4)	30.6	69.6	3
May	45.8 (± 19.5)	41.6	84.4	9	371 (± 319.8)	268.9	987.4	9
Spring	**38.2 (± 23.7)**	**40.4**	**84.4**	**14 [15]**	**288 (± 312.3)**	**181.3**	**987.4**	**15 [15**
August	64.7 (± 29.5)	59.0	114.0	5	331.5 (± 101.2)	322.6	445.9	5
September	42.7 (± 41.6)	28.2	115.8	5	25.4 (± 21.2)	20.9	53.5	5
October	72 (± 55.8)	71.2	129.1	5	282.9 (± 191.6)	296.1	575.9	5
Autumn	**59.8 (± 42.4)**	**50.3**	**129.1**	**15 [15]**	**213.3 (± 181.3)**	**217.5**	**575.9**	**15 [15]**
Both years								
March	55.8 (± 39.1)	44.5	137.1	7	237.5 (± 296)	69.8	733.0	8
April	40.9 (± 59.3)	22.0	184.1	8	313.8 (± 460.6)	91.3	1102.9	8
May	45.4 (± 21.7)	41.1	84.4	14	366.6 (± 282.7)	264.0	987.4	14
Spring	**46.6 (± 38.2)**	**40.1**	**184.1**	**29 [30]**	**318.1 (± 333.4)**	**209.4**	**1102.9**	**30 [30]**
August	50.3 (± 31.2)	47.5	114.0	10	316.6 (± 173)	286.2	654.5	10
September	43.7 (± 31.2)	33.2	115.8	9	72.1 (± 60.7)	60.4	186.8	10
October	59 (± 51)	36.3	129.1	7	231.4 (± 180.2)	130.8	575.9	7
November	83.7 (± 34.4)	95.0	108.6	5	166.7 (± 121.5)	198.1	269.4	3
Autumn	**55.7 (± 37.6)**	**44.7**	**129.1**	**31 [35]**	**200.2 (± 169.9)**	**148.0**	**654.5**	**30 [35]**



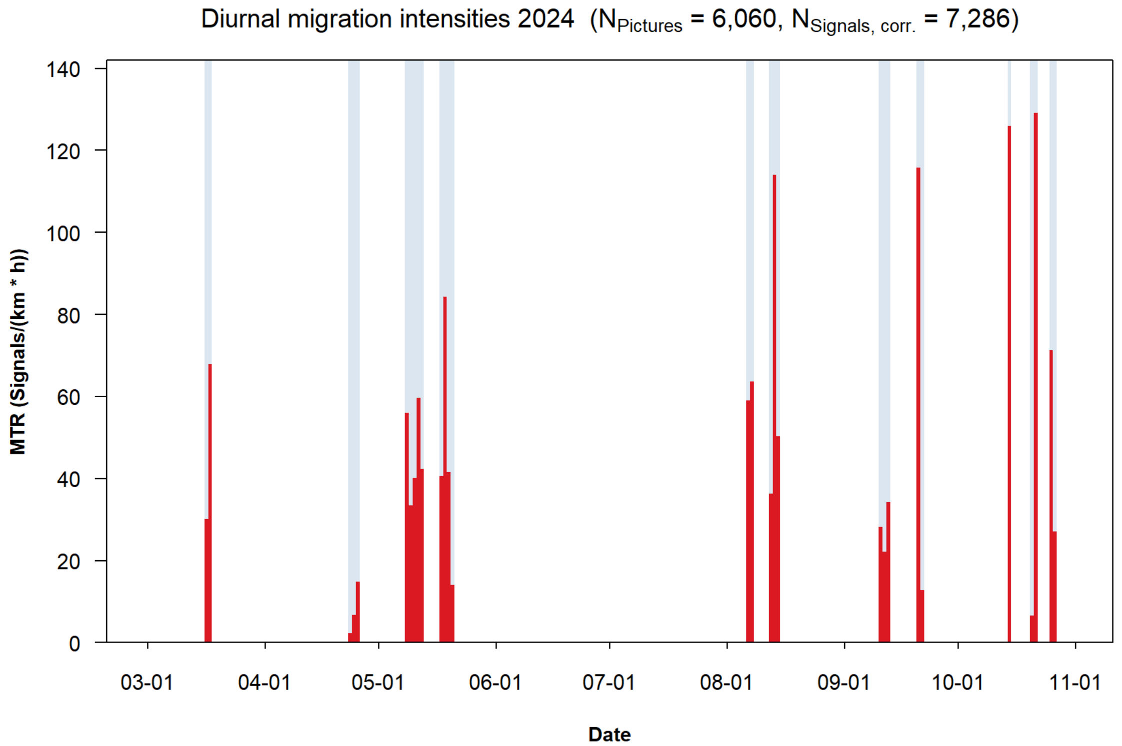


Figure 5.83 Diurnal migration intensity in spring and autumn of 2023 (top) and 2024 (bottom) based on daily migration traffic rates (MTR) calculated from the vertical radar in the pre-investigation area KF II OWF N. MTR is specified as radar signals per km and hour (up to 1,000 m altitude). Areas highlighted in light grey indicate the survey days. Note the different y-axis scale, when comparing with diurnal migration intensity.

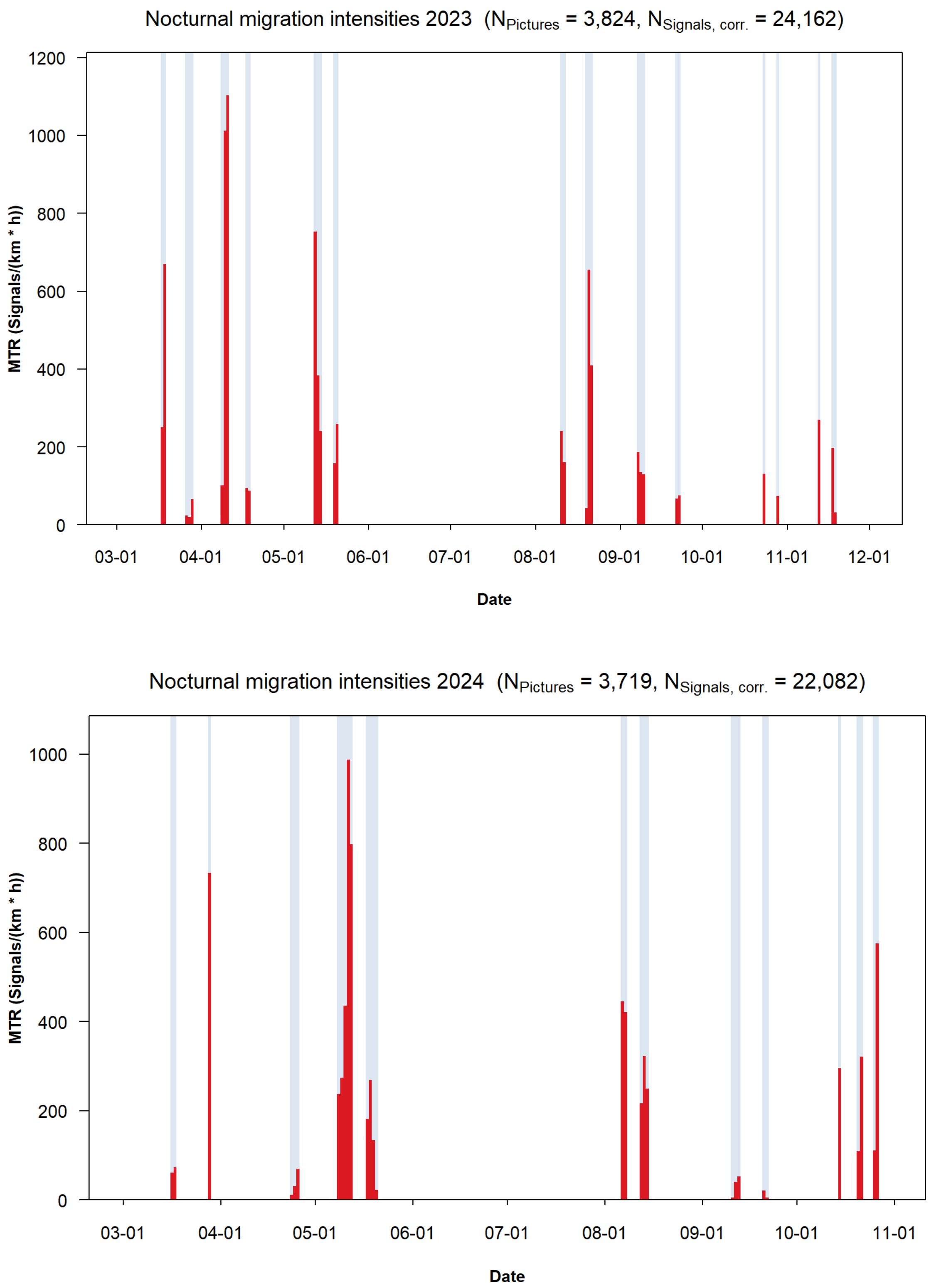


Figure 5.84 Nocturnal migration intensity in spring and autumn of 2023 (top) and in 2024 (bottom) based on daily migration traffic rates (MTR) calculated from the vertical radar in the pre-investigation area KF II OWF N. See Figure 5.83 for details.

KF II OWF S

In the KF II OWF N pre-investigation area, 49 full 24h-observation days were planned for the two survey years according to the scope. A total of 47 days and 45 nights with analysable vertical radar signals (without interference from rain or excessive swell) could be used to calculate the average migration intensities (see Table 5.42), which corresponds to a proportion of >90% analysable data.

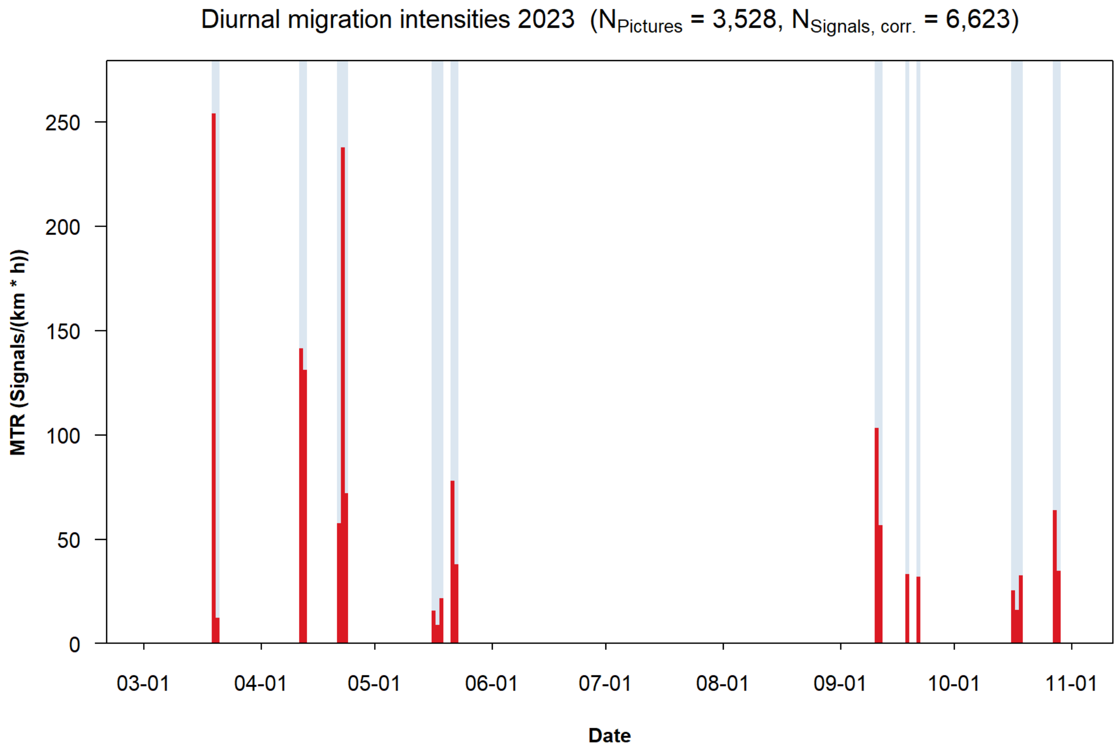
In spring, mean migration intensity during daytime was larger than at KF II OWF N both during days (mean = 67.4 MTR, median = 54.0 MTR) and during nights (mean = 425.0 MTR, median = 245.0 MTR, Table 5.42). Diurnal migration intensity was higher in March (mean = 100.6 MTR), due to a high migration event on the 19th of March 2023 (254.0 MTR, Figure 5.85), but the median was slightly larger in April (71.9 vs 68.1 MTR). Nocturnal migration was higher in the middle of the spring season (mean = 832.3 MTR, median = 738.1 MTR) due to a very large peak migration (2,305.7 MTR) that occurred on the night of 22nd of April 2023 (Figure 5.86). However, April was the month with lowest diurnal and nocturnal migration in the second year of surveys.

In autumn, mean migration intensity during days was similar to the area KF II OWF N (53.6 MTR) but the median was lower (26.8 MTR) with the maximum migration taking place in October (60.4 MTR) when the maximum value occurred on the 23rd of October, 2024 (209.8 MTR, Figure 5.85). Mean migration intensity during nights was larger compared to days, but much lower than during spring and also lower than nocturnal migration at KF II OWF N (mean = 82.4 MTR, median = 52.4 MTR). The highest migration intensity during nights in autumn occurred also in the middle of the season in October (mean = 101.6 MTR, median = 72.8 MTR) and the maximum peak migration event (418.1 MTR) which occurred on the night 10th of September 2023 (Figure 5.86). On this date, the maximum diurnal migration rate of autumn of 2023 also took place.

Table 5.42 Monthly and seasonal diurnal and nocturnal migration rates (MTR) calculated from vertical radar in spring and autumn of 2023 and 2024 in the pre-investigation area KF II OWF S.

Year	Diurnal migration (MTR)				Nocturnal migration (MTR)			
	Mean (± SD)	Median	Maximum	Number of days	Mean (± SD)	Median	Maximum	Number of nights [planned]
				2023				
March	133.1 (± 171)	133.1	254.0	2	387.2	387.2	387.2	1
April	128 (± 71.2)	131.0	237.7	5	1244.9 (± 742.3)	1006.6	2305.7	4
May	32.4 (± 27.6)	21.8	77.9	5	200.2 (± 164.5)	209.5	425.7	5
Spring	**89 (± 85.3)**	**64.8**	**254.0**	**12 [12]**	**636.8 (± 687.7)**	**406.4**	**2305.7**	**10 [12]**
September	56.3 (± 33.3)	45.0	103.3	4	153.3 (± 176.8)	71.4	418.1	4
October	34.7 (± 18)	32.8	64.1	5	96 (± 68.5)	70.5	197.3	4
November					18.8	18.8	18.8	1
Autumn	**44.3 (± 26.6)**	**33.3**	**103.3**	**9 [10]**	**112.9 (± 124.7)**	**68.2**	**418.1**	**9 [10]**
				2024				
March	68.1 (± 48)	68.1	102.1	2	678.8 (± 527.9)	678.8	1052.1	2
April	1.4 (± 1.1)	1.4	2.2	2	6.9 (± 2.8)	6.9	8.9	2
May	51.2 (± 26.3)	58.6	79.9	8	201.4 (± 83.2)	187.6	341.1	8
Spring	**45.7 (± 33.5)**	**42.2**	**102.1**	**12 [12]**	**248.6 (± 275)**	**187.6**	**1052.1**	**12 [12]**
September	26.9 (± 20.4)	22.8	53.6	5	57.5 (± 44.5)	42.3	108.2	5
October	86.1 (± 104.5)	20.5	209.8	5	106 (± 123.5)	87.9	313.7	5
November	46.3 (± 36.1)	41.8	93.2	4	15.3 (± 9.9)	17.1	25.0	4
Autumn	**53.6 (± 67)**	**26.8**	**209.8**	**14 [15]**	**62.8 (± 82.1)**	**32.8**	**313.7**	**14 [15]**

Year	Diurnal migration (MTR)				Nocturnal migration (MTR)			
	Mean (± SD)	Median	Maximum	Number of days	Mean (± SD)	Median	Maximum	Number of nights [planned]
Both years								
March	100.6 (± 109.2)	68.1	254.0	4	581.6 (± 409.5)	387.2	1052.1	3
April	91.8 (± 84.9)	71.9	237.7	7	832.3 (± 859.9)	738.1	2305.7	6
May	44 (± 27.4)	38.0	79.9	13	201 (± 114.3)	199.1	425.7	13
Spring	**67.4 (± 67.1)**	**54.0**	**254.0**	**24 [24]**	**425 (± 530.5)**	**245.0**	**2305.7**	**22 [24]**
September	40 (± 29.4)	33.3	103.3	9	100.1 (± 123.6)	65.4	418.1	9
October	60.4 (± 75.7)	29.2	209.8	10	101.6 (± 97)	72.8	313.7	9
November	46.3 (± 36.1)	41.8	93.2	4	16 (± 8.7)	18.8	25.0	5
Autumn	**50 (± 54.1)**	**32.8**	**209.8**	**23 [25]**	**82.4 (± 101.3)**	**52.4**	**418.1**	**23 [25]**



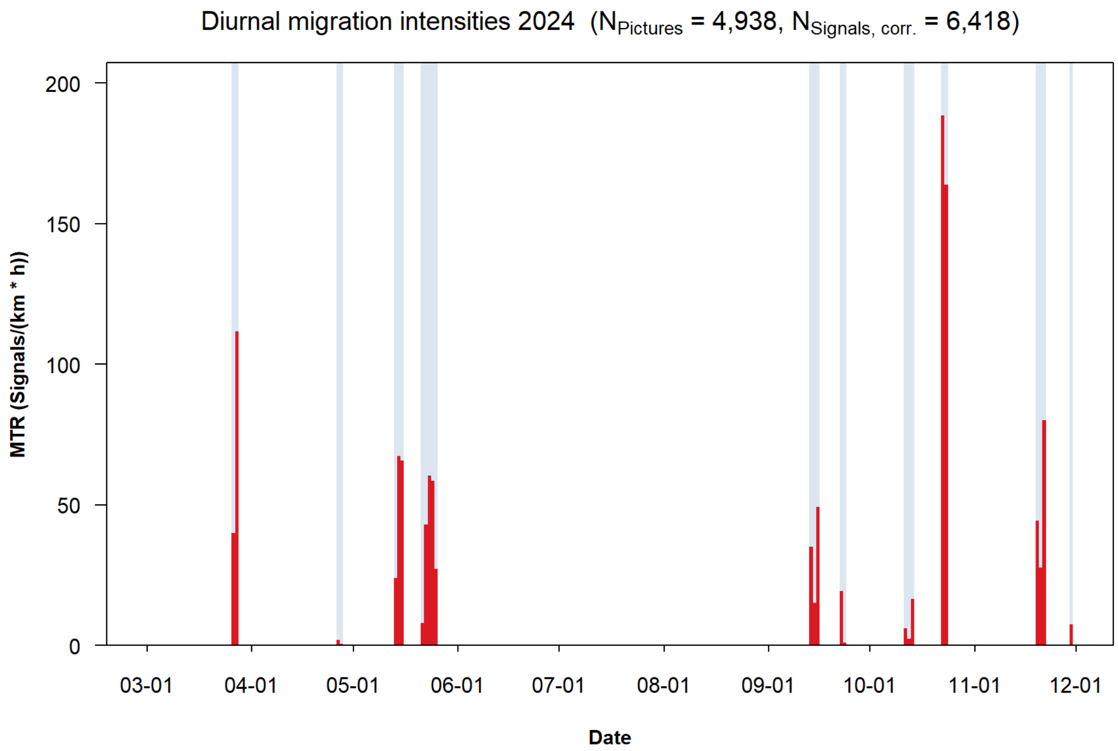
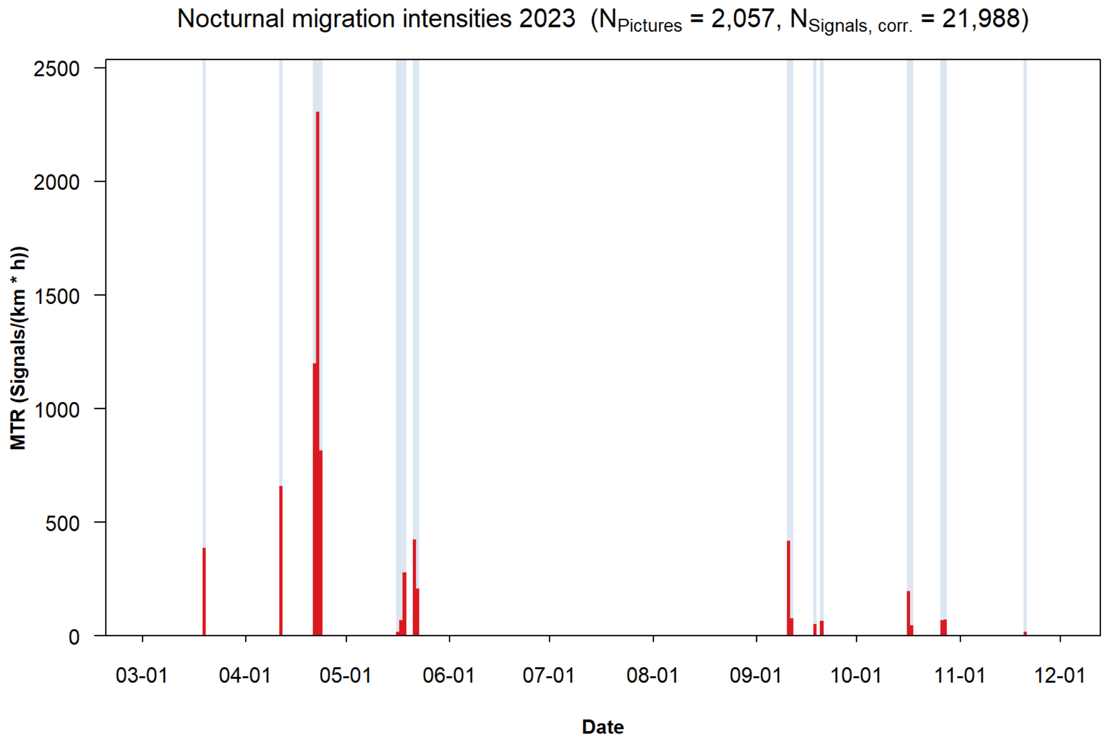


Figure 5.85 Diurnal migration intensity in spring and autumn of 2023 (top) and 2024 (bottom) based on daily migration traffic rates (MTR) calculated from the vertical radar in the pre-investigation area KF II OWF S. See Figure 5.83 for details.



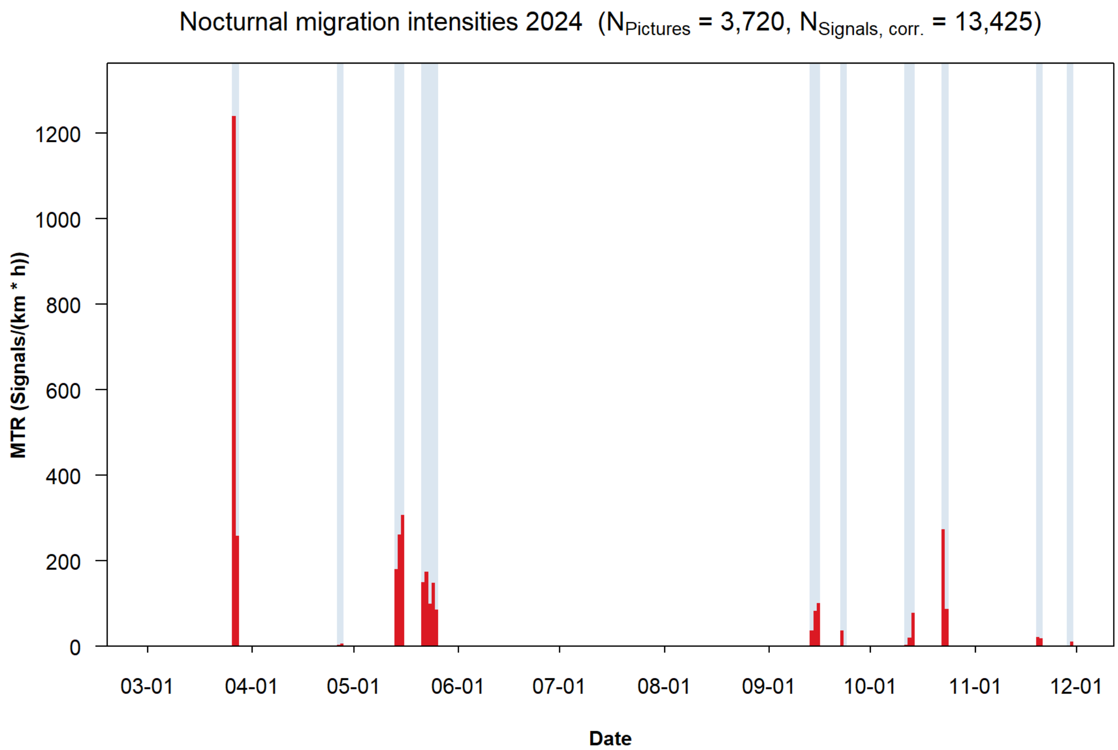


Figure 5.86 Nocturnal migration intensity in spring and autumn of 2023 based on daily migration traffic rates (MTR) calculated from the vertical radar in the pre-investigation area KF II OWF S. See Figure 5.83 for details.

24-HOUR MIGRATION INTENSITY

Migration intensity over a course of 24 hours was similar in both areas and therefore the pattern is described together. Both in spring and autumn a significantly higher level of migration activity was observed during the night than during the daylight phase (Figure 5.87 and Figure 5.88). Migration intensities during day were higher during the first hour after sunrise and then decreased during the course of the day to increase again one hour before sunset. Only in autumn of the southern area, was migration intensity in general low and similar (low) intensities were registered during the second half of the night as during the first hours of migration after sunrise.

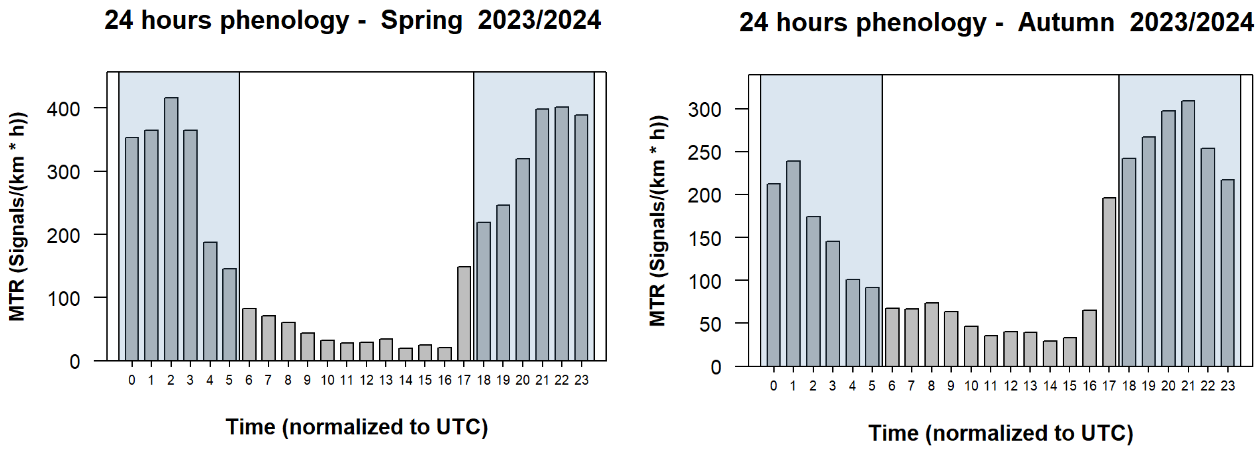


Figure 5.87 24-h migration intensity from vertical radar data in spring (left) and autumn (right) in the pre-investigation area KF II OWF N. Data of both years have been combined. As daylength varies over the year, nocturnal (blue shaded) and diurnal observations of the single survey dates are depicted stretched/compressed to a "normalised" length of 12 hours each. Time data in UTC (minus one hour compared to MET/ two hours to MEST).

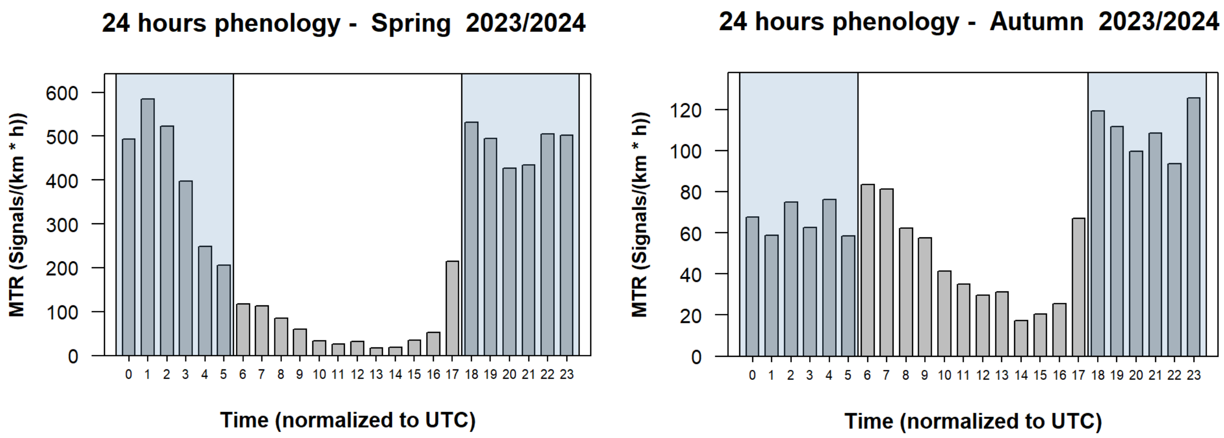


Figure 5.88 24 h migration intensity from vertical radar data in spring (left) and autumn (right) in the pre-investigation area KF II OWF S. See Figure 5.87 for details.

