

Introduction and current state of knowledge on divers in German waters

Stefan Garthe,
Anna-Marie Corman, Katharina Fließbach, Nils Guse,
Nele Markones, Bettina Mendel, Verena Peschko,
Henriette Schwemmer, Philipp Schwemmer



Christian-Albrechts-Universität zu Kiel

**Research and Technology Centre (FTZ), Büsum,
Kiel University, Germany**



1 Distribution, seasonal dynamics, year-to-year variation

2 Population sizes, population trends

3 Diet

4 Habitat selection

5 Human pressures: Set net fisheries

6 Human pressures: Offshore wind farms

7 Human pressures: Ship traffic

**Distribution,
seasonal dynamics,
year-to-year variation**





Vogelwarte 53, 2015: 121 – 138
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Verbreitung, Jahresdynamik und Bestandsentwicklung der Seetaucher *Gavia spec.* in der Deutschen Bucht (Nordsee)

Stefan Garthe, Henriette Schwemmer, Nele Markones, Sabine Müller & Philipp Schwemmer

Garthe S, Schwemmer H, Markones N, Müller S & Schwemmer P 2015: Distribution, seasonal dynamics and population trend of divers *Gavia spec.* in the German Bight (North Sea). Vogelwarte 53: 121-138.

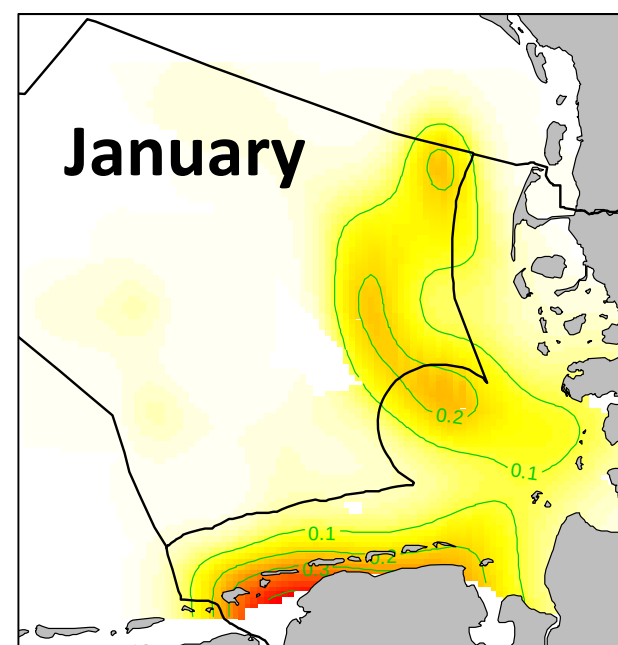
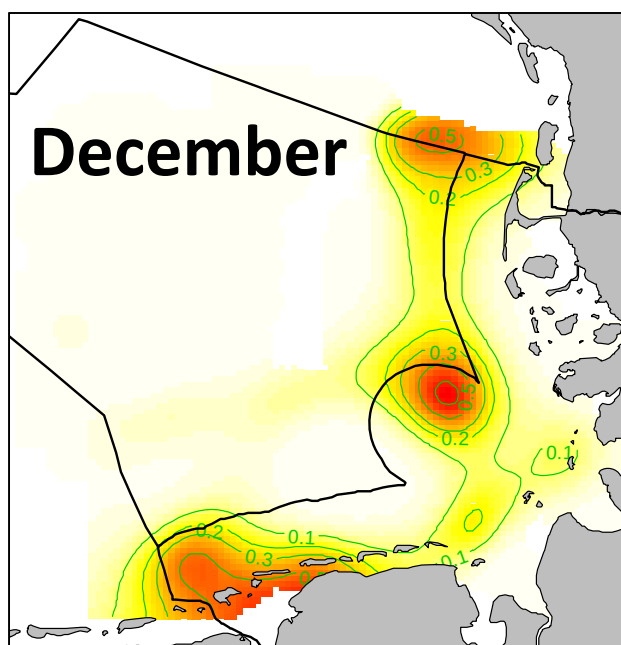
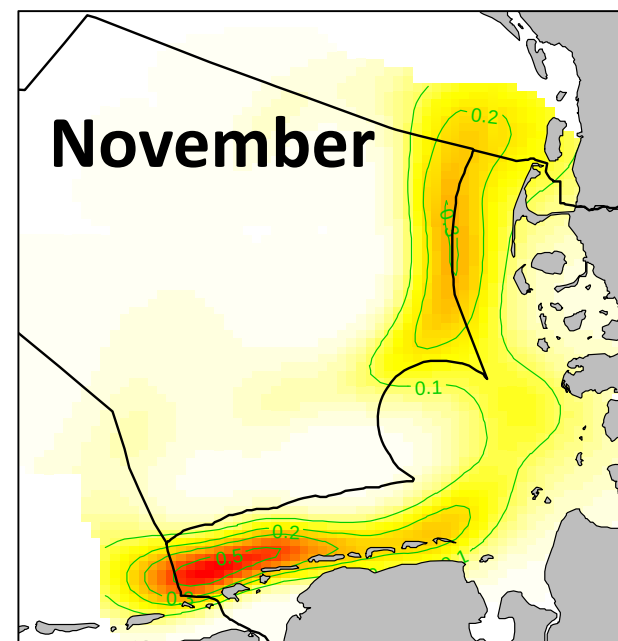