FLIGHT ALTITUDE

KF II OWF N

For the plotting of altitude distribution all vertical radar signals (of both years combined) were used (including data from day and nights with less than 70 % of analysable data). Bird signals obtained from vertical radar data (up to 1,000 m altitude), showed a different vertical distribution between diurnal and nocturnal migration (Figure 5.89). During daytime, the majority of signals (29% and 28% in spring and autumn, respectively) was detected in the very first 100 metres above the water surface. Above this layer, a constant record of bird activity varying between 6.5 – 9% was observed in spring whereas in autumn a moderate decline of bird activity with increasing altitude occurred, reaching from 13% of signals at 100-200 m to 4% at 600-700 m of altitude. A slight increase of bird activity was observed at the top layers of altitude.

Nocturnally detected bird signals were more evenly spread over the whole altitude range both in spring and autumn. In spring, the proportion of signals at each 100 m layer varied between 8% at the 100 – 200 m layer to 12% at the 600 – 700 m layer (Figure 5.89). In autumn, the first 100 m of altitude contained the highest proportions of signals (15%), with a progressive decline of the proportion of signals with increasing altitude up to about 500 – 600 m, then a slight increase in the signals was observed again up to the 800-900 m layer of altitude (Figure 5.89).

In spring, flight height distribution of high migration intensity days or nights (five days or five nights) showed that more signals were detected in the higher altitude classes than in the lower altitude classes (63% and 61% in the upper 500 m during diurnal and nocturnal migration, respectively). In autumn, more signals were detected in the upper altitude classes during days of high migration intensity (Figure 5.90)

KF II OWF S

At the proposed KF II OWF S, vertical altitude distribution in spring did not differ much between day and night. In this season, there was a relative constant and similar proportion of bird signals detected at all altitudes with the only difference that during days, about 14% of signals were detected in the very first 100 m and then a varying proportion between 8-10% of signals for all subsequent layers of altitude whereas during nights, bird signal activity varied between 8-10% in the first 700 m of altitude and then slightly increased to 12% in the upper layers of altitude (Figure 5.91).

During diurnal migration in autumn a similar altitude distribution of bird signals as in the northern area was observed in the southern area. About 29% of signals were detected in the very first layer of altitude with a moderate decrease with altitude in the subsequent layers, varying between 12% at 100-200 m to 5% at 700 – 800 m of altitude. There was however a slight increase in bird activity at altitudes between 500 and 600 m (10%). During nights, most bird activity was also registered in the bottom layer (~20%) with a decrease of bird activity in the subsequent layers. However, in the very top layer there was again an increase of bird activity in autumn (900 – 1000 m, 12%, Figure 5.91).

In spring, more migration took place in the upper altitude classes during nights with highest migration, whereas the flight height distribution during days did not differ according to migration intensity level. In autumn, there were also more signals detected in the upper altitude classes in days of intense migration than in other days, and this pattern was stronger during nights (Figure 5.92).

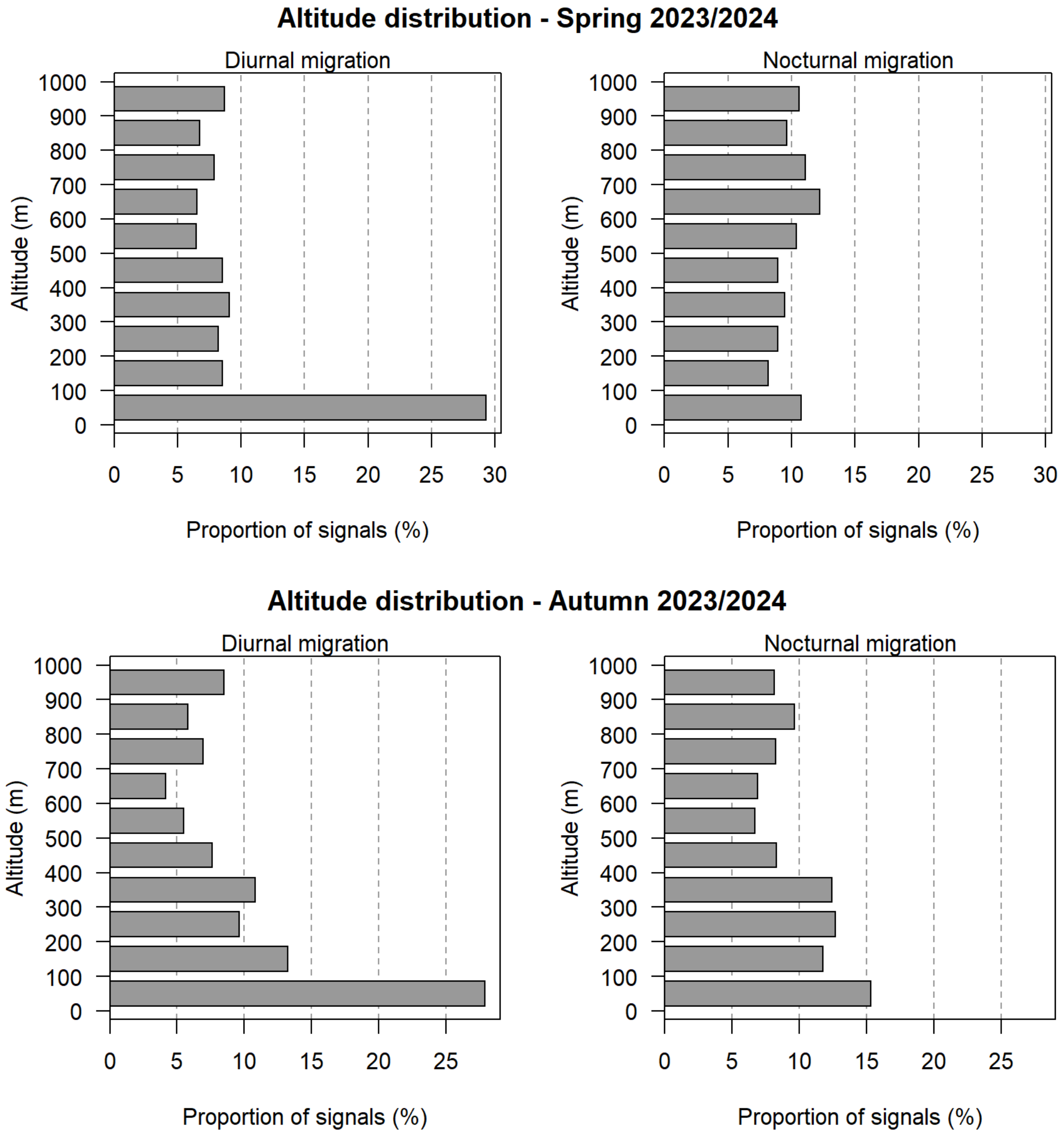


Figure 5.89 Flight altitude distribution from vertical radar data during spring (top) and autumn (bottom) in the pre-investigation area KF II OWF N. Data of both years have been combined. Depicted is the relative appearance of signals up to 1,000 m height in 100 m increments. The graph on the left shows the altitude distribution of birds during the daylight phase, the right graph during the night.

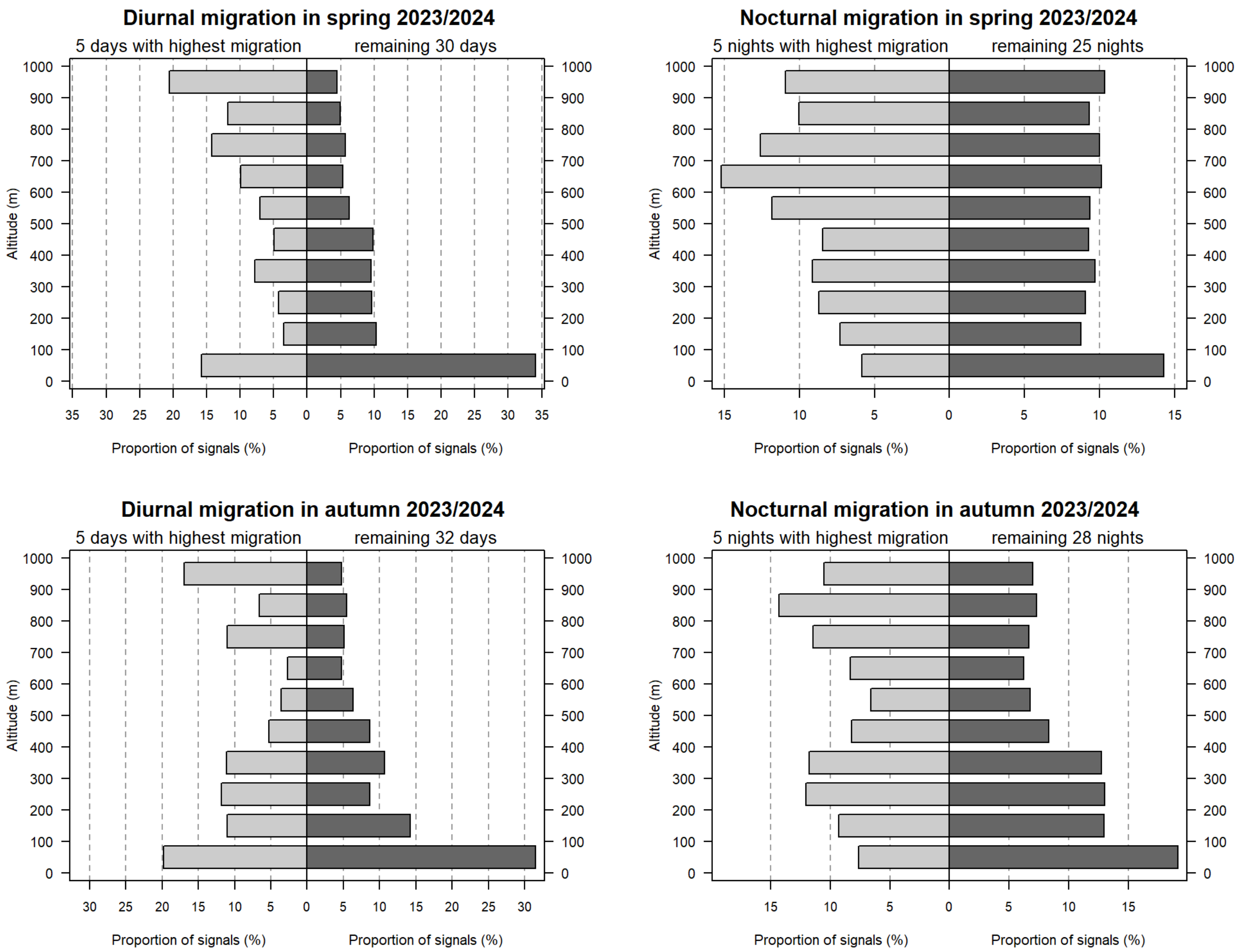


Figure 5.90 Flight altitude distribution from vertical radar data (data of 2023 and 2024 pooled) during spring (top) and autumn (bottom) in the pre-investigation area KF II OWF N divided according to the 5 dates with highest migration intensity (light grey) and all other dates (dark grey). Depicted is the relative appearance of signals up to 1,000 m height in 100 m increments. The graph on the left shows the altitude distribution of birds during the daylight phase, the right graph during the night.

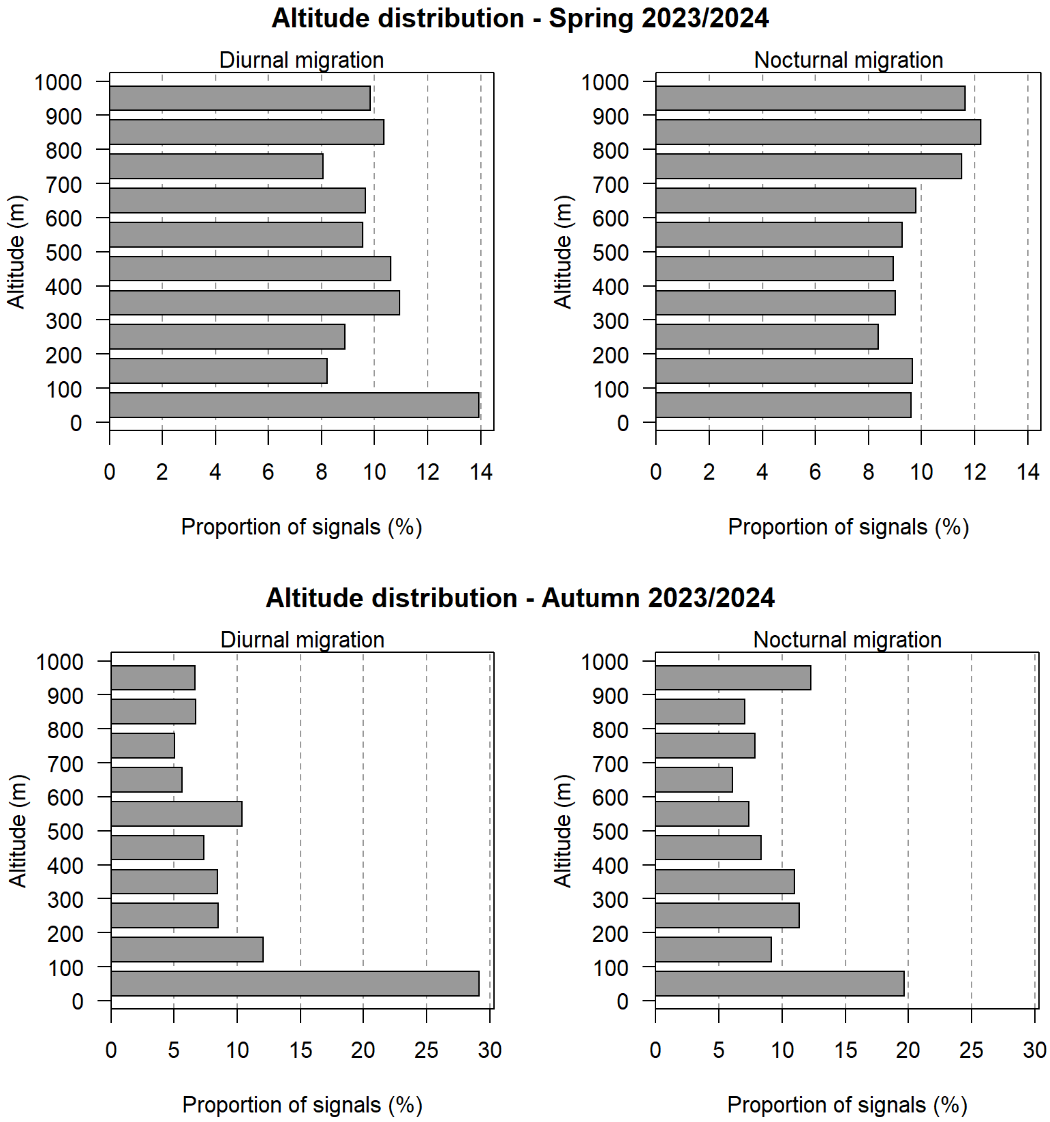


Figure 5.91 Flight altitude distribution from vertical radar data during spring (top) and autumn (bottom)in the pre-investigation area KF II OWF S. Data of both years have been combined. Depicted is the relative appearance of signals up to 1,000 m height in 100 m increments. The graph on the left shows the altitude distribution of birds during the daylight phase, the right graph during the night.

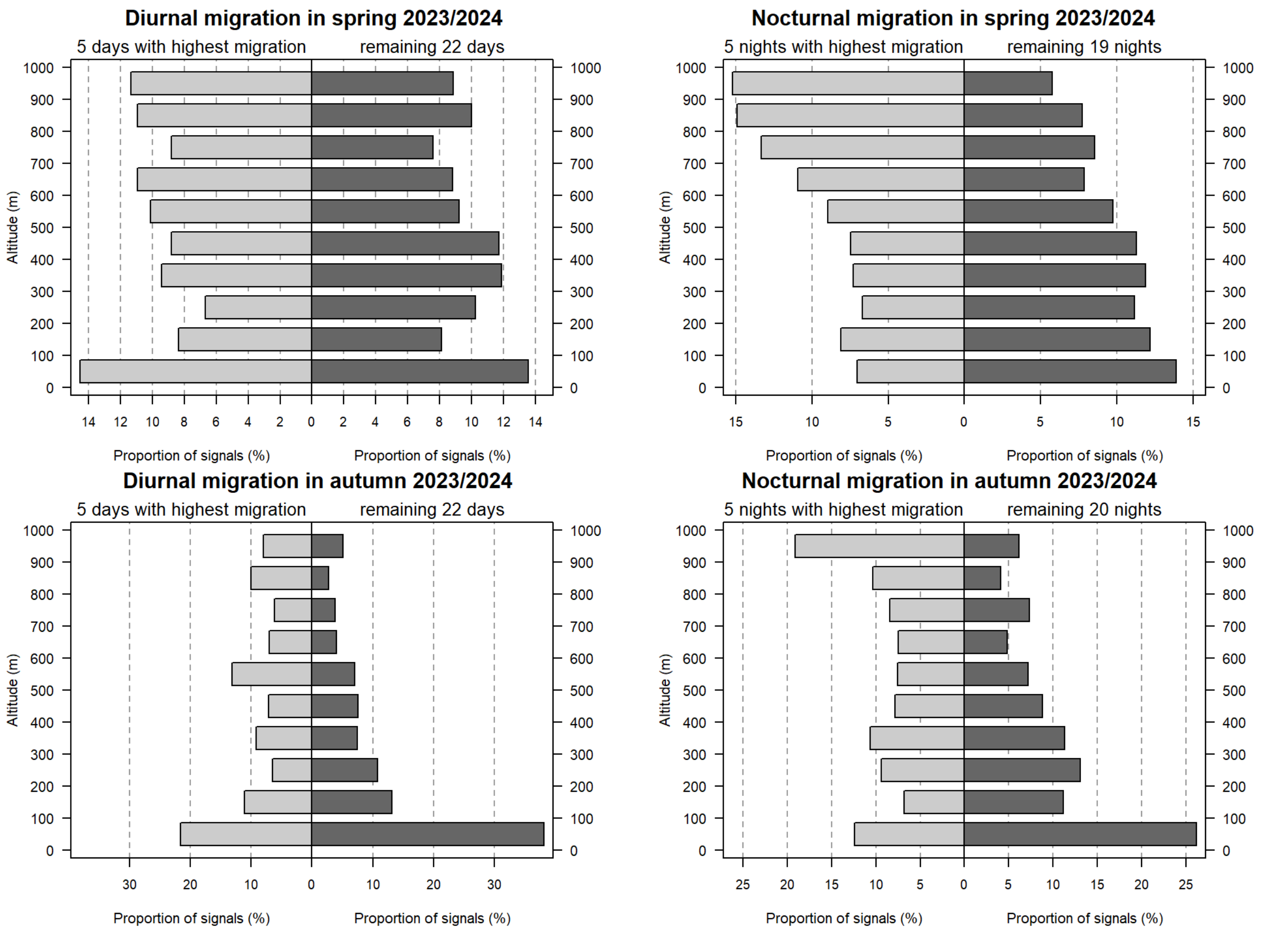


Figure 5.92 Flight altitude distribution from vertical radar data (data of 2023 and 2024 pooled) during spring (top) and autumn (bottom) in the pre-investigation area KF II OWF N divided according to the 5 dates with highest migration intensity (light grey) and all other dates (dark grey). Depicted is the relative appearance of signals up to 1,000 m height in 100 m increments. The graph on the left shows the altitude distribution of birds during the daylight phase, the right graph during the night.

FLIGHT DIRECTIONS

KF II OWF N

Fight directions of bird signals obtained from horizontal radar indicate similar mean directions of flight for diurnal and nocturnal migration at each season.

In spring, a total of 646 horizontal tracks were analysed, 266 were observed during days and 360 at night. Results showed a statistically significant flight direction to the northeast for during diurnal and nocturnal migration (mean direction of flight during days was 43° whereas during nights 56°). During nights there was a larger proportion of bird signals being detected also flying more to the north and to the east (Figure 5.93).

In autumn, fewer horizontal tracks could be analysed (a total of 409 of which 282 were analysed for diurnal migration and the remaining 127 during nights). Nonetheless, mean flight direction was statistically significant and in the same direction both during night and days (262° and 252°, for days and nights, respectively). There was a larger proportion of bird signals grouped between 240 and 260° (SWW) during nights than during days (43% vs. 23%, Figure 5.93).

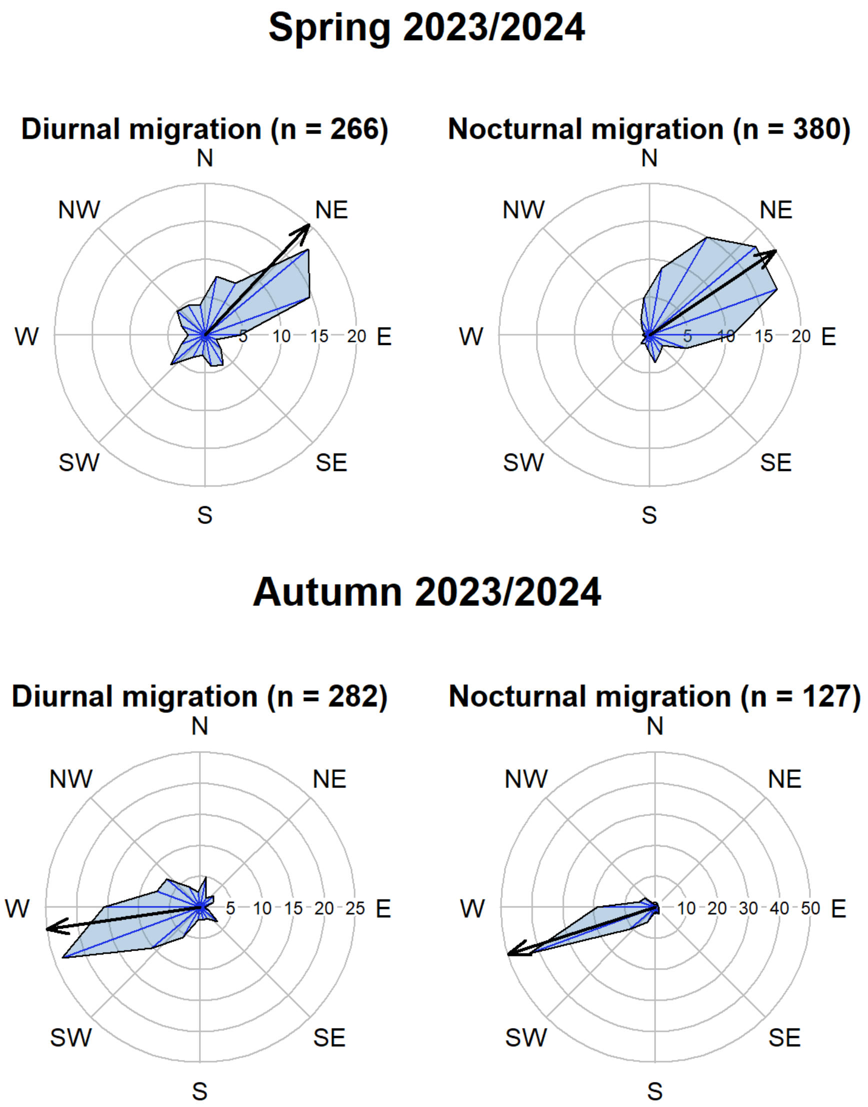


Figure 5.93 Flight direction of bird signals according to the horizontal radar shown in percentage (%) during diurnal and nocturnal migration in spring (top) and autumn (bottom) at the KF II OWF N pre-investigation area. Data of both years have been combined. For plotting purposes, flight directions were grouped into groups of 20° increments. Each blue line represents the middle point of the respective grouping. Black arrows indicate a statistically significant mean flight direction of all signals together.

KF II OWF S

In the southern area, fewer horizontal radar tracks were available for analysis and almost the same amount for spring and autumn (301 for spring and 272 for autumn). There was a statistically significant mean flight direction at more or less the same direction during diurnal and nocturnal migration in spring (72° and 70°, NEE, respectively for day and nights) and autumn (234°, SW and 252°, SWW, respectively, Figure 5.94).

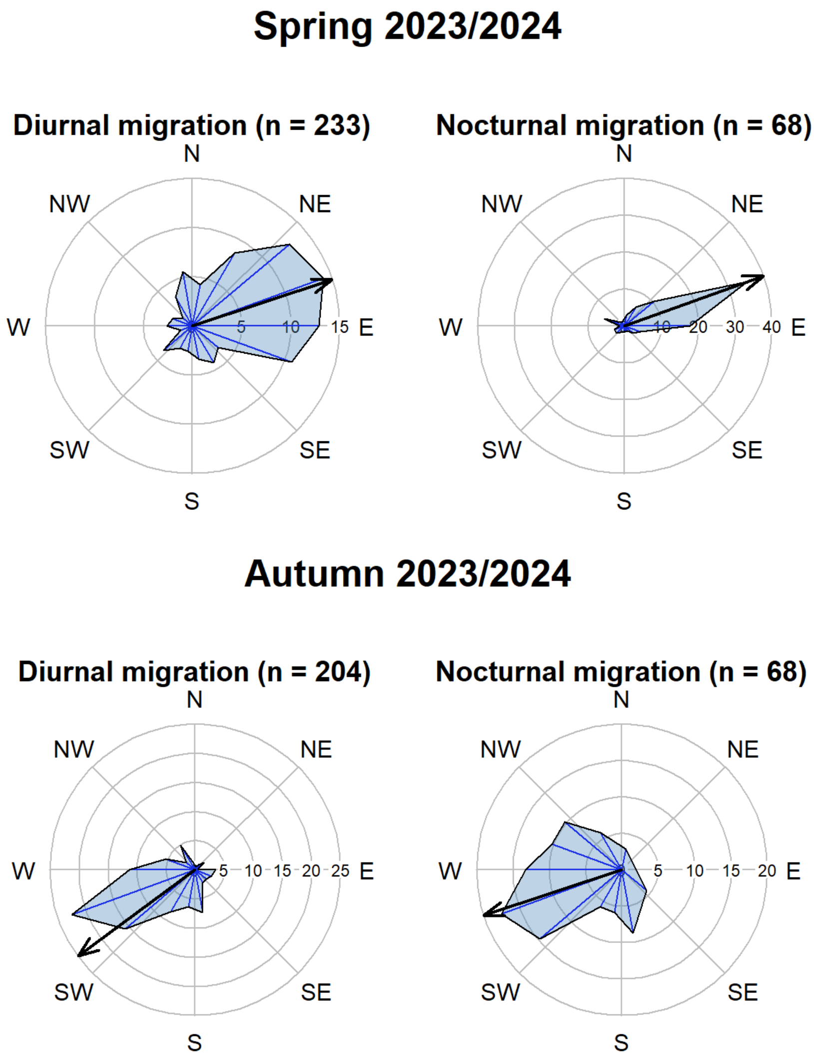


Figure 5.94 Flight direction of bird signals according to the horizontal radar shown in percentage (%) during diurnal and nocturnal migration in spring and autumn at the KF II OWF S pre-investigation area. See Figure 5.93 for details.

The main difference in flight directions detected by horizontal radar between the northern and southern area was that in the northern area birds were detected flying more to the NE in spring whereas in the southern area their flight was more directed towards the NEE. Similarly, in autumn, in the KF II OWF N, they are taking a more SWW direction of flight, whereas they tend to move more towards the SW (at least during diurnal migration) in the southern area.

6 DISCUSSION

6.1 RESTING BIRDS

In the following section, conclusions from the results of the resting bird surveys will be drawn regarding the importance of the pre-investigation area for the relevant species. Furthermore, the results will be compared with existing data from the area. During the twelve digital aerial surveys conducted over two monitoring years — the first from February to December 2023, and the second from February to December 2024 — a total of 22,415 resting birds belonging to 23 species were observed in the first year, while 16,831 resting birds classified into 26 species were detected in the second year.

Sea ducks were the most abundant species group among resting birds recorded during both survey years. Common scoter and common eider were the predominant species throughout the monitoring period, accounting for more than two-thirds of all resting birds recorded. South of the planned OWF, Skov et al. (2011) reported mean densities of 17.60 ind./km² in the Darss–Plantagenet Ground area (Germany) for common scoter. North of the OWF, next to the Falsterbo peninsula (Sweden), mean densities of common eiders were estimated at 8.39 ind./km². While the densities observed in this baseline monitoring were slightly lower for common scoters and similar for common eiders, the overall findings align with previous studies on the spatiotemporal distribution of these two species. The numbers of these species and other sea ducks detected peaks during winter before they leave to migrate to their breeding grounds.

Sea ducks generally prefer shallow waters for foraging, as documented in previous studies (MADSEN 1954; ZYDELIS 2000; NEHLS 2001). Since they obtain their prey by diving, individuals must balance the energy gained from food with the energy expended while foraging—an equation that is generally more favourable in shallower areas. The coastal areas of eastern Sjælland, Møn, and Falster (Denmark), as well as the waters south of Falsterbo (Sweden), are well-known wintering grounds that support large populations of ducks (DURINCK et al. 1994; PETERSEN & NIELSEN 2011; SKOV et al. 2011). The highest bird densities for this group were observed during the winter months and early spring, primarily in shallow waters with generally low bathymetry.