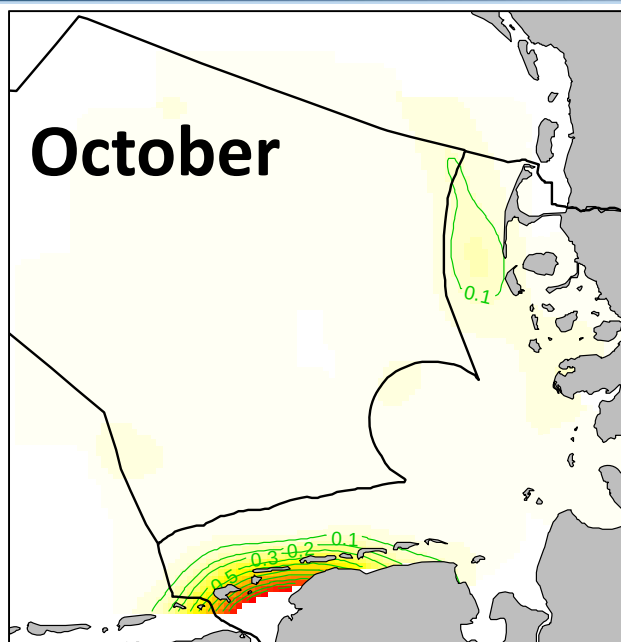
One of the most important wintering sites for Red-throated Divers *Gavia stellata* is the offshore zone of the German North Sea. The implementation of the EU Birds Directive in German offshore waters requires special protection of divers that comprise mainly Red-throated and Black-throated *G. arctica* Divers. An important first step concerning the protection was the establishment of two Special Protection areas for birds in the EEZ of the North and Baltic Seas in 2004. Anthropogenic activities at sea, such as the construction of offshore wind farms or ship traffic, have strong impacts on divers. In the course of the ongoing marine spatial planning it is particularly important to improve the knowledge on distribution patterns and phenology of divers in the German part of the North Sea.

This publication presents the most recent analysis of spatio-temporal patterns of divers in the German North Sea. By merging data from scientific projects and environmental impact studies, the data basis could be considerably improved. Divers were recorded by ship-based and aerial surveys during 2000 to 2013. Distribution patterns on a 1 km x 1 km grid were interpolated using Generalized Additive Models.

Combined data from aerial and ship-based surveys during 2000 to 2013 from

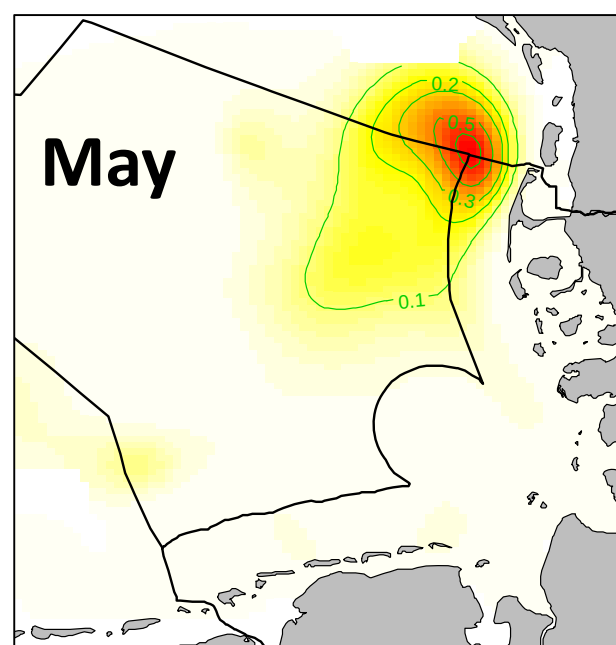
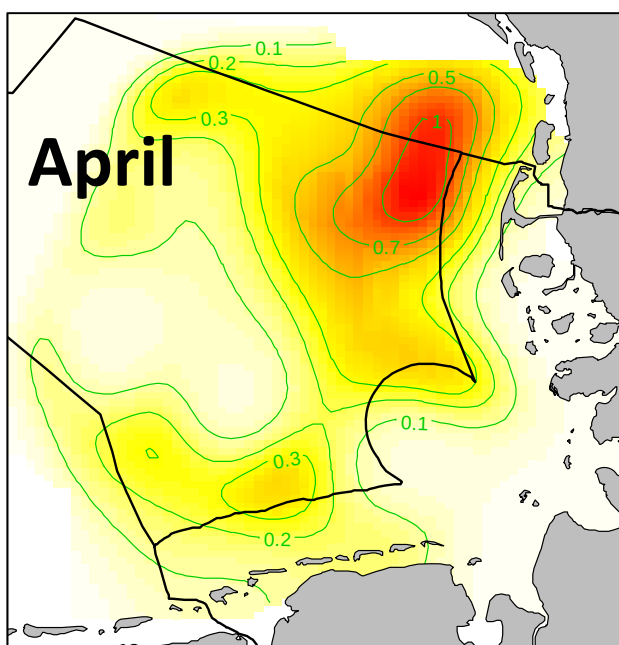
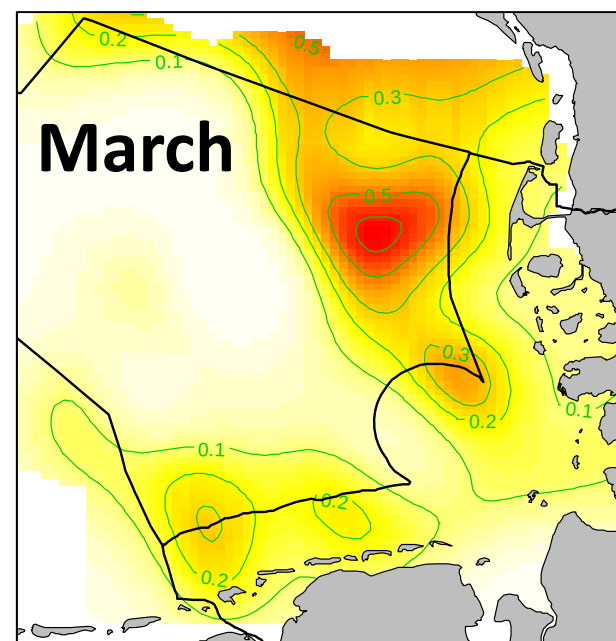
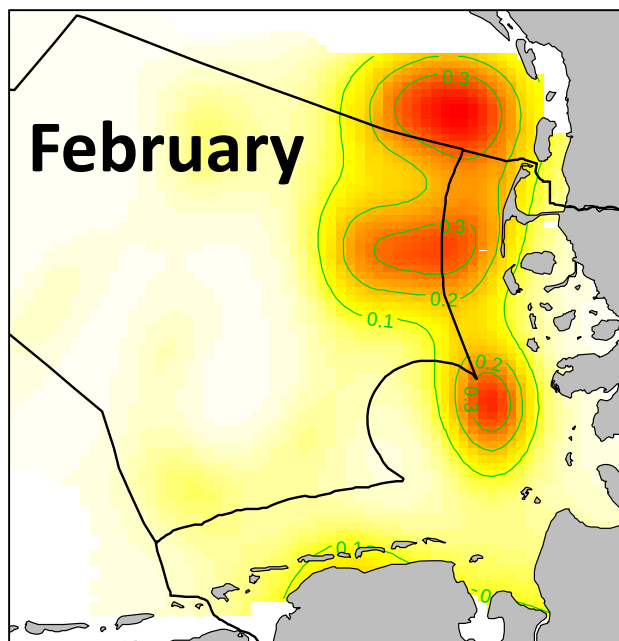
- research projects (FTZ)
- marine biodiversity monitoring (BfN)
- environmental impact- and monitoring-studies (BSH)