This preference was largely confirmed by the distribution patterns observed in the pre-investigation area, where sea ducks were primarily concentrated in coastal waters. However, an interesting exception was noted in the case of common eider during spring, with numerous individuals observed in and around the operational OWF at Kriegers Flak (Figure 5.9). While common eiders are generally assumed to avoid flying between wind turbines, studies at Danish and Swedish wind farms have reported that some individuals do pass through turbine arrays (PETERSEN & MALM 2006; MASDEN et al. 2009; GREEN 2015). If prey availability remains favourable within wind farm areas, common eiders may still utilize these habitats to some extent for foraging (GUILLEMETTE 1998; 1999; DIERSCHKE et al. 2016).

Gulls were the second largest group of resting birds during the two years of observations, with herring gull and common gull being the main representatives in terms of abundance within this group. Despite being present in the investigated area during the entire year, their abundance and detectability increased towards the winter months.

The densities of herring gull and common gull south of the planned OWF areas, close to the German coastline, have been registered at 0.34 ind./km^2 and 0.12 ind./km^2, respectively, in previous studies (BORKENHAGEN et al.

2021). Both species have shown slightly lower densities of 0.2-0.6 ind./km² in the surveyed area, with strong preference for coastal areas but with ubiquitous distribution, including within the limits of the planned OWF.

Other species, such as the little gull, were observed within the area of the planned OWF during survey efforts. The highest densities were recorded in winter, with up to 0.13 ind./km² south of the proposed OWF site. Comparable wintering densities have been reported for this species in previous studies, underscoring the significance of this region during their non-breeding period (HELCOM 2019c). Little Gulls are known to gather in large numbers along the coast of Usedom and within the Greifswald Lagoon (Germany) prior to migrating overland across western Europe to the Atlantic at the end of the breeding season (MENDEL et al. 2008b). Notable migratory peaks occur in both spring and autumn in German (SCHWEMMER & GARTHE 2006) and Dutch North Sea waters, where over 100,000 individuals may congregate at key stopover sites (FIJN et al. 2022). However, a portion of the population remains within the Baltic Sea throughout the winter. These individuals tend to concentrate in the southern and central parts of the Baltic, where the overwintering population has been estimated at approximately 2,245 individuals (DURINCK et al. 1994; HELCOM 2019c).

The highest densities of both common and black-headed gulls were primarily observed in coastal areas, with only a few individuals recorded further offshore. In contrast, herring gulls and especially great black-backed gulls were more widely distributed and frequently found in offshore regions. Black-legged kittiwake was expected to be a common overwintering species in the area; however, survey results revealed a different pattern, with only scarce sightings and low densities. While previous studies on kittiwake distribution (HELCOM 2019e) indicated a tendency for higher densities in the Kattegat area, their presence in Krieger Flak was notably limited.

Gulls typically forage by picking prey from the water surface (MENDEL et al. 2018) but are also known to be ship followers (CAMPHUYSEN 1995; GARTHE et al. 2016). This behaviour explains why some gull species are commonly found in offshore areas. All gull species were frequently observed in and around the operational OWF at Kriegers Flak. Dierschke et al. (2016) noted that larger gull species, in particular, are often attracted to offshore wind farms, as these structures provide resting and roosting opportunities.

The number of observed auks was relatively low compared to major groups such as sea ducks and gulls, yet they accounted for 4.4–4.8% of all recorded resting birds. The two predominant species, razorbill and common guillemot, were primarily present during winter and early spring, when their highest densities were recorded, reaching up to 0.93-1.31 ind./km². These findings align with previous analyses of the Danish Baltic Sea region, where overall densities of 1.83 ind./km² were observed, with a higher concentration in waters 20–40 meters deep (PETERSEN & NIELSEN 2011).

The main known distribution area for wintering auks is in Kattegat (north of Sjælland). However, the two-years surveys in the Krieger Flak area suggest that also this area is of importance for this group of birds, as they were detected in medium to high densities within the limits of the operational and planned areas for OWF' s at Kriegers Flak.

6.1 MIGRATING BIRDS

6.1.1 DIURNAL MIGRATION

SPECIES COMPOSITION

Results of the two survey years in both pre-investigation areas (KF II OWF N and KF II OWF S) show similarities with regards to species commonly crossing both areas during spring and autumn migration. They also point to differences, however, especially regarding the migration intensity. Survey efforts differed in both areas with more survey dates in the northern area than in the southern area (63 days and 47 days, respectively). In the southern area, no survey took place in August, and - in comparison to the northern area - fewer days were surveyed in each season.

In total, 15,841 migrating birds were observed in the northern pre-investigation area in the first year (2023) with rather similar numbers in both seasons (spring and autumn), whereas three times as many birds were registered in the southern area (with more birds seen in spring than in autumn). In 2024, however, there was a noticeable increase in the number of migrating birds recorded in the northern area, and although large numbers of migrating birds were detected in the southern area as well, many more birds (around 5000 birds more) were detected in the northern area in each season (during spring: 25,542 in the northern area vs. 21,248 in the southern area and during autumn: 18,988 in the northern area vs. 13,795 in the southern area) and thus in very similar numbers as the migration detected in the southern area in 2023. When pooling the data of both survey years, the results still show a larger number of migrating birds detected in the southern area, although the difference in the total number of migrating birds is less pronounced (due to the influence of the second year of surveys in the northern area).

Migration rates were expected to be higher in the northern area due to the proximity of this area to land and its location between Falsterbo and Møn, an area well known for its migration passages. Nonetheless, more birds were registered during migration in the southern area, although more species were detected in the northern area. The general composition of species groups holds for both pre-investigation areas, though there were, however differences in the dominance or occurrence of certain species in one year with respect to the other one (see below).

The most common species group in both areas were geese. Geese represented 83% and 46%, respectively, of all birds recorded migrating in spring and autumn in the northern area, and 87% and 40%, respectively, of all birds recorded migrating in spring and autumn in the southern area. Hence, they made up similar proportions of the entire migration activity in each season in both areas. The most common species observed in 2023 was the barnacle goose (*Branta leucopsis*), which was the most numerous species observed in both areas. In 2024, brent geese (*Branta bernicla*) were observed in the northern area and were the second most numerous species of geese after barnacle geese. In the southern area, however, they were the most numerous species during the second survey year, and they accounted for about 93% of all migrating birds in spring of 2024. Barnacle geese were hardly seen during that season and in this area. Surveys conducted in 2024 showed that both pre-investigation areas are also transit routes for another goose species: the brent goose. These differences in species occurrence from year to year can be explained also by the fact that the surveys of the second year took place later in May than during the first year. GREEN (1998) studied the spring migration patterns of both goose species in southern Sweden and found that brent geese migration took place after the one of barnacle geese. Survey dates in 2024 in both pre-investigation areas were much later in May than during the first year, which might explain the differences in the numbers of both species. Nonetheless, both year of surveys confirm that both species do migrate through both areas.

The largest population of barnacle geese in Europe migrates in spring to their breeding locations in Russia and returns to their wintering areas at the North Sea in autumn (e.g., GREEN 1998; VAN DER JEUGD et al. 2009). The Kriegers Flak II pre-investigation areas are located within the main path of their migratory flyway (e.g., GREEN 1998; VAN DER JEUGD et al. 2009). GREEN (1998) has indicated that there is a gradient from south to north in terms of the routes of (spring) migration for barnacle geese with most birds crossing the sea close to the southwestern part of Sweden and coinciding with the location of the proposed OWF areas of KF II OWF (see GREEN 1998). This might explain why so many geese occurred in both areas and especially in the most southern area. Given that the species has experienced a rapid increase in its numbers in past decades, reaching 1,400,000 individuals according to the Waterbirds Populations Portal (estimation till 2018, http://wpe.wetlands.org, accessed on 11.04.2024), the large numbers observed of this species during spring and autumn migration are not surprising.

The brent goose is a Holarctic breeding species with four subspecies, two of which occur in Europe: The nominate subspecies *bernicla* (dark-bellied brent goose) breeds in northern Russia (Siberia) and winters along the coasts of northwest Europe whereas the white-bellied brent goose (*B. b. hrota*) breeds on western Greenland, Canada and Svalbard and winters in Ireland and Denmark. The migration patterns of the dark-bellied brent geese is very similar to that of the barnacle geese with the core of spring migration crossing the sea close to the southwestern part of Sweden coinciding with the location of the proposed OWF areas (see GREEN 1998). The population estimates of this subspecies is around 211,000 individuals according to the Waterbirds Populations Portal (estimate from 2011, http://wpe.wetlands.org, accessed on 03.07.2025). Although the species is less numerous than the barnacle goose, large numbers were seen in the study areas, as it apparently tends to fly in large flock sizes within a shorter period of time by end May (cf. Green 1998).

Ducks were the second most abundant group of diurnally migrating birds in both areas during both seasons. Two species were most numerous: the common scoter and the common eider.

Common scoters breed at northern latitudes, in the tundra regions of Iceland, northern Norway and Siberia, but also in small numbers in Britain and Ireland (MENDEL et al. 2008a). They occur in the North Sea, Skagerrak and the Baltic Sea as resting and moulting birds throughout the year, but in particularly high numbers in winter (MENDEL et al. 2008a). The main wintering areas are located in the Baltic, along the Wadden Sea and along the Atlantic coast south to North Africa, with particularly large numbers in the northern Kattegat (SKOV et al. 1995). Common eiders breed along the coasts of Iceland, Britain, Fennoscandia and on the Arctic coast of Russia as well as Canada. They also breed in Denmark and northern Germany, but these individuals are mostly sedentary. They winter in the Baltic Sea (largely to the east of Denmark and the north-eastern coast of Germany) as well as along the west coast of Norway and the Wadden Sea (DURINCK et al. 1994).

Common scoters were more common in the northern area (42% of all ducks registered in the northern area), whereas common eiders were more common in the southern area (almost 50% of all ducks registered in that area over the two survey years). While some of these ducks were migrating to and from their breeding areas in spring and autumn (especially in the middle of the season, when peak migration events occurred, see Results), it is possible that some of these birds may have been wintering in close proximity, especially common eiders that may also winter in shallower waters to the west of the planning areas (DURINCK et al. 1994). During the eleven digital aerial surveys conducted in the area across both years, there were high numbers of these species observed especially in spring (in particular of common eiders). To the west of the area, there are shallow waters suitable for these ducks.

A third species of duck was relevant in both pre-investigation areas especially in autumn: the Eurasian wigeon (*Mareca penelope*). Eurasian wigeons represented 8.5% and 11.3% of all ducks in autumn in the northern and in the southern area, respectively. They were mostly flying towards the southwest at low altitudes. The species is palearctic with a breeding distribution in northern Eurasia from Iceland eastwards. Birds that breed in Fennoscandia and western Russia tend to winter in northwestern Europe (SCOTT & ROSE 1996), and individuals of this population were most likely observed on their migration route towards northwestern coastal areas of Europe.

Songbirds were the third most abundant group during diurnal migration, especially in autumn in both pre-investigation areas where they represented > 12% of all migrating birds during the first survey year. In the second survey year, songbirds were the most common group in autumn in the southern pre-investigation area representing 41% of all migrating birds. At the same time, songbirds represented only 7% of all migrating birds in the same season in the northern area. Many passerine species were recorded, however, none very dominant. Sky larks, meadow pipits and Eurasian siskins were common to both areas, especially in autumn, whereas barn swallows were the most commonly identified species in spring in both areas (representing ~18% and 13% of all passerines in spring in the northern and southern pre-investigation area, respectively). In addition, white wagtails were common in spring in the northern area, whereas common starlings were very common in the southern area in autumn. The occurrence of comparatively more songbirds in autumn than in spring in both areas was expected. Due to the year's young fledged during summer, passerine migration in autumn is considered to comprise almost twice as many birds crossing the Baltic (cf. BELLEBAUM et al., 2010).

Altogether, these three groups represented the bulk of migrating birds (>90%) in both seasons and both areas. Nonetheless, there were also other groups and species that are worth mentioning, either their numbers are threatened and requiring conservation measures, or because considerable numbers of them were observed flying at altitudes above 20 m, possibly coinciding with the rotor height. These were, for example, divers (in particular, red-throated divers, *Gavia stellata*), which were more common towards the end of the autumn season, especially in the northern area; birds of prey such as red kites and Eurasian sparrowhawks (the former common in the northern area during autumn, and the latter common in both areas) and Eurasian curlews. In addition, there was a large number of migrating cranes (*Grus grus*) observed only in autumn of 2024 in the southern pre-investigation area. The cranes were flying mainly in a southerly to south-westerly direction and above 20 m of altitude with most of them (62%) flying between 100 and 200 m of altitude. Many of the cranes are breeding in Fennoscandia and the observed cranes were believed to originate from populations using the western European flyway that most probably originated in Norway and Sweden (see HANSSON et al. 2024). These are all populations having declined for different reasons in the last years and/or are considered within some conservation category (Birds Directive, SPEC or UICN, see Appendix).

In particular cranes which were detected at large numbers in autumn of 2024, and their main flight altitude coincides with the rotor height may be considered susceptible to collision with wind turbines. Previous studies conducted in the Kriegers Flak area (ELLIS & WARBERG BECKER 2015; SKOV et al. 2015) have shown a relatively low risk for collision and comparatively low mortality even when assuming a very low avoidance rate (e.g., 0.69, see Skov et al 2015). A most recent study close to Kriegers Flak and Bornholm using tagged cranes and visual observations from anchored vessels has provided data showing that cranes may show even a stronger avoidance rate (> 0.98) which suggests a much lower risk of collision. Whereas cranes do not seem to avoid passing through the turbines they do seem to be able to modify their flight behaviour with regards to the operating status of the wind turbines (WSP & BIOCONSULT SH 2024). These results agree with the results from another study conducted on an onshore wind farm with cranes exhibiting high avoidance despite flying through the wind farms (Drachmann et al. 2021). Nonetheless, collision risk might be higher with unfavourable weather conditions and low visibility and it must be considered the possible influence of cumulative impacts when several OWF are built on the migration route of cranes.

MIGRATION INTENSITIES

During the first survey year, migration intensities were considerably higher in the southern compared to the northern pre-investigation area (almost three times as many birds were registered in the southern pre-investigation area). The second survey year showed that high number of migrating birds may also cross the northern area, and that high numbers of migrating birds are crossing both subareas every year. When pooling data of both years, however, migration intensities derived from observer-based data were still higher in the southern pre-investigation area compared to the northern pre-investigation area, and this pattern also remained true when comparing means and medians of both seasons. This pattern was remarkable because KF II OWF S is located further offshore from the coast than the northern area, and a more intense migration of birds through areas closer to land was expected.
Mean values of spring and autumn migration were at a similar level within each pre-investigation area (KF II OWF N: 142.7 ind./h and 146.4 ind./h for spring and autumn, respectively; KF II OWF S: 246.7 ind./h and 256.6 ind./h for spring and autumn, respectively). Due to the influence of high migration peaks (geese migration events), variability was much higher in spring and thus medians were lower in spring than in autumn in both pre-investigation areas (see Results). This would be more in line with expectations of higher migration intensities (larger numbers of birds seen) in autumn compared to spring (because also newly hatched migrants are included).

Monthly migration intensities also showed congruence between both pre-investigation areas. In spring, May was by far the month with the highest mean migration intensities (due to the geese peak migration events). When looking at median intensities, however, April was the month with highest intensities in both pre-investigation areas. In autumn, mean and median values were highest in October for both pre-investigation areas.

Data from vertical radar, on the other hand, suggested no major differences in migration intensities between the two pre-investigation areas during diurnal migration with slightly higher mean (and median) intensities in autumn in the northern area compared to spring (46.6 and 55.7 MTR, for spring and autumn, respectively). The opposite was true for the southern pre-investigation area (67.4 and 50 MTR for spring and autumn, respectively). Vertical radar data did not appear to record any of the peak migration events of geese. No such high peak was observed in any year and in any area. Therefore, monthly migration intensities differed between areas and also with respect to data recorded from observers. In spring, March was the month with the highest mean migration intensity. In autumn, November was the month with highest migration intensity in the northern pre-investigation area, but October was the month with highest migration intensity in the southern pre-investigation area.

FLIGHT DIRECTIONS

Information from horizontal radar shows that most of the detected bird echoes during daylight hours headed towards NE in spring in the northern area and ENE in spring in the southern area, as well as WSW in autumn in both areas. Hence, the great majority of birds detected by horizontal radar were crossing the area on their way to their breeding grounds (spring) and into their wintering areas (autumn), respectively. The observed directions agreed with each other, irrespective of the survey year. This was to be expected since the horizontal radar is designed to collect data when the sea is calm which normally coincides with weather conditions suitable for migration. Part of the detected echoes may also indicate migratory directions of the most commonly occurring geese. GREEN (1998) measured flight directions of barnacle and brent geese migrating through Lund, Scania during spring (see Figure 6 of his publication), and these directions coincided with the migrations observed in the northern and southern pre-investigation areas (which contained large proportions of barnacle and brent geese in 2024). Furthermore, patterns registered by horizontal radar also represent migration of other groups as well.

FLIGHT ALTITUDES

Data collected by vertical radar confirm, that altitudes below 100 m were utilized most in both areas during all seasons. Furthermore, at least in spring, bird migration intensity was nearly twice as high in the southern area compared to the northern area. In autumn, proportions were the opposite, but the difference was less pronounced.

TEMPORAL PATTERNS

Data from vertical radar showed congruence in the temporal patterns of migration intensity, with more intense migration registered during the first half of the day and a progressive decline towards the end of the day, followed by a steep increase in migration intensity just before the onset of civil evening twilight. This pattern was observed irrespective of season and pre-investigation area. Data from observers show also a higher migration intensity during the first hours of the day compared to later hours in the northern pre-investigation area (more pronounced in spring). In the southern pre-investigation area, the pattern was not as clear.

6.1.2 NOCTURNAL MIGRATION

Many species of nocturnally migrating birds produce species-specific flight calls during migration thought to serve flock maintenance, orientation and stimulation of migration activity among others (FARNSWORTH 2005). Because direct observations of nocturnal migrants are difficult to obtain, the recording of flight calls is often used to study nocturnal migration and is regarded to be the best method for obtaining taxonomic information on the migrating species (WELCKER & VILELA 2018). The analysis of flight calls provides us information on species composition and relative frequency of their abundances as well as the temporal activity pattern. However, it is not possible to compare calls/h with individuals/h, since the frequency of flight calls does not only depend on the calling species but may be affected also by a variety of additional factors such as time of the day and atmospheric conditions (FARNSWORTH 2005; HÜPPOP & HILGERLOH 2012).

An interesting pattern was observed during the analysis of nocturnal calls: no calls were recorded during many nights in spring, especially in May (late spring) and this observation was consistent in both areas but stronger in the southern area (no calls were detected in 15 out of 30 nights and 15 out of 25 nights, in the northern and southern area, respectively, during both years). Other recent studies have also found out that in (late) May, there might be few vocal passerines migrating (see e.g., WEISSHAUPT et al. 2024). Moreover, migration dynamics might also differ between spring and autumn with spring nocturnal migration being characterized by occasional intense nights with many low-migration nights whereas in autumn, migration appears to be more consistent and concentrated so that flight calls might be more frequently heard. In addition, it is possible that spring migrants may be flying at higher altitudes than autumn migrants, making it more difficult to detect calls at sea-based level (e.g., the distribution of nocturnal migration echoes from vertical radar data in spring and autumn shows a larger proportion of bird echoes closer to the surface in autumn than in spring). Nonetheless, this was an unexpected result.

The analysis of flight calls conducted at both areas of KF II OWF showed that songbirds were the dominant group during nocturnal migration (>65% to >90%) with other groups such as waders, gulls and ducks occurring less frequently. There was however, one exception: in spring of 2024 in the norther pre-investigation area, nocturnal calls were dominated by calls of barnacle geese (86%). At that time, calls of nocturnal passerines were comparatively rarely heard and constituted only <5% of all calls heard in the season. This was, however, the result of peak migration events of barnacle geese observed between the 9th and 10th of May of 2024 in the northern pre-investigation area. Geese are often considered diurnal migrants; however, very large numbers of migrating barnacle geese were recorded during diurnal migration on those dates, and the analysis of nocturnal calls has shown that migration of these geese extended during the nights as well: high numbers of calls were heard during the nights of those dates. It must be then noted that when the calls of geese are not taken into account, the proportion of calls of other regularly occurring groups such as songbirds and waders are larger and more in accordance with the expected patterns.

It is well known that the bulk of migration movements occur during the night (ALERSTAM 1990) and that it is clearly dominated by passerines. Millions of songbirds migrate twice a year between their breeding ranges in Scandinavia and northern Russia and their wintering grounds in southern Europe and Africa (BERTHOLD et al. 2003). The total number of nocturnal passerine migrants has been estimated for the western Baltic Sea at about 200-300 million in spring and about half a billion (BELLEBAUM et al. 2010a).

In both areas, substantially more nocturnal bird calls were detected in autumn than in spring, which is in line with expectations since the autumn migration also includes young birds on their first migration towards the wintering areas. It is known, however, that call intensity during migration is especially high during nights with poor visibility, and such weather conditions are more common in autumn. Several studies have suggested that call rates may be directly affected by cloud cover, ceiling height and humidity (GRABER & COCHRAN 1960; GRABER 1968; FARNSWORTH 2005; HÜPPOP & HILGERLOH 2012). Moreover, WELCKER & VILELA (2019) also found that call rates are typically low in spring especially with clear skies or when the sky was partly cloudy. In autumn, however, they found high call intensities also during nights when the skies were cloudless.

Thrushes (*Turdus* spp.) were more common than other songbirds during (early) spring and (late) autumn migration except for the autumn migration in the southern pre-investigation area where they represented only a minority of all songbirds. As the main passage date of thrushes in autumn is later than that of other nocturnal songbirds, one could suggest that this may result due to the fewer number of survey dates in the southern pre-investigation area. However, this unexpected result is probably due to a large migration event of non-thrushes on the 10th of September 2023 (with 730 calls/h, of which 650 calls/h belonged to European robins alone).

Diurnal and nocturnal echoes from the horizontal radar provided similar findings. In spring, the main flight direction was NE and ENE for the northern and southern pre-investigation area, respectively. In autumn, bird echoes were detected heading towards WSW in both areas. The (small) difference in flight direction between the two areas in spring may be caused by the specific location of the anchor points: birds in the northern area heading for the nearest point of the coast, which was Falsterbo in the north-east, whereas in the southern, more offshore area, the birds orientated directly towards their Scandinavian/Siberian breeding areas.

Data from the vertical radar showed high migration intensities during the night in both areas. Migration intensity was higher in spring than in autumn in both areas and higher in the southern area (mean spring migration with 318.1 MTR and 425 MTR for the northern and southern pre-investigation area, respectively), where also a value of >2,300 MTR for a single night occurred. On the other hand, autumn migration intensity was higher in the northern area than in the southern area (mean: 200.2 MTR vs. 82.4 MTR in the northern and southern pre-investigation areas, respectively). In this case, results of vertical radar do not coincide with the results from observers. Calling intensity in the northern and southern pre-investigation areas were similar in spring (~ 7 calls/h) and higher in autumn in both areas (KF II OWF N: 25.7 calls/h, KF II OWF S: 45.8 calls/h), a pattern that can be expected since autumn migration includes young birds also (see above).

The distribution of migration altitudes was even during the night in both seasons, but especially in spring. Since no decreasing gradient towards higher altitudes was observed, it can be assumed that nocturnal migration also took place above 1,000 m but was covered only partially at these locations.

7 DATA AND KNOWLEDGE GAPS

Resting birds:

The present study indicates that there is already a comprehensive understanding of the bird species that regularly occur within the pre-investigation area of the proposed Kriegers Flak II OWF. But the analysis of data collected in the field between February 2023 and December 2024 show that details on fine-scale distribution patterns, seasonal occurrence and absolute density information from different times of the year are highly valuable and add a lot of new and additional information to the existing knowledge. This information is of utmost importance in order to make a strong assessment of the potential environmental impacts of the OWF development at the Kriegers Flak area.

In this study, twelve digital aerial surveys were conducted between February 2023 and December 2024 covering an area of 4,120.7 km² with an approximated 11% of coverage of the targeted area. The advantage of digital aerial data collection is that densities of seabirds can be assessed quickly and with a uniform collection effort on a large spatial scale in contrast to ship-based surveys and observer-based aerial surveys, where corrections for missing birds in greater distances have to be applied (ŽYDELIS et al. 2019). Still, this method is considered a "snap-shot"-method since the distribution of seabirds is only observed during the specific time frame of a flight and not continuously. Therefore, the results only show the abundance on the specific survey date and during daylight hours, so distribution patterns can differ when comparing results from different days, months or years.

Nonetheless, our results show that the patterns of resting birds in the Kriegers Flak II area coincide with the existing knowledge while simultaneously giving much more precise details on the presence of birds in the pre-investigation area. As the distribution of birds always depends on the situation on the respective survey day, surveys should therefore be performed in different months, covering different seasons and preferably two years to be able to draw better conclusions about seasonal and spatial distribution patterns. The knowledge gap was covered by systematically monitoring the same area over a period of two years.

Migrating birds:

The data collected on migrating birds were important to fill the gap of existing knowledge from the offshore areas. Although the extensive literature review provided a solid basis to assess, which migratory bird species groups could be expected in the investigation area and its surroundings, the field data provided precise information on migration intensity, species composition and flight height distribution.

The existing data already give extensive information on bird species migrating through the area and their migratory behaviour, which already allows for a rough estimate of the bird migration in the Kriegers Flak pre-investigation areas. The data collected over the last two years is very detailed and thus, provides a good insight into the actual migration activity at the exact locations of KF II N & S, but it also confirms that bird migration is highly variable and that precise predictions may therefore not be possible. Therefore, in spite of the very consistent and ample results, it would be still necessary to evaluate if it is possible to better predict when large numbers of migrating birds are expected to cross the area.

8 CONCLUSIONS

8.1 RESTING BIRDS:

The results of the resting bird surveys underscore the ecological importance of the pre-investigation area for several key avian groups, particularly sea ducks, gulls, and auks. The coastal waters of eastern Sjælland, Møn, and Falster, as well as those south of Falsterbo, serve as crucial wintering habitats, especially for common scoter and common eider. These species' preference for shallow, coastal waters is consistent with previous studies, and their observed densities, although slightly lower in certain areas, align with previous data from the region.

The occurrence of common eiders within and near the operational OWF at Kriegers Flak suggests that some individuals may exploit wind farm areas when prey availability is favourable. However, this behaviour should not be interpreted as broad-scale tolerance or attraction to wind farm environments, given the known sensitivity of many sea ducks towards ship traffic as well as wind farms.

Gulls were the second most abundant group of resting birds, with herring gull and common gull dominating observations. Their numbers increased during winter, and while they primarily favoured coastal zones, notable offshore concentrations—particularly near OWF infrastructure—were also documented. These patterns may reflect opportunistic foraging behaviour rather than a consistent ecological reliance on wind farm areas.

Auks were present in comparatively lower numbers, consistent with their more localized winter distributions. Nevertheless, the detection of high local densities within both planned and operational OWF zones at Kriegers Flak indicates that these areas may hold seasonal importance for certain auk populations.

While these observations offer valuable insights into species-specific spatial and temporal use of the area, they also highlight the complexity of interpreting bird–OWF interactions. The presence of birds within or near OWF sites should not be overgeneralized as evidence of negligible impact or habitat suitability. Instead, such findings underscore the need for species-specific, context-dependent assessments to accurately evaluate potential ecological risks associated with OWF development.

8.2 MIGRATING BIRDS

Results from visual observations and flight calls indicate that the pre-investigation area is crossed by migrating birds in quite high numbers compared to areas in the North Sea and other areas in the western Baltic Sea (e.g., the Pomeranian Bay). Despite more survey days having been available for the northern area, higher migration intensity, both diurnal and nocturnal were registered at the southern anchor position than at the northern one, especially in spring, contrary to expectations. Both areas (northern and southern areas) are part of the coastal diurnal migration with geese (barnacle and brent goose) and ducks (common scoter and common eider) as the most dominant species occurring in high to very high numbers on certain days with good migration conditions. Flying altitudes of ducks were mostly below 20 m whereas geese were frequently observed at all altitudes (also above 50 m), as expected. During diurnal migration, songbirds were mostly representative in autumn when they crossed the area regularly. During nocturnal migration, they were the most relevant species group. One exception was observed in spring of 2024 when large numbers of calls of barnacle geese were heard, in much

higher numbers than songbirds or other commonly migrating nocturnal group. In this case, the calls of barnacle geese were all heard during two nights in May which coincided with the peak migrating dates of barnacle geese during days. Waders were more representative in the northern area than in the southern area.
Cormorants and gulls were observed regularly in both the northern and southern area. Other groups such as divers, waders, terns and auks were however more often seen in the northern area.

Birds of prey were frequently observed as expected but compared to the most abundant species like geese and ducks in much smaller numbers and mostly in autumn (6-14 individuals in spring or 86-112 in autumn (variation depending on the year and area), thus their relative abundances in relation to the total number of migrating birds registered in any of the areas were negligible. Other groups such as cranes occurred also regularly in spring (23 – 64 individuals, depending on the area and year), but the second year of surveys demonstrated that the area can register large number of migrating birds as well, although there is extreme variation depending on the year (0 – 1738, i.e. in autumn of the first year no cranes were detected in any of the areas but in the second year low number of individuals were detected in one area: 9 whereas large numbers were detected in the southern area). Cranes and birds of prey need to be mentioned due to their large sizes, their status as protected species (because many of them are considered endangered), and their preferred flying height which coincides with the rotor height, potentially placing them at risk of collision with wind turbines.