Distribution, seasonal dynamics



from:
Garthe et al.
(2015),
Vogelwarte

Distribution, seasonal dynamics



from:
Garthe et al.
(2015),
Vogelwarte

Distribution, seasonal dynamics

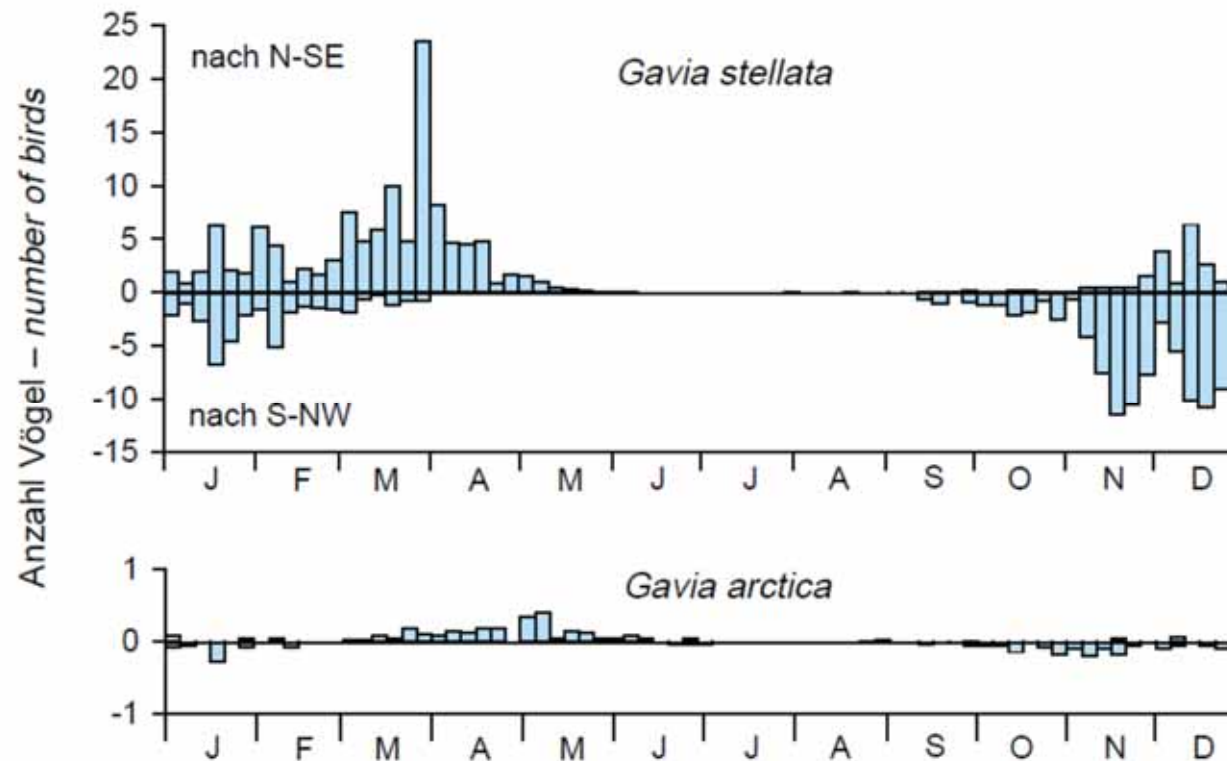
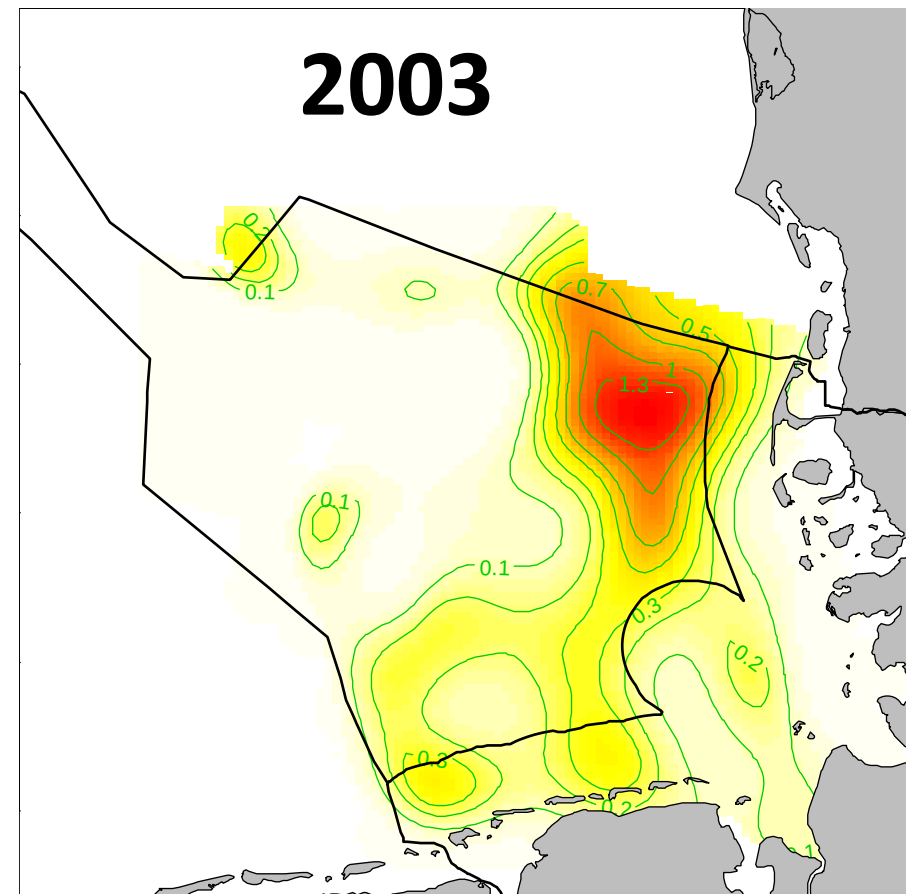
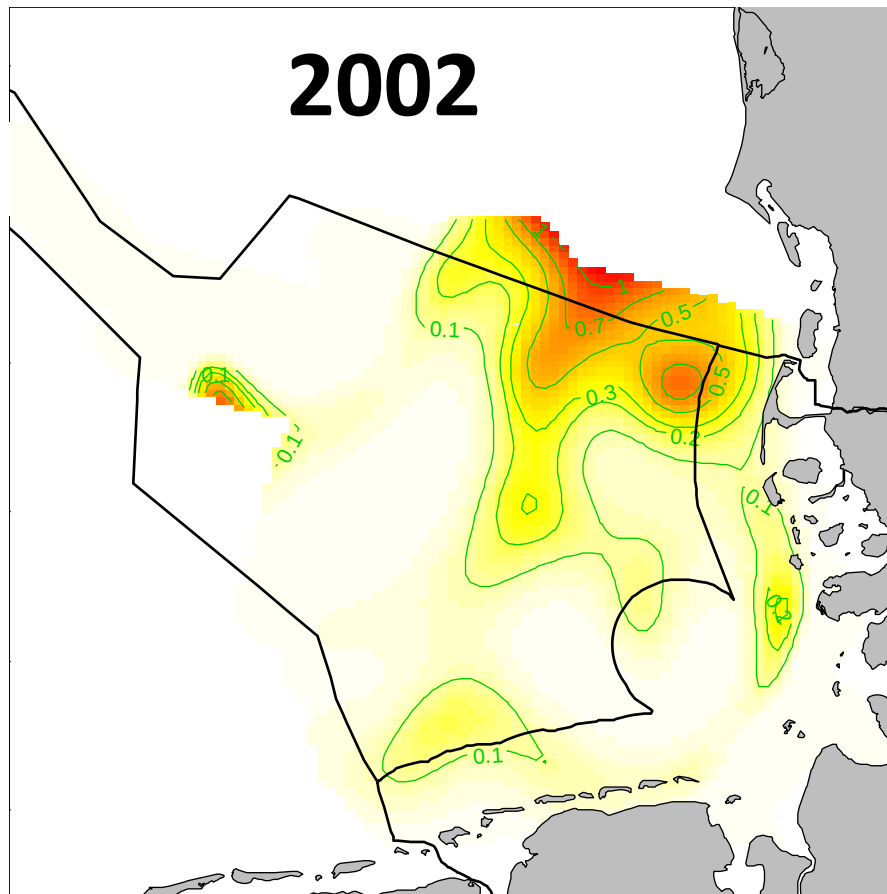