Results from both, the vertical radar and the bird calls suggest that the pre-investigation area is part of the broadband nocturnal migration route for passerines. Flight height distribution between 0 and 1,000 m shows that during day the lower level below 100 m is the level with highest bird migration intensity. At night birds were in general more evenly distributed across altitude levels, especially in spring. In autumn, the pattern was not so pronounced, and highest intensity occurred between 300-400 m (both areas) and 900-1000 m (KF II S only) which suggests that some bird migration may have also taken place above 1,000 metres. The temporal distribution of birds during a 24h day show, that the nocturnal migrants arrived at the positions inside the proposed OWF areas one hour after sunset and highest Migration Traffic Rates (MTR) occurred in the first half of the night before the migration intensity gradually decreased until sunrise. During the day light phase, migration was significantly reduced compared to nights and highest MTR was measured in the first hours after sunrise. The hour with lowest migration was always the hour before sunset. This pattern reflects the typical migration pattern from offshore areas with a high flux of nocturnal migrants.

Results of the second year were important to complement and confirm the results of the first year. Despite natural annual variability in abundances, there was an overall congruence in the migration patterns of both years and Kriegers Flak II OWF is an important migration passage that is crossed by large numbers of migrating birds, especially of geese, ducks and songbirds.

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10 APPENDIX

10.1 RESTING BIRDS

Table A 1. Species list of all birds detected during the five digital aerial surveys between February and December 2024 in the pre-investigation area. Species names are provided in English, Danish and in Latin names as well as their inclusion in various relevant categories of conservation at European level. Number of individuals and whether the bird is considered a resting (R) or only a migratory (M) bird (and thus not considered in the analysis of resting birds) is also indicated.

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
Divers	Red-throated diver	*Gavia stellata*	Rødstrubet Lom	R/M	227	I	LC	LC	B 2e
	Black-throated diver	*Gavia arctica*	Sortstrubet Lom	R/M	55	I	LC	LC	B 2c
	Great Northern diver	*Gavia immer*	Islom	R/M	1	I	LC	LC	A 1c
	Unidentified diver	*Gavia sp.*		R/M	50				
Grebes	Great crested grebe	*Podiceps cristatus*	Toppet Lappedykker	R/M	32		LC	LC	C 1
	Red-necked grebe	*Podiceps grisegena*	Gråstrubet Lappedykker	R/M	27		VU	VU	A 3c
	Slavonian Grebe	*Podiceps auritus*	Nordisk Lappedykker	R/M	53	I	VU	NT	A 1b 1c
	Red-necked grebe / Great crested grebe	*Podiceps grisegena/Podiceps cristatus*		R/M	36				

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	Unidentified grebe	*Podicipedidae sp.*		R/M	36				
Gannets	Northern gannet	*Morus bassanus*	Sule	R/M	4		LC	LC	C 1
Cormorants	Great cormorant	*Phalacrocorax carbo*	Skarv	R/M	208		LC	LC	C 1
Herons	Grey heron	*Ardea cinerea*	Fiskehejre	M	12		LC	LC	C 1
Swams	Mute swan	*Cygnus olor*	Knopsvane	M	218		LC	LC	C 1
	Bewick's swan	*Cygnus columbianus bewickii*		M	2				A 2
	Unidentified swan	*Cygnus sp.*		M	5				
Geese	Bean goose	*Anser fabalis*	Tajgasædgås	M	4		VU	LC	A 3c*
	Tundra bean goose	*Anser fabalis rossicus*		M	2				C 1
	Greater white-fronted goose	*Anser albifrons*	Blisgås	M	219	I *	LC	LC	C 1
	Greylag goose	*Anser anser*	Grågås	M	38		LC	LC	C 1 / B 1

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	Unidentified grey goose	*Anser sp.*		M	1				
	Canada goose	*Branta canadensis*	Cadagås	M	25		N/A	LC	
	Barnacle goose	*Branta leucopsis*	Bramgås	M	118	I	LC	LC	C 1
	Brent goose	*Branta bernicla*	Knortegås	M	318		LC	LC	
	Common shelduck	*Tadorna tadorna*	Gravand	M	73		LC	LC	B 2a
Dabbling ducks	Eurasian wigeon	*Mareca penelope*	Pibeand	M	837		VU	LC	B 2c
	Gadwall	*Mareca strepera*	Krand	M	3		LC	LC	C 1
	Eurasian teal	*Anas crecca*	Krikand/Amerikansk krikand	M	61		LC	LC	C 1
	Mallard	*Anas platyrhynchos*	Gråand	M	349		LC	LC	C 1
	Northern pintail	*Anas acuta*	Spidsand	M	104		EN	VU	B 1
	Northern shoveler	*Spatula clypeata*	Skeand	M	98		NT	LC	B 1

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	Unidentified swimming duck	*Anas sp.*		M	180				
Diving ducks	Common pochard	*Aythya ferina*	Taffeland	M	3		VU	VU	A 1b
	Tufted duck	*Aythya fuligula*	Troldand	M	1		VU	NT	B (2c)
	Greater scaup	*Aythya marila*	Bjergand	M	11		EN	LC	C 1
Sea ducks	Common eider	*Somateria mollissima*	Ederfugl	R/M	4,665		VU	EN	A 4
	Long-tailed duck	*Clangula hyemalis*	Havlit	R/M	994		LC	LC	A 1b
	Common scoter	*Melanitta nigra*	Sortand	R/M	6,233		N/A	LC	B 2a
	Common scoter / Velvet scoter	*Melanitta sp.*		R/M	287				
	Velvet scoter	*Melanitta fusca*	Fløjlsand	R/M	900		VU	VU	A 1b
	Common goldeneye	*Bucephala clangula*	Hvind	M	56		LC	LC	B 2c

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
Mergansers	Smew	*Mergellus albellus*	Lille Skallesluger	M	2	I	LC	LC	B 1
	Red-breasted merganser	*Mergus serrator*	Toppet Skallesluger	M	483		NT	NT	B 2c
	Goosander	*Mergus merganser*	Stor Skallesluger	M	7		LC	LC	C 1
Ducks	unidentified duck	*Anatinae sp.*		M	529				
Birds of prey	Eurasian sparrowhawk	*Accipiter nisus*	Spurvehøg	M	39	I *	LC	LC	
	Common buzzard	*Buteo buteo*	Musvåge	M	3		LC	LC	
	Common kestrel	*Falco tinnunculus*	Tårnfalk	M	6		LC	LC	
Waders	Eurasian oystercatcher	*Haematopus ostralegus*	Strandskade	M	16		VU	VU	A 4
	Avocet	*Recurvirostra avosetta*	Klyde	M	20	I	LC	LC	B 1
	European golden plover	*Pluvialis apricaria*	Hjejle	M	5	I	LC	LC	C 1
	Grey plover	*Pluvialis squatarola*	Strandhjejle	M	23		LC	LC	B 2e
	Red knot	*Calidris canutus*	Islandsk Ryle	M	12		LC	LC	A 4

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	Dunlin	*Calidris alpina*	Almindelig Ryle	M	1	I *	LC	LC	C1
	Eurasian curlew	*Numenius arquata*	Storspove	M	7		NT	NT	A 4
	unidentified wader	*Limicolae*		M	68				
Skuas	Arctic skua	*Stercorarius parasiticus*	Almindelig Kjove	R/M	2		EN	EN	
Gulls	Little gull	*Hydrocoloeus minutus*	Dværgmåge	R/M	99	I	LC	LC	A (3c 3e)
	Black-headed gull	*Chroicocephalus ridibundus*	Hættemåge	R/M	259		VU	LC	B 2c
	Common gull	*Larus canus*	Stormmåge	R/M	586		LC	LC	B 2c
	Unidentified small gull	*Larus small sp.*		R/M	66				
	Lesser black-backed gull	*Larus fuscus*	Sildemåge	R/M	33		LC	LC	A 3c / B 2e / C1
	Herring gull	*Larus argentatus*	Sølvmåge	R/M	705		VU	LC	B 2c 2e /C1

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	Caspian gull	*Larus cachinnans*	Kaspisk Måge	R/M	1		LC	LC	C 1
	Great black-backed gull	*Larus marinus*	Svartbag	R/M	149		NT	LC	B 2c
	Common gull / Herring gull	*Larus argentatus/Larus canus*		R/M	41				
	Unidentified large gull	*Larus (magnus) sp.*		R/M	89				
	Great black-backed gull / Lesser black-backed gull	*Larus fuscus/Larus marinus*		R/M	8				
	Black-legged kittiwake	*Rissa tridactyla*	Ride	R/M	1		EN	VU	A 1b
	Unidentified gull	*Laridae sp.*		R/M	13				
Terns	Sandwich tern	*Thalasseus sandvicensis*	Splitterne	R/M	43	I	LC	LC	C 1
	Common tern / Arctic tern	*Sterna hirundo/Sterna paradisaea*		R/M	62	I			C 1
	Little tern	*Sternula albifrons*	Dværgterne	R/M	13	I	LC	LC	A 2

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
	tern / small gull	*Sterna spp / Larus spp.*		R/M	11				
	Unidentified tern	*Sternidae sp.*		R/M	26				
Auks	Common guillemot	*Uria aalge*	Lomvie	R/M	109	I *	LC	LC	C 1 / B 1
	Common guillemot / Razorbill	*Uria aalge / Alca torda*		R/M	269				
	Razorbill	*Alca torda*	Alk	R/M	375		LC	LC	C 1
	Black guillemot	*Cepphus grylle*	Tejst	R/M	47		LC	LC	B 1
	Unidentified auk	*Alcidae sp.*		R/M	16				
Pigeons	Feral pigeon	*Columba livia domestica*		M	1				
	Stock pigeon	*Columba oenas*	Huldue	M	4		LC	LC	
	Common wood pigeon	*Columba palumbus*	Ringdue	M	8	I *	LC	LC	
Swifts	Common swift	*Apus apus*	Mursejler	M	1		NT	NT	

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
Songbirds	White wagtail / Pied wagtail	*Motacilla alba*	Hvid Vipstjert	M	1		LC	LC	
	Chiffchaff / Willow warbler	*Phylloscopus collybita/Phylloscopus trochilus*		M	2				
	Eurasian jackdaw	*Coloeus monedula*	Allike	M	2		LC	LC	
	Rook	*Corvus frugilegus*	Råge	M	2		LC	VU	
	Hooded crow	*Corvus cornix*	Gråkrage	M	1				
	Chaffinch	*Fringilla coelebs*	Bogfinke	M	284	I *	LC	LC	
	Brambling	*Fringilla montifringilla*	Kvækerfinke	M	5		LC	LC	
	Unidentified finch	*Fringilla sp.*		M	528				
	Unidentified songbird	*Passerine sp*		M	3,120				
-	Unidentified bird	*Aves sp*		M	360				

Species groups	Common names in English	Scientific name	Common names in Danish	Resting / Migratory	Number of ind.	Conservation/Protection categories			
						Birds Dir	UICN	EU Cat 28	AEWA
-	No animal sighting	No animal sighting		M	154				
Total					25,263				

10.2 MIGRATING BIRDS

Table A-2: Species list of all migrating birds observed (diurnal migration, visual observations) during the surveys in spring and autumn of 2023 and 2024 in the pre-investigation area Kriegers Flak (North and South). The table also indicates if a species is listed under one of the four conservation categories of Table A-4 (Annex I of the Bird Directive, EN, VU or NT of the IUCN and Birdlife categories and category A of the AEWA convention).

Species groups	English names	Conservation category	Kriegers Flak II North						Kriegers Flak II South					
			Spring			Autumn			Spring			Autumn		
			2023	2024	Total	2023	2024	Total	2023	2024	Total	2023	2024	Total
Divers	Red-throated diver	x	10	6	16	134	20	154	19	6	25	8	10	18
Divers	Black-throated diver	x	4	6	10	7	18	25	6	2	8	2	14	16
Divers	Great Northern diver	x	0	0	0	0	0	0	1	0	1	0	0	0
Divers	unidentified diver		14	14	28	14	17	31	23	29	52	6	13	19
Grebes	Great crested grebe		2	0	2	0	0	0	0	0	0	0	0	0
Grebes	Red-necked grebe	x	7	0	7	0	0	0	6	0	6	0	0	0
Grebes	unidentified grebe		0	0	0	0	2	2	0	0	0	0	3	3

Gannets	Northern gannet		1	1	2	5	4	9	0	1	1	2	3	5
Cormorants	Great cormorant		403	147	550	422	719	1,141	262	430	692	174	540	714
Herons	Great white Egret	x	0	0	0	4	1	5	0	0	0	0	15	15
Herons	Grey heron		0	1	1	2	31	33	2	17	19	3	18	21
Swans	Mute swan		6	8	14	16	0	16	1	5	6	2	8	10
Swans	Bewick´s swan	x	4	0	4	0	0	0	0	0	0	0	0	0
Swans	Whooper swan	x	4	0	4	69	0	69	0	0	0	0	17	17
Swans	unidentified swan		14	11	25	8	0	8	20	4	24	0	4	4
Geese	unidentified goose		190	5,734	5,924	174	2,989	3,163	56	134	190	3,513	629	4,142
Geese	Bean goose	x	0	10	10	78	57	135	0	0	0	1	0	1
Geese	Tundra bean goose		0	0	0	0	23	23	0	0	0	0	2	2
Geese	Pink-footed goose		0	0	0	0	0	0	0	0	0	0	5	5
Geese	Greater white-fronted goose	x	519	0	519	5	161	166	350	0	350	548	405	953
Geese	Greylag goose		316	283	599	66	284	350	214	130	344	38	168	206
Geese	unidentified grey goose		0	0	0	0	131	131	0	0	0	0	521	521

Geese	Canada goose		0	96	96	2	0	2	0	0	0	0	8	8
Geese	Barnacle goose	x	2,899	15,61 2	18,511	2,304	3,872	6,176	7,792	46	7,838	6,378	311	6,689
Geese	Brent Goose		51	1,986	2,037	11	1,697	1,708	28	19,424	19,452	262	10	272
Geese	unidentified black goose		0	0	0	306	220	526	14203	0	14203	59	70	129
Geese	Common shelduck		2	1	3	2	3	5	0	0	0	0	0	0
Ducks	Eurasian wigeon	x	14	2	16	208	411	619	4	22	26	378	488	866
Ducks	Gadwall		0	2	2	0	0	0	0	0	0	2	1	3
Ducks	Common teal		0	0	0	32	231	263	12	4	16	70	64	134
Ducks	Mallard		0	2	2	3	6	9	4	0	4	5	32	37
Ducks	Northern pintail	x	0	8	8	6	17	23	0	1	1	20	14	34
Ducks	Northern shoveler	x	0	0	0	10	31	41	8	0	8	4	1	5
Ducks	unidentified swimming duck		0	3	3	75	0	75	8	0	8	49	24	73
Ducks	Common pochard	x	0	0	0	1	0	1	0	0	0	0	0	0
Ducks	Tufted duck	x	4	4	8	4	12	16	0	0	0	43	24	67
Ducks	Greater scaup	x	0	0	0	28	0	28	0	0	0	0	7	7

Ducks	Common Eider	x	1,064	523	1,587	413	948	1,361	1,247	106	1,353	3,308	1,175	4,483
Ducks	Long-tailed duck	x	82	2	84	18	0	18	23	22	45	2	6	8
Ducks	Common scoter		906	265	1,171	908	2,369	3,277	2,007	415	2,422	318	608	926
Ducks	Common scoter / velvet scoter		25	0	25	0	41	41	0	0	0	13	20	33
Ducks	Velvet scoter	x	49	7	56	99	77	176	62	8	70	36	91	127
Ducks	Common goldeneye		0	0	0	4	0	4	0	0	0	0	1	1
Ducks	Red-breasted merganser	x	105	133	238	45	37	82	76	11	87	37	30	67
Ducks	Goosander		15	11	26	37	1	38	5	4	9	103	37	140
Ducks	unidentified merganser		9	13	22	26	1	27	0	4	4	1	4	5
Ducks	unidentified duck		74	35	109	513	668	1,181	39	32	71	202	452	654
Birds of prey	European honey-buzzard	x	0	0	0	2	13	15	1	3	4	6	6	12
Birds of prey	Red kite	x	0	0	0	36	23	59	0	0	0	4	5	9
Birds of prey	White-tailed sea-eagle	x	1	1	2	0	0	0	0	2	2	0	0	0

Birds of prey	Western marsh-harrier	x	0	0	0	11	4	15	0	0	0	0	2	2
Birds of prey	Hen harrier	x	1	0	1	1	1	2	0	1	1	8	0	8
Birds of prey	unidentified harrier		0	1	1	1	1	2	2	0	2	0	2	2
Birds of prey	Northern goshawk		0	0	0	0	0	0	0	0	0	2	0	2
Birds of prey	Eurasian sparrowhawk		3	7	10	33	42	75	8	3	11	70	66	136
Birds of prey	Eurasian buzzard		0	0	0	0	0	0	0	0	0	2	0	2
Birds of prey	unidentified buzzard		0	1	1	0	0	0	0	0	0	0	0	0
Birds of prey	unidentified bird of prey		0	0	0	0	0	0	3	1	4	2	5	7
Birds of prey	Osprey	x	1	0	1	3	5	8	0	0	0	2	5	7
Birds of prey	Eurasian kestrel		0	1	1	1	4	5	0	1	1	7	7	14
Birds of prey	Merlin	x	0	3	3	1	4	5	0	0	0	2	12	14
Birds of prey	Eurasian hobby		0	0	0	0	0	0	0	1	1	0	0	0
Birds of prey	Peregrine falcon	x	0	0	0	0	0	0	0	0	0	0	2	2
Cranes	Common crane	x	47	23	70	0	9	9	64	38	102	0	1,738	1,738

Waders	Eurasian oystercatcher	x	0	0	0	35	39	74	0	0	0	0	0	0
Waders	Little ringed plover		1	0	1	0	0	0	0	0	0	0	0	0
Waders	Common ringed plover		1	0	1	20	0	20	0	0	0	0	0	0
Waders	Eurasian golden plover	x	2	0	2	13	26	39	1	0	1	0	6	6
Waders	Grey plover		0	0	0	9	1	10	0	0	0	0	0	0
Waders	Sanderling		0	0	0	0	0	0	0	0	0	2	0	2
Waders	Dunlin	x	0	0	0	135	72	207	0	0	0	7	12	19
Waders	unidentified sandpiper		0	0	0	0	0	0	0	0	0	0	23	23
Waders	Ruff	x	0	0	0	1	0	1	0	0	0	0	0	0
Waders	Common snipe	x	0	0	0	4	1	5	0	0	0	0	1	1
Waders	Black-tailed godwit	x	0	0	0	4	0	4	0	0	0	0	0	0
Waders	Bar-tailed godwit	x	0	0	0	13	2	15	0	0	0	0	0	0
Waders	Eurasian whimbrel		0	0	0	6	0	6	0	0	0	0	0	0
Waders	Eurasian curlew	x	121	0	121	8	0	8	89	0	89	3	0	3

Waders	Common redshank	x	0	0	0	3	0	3	0	0	0	0	0	0
Waders	Green sandpiper		0	0	0	0	0	0	0	0	0	0	1	1
Waders	unidentified wader		24	6	30	18	13	31	0	0	0	21	16	37
Skuas	Arctic skua	x	0	2	2	4	4	8	1	0	1	0	1	1
Skuas	unidentified skua		0	1	1	12	8	20	0	0	0	0	0	0
Gulls	Mediterranean gull	x	0	0	0	0	0	0	0	2	2	0	0	0
Gulls	Little gull	x	27	5	32	80	10	90	8	11	19	36	152	188
Gulls	Black-headed gull	x	34	6	40	11	79	90	9	3	12	17	14	31
Gulls	Common gull		208	34	242	50	120	170	63	33	96	54	87	141
Gulls	unidentified small gull		0	0	0	0	29	29	0	0	0	0	0	0
Gulls	Lesser black-backed gull	x	26	11	37	5	16	21	20	5	25	6	6	12
Gulls	Herring gull	x	77	20	97	43	54	97	76	20	96	40	14	54
Gulls	Caspian gull		0	1	1	6	22	28	6	5	11	11	5	16
Gulls	Common/herring gull		0	1	1	0	0	0	0	0	0	0	0	0

Gulls	Great Black-backed gull	x	4	5	9	18	37	55	4	3	7	35	9	44
Gulls	unidentified large gull		18	0	18	14	67	81	12	11	23	36	31	67
Gulls	Lesser black-backed gull/great black-backed gull		0	1	1	2	0	2	0	0	0	0	0	0
Gulls	Black-legged kittiwake	x	2	0	2	3	0	3	0	1	1	0	0	0
Gulls	unidentified gull		0	0	0	0	8	8	3	0	3	1	7	8
Terns	Caspian tern	x	0	1	1	0	0	0	0	0	0	0	0	0
Terns	Sandwich tern	x	33	6	39	3	10	13	5	6	11	0	0	0
Terns	Common tern	x	0	9	9	168	135	303	0	0	0	0	0	0
Terns	Arctic tern	x	0	7	7	1	13	14	0	0	0	0	0	0
Terns	Common tern / Arctic tern	x	0	148	148	49	92	141	0	70	70	0	3	3
Terns	Black tern	x	0	0	0	0	5	5	0	0	0	0	0	0
Terns	unidentified tern		22	11	33	30	43	73	0	3	3	0	1	1
Auks	Common guillemot		40	14	54	14	3	17	13	5	18	17	7	24

Auks	Common guillemot / razorbill		49	48	97	31	7	38	34	14	48	21	26	47
Auks	Razorbill		34	11	45	25	5	30	24	11	35	11	7	18
Auks	Black guillemot		21	5	26	4	0	4	0	0	0	0	0	0
Auks	unidentified auk		0	0	0	1	0	1	1	0	1	0	0	0
Pigeons	City pigeon		0	1	1	0	0	0	0	0	0	0	1	1
Pigeons	Stock dove		0	0	0	0	0	0	1	0	1	3	1	4
Pigeons	Common wood-pigeon		1	0	1	0	1,586	1,586	3	1	4	0	2	2
Owls	Northern long-eared owl		0	0	0	1	0	1	0	0	0	0	0	0
Owls	Long-eared / short-eared owl		0	0	0	1	1	2	0	0	0	0	0	0
Owls	Short-eared owl	x	0	0	0	1	0	1	0	0	0	1	0	1
Swifts	Common swift	x	0	1	1	1	3	4	1	0	1	0	0	0
Songbirds	Wood lark	x	0	0	0	8	0	8	0	0	0	0	1	1
Songbirds	Eurasian skylark		18	1	19	293	628	921	26	0	26	309	224	533
Songbirds	Bank swallow		1	0	1	0	8	8	1	1	2	1	0	1

Songbirds	Barn swallow		18	67	85	110	23	133	46	27	73	122	75	197
Songbirds	Northern house martin		0	5	5	0	0	0	1	7	8	0	0	0
Songbirds	unidentified swallow/martin		4	5	9	0	0	0	3	1	4	0	2	2
Songbirds	Tree pipit		0	0	0	6	12	18	0	2	2	2	0	2
Songbirds	Meadow pipit		3	27	30	45	171	216	40	11	51	80	1,171	1,251
Songbirds	Rock pipit		0	0	0	3	1	4	0	0	0	2	0	2
Songbirds	unidentified pipit		25	10	35	28	8	36	72	1	73	70	50	120
Songbirds	Western yellow wagtail		0	17	17	17	6	23	0	1	1	1	0	1
Songbirds	Grey wagtail		0	0	0	0	8	8	0	0	0	1	5	6
Songbirds	White wagtail / pied wagtail		27	9	36	1	9	10	9	3	12	14	30	44
Songbirds	Eurasian wren		1	0	1	4	4	8	8	0	8	1	3	4
Songbirds	Dunnock		1	0	1	0	0	0	2	0	2	0	0	0
Songbirds	European robin		0	0	0	0	0	0	6	0	6	3	1	4
Songbirds	Black redstart		0	0	0	0	3	3	0	0	0	0	0	0

Songbirds	unidentified redstart		0	0	0	0	0	0	1	0	1	0	0	0
Songbirds	Northern wheatear	x	0	0	0	1	0	1	0	0	0	1	0	1
Songbirds	Common blackbird		1	0	1	1	0	1	5	0	5	0	0	0
Songbirds	Song thrush		0	0	0	1	0	1	0	0	0	0	5	5
Songbirds	Redwing		0	0	0	0	0	0	8	0	8	5	0	5
Songbirds	unidentified thrush		0	0	0	1	0	1	3	0	3	2	76	78
Songbirds	Common chiffchaff		0	0	0	0	1	1	2	1	3	0	1	1
Songbirds	Willow warbler		0	2	2	0	0	0	0	0	0	1	0	1
Songbirds	unidentified leaf warbler		0	0	0	0	0	0	0	1	1	2	1	3
Songbirds	Goldcrest		1	0	1	2	4	6	2	2	4	2	3	5
Songbirds	Common firecrest		0	0	0	0	0	0	10	0	10	0	0	0
Songbirds	Spotted flycatcher		0	0	0	1	0	1	0	0	0	0	0	0
Songbirds	Red-breasted flycatcher	x	0	0	0	0	0	0	0	1	1	0	0	0
Songbirds	Eurasian blue tit		0	0	0	1	0	1	2	0	2	2	0	2
Songbirds	Great tit		1	0	1	3	0	3	4	1	5	0	0	0

Songbirds	Rook	x	4	0	4	0	0	0	0	0	0	0	0	0
Songbirds	Carrion crow		3	0	3	0	0	0	7	1	8	9	0	9
Songbirds	Hooded Crow		0	0	0	0	0	0	9	3	12	0	0	0
Songbirds	unidentified crow		0	0	0	0	0	0	3	1	4	0	4	4
Songbirds	Common starling		10	3	13	6	1	7	6	9	15	568	3	571
Songbirds	Common chaffinch		1	0	1	19	30	49	13	1	14	61	363	424
Songbirds	Brambling		16	0	16	0	0	0	10	0	10	10	236	246
Songbirds	unidentified *Fringilla* finch		5	0	5	0	0	0	0	0	0	0	274	274
Songbirds	European greenfinch		8	0	8	6	0	6	3	0	3	0	0	0
Songbirds	European goldfinch		5	2	7	0	21	21	18	0	18	37	38	75
Songbirds	Eurasian siskin		19	0	19	106	47	153	16	1	17	450	258	708
Songbirds	Eurasian linnet		2	0	2	2	2	4	3	9	12	16	126	142
Songbirds	Twite	x	0	0	0	41	0	41	0	0	0	6	0	6
Songbirds	Common redpoll		0	0	0	15	0	15	0	0	0	9	0	9
Songbirds	unidentified poll		4	0	4	160	32	192	6	19	25	78	1,221	1,299

Songbirds	Snow bunting		0	0	0	1	0	1	0	0	0	0	0	0
Songbirds	Reed bunting		0	0	0	4	0	4	0	0	0	3	24	27
Songbirds	unidentified songbird		78	76	154	106	253	359	71	33	104	400	1,464	1,864
Songbirds	unidentified bird	x	7	0	7	0	0	0	9	0	9	0	0	0
TOTAL		**59**	**7,854**	**25,542**	**33,396**	**7,987**	**18,988**	**26,975**	**27,355**	**21,248**	**48,603**	**18,282**	**13,795**	**32,077**

Table A-2: Species list of all migrating birds heard (nocturnal migration, flight calls) during the surveys in spring and autumn of 2023 and 204 in the pre-investigation area Kriegers Flak II (North and South). The table also indicates if a species is listed under one of the four conservation categories of Table A-4 (Annex I of the Bird Directive, EN, VU or NT of the IUCN and Birdlife categories and category A of the AEWA convention).

Species groups	English names	Conservation category	Kriegers Flak II North						Kriegers Flak II South					
			Spring			Autumn			Spring			Autumn		
			2023	2024	Total	2023	2024	Total	2023	2024	Total	2023	2024	Total
Herons	Grey heron		0	0	0	2	0	2	0	0	0	0	0	0
Geese	Greater white-fronted goose	x	0	0	0	0	2	2	0	0	0	0	0	0
Geese	Barnacle goose	x	0	545	545	6	23	29	0	0	0	0	0	0

Geese	Brent goose		0	0	0	0	0	0	5	0	5	0	0	0
Ducks	Common teal		0	0	0	0	1	1	3	0	3	0	0	0
Ducks	Tufted duck	x	0	0	0	0	10	10	0	0	0	0	0	0
Ducks	Common eider	x	0	10	10	0	0	0	0	0	0	0	0	0
Ducks	Common scoter		3	0	3	0	0	0	17	0	17	0	0	0
Waders	Eurasian oystercatcher	x	0	15	15	0	0	0	1	0	1	0	0	0
Waders	Pied avocet	x	0	0	0	2	0	2	0	0	0	0	0	0
Waders	Little ringed plover		0	0	0	2	0	2	0	0	0	0	0	0
Waders	Common ringed plover		0	3	3	15	0	15	0	0	0	0	0	0
Waders	Eurasian golden plover	x	4	0	4	0	3	3	0	0	0	7	0	7
Waders	Dunlin	x?	0	2	2	231	3	234	0	0	0	24	0	24
Waders	Jack snipe		0	0	0	8	0	8	0	0	0	0	0	0
Waders	Common snipe	x	11	0	11	23	1	24	0	0	0	0	0	0
Waders	Bar-tailed godwit	x	2	0	2	0	0	0	0	0	0	0	0	0
Waders	Eurasian whimbrel		0	14	14	2	2	4	0	0	0	3	0	3
Waders	Spotted redshank	x	0	0	0	2	0	2	0	0	0	0	0	0

Waders	Common redshank	x	0	0	0	0	23	23	0	6	6	0	0	0
Waders	Wood sandpiper	x	5	0	5	0	0	0	0	0	0	0	0	0
Waders	Common sandpiper		0	2	2	17	2	19	0	2	2	110	0	110
Gulls	Black-headed gull	x	0	0	0	0	0	0	10	0	10	0	0	0
Gulls	Common gull		87	2	89	0	0	0	4	0	4	0	0	0
Gulls	Herring gull	x	5	0	5	0	0	0	0	0	0	0	0	0
Gulls	Unidentified gull		0	1	1	0	0	0	0	0	0	0	0	0
Terns	Sandwich tern	x	0	1	1	0	0	0	0	0	0	0	0	0
Terns	Common tern	x	0	0	0	0	14	14	0	0	0	0	0	0
Pigeons	Stock dove		0	0	0	0	0	0	0	0	0	1	0	1
Owls	Northern long-eared owl		0	0	0	0	0	0	1	0	1	0	0	0
Songbirds	Eurasian Skylark		0	0	0	14	26	40	31	0	31	162	6	168
Songbirds	Tree pipit		0	0	0	67	30	97	0	0	0	43	0	43
Songbirds	Meadow pipit		0	0	0	6	41	47	0	0	0	0	0	0
Songbirds	Red-throated Pipit	x	0	0	0	0	3	3	0	0	0	0	0	0
Songbirds	Unidentified pipit		0	0	0	0	0	0	0	0	0	1	0	1

Songbirds	Western yellow wagtail		0	0	0	0	20	20	0	0	0	0	0	0
Songbirds	White wagtail / Pied wagtail		0	0	0	0	0	0	0	0	0	3	0	3
Songbirds	Eurasian wren		0	0	0	3	0	3	0	0	0	0	0	0
Songbirds	Dunnock		0	0	0	10	3	13	0	0	0	0	0	0
Songbirds	European robin		62	5	67	421	583	1,004	132	2	134	3,304	374	3,678
Songbirds	Common redstart		0	0	0	1	0	1	0	0	0	9	0	9
Songbirds	Common blackbird		56	0	56	1,007	17	1,024	176	1	177	126	97	223
Songbirds	Fieldfare		2	3	5	57	18	75	5	0	5	1	5	6
Songbirds	Song thrush		25	2	27	291	227	518	224	6	230	201	65	266
Songbirds	Redwing		98	23	121	1,602	250	1,852	124	27	151	453	131	584
Songbirds	Mistle thrush		0	0	0	3	0	3	0	0	0	0	0	0
Songbirds	Lesser whitethroat		0	0	0	0	0	0	0	0	0	1	0	1
Songbirds	Common chiffchaff		0	0	0	0	0	0	0	0	0	0	1	1
Songbirds	Unidentified leaf warbler		0	0	0	0	0	0	0	0	0	24	0	24
Songbirds	Goldcrest		0	0	0	14	14	28	0	0	0	15	0	15
Songbirds	Spotted flycatcher		0	2	2	5	0	5	0	0	0	4	0	4

Songbirds	Great tit		0	0	0	6	0	6	0	0	0	0	0	0
Songbirds	Common starling		0	0	0	3	1	4	0	0	0	0	5	5
Songbirds	Common chaffinch		0	0	0	2	1	3	0	0	0	0	0	0
Songbirds	Brambling		0	0	0	6	8	14	2	0	2	3	4	7
Songbirds	Reed bunting		0	0	0	32	5	37	0	0	0	42	0	42
Songbirds	Unidentified songbird		0	1	1	79	1	80	1	0	1	288	0	288
Songbirds	Unidentified bird	x?	0	5	5	0	0	0	0	0	0	0	0	0
			360	**636**	**996**	**3,939**	**1,332**	**5,271**	**736**	**44**	**780**	**4,825**	**688**	**5,513**

Table A-4: Species list of all migrating birds observed (diurnal migration, visual observations) and heard (nocturnal migration, flight calls) during the surveys in spring of 2023 in the pre-investigation area Kriegers Flak II North and South. Species names are provided in English, Danish and in Latin names as well as their inclusion in various relevant categories of conservation at European level.

Species groups	Common names in		Scientific names	Conservation/Protection categories				Investigation area		Season		Type of data	
	English	Danish		Birds Dir	UICN	EU Cat 27 + UK	AEWA	KFN	KFS	Spring	Autumn	Visual obs.	Night calls
Divers	Red-throated Diver	Rødstrubet Lom	*Gavia stellata*	I	LC	LC	B 2e	x	x	x	x	x	

Divers	Black-throated Diver	Sortstrubet lom	*Gavia arctica*	I	LC	LC	B 2c	x	x	x	x	x	
Divers	Great northern diver	Islom	*Gavia immer*	I	LC	LC	A 1c		x	x		x	
Grebes	Great crested Grebe	Toppet lappedykker	*Podiceps cristatus*		LC	LC	C 1	x		x		x	
Grebes	Red-necked grebe	Gråstrubet lappedykker	*Podiceps grisegena*		VU	VU	A 3c	x	x	x		x	
Gannets	Northern gannet	Sule	*Morus bassanus*		LC	LC	C 1	x	x	x	x	x	
Cormorants	Great cormorant	Skarv	*Phalacrocorax carbo*		LC	LC	C 1	x	x	x	x	x	
Herons	Great white egret	Sølvhejre	*Ardea alba*	I	LC	LC	C 1	x	x		x	x	
Herons	Grey heron	Fiskehejre	*Ardea cinerea*		LC	LC	C 1	x	x	x	x	x	x
Swans	Mute swan	Knopsvane	*Cygnus olor*		LC	LC	C 1	x	x	x	x	x	
Swans	Bewick´s swan	NA	*Cygnus columbianus bewickii*				A 2	x		x		x	
Swans	Whooper swan	Sangsvane	*Cygnus cygnus*	I	LC	LC	C 1	x	x	x	x	x	
Geese	Bean goose	Tajgasædgås	*Anser fabalis*		LC	VU	A 3c*	x	x	x	x	x	
Geese	Tundra bean goose	NA	*Anser fabalis rossicus*				C 1	x	x		x	x	
Geese	Pink-footed goose	Kortnæbbet gås	*Anser brachyrhynchus*		LC	LC	B 1		x		x	x	

Geese	Greater white-fronted goose		*Anser albifrons*	I *				x	x	x	x	x	x
Geese	Greylag goose	Grågås	*Anser anser*		LC	LC	C 1 / B 1	x	x	x	x	x	
Geese	Canada goose	Canadagås	*Branta canadensis*		LC	N/A		x	x	x	x	x	
Geese	Barnacle goose	Bramgås	*Branta leucopsis*	I	LC	LC	C 1	x	x	x	x	x	x
Geese	Brent goose	Knortegås	*Branta bernicla*		LC	LC		x	x	x	x	x	x
Geese	Common shelduck	Gravand	*Tadorna tadorna*		LC	LC	B 2a	x		x	x	x	
Ducks	Eurasian wigeon	Pibeand	*Mareca penelope*		LC	VU	B 2c	x	x	x	x	x	
Ducks	Gadwall	Knarand	*Mareca strepera*		LC	LC	C 1	x	x	x	x	x	
Ducks	Common teal	Krikand/Amerikansk krikand	*Anas crecca*		LC	LC	C 1	x	x	x	x	x	x
Ducks	Mallard	Gråand	*Anas platyrhynchos*		LC	LC	C 1	x	x	x	x	x	
Ducks	Northern pintail	Spidsand	*Anas acuta*		VU	EN	B 1	x	x	x	x	x	
Ducks	Northern shoveler	Skeand	*Spatula clypeata*		LC	NT	B 1	x	x	x	x	x	
Ducks	Common pochard	Taffeland	*Aythya ferina*		VU	VU	A 1b	x			x	x	
Ducks	Tufted duck	Troldand	*Aythya fuligula*		NT	VU	B (2c)	x	x	x	x	x	x
Ducks	Greater scaup	Bjergand	*Aythya marila*		LC	EN	C 1	x	x		x	x	

Ducks	Common eider	Ederfugl	*Somateria mollissima*		EN	VU	A 4	x	x	x	x	x	x
Ducks	Long-tailed Duck	Havlit	*Clangula hyemalis*		LC	LC	A 1b	x	x	x	x	x	
Ducks	Common scoter	Sortand	*Melanitta nigra*		LC	N/A	B 2a	x	x	x	x	x	x
Ducks	Velvet scoter	Fløjlsand	*Melanitta fusca*		VU	VU	A 1b	x	x	x	x	x	
Ducks	Common goldeneye	Hvinand	*Bucephala clangula*		LC	LC	B 2c	x	x		x	x	
Ducks	Red-breasted Merganser	Toppet skallesluger	*Mergus serrator*		NT	NT	B 2c	x	x	x	x	x	
Ducks	Goosander	Stor skallesluger	*Mergus merganser*		LC	LC	C 1	x	x	x	x	x	
Birds of prey	European honey-buzzard	Hvepsevåge	*Pernis apivorus*	I	LC	LC		x	x	x	x	x	
Birds of prey	Red kite	Rød glente	*Milvus milvus*	I	LC	LC		x	x		x	x	
Birds of prey	White-tailed sea-eagle	Havørn	*Haliaeetus albicilla*	I	LC	LC		x	x	x		x	
Birds of prey	Western marsh-harrier	Rørhøg	*Circus aeruginosus*	I	LC	LC		x	x		x	x	
Birds of prey	Hen harrier	Blå kærhøg	*Circus cyaneus*	I	LC	VU		x	x	x	x	x	
Birds of prey	Northern goshawk	Duehøg	*Accipiter gentilis*	I *	LC	LC			x		x	x	

Birds of prey	Eurasian sparrowhawk	Spurvehøg	*Accipiter nisus*	I *	LC	LC		x	x	x	x	x	
Birds of prey	Eurasian buzzard	Musvåge	*Buteo buteo*		LC	LC			x		x	x	
Birds of prey	Osprey	Fiskeørn	*Pandion haliaetus*	I	LC	LC		x	x	x	x	x	
Birds of prey	Eurasian kestrel	Tårnfalk	*Falco tinnunculus*		LC	LC		x	x	x	x	x	
Birds of prey	Merlin	Dværgfalk	*Falco columbarius*	I	VU	VU		x	x	x	x	x	
Birds of prey	Eurasian hobby	Lærkefalk	*Falco subbuteo*		LC	LC			x	x		x	
Birds of prey	Peregrine falcon	Vandrefalk	*Falco peregrinus*	I	LC	LC			x		x	x	
Cranes	Common crane	Trane	*Grus grus*	I	LC	LC	C 1	x	x	x	x	x	
Waders	Eurasian oystercatcher	Strandskade	*Haematopus ostralegus*		VU	VU	A 4	x	x	x	x	x	x
Waders	Pied avocet	Klyde	*Recurvirostra avosetta*	I	LC	LC	B 1	x			x		x
Waders	Little ringed plover	Lille præstekrave	*Charadrius dubius*		LC	LC	C 1	x		x	x	x	x
Waders	Common ringed plover	Stor præstekrave	*Charadrius hiaticula*		LC	LC	B 1	x		x	x	x	x

Waders	Eurasian golden plover	Hjejle	*Pluvialis apricaria*	I	LC	LC	C 1	x	x	x	x	x	x
Waders	Grey plover	Strandhjejle	*Pluvialis squatarola*		LC	LC	B 2e	x			x	x	
Waders	Sanderling	Sandløber	*Calidris alba*		LC	LC	C 1		x		x	x	
Waders	Dunlin	Almindelig Ryle	*Calidris alpina*	I *	LC	LC	C1	x	x	x	x	x	x
Waders	Ruff	Brushane	*Calidris pugnax*	I	NT	NT	B 2c	x			x	x	
Waders	Jack snipe	Enkeltbekkasin	*Lymnocryptes minimus*		LC	LC	C 1	x			x		x
Waders	Common snipe	Dobbeltbekkasin	*Gallinago gallinago*		VU	LC	B 2c	x	x	x	x	x	x
Waders	Black-tailed godwit	Stor kobbersneppe	*Limosa limosa*		NT	EN	A 3c 3e	x			x	x	
Waders	Bar-tailed godwit	Lille kobbersneppe	*Limosa lapponica*	I	LC	LC	A 4	x		x	x	x	x
Waders	Eurasian whimbrel	Småspove	*Numenius phaeopus*		LC	LC	C 1	x	x	x	x	x	x
Waders	Eurasian curlew	Storspove	*Numenius arquata*		NT	NT	A 4	x	x	x	x	x	
Waders	Spotted redshank	Sortklire	*Tringa erythropus*		LC	NT	A 3c 3e	x			x		x
Waders	Common redshank	Rødben	*Tringa totanus*		VU	VU	B 2c / C 1	x	x	x	x	x	x
Waders	Green sandpiper	Svaleklire	*Tringa ochropus*		LC	LC	C 1		x		x	x	

Waders	Wood sandpiper	Tinksmed	*Tringa glareola*	I	LC	LC	C 1	x		x			x
Waders	Common sandpiper	Mudderklire	*Actitis hypoleucos*		LC	LC	B 2c	x	x	x	x		x
Skuas	Arctic skua	Almindelig kjove	*Stercorarius parasiticus*		EN	EN		x	x	x	x	x	
Gulls	Mediterranean gull	Sorthovedet måge	*Ichthyaetus melanocephalus*	I	LC	LC	B 2a (2e)		x	x		x	
Gulls	Little gull	Dværgmåge	*Hydrocoloeus minutus*	I	LC	LC	A (3c 3e)	x	x	x	x	x	
Gulls	Black-headed gull	Hættemåge	*Chroicocephalus ridibundus*		LC	VU	B 2c	x	x	x	x	x	x
Gulls	Common gull	Stormmåge	*Larus canus*		LC	LC	B 2c	x	x	x	x	x	x
Gulls	Lesser black-backed gull	Sildemåge	*Larus fuscus*		LC	LC	A 3c / B 2e / C1	x	x	x	x	x	
Gulls	Herring gull	Sølvmåge	*Larus argentatus*		LC	VU	B 2c 2e /C1	x	x	x	x	x	x
Gulls	Caspian gull	Kaspisk måge	*Larus cachinnans*		LC	LC	C 1	x	x	x	x	x	
Gulls	Great Black-backed gull	Svartbag	*Larus marinus*		LC	NT	B 2c	x	x	x	x	x	
Gulls	Black-legged kittiwake	Ride	*Rissa tridactyla*		VU	EN	A 1b	x	x	x	x	x	

Terns	Caspian tern	Rovterne	*Hydroprogne caspia*	I	LC	LC	A 1c	x		x		x	
Terns	Sandwich tern	Splitterne	*Thalasseus sandvicensis*	I	LC	LC	C 1	x	x	x	x	x	x
Terns	Common tern	Fjordterne	*Sterna hirundo*	I	LC	LC	C 1	x		x	x	x	x
Terns	Arctic tern	Havterne	*Sterna paradisaea*	I	LC	LC	C 1	x		x	x	x	
Terns	Black tern	Sortterne	*Chlidonias niger*	I	LC	LC	B 2c	x			x	x	
Auks	Common guillemot	Lomvie	*Uria aalge*	I *	LC	LC	C 1 / B 1	x	x	x	x	x	
Auks	Razorbill	Alk	*Alca torda*		LC	LC	C 1	x	x	x	x	x	
Auks	Black guillemot	Tejst	*Cepphus grylle*		LC	LC	B 1	x		x	x	x	
Pigeons	City pigeon	NA	*Columba livia domestica*					x	x	x	x	x	
Pigeons	Stock dove	Huldue	*Columba oenas*		LC	LC			x	x	x	x	x
Pigeons	Common wood-pigeon	Ringdue	*Columba palumbus*	I *	LC	LC		x	x	x	x	x	
Owls	Northern long-eared owl	Skovhornugle	*Asio otus*		LC	LC		x	x	x	x	x	x
Owls	Short-eared owl	Mosehornugle	*Asio flammeus*	I	LC	LC		x	x		x	x	
Swifts	Common swift	Mursejler	*Apus apus*		NT	NT		x	x	x	x	x	

Songbirds	Wood lark	Hedelærke	*Lullula arborea*	I	LC	LC		x	x		x	x	
Songbirds	Eurasian skylark	Sanglærke	*Alauda arvensis*		LC	LC		x	x	x	x	x	x
Songbirds	Bank swallow	Digesvale	*Riparia riparia*		LC	LC		x	x	x	x	x	
Songbirds	Barn swallow	Landsvale	*Hirundo rustica*		LC	LC		x	x	x	x	x	
Songbirds	Northern house martin	Bysvale	*Delichon urbicum*		LC	LC		x	x	x		x	
Songbirds	Tree pipit	Skovpiber	*Anthus trivialis*		LC	LC		x	x	x	x	x	x
Songbirds	Meadow pipit	Engpiber	*Anthus pratensis*		LC	LC		x	x	x	x	x	x
Songbirds	Red-throated pipit	Rødstrubet piber	*Anthus cervinus*		LC	EN		x			x		x
Songbirds	Rock pipit	NA	*Anthus spinoletta litoralis*					x	x		x	x	
Songbirds	Western yellow wagtail	Gul vipstjert	*Motacilla flava*		LC	LC		x	x	x	x	x	x
Songbirds	Grey wagtail	Bjergvipstjert	*Motacilla cinerea*		LC	LC		x	x		x	x	
Songbirds	White wagtail / Pied wagtail	Hvid vipstjert	*Motacilla alba*		LC	LC		x	x	x	x	x	x
Songbirds	Eurasian wren	Gærdesmutte	*Troglodytes troglodytes*	I *	LC	LC		x	x	x	x	x	x
Songbirds	Dunnock	Jernspurv	*Prunella modularis*		LC	LC		x	x	x	x	x	x

Songbirds	European robin	Rødhals	*Erithacus rubecula*		LC	LC		x	x	x	x	x	x
Songbirds	Black redstart	Husrødstjert	*Phoenicurus ochruros*		LC	LC		x			x	x	
Songbirds	Common redstart	Rødstjert	*Phoenicurus phoenicurus*		LC	LC		x	x		x		x
Songbirds	Northern wheatear	Stenpikker	*Oenanthe oenanthe*		LC	NT		x	x		x	x	
Songbirds	Common blackbird	Solsort	*Turdus merula*		LC	LC		x	x	x	x	x	x
Songbirds	Fieldfare	Sjagger	*Turdus pilaris*		LC	LC		x	x	x	x		x
Songbirds	Song thrush	Sangdrossel	*Turdus philomelos*		LC	LC		x	x	x	x	x	x
Songbirds	Redwing	Vindrossel	*Turdus iliacus*		LC	LC		x	x	x	x	x	x
Songbirds	Mistle thrush	Misteldrossel	*Turdus viscivorus*		LC	LC		x			x		x
Songbirds	Lesser whitethroat	Gærdesanger	*Curruca curruca*		LC	N/A			x		x		x
Songbirds	Common chiffchaff	Gransanger	*Phylloscopus collybita*		LC	N/A		x	x	x	x	x	x
Songbirds	Willow warbler	Løvsanger	*Phylloscopus trochilus*		LC	LC		x	x	x	x	x	
Songbirds	Goldcrest	Fuglekonge	*Regulus regulus*		LC	LC		x	x	x	x	x	x
Songbirds	Common firecrest	Rødtoppet fuglekonge	*Regulus ignicapilla*		LC	LC			x	x		x	

Songbirds	Spotted flycatcher	Grå Ffuesnapper/Tyrrhensk fluesnapper	*Muscicapa striata*		LC	LC		x	x	x	x	x	x
Songbirds	Red-breasted flycatcher	Lille fluesnapper	*Ficedula parva*	I	LC	LC			x	x		x	
Songbirds	Eurasian blue tit	Blåmejse	*Cyanistes caeruleus*		LC	N/A		x	x	x	x	x	
Songbirds	Great tit	Musvit	*Parus major*		LC	LC		x	x	x	x	x	x
Songbirds	Rook	Råge	*Corvus frugilegus*		VU	LC		x		x		x	
Songbirds	Carrion crow	Sortkrage	*Corvus corone*		LC	LC		x	x	x	x	x	
Songbirds	Hooded crow	Gråkrage	*Corvus cornix*						x	x		x	
Songbirds	Common starling	Stær	*Sturnus vulgaris*		LC	LC		x	x	x	x	x	x
Songbirds	Common chaffinch	Bogfinke	*Fringilla coelebs*	I *	LC	LC		x	x	x	x	x	x
Songbirds	Brambling	Kvækerfinke	*Fringilla montifringilla*		LC	LC		x	x	x	x	x	x
Songbirds	European greenfinch	Grønirisk	*Chloris chloris*		LC	LC		x	x	x	x	x	
Songbirds	European goldfinch	Stillits	*Carduelis carduelis*		LC	LC		x	x	x	x	x	
Songbirds	Eurasian siskin	Grønsisken	*Spinus spinus*		LC	LC		x	x	x	x	x	
Songbirds	Eurasian linnet	Tornirisk	*Linaria cannabina*		LC	LC		x	x	x	x	x	

Songbirds	Twite	Bjergirisk	*Linaria flavirostris*		LC	VU		x	x		x	x	
Songbirds	Common redpoll	Stor gråsisken	*Acanthis flammea*		LC	LC		x	x		x	x	
Songbirds	Snow bunting	Snespurv	*Plectrophenax nivalis*		LC	LC		x			x	x	
Songbirds	Reed bunting	Rørspurv	*Emberiza schoeniclus*		LC	LC		x	x		x	x	x
Total								**127**	**116**	**107**	**127**	**131**	**53**

10.2.1 DIVERS

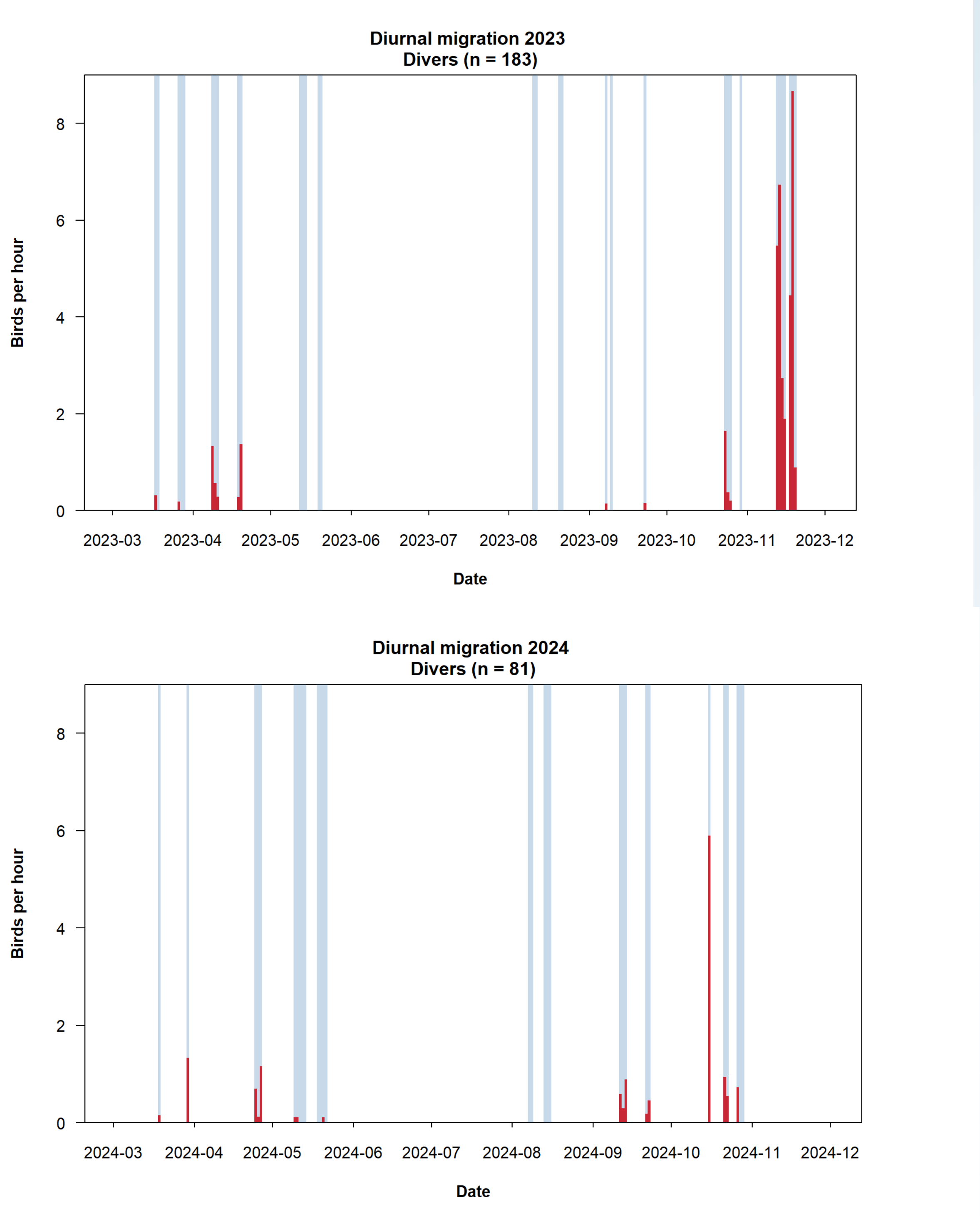
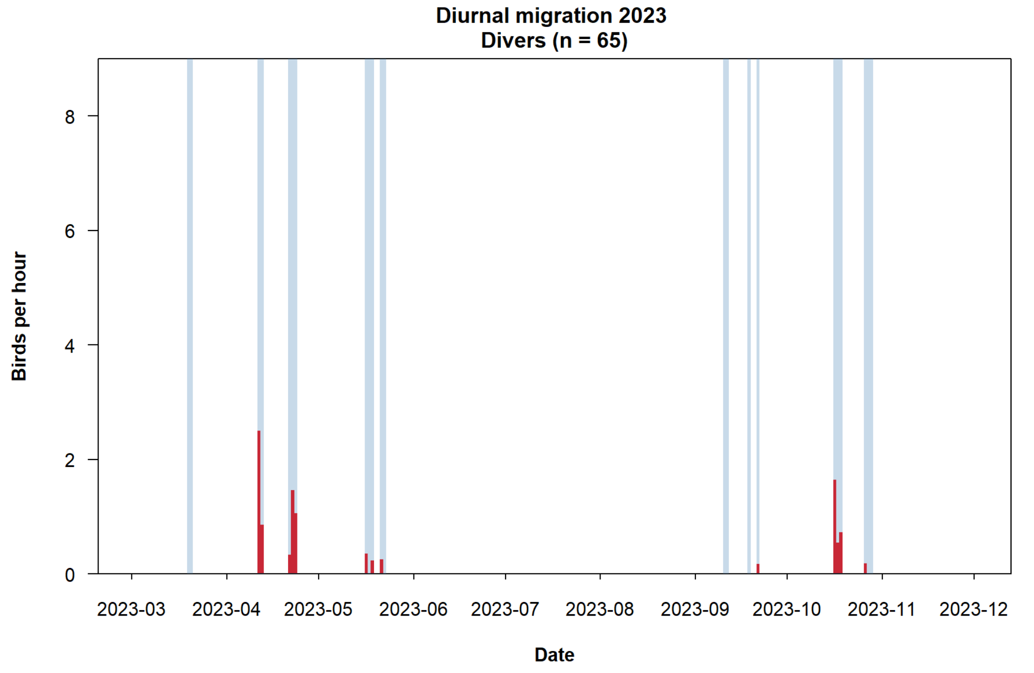


Figure 10-1 Diurnal migration intensity of divers derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024



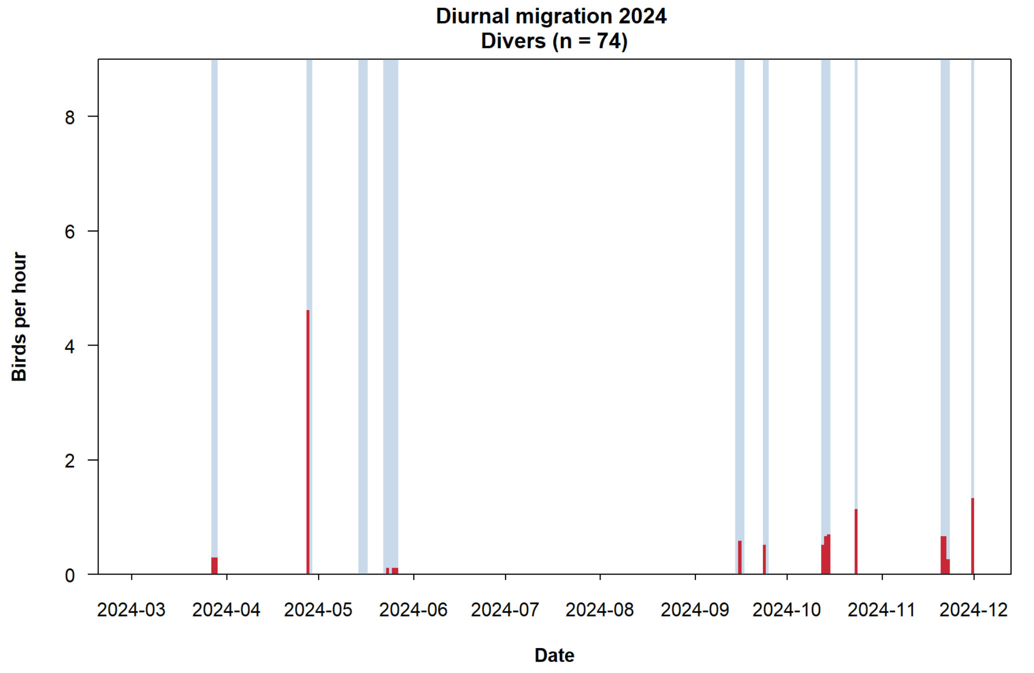


Figure 10-2 Diurnal migration intensity of divers derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.2 CORMORANTS

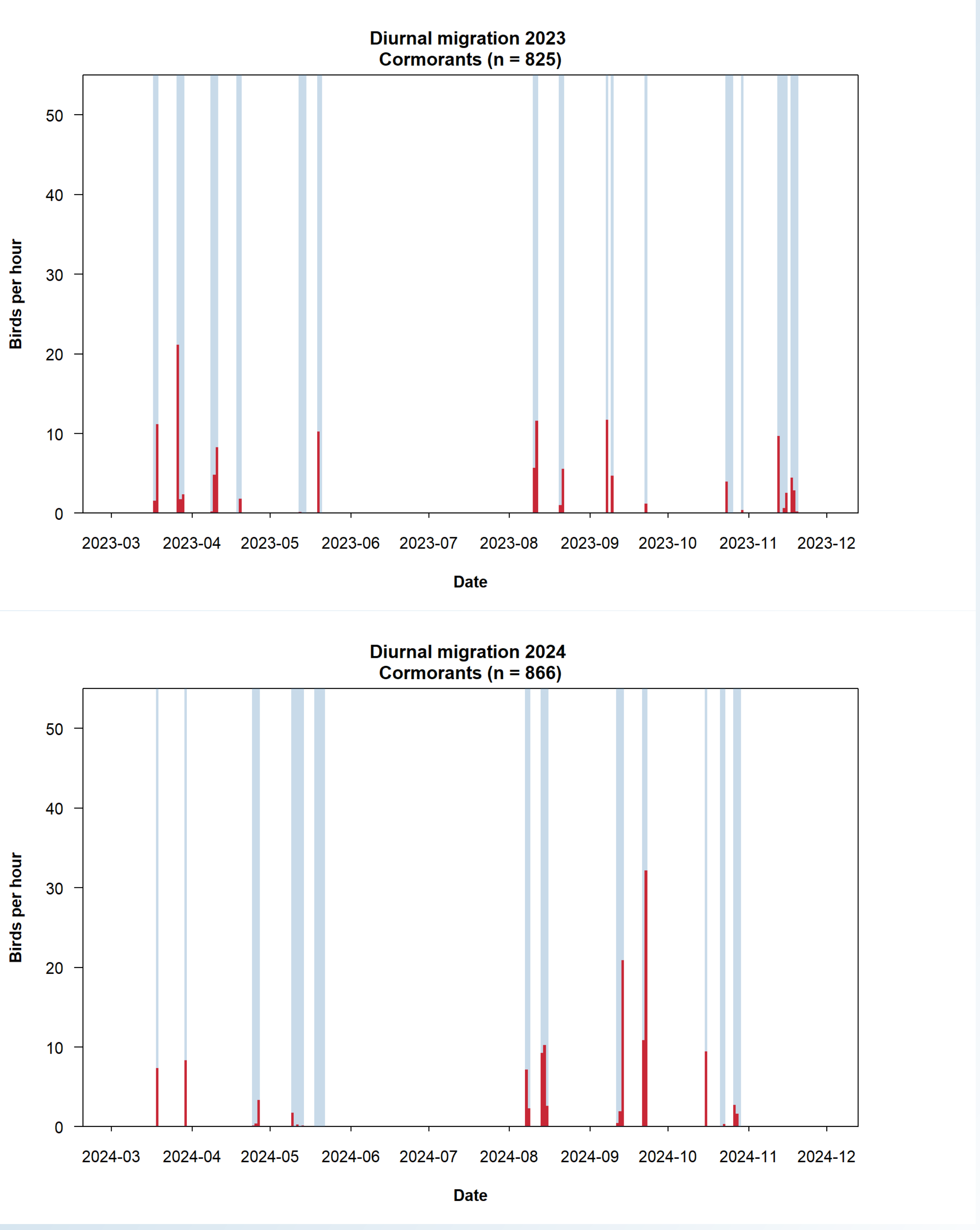


Figure 10-3 Diurnal migration intensity of divers derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

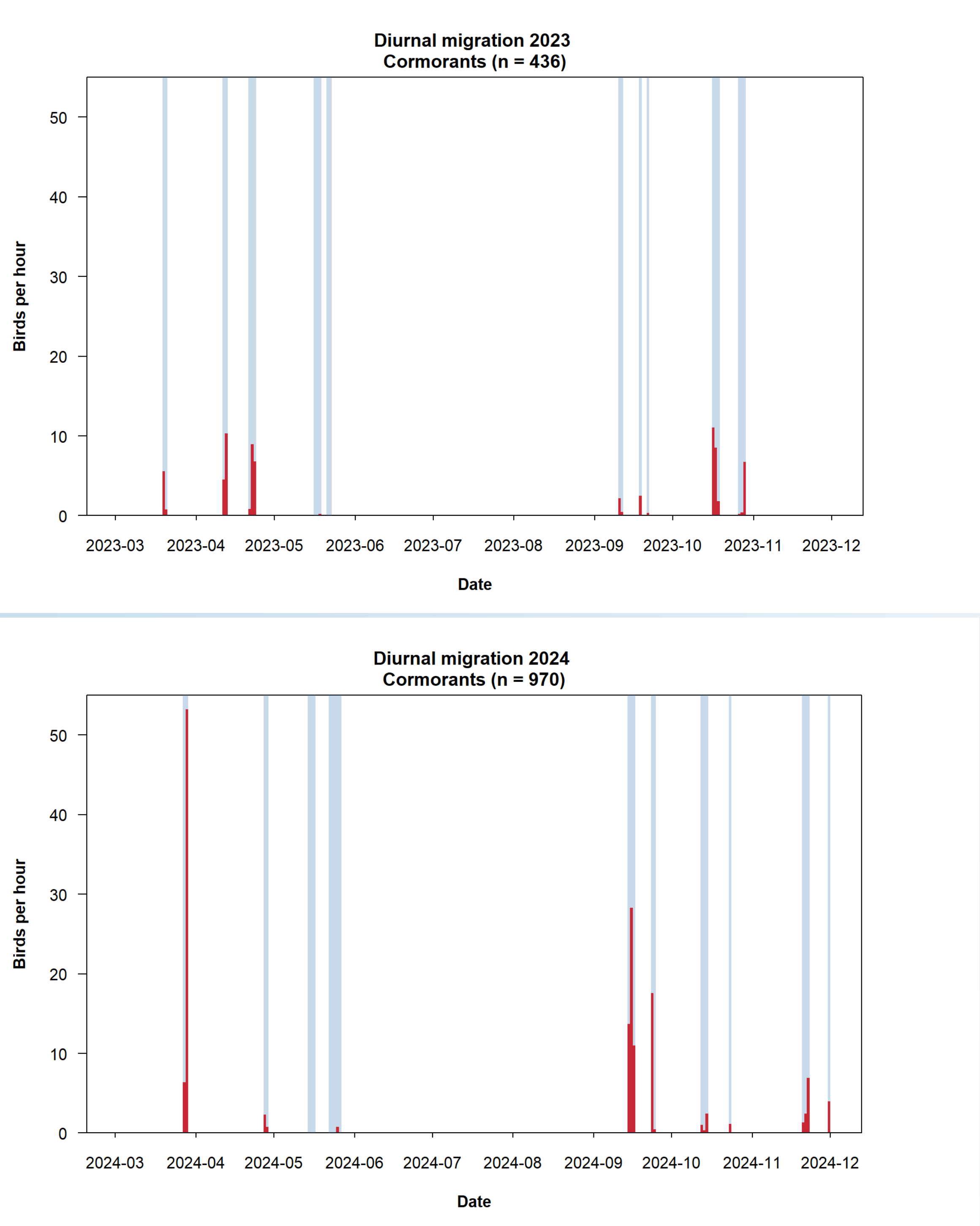
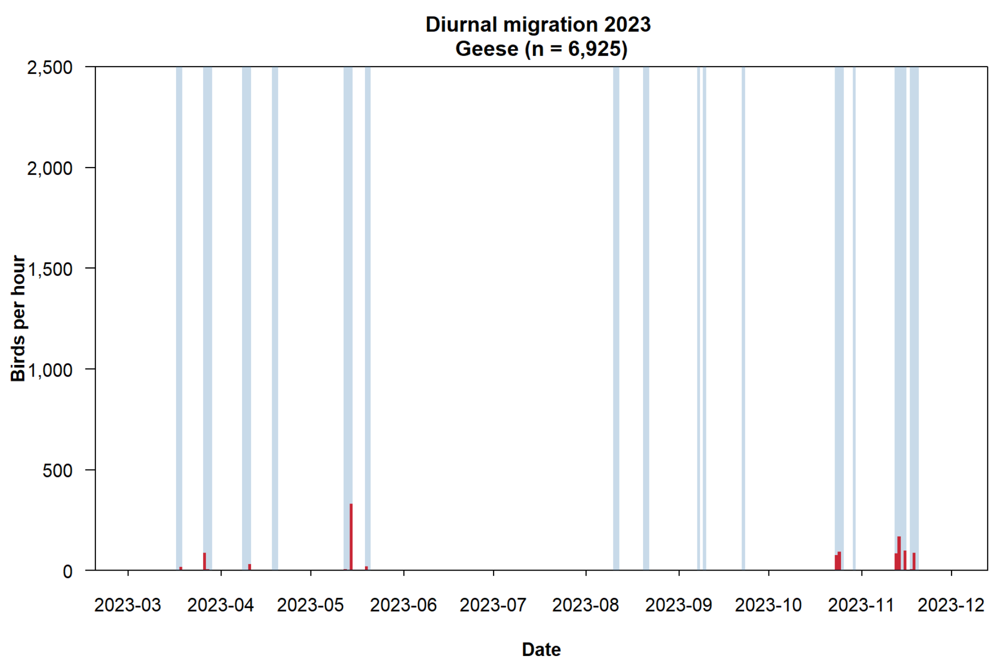


Figure 10-4 Diurnal migration intensity of cormorants derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.3 GEESE



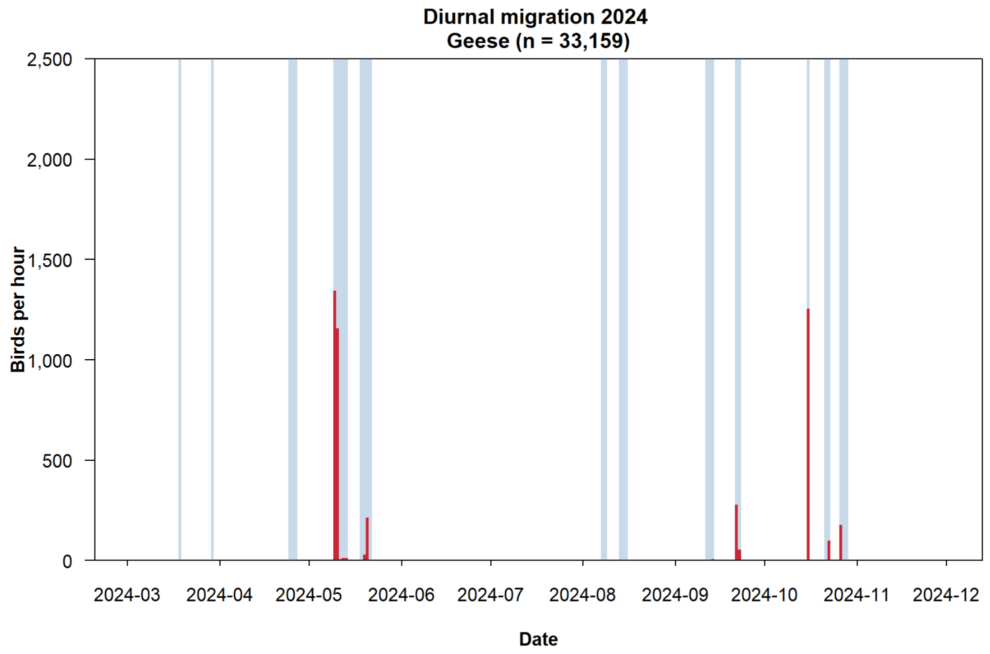


Figure 10-5 Diurnal migration intensity of geese derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

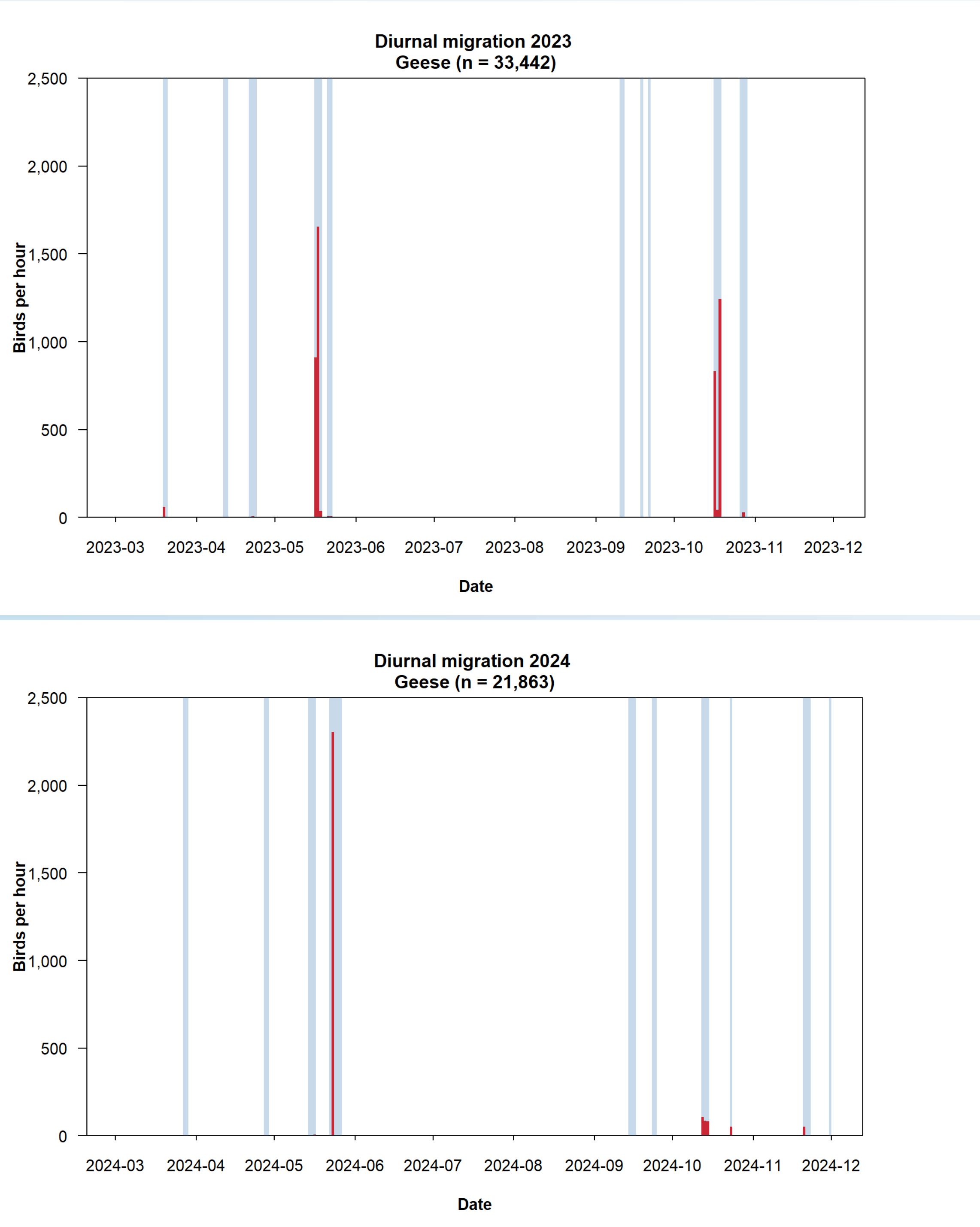


Figure 10-6 Diurnal migration intensity of geese derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.4 DUCKS

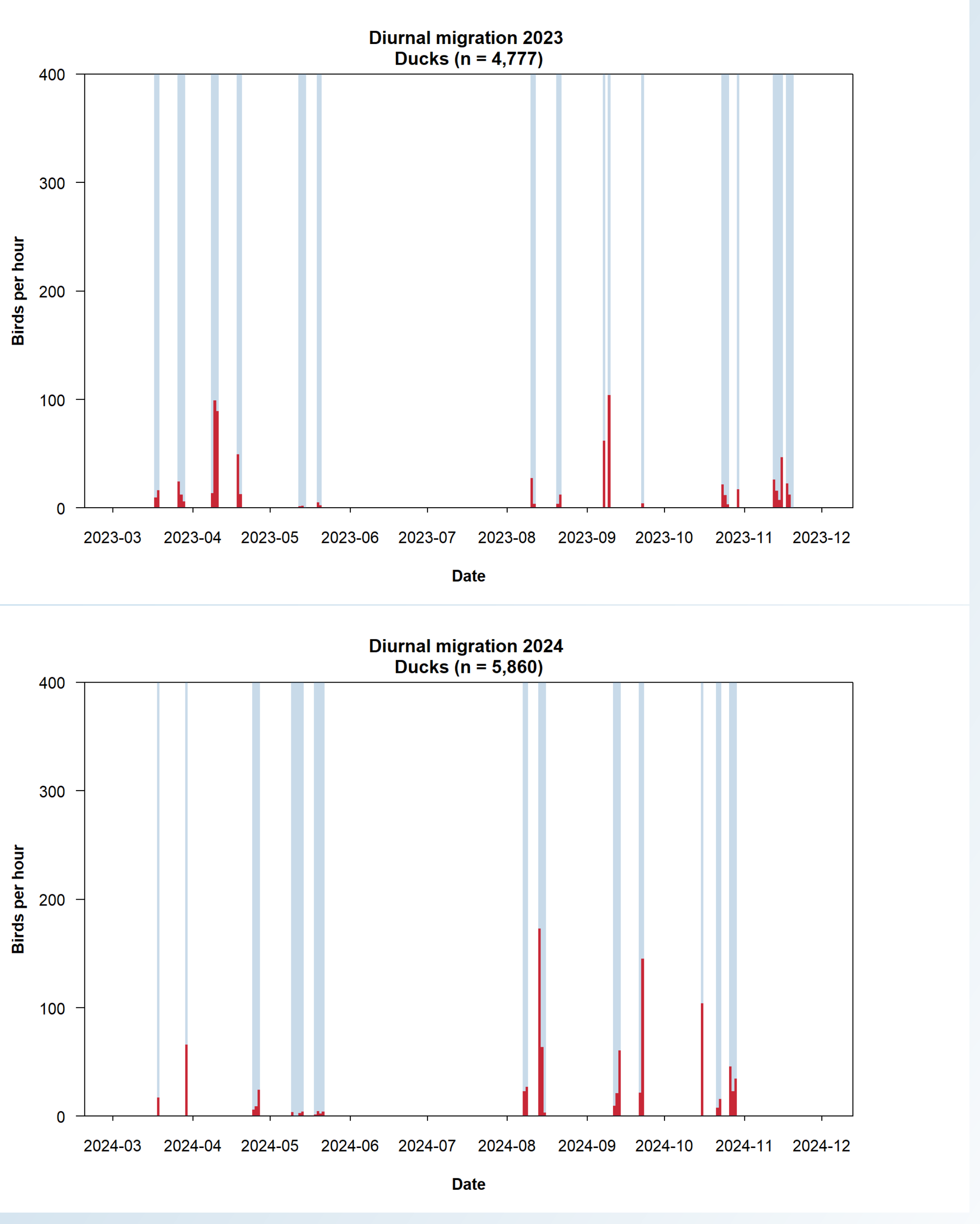


Figure 10-7 Diurnal migration intensity of ducks derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

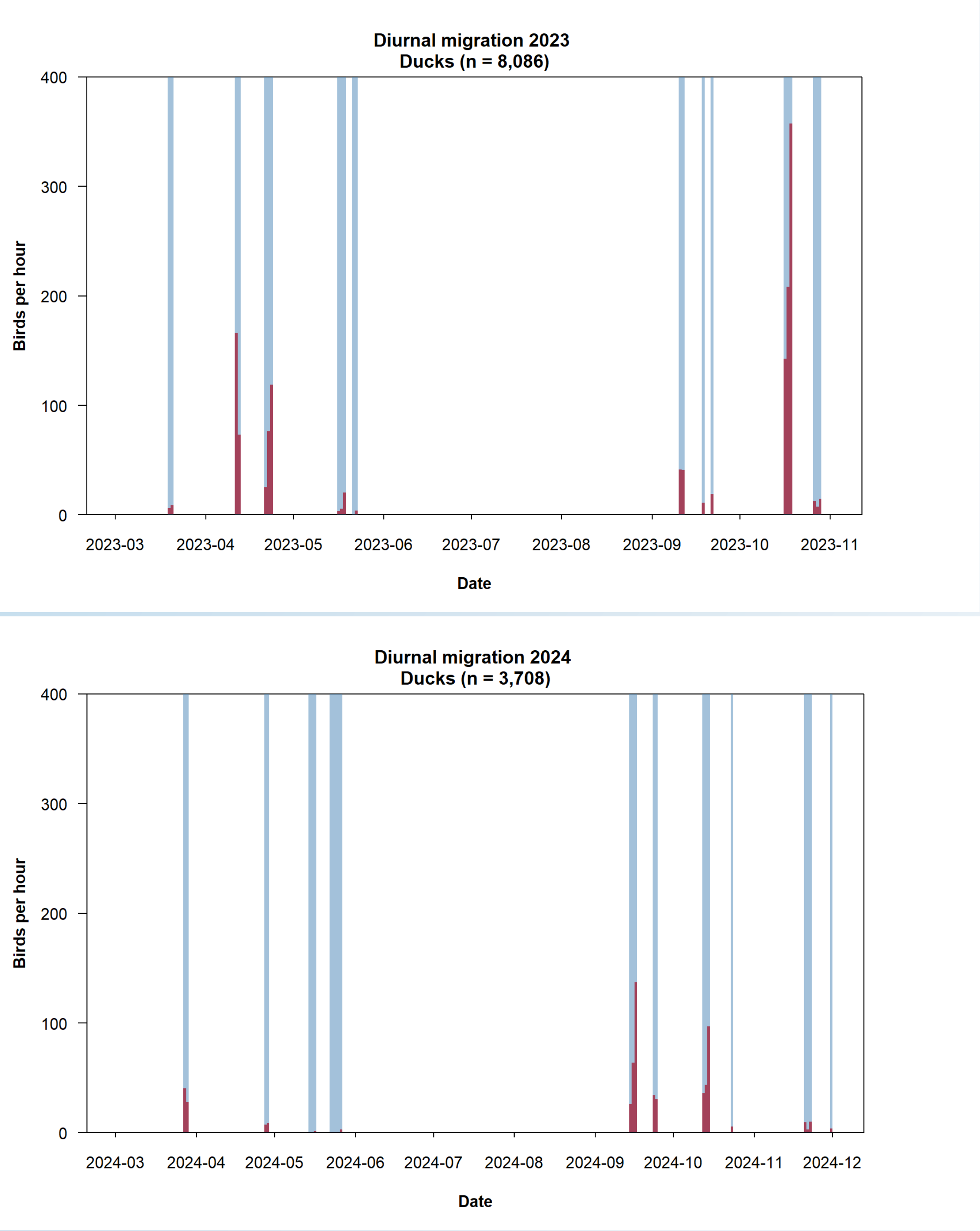


Figure 10-8 Diurnal migration intensity of ducks derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.5 BIRDS OF PREY

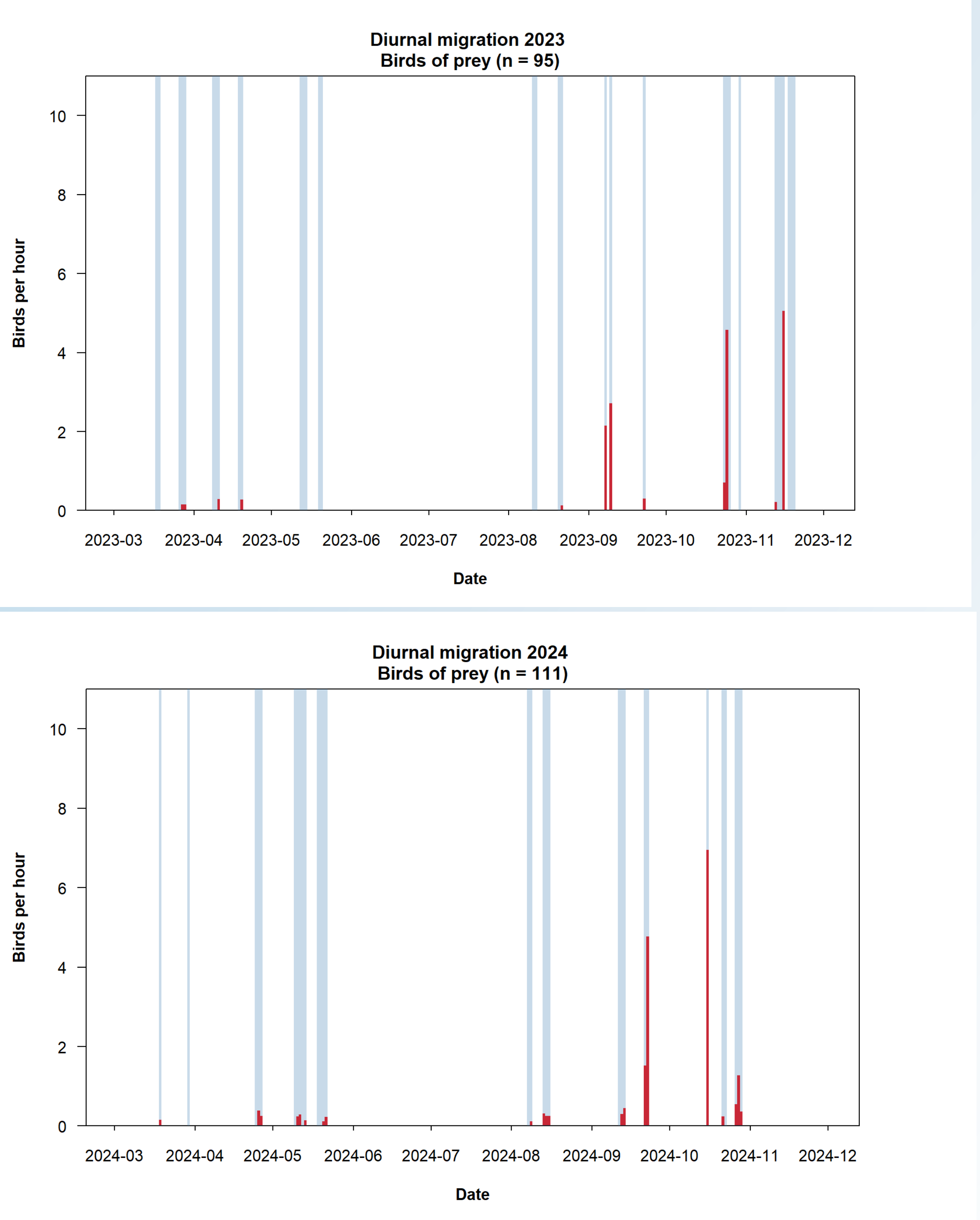
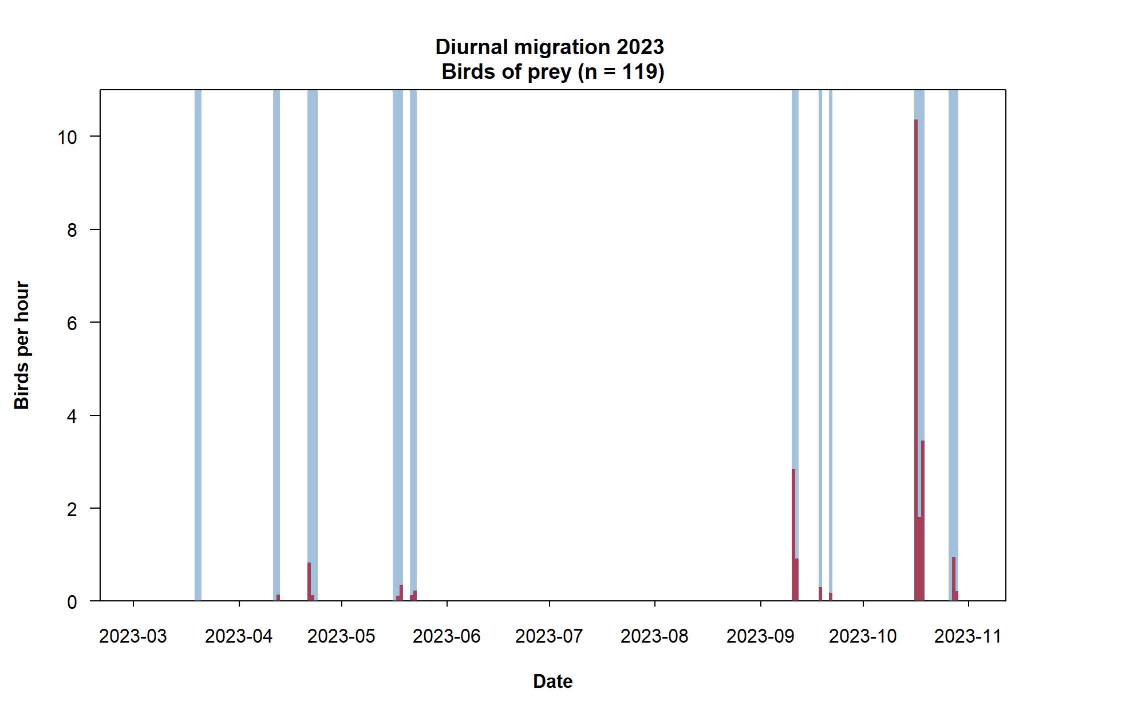


Figure 10-9 Diurnal migration intensity of birds of prey derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.



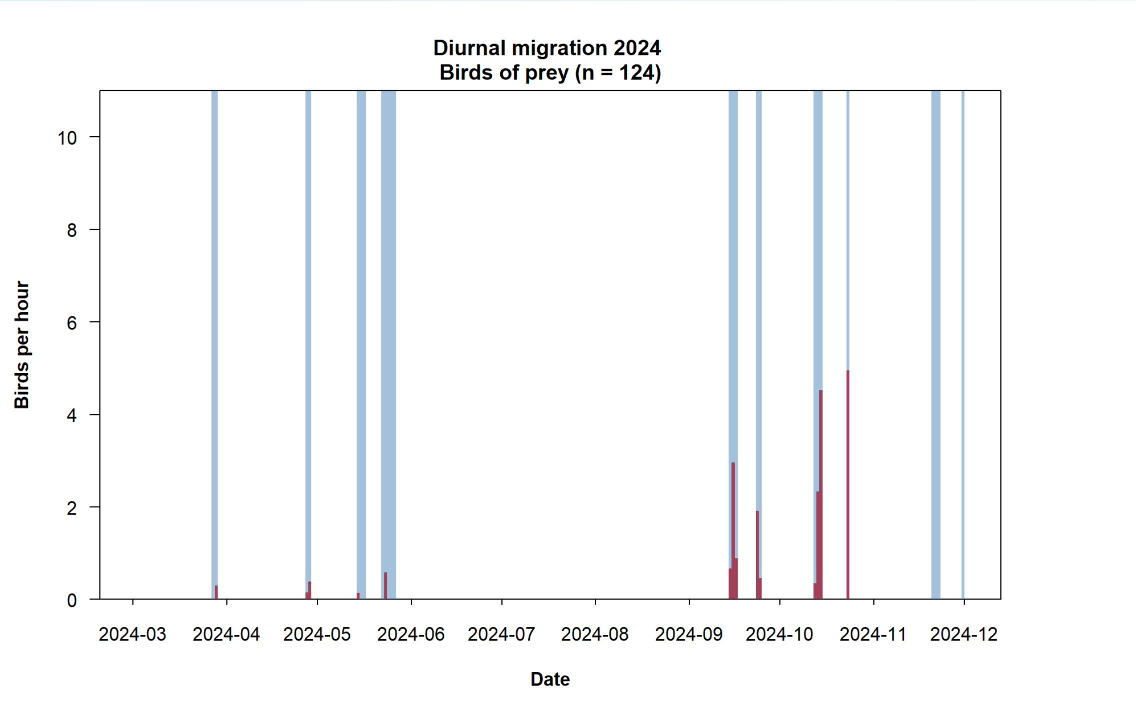


Figure 10-10 Diurnal migration intensity of birds of prey derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.6 CRANES

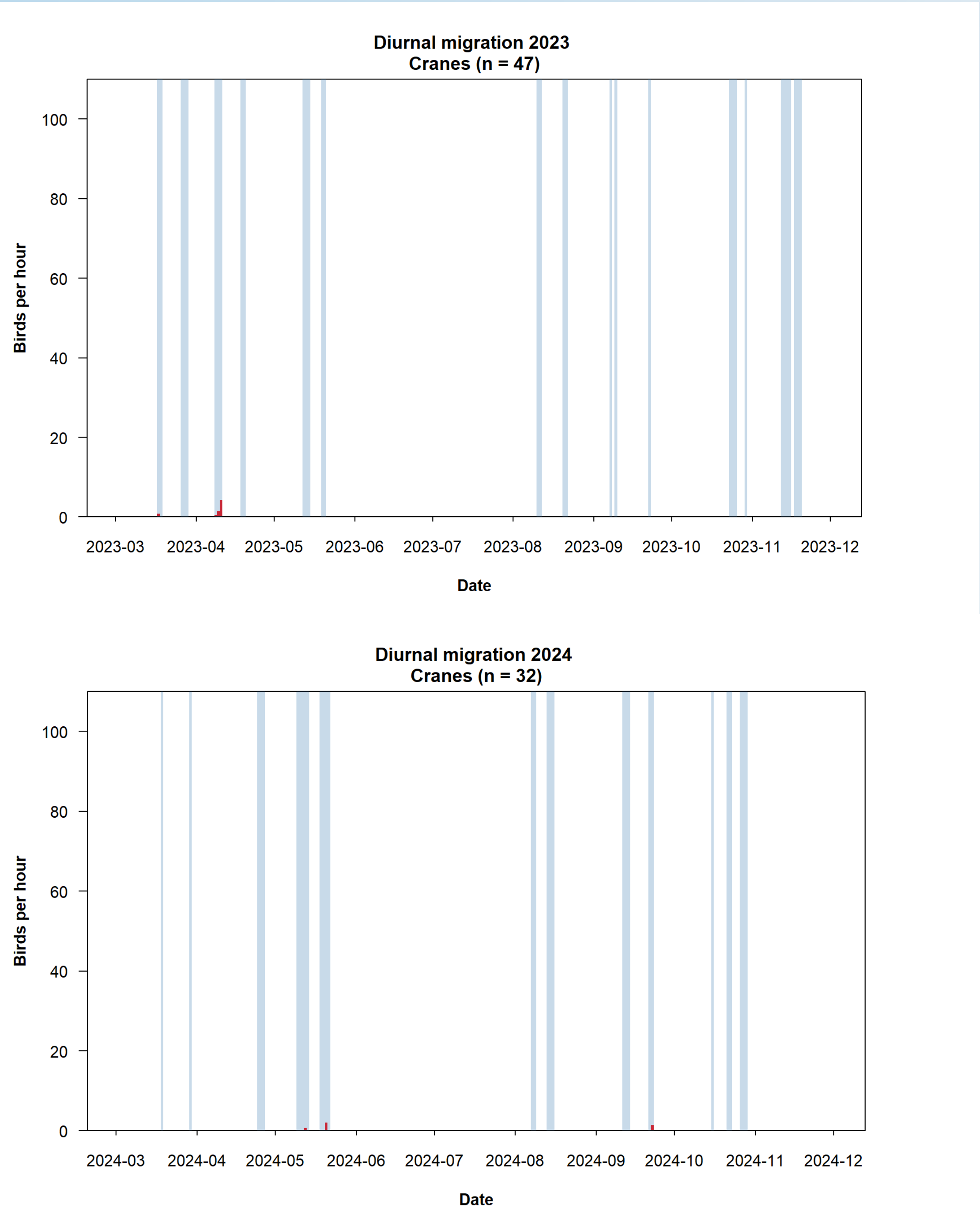
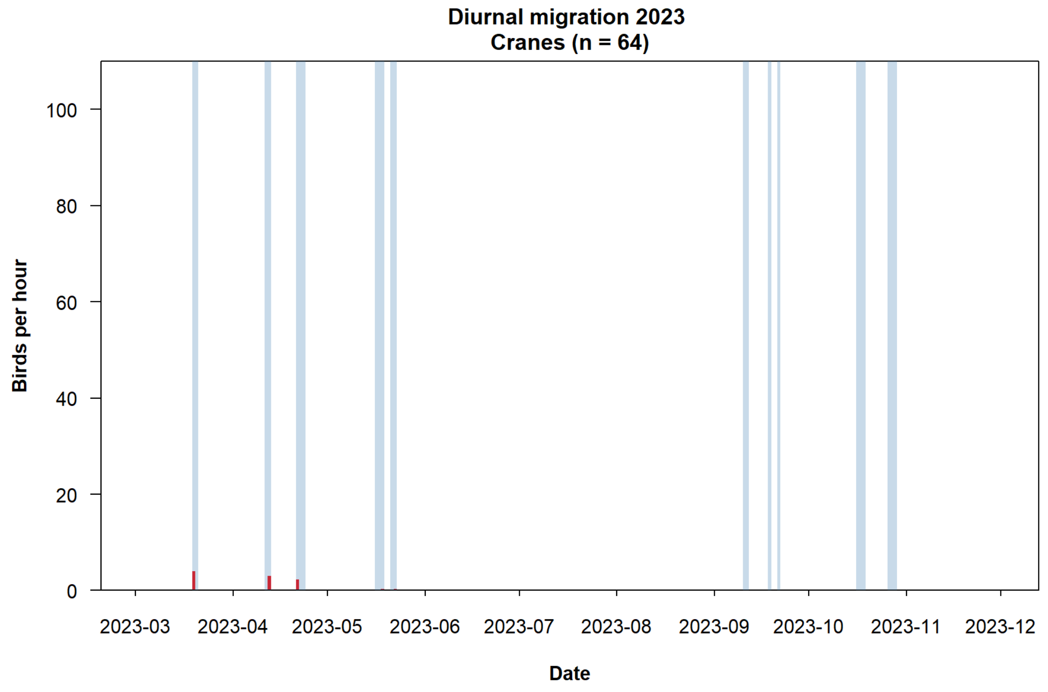


Figure 10-11 Diurnal migration intensity of cranes derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.



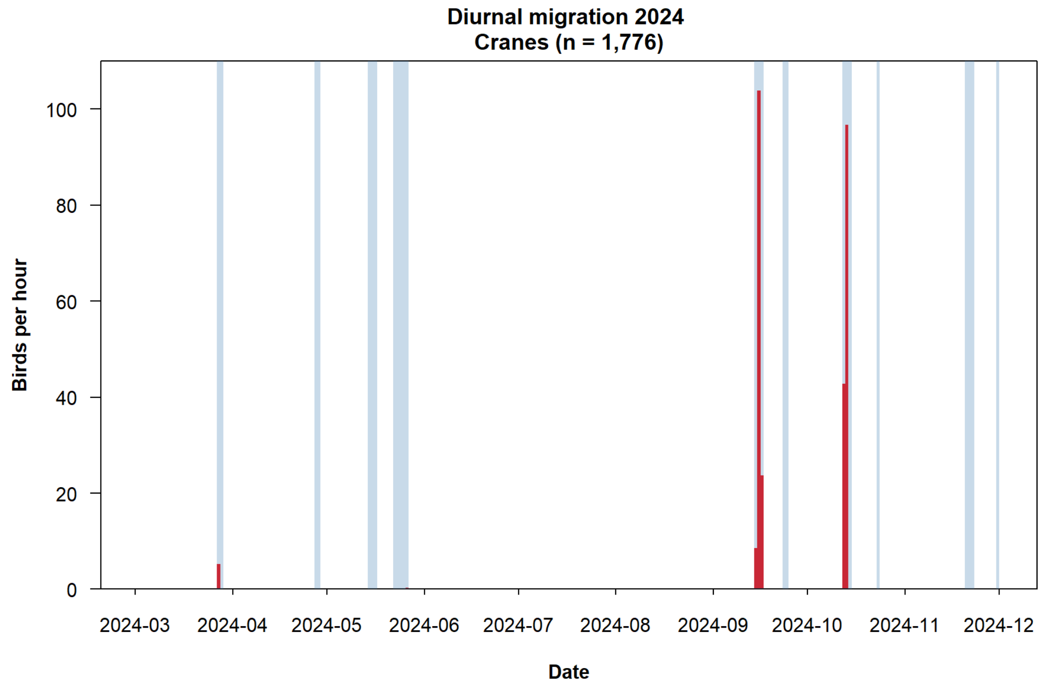


Figure 10-12 Diurnal migration intensity of cranes derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.7 WADERS

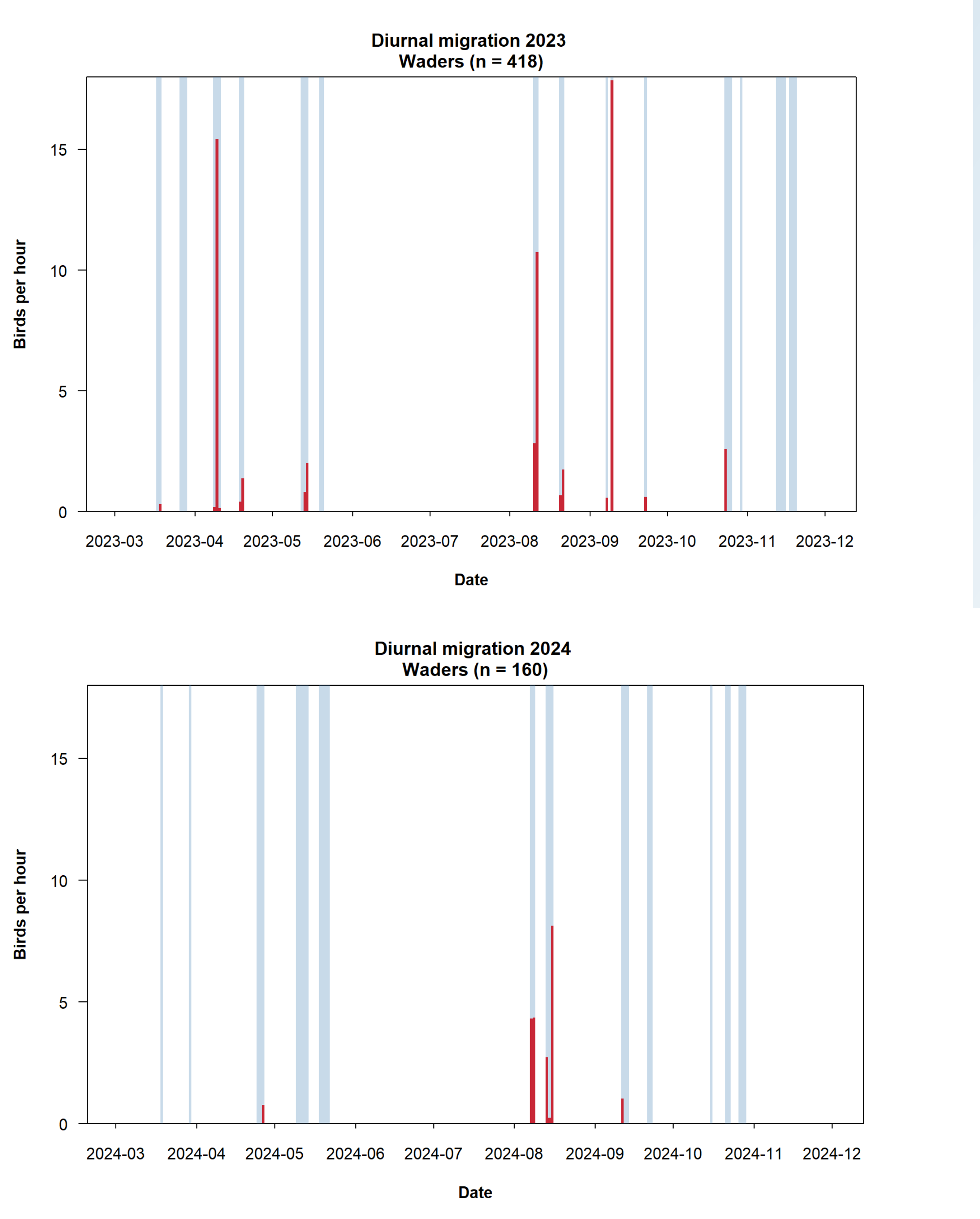


Figure 10-13 Diurnal migration intensity of waders derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

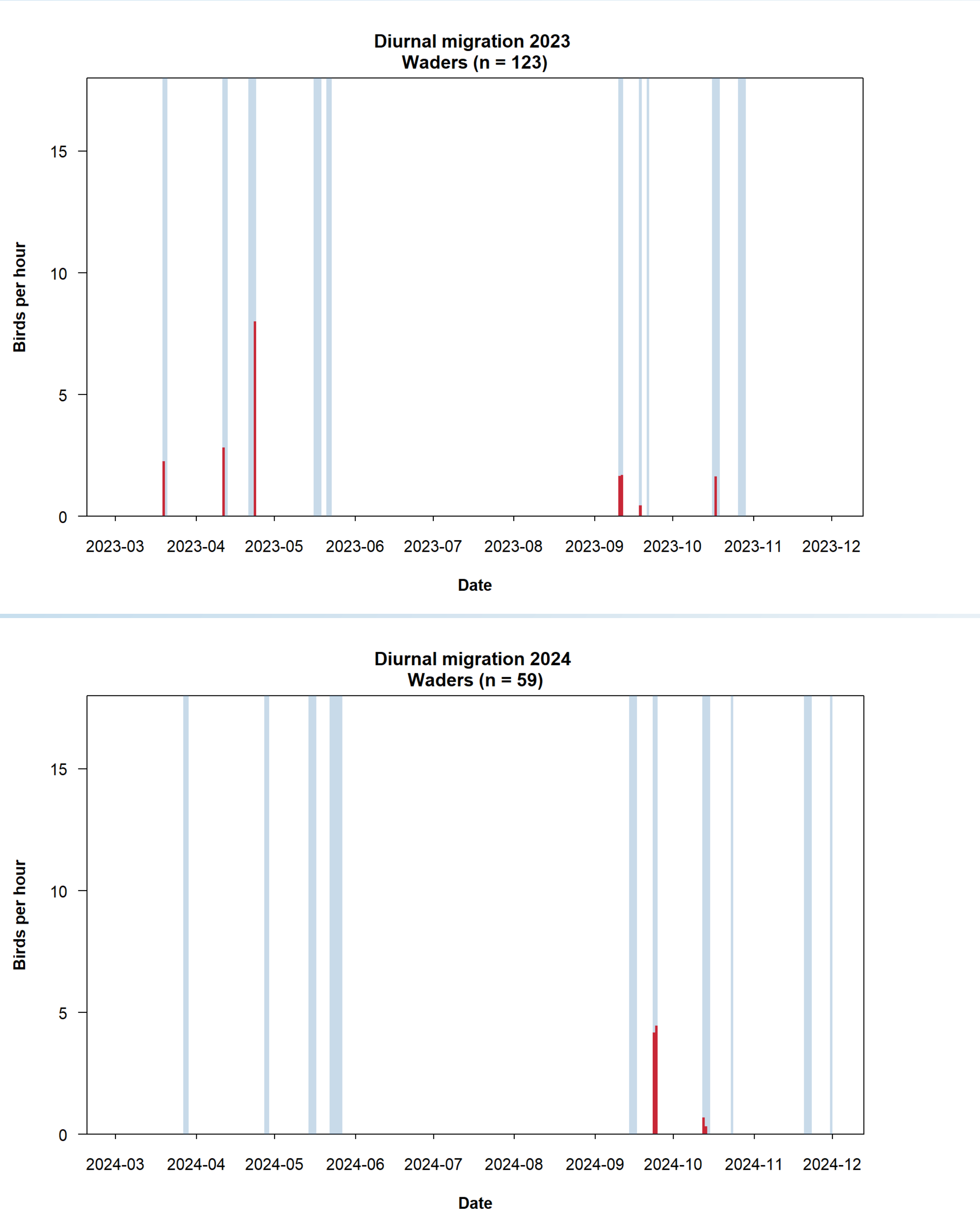


Figure 10-14 Diurnal migration intensity of waders derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.8 GULLS

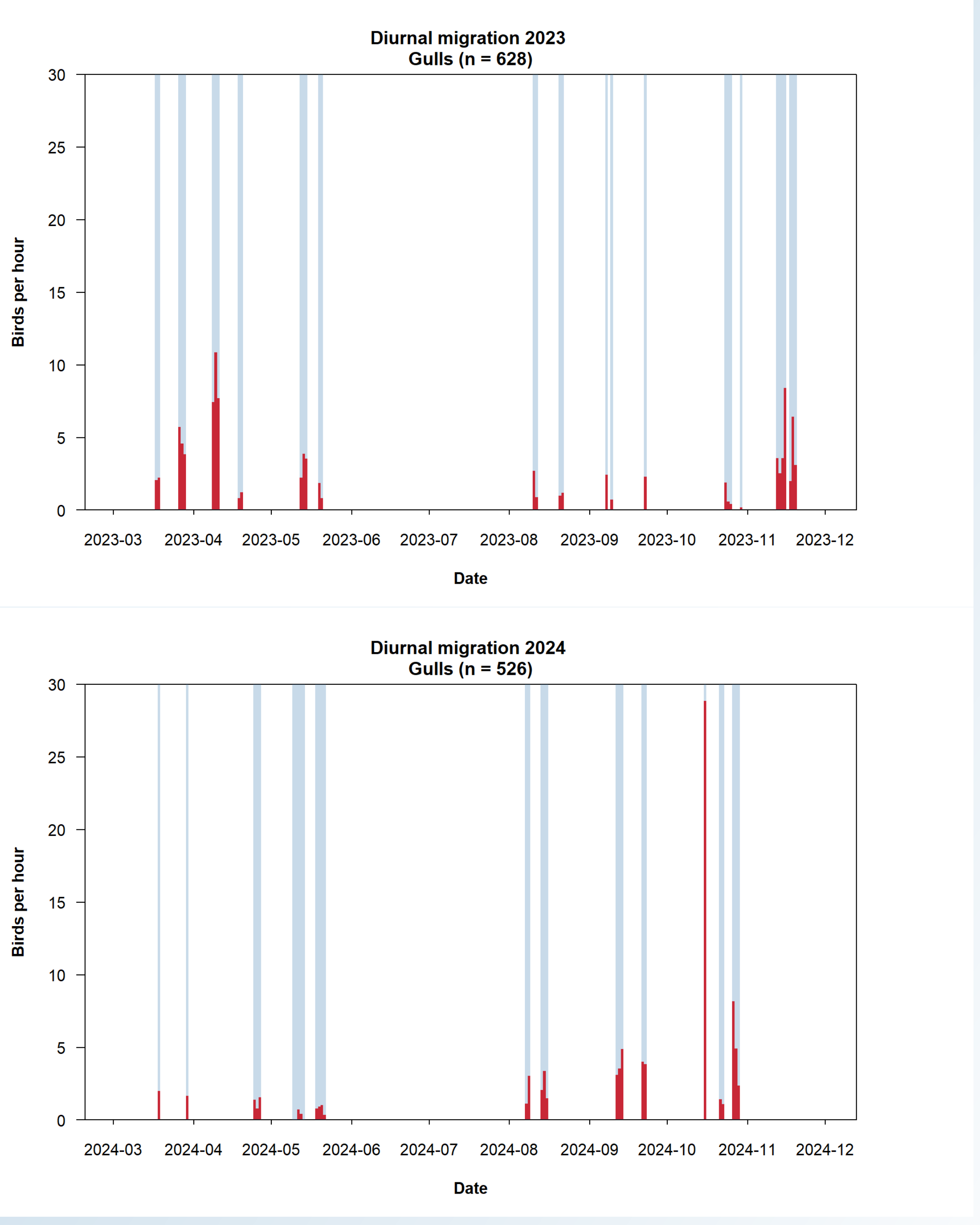
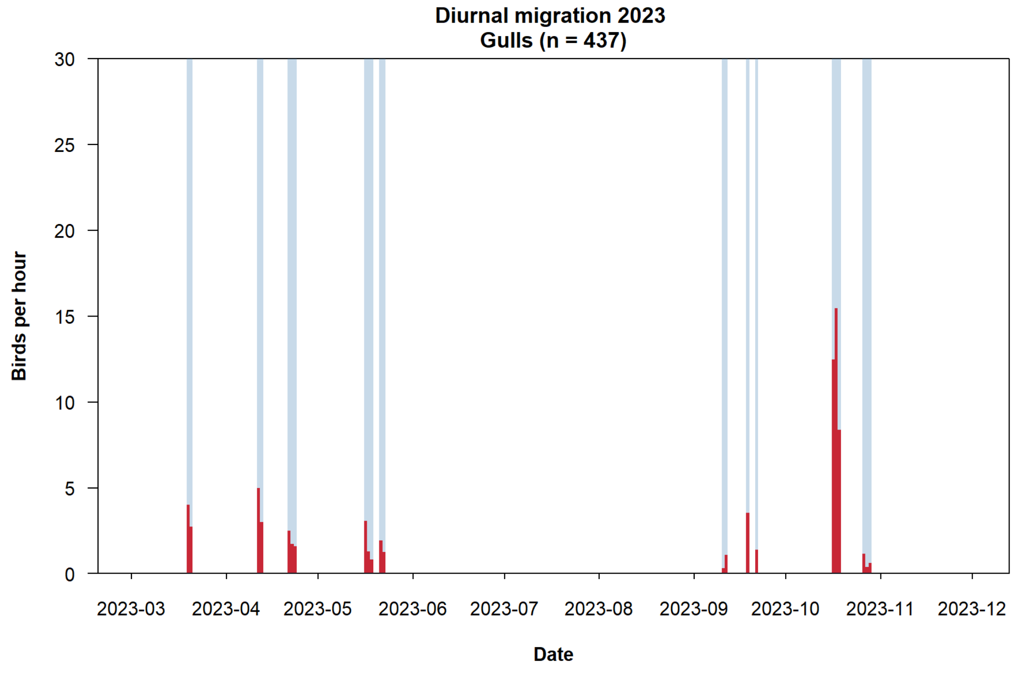


Figure 10-15 Diurnal migration intensity of gulls derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.



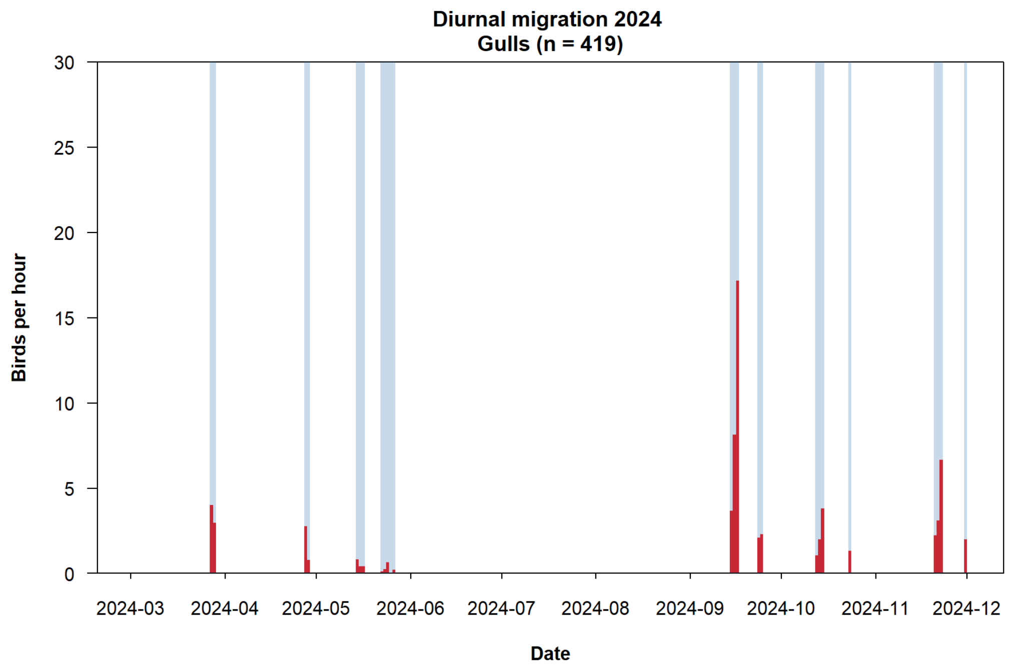


Figure 10-16 Diurnal migration intensity of gulls derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.9 TERNS

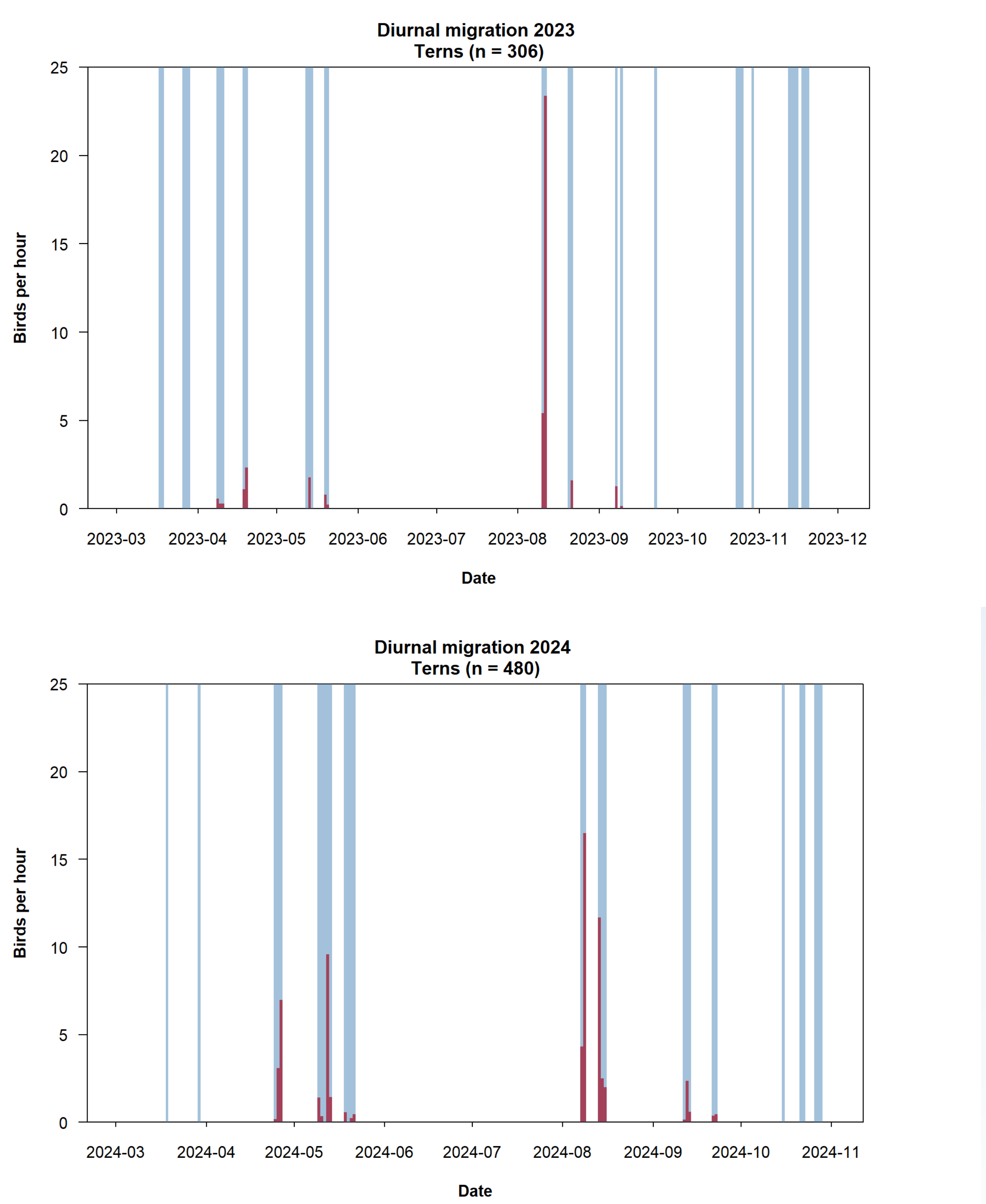


Figure 10-17 Diurnal migration intensity of terns derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

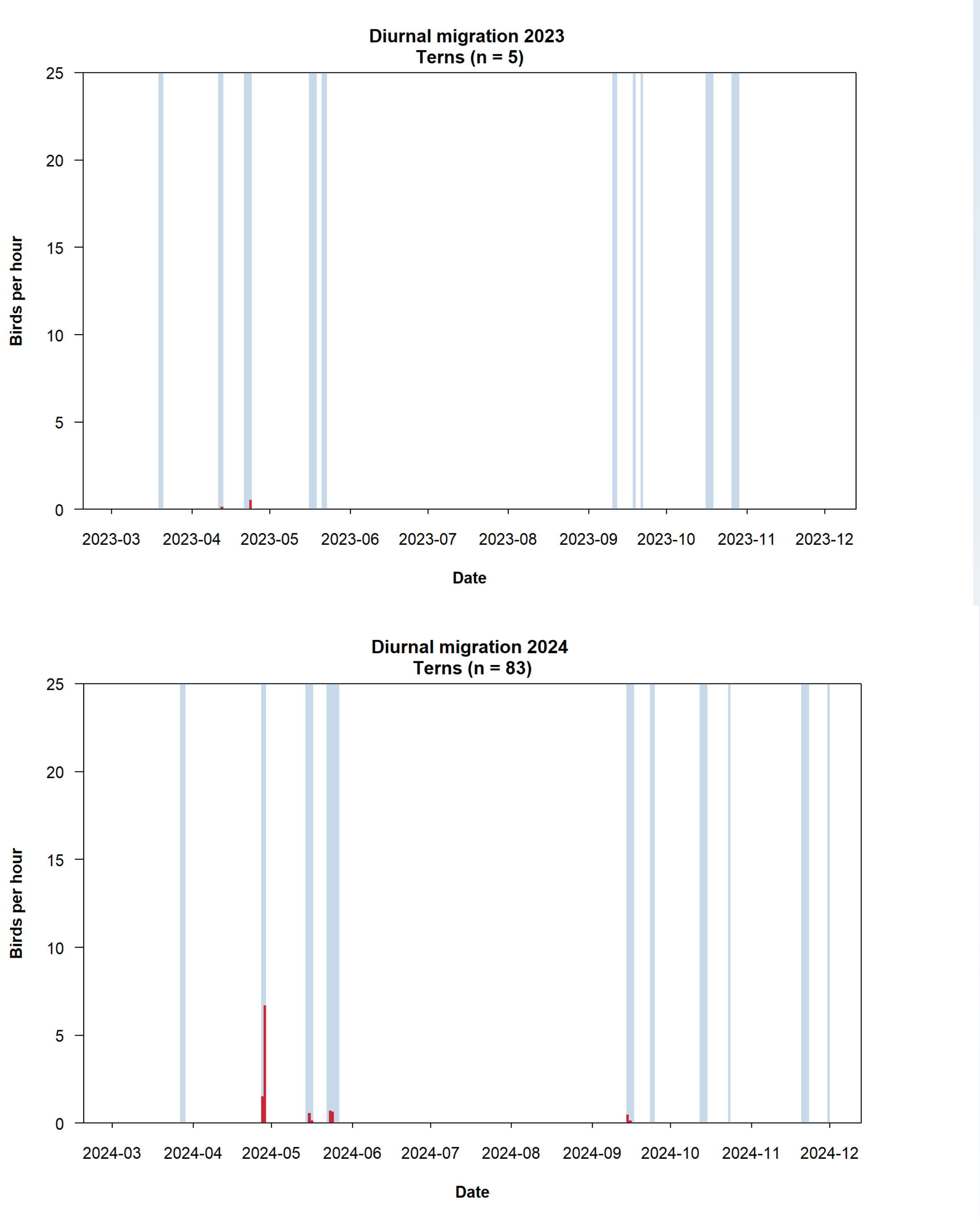


Figure 10-18 Diurnal migration intensity of terns derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.10 AUKS

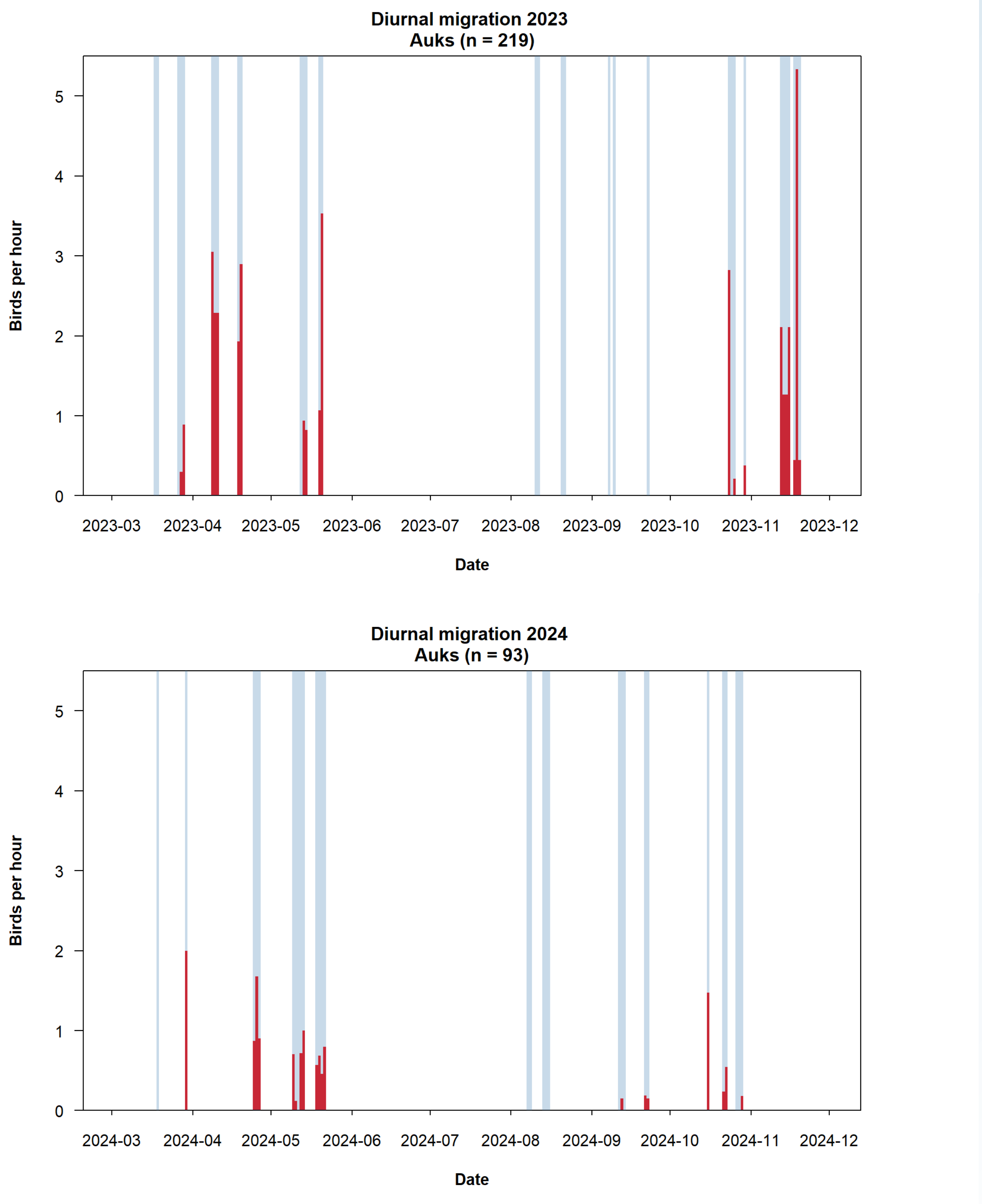


Figure 10-19 Diurnal migration intensity of auks derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024.

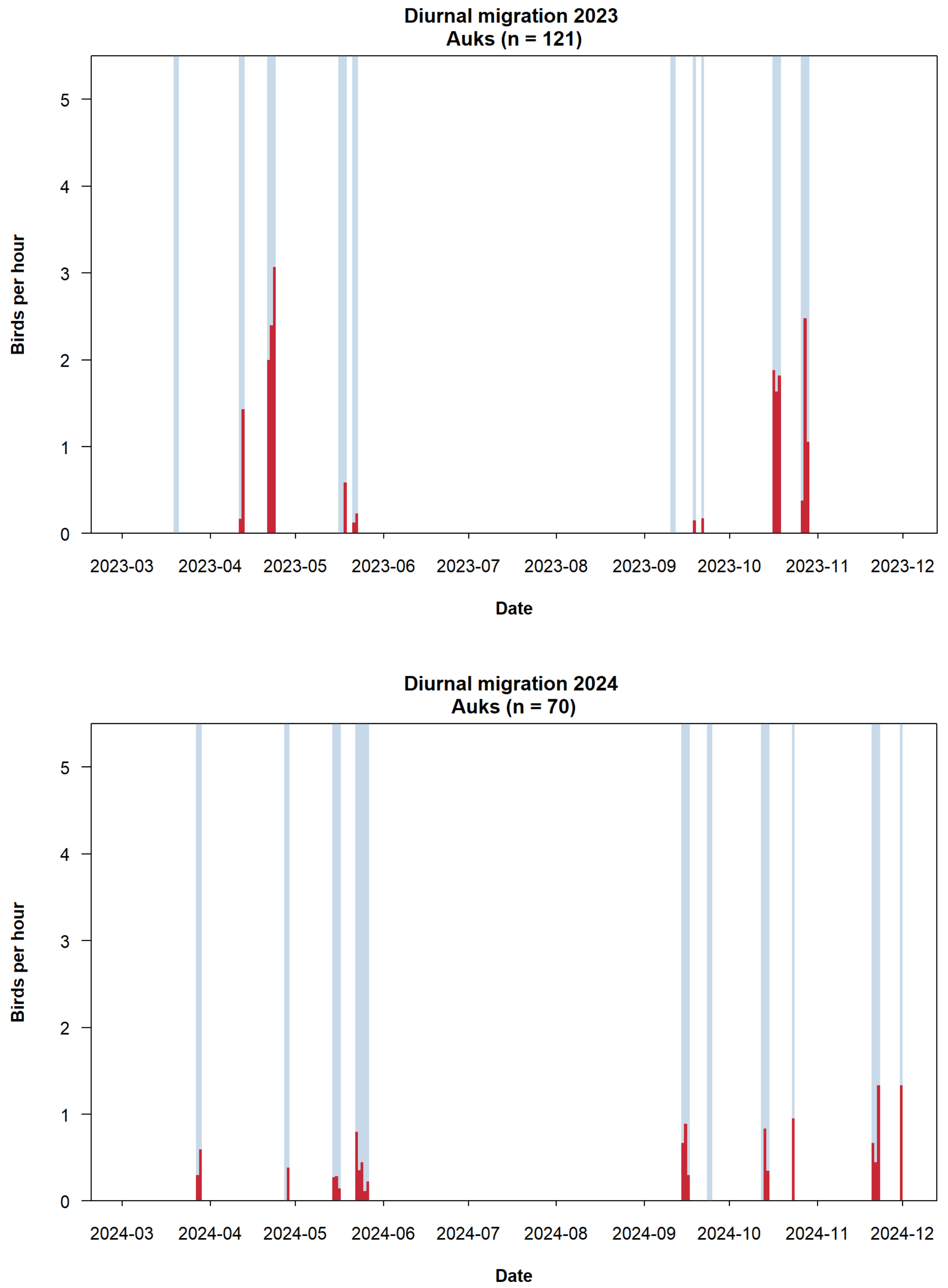


Figure 10-20 Diurnal migration intensity of auks derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.11 PIGEONS

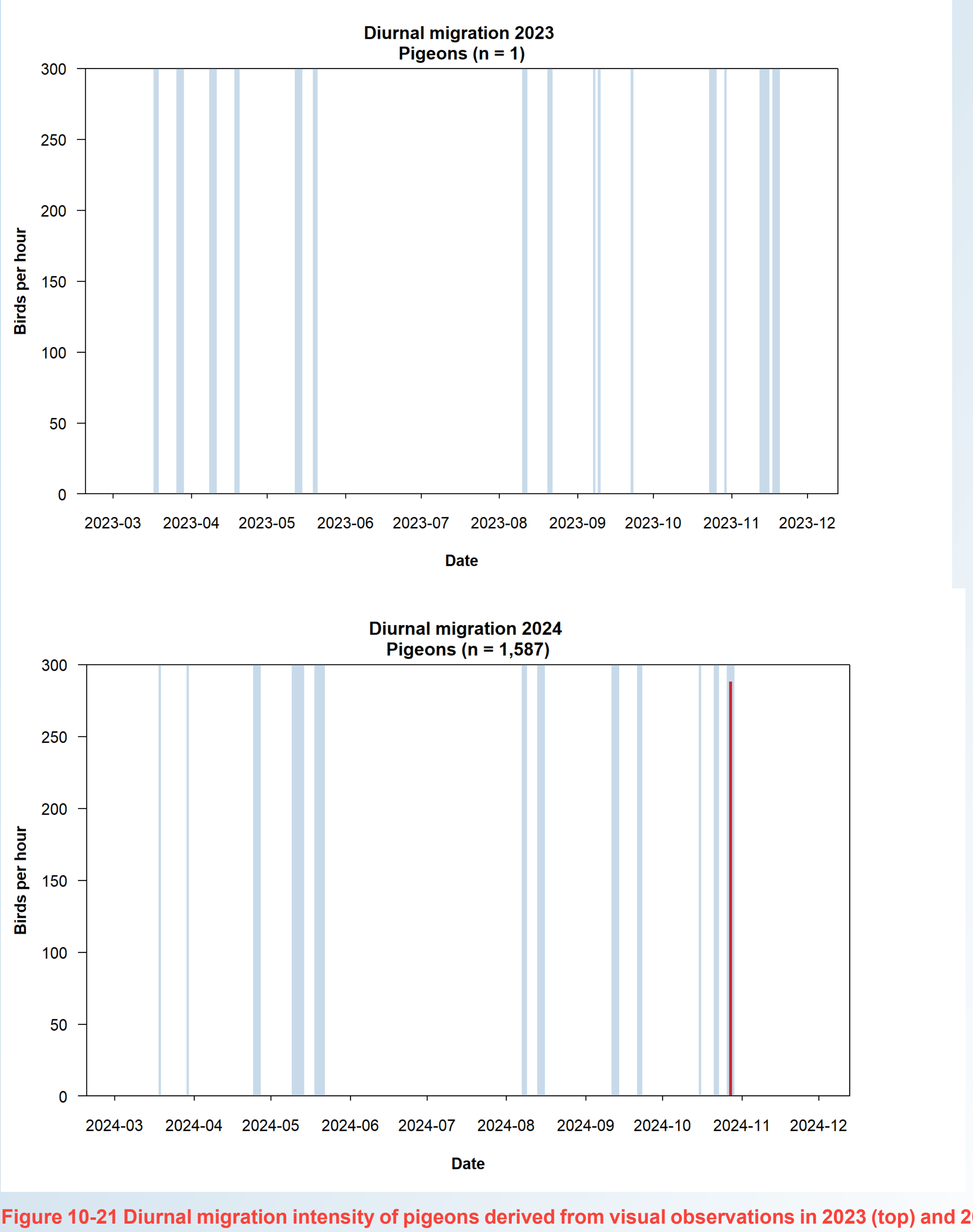


Figure 10-21 Diurnal migration intensity of pigeons derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024

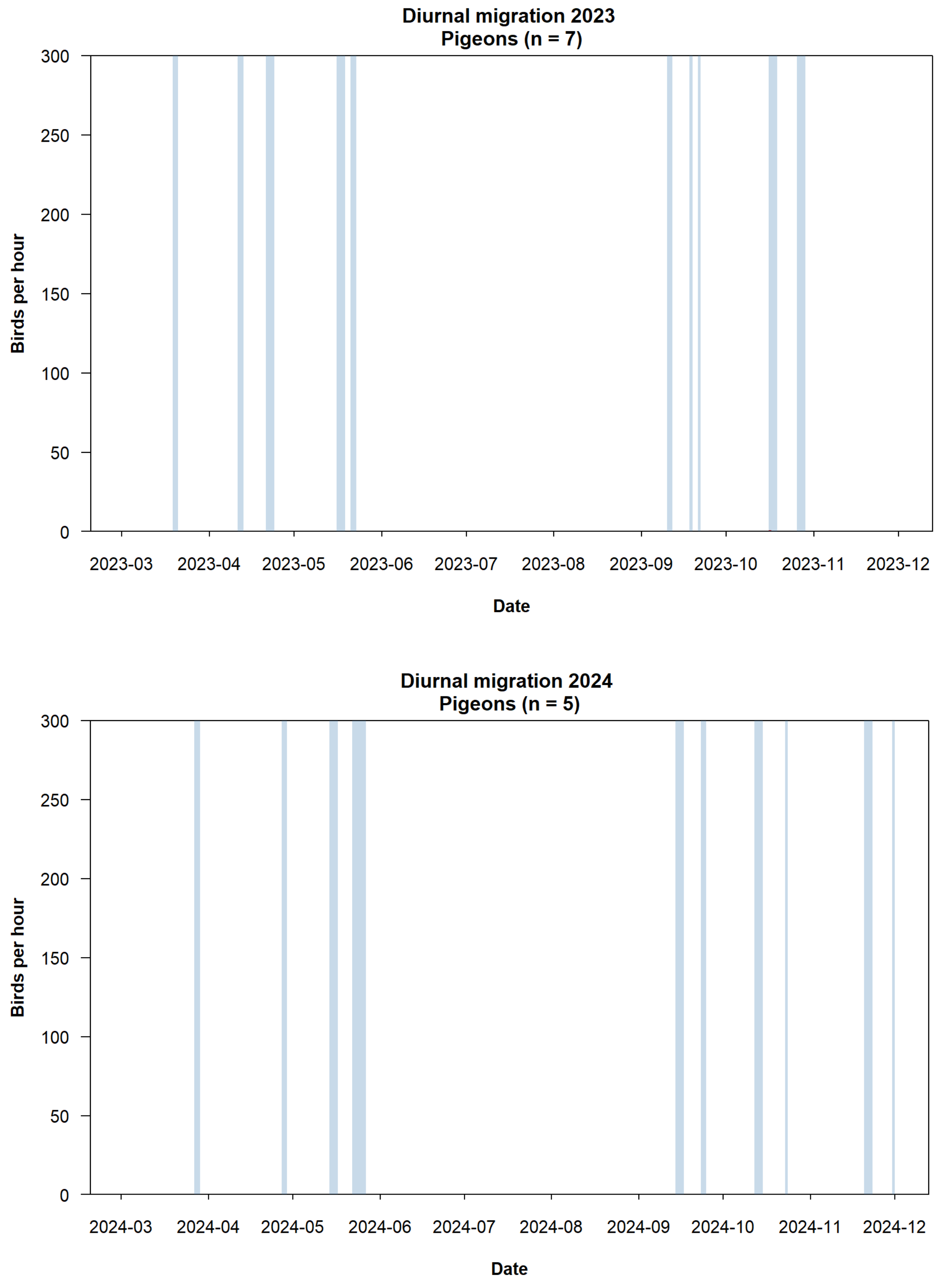
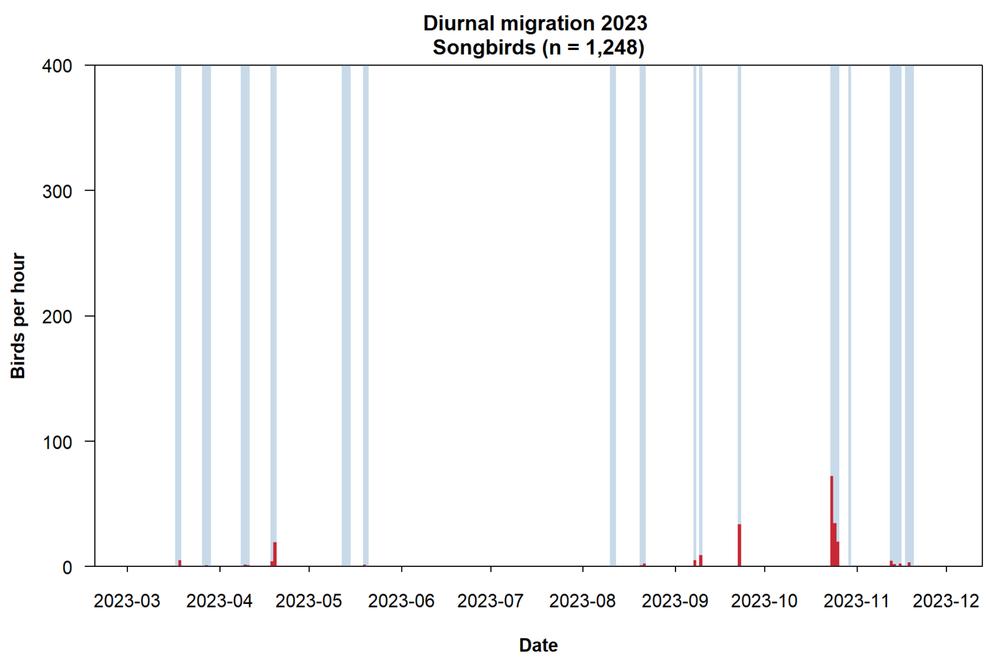


Figure 10-22 Diurnal migration intensity of pigeons derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.

10.2.12 SONGBIRDS



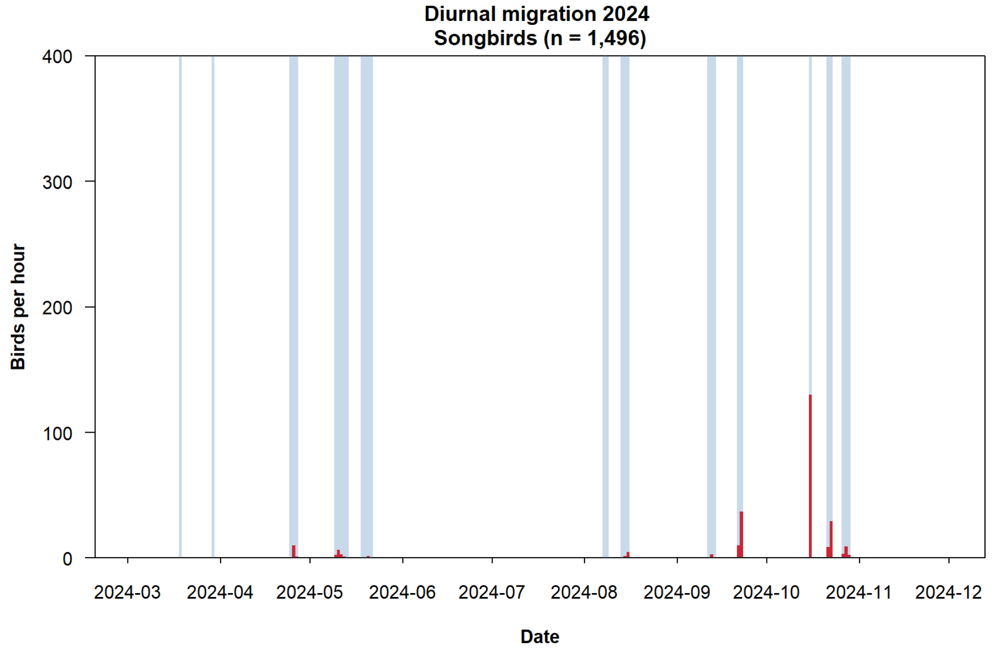


Figure 10-23 Diurnal migration intensity of songbirds derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF N. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in November 2024

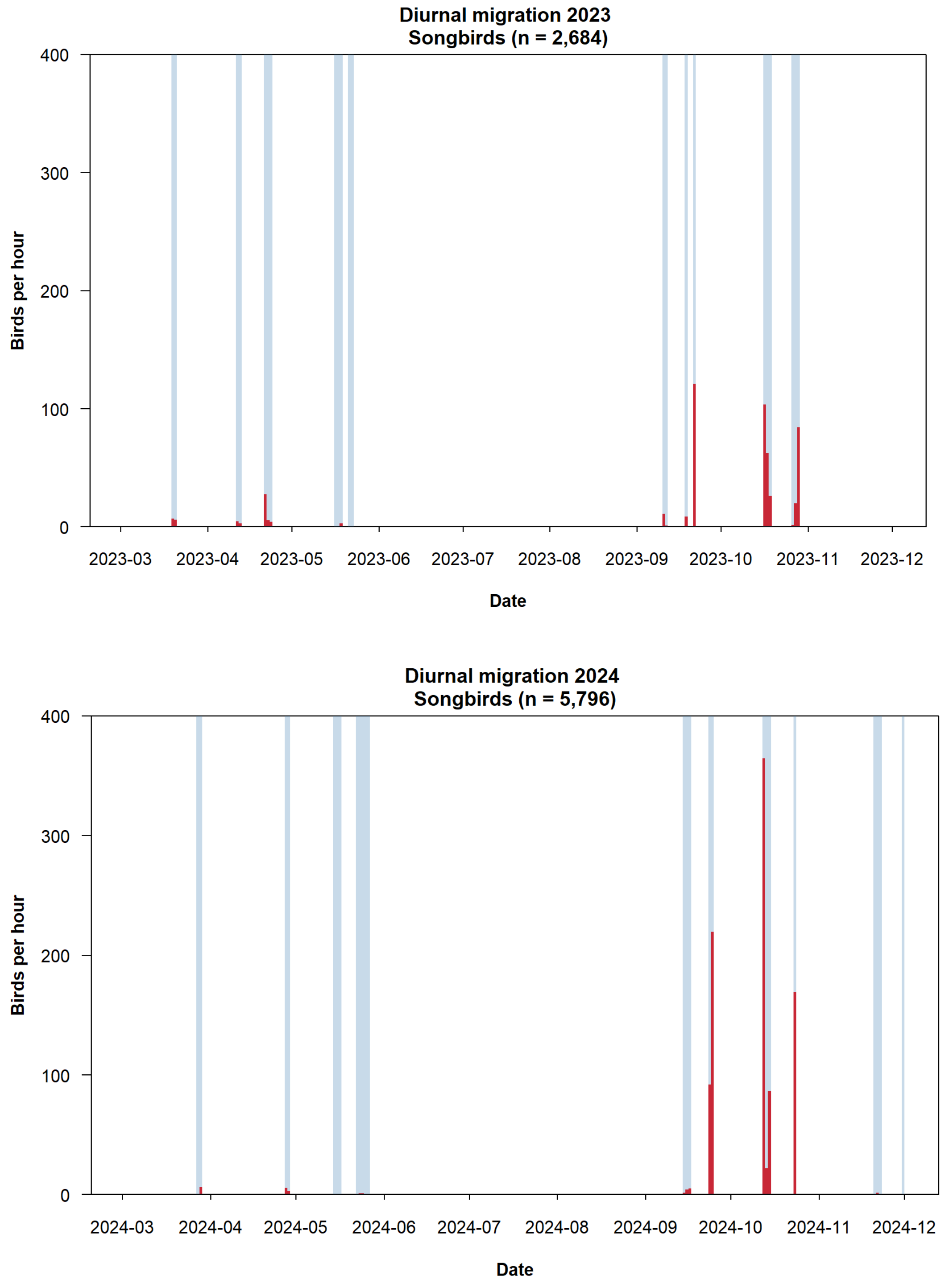


Figure 10-24 Diurnal migration intensity of songbirds derived from visual observations in 2023 (top) and 2024 (bottom) in the pre-investigation area KF II OWF S. Light blue shades indicate the dates of the surveys (33 dates in 2023 and 30 in 2024). Y-axis have been standardized for comparisons. There were no surveys in August or in November 2023.