Abb. 1: Phänologie ziehender Seetaucher bei Helgoland nach Zugplanbeobachtungen ($n = 8395$ Sterntaucher bzw. 173 Prachtaucher in 3073 Beobachtungsstunden). Pentadenweise ist die mittlere Anzahl der pro Stunde in Heimzugrichtung (N bis SE, Säulen nach oben) bzw. in Wegzugrichtung (S bis NW) vorbeiziehenden Vögel eingezeichnet. – *Phenology of migrating divers at Helgoland ($n = 8395$ Red-throated Divers and 173 Black-throated Divers in 3073 hours of observation). For each five-day period the mean number of birds flying in homeward direction (N to SE; upper columns) and in direction towards winter quarters (S to NW; lower columns) is shown.*

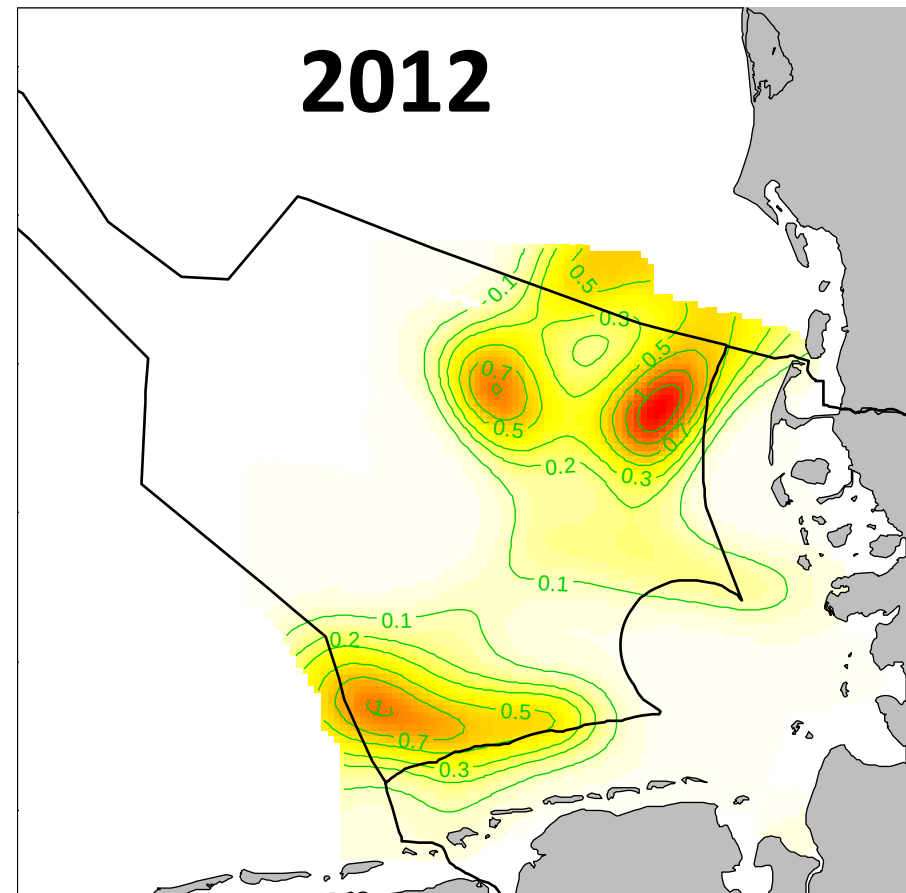
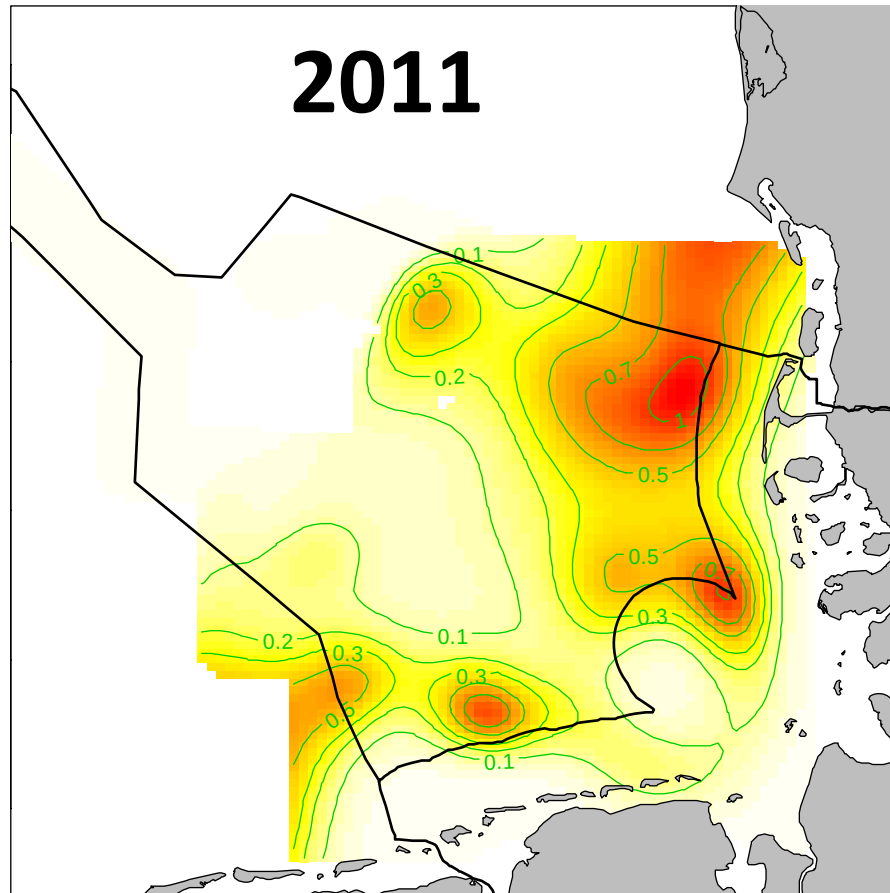
from: Dierschke (2002), Vogelwelt

Distribution, year-to-year variation



from: Garthe et al. (2015), Vogelwarte

Distribution, year-to-year variation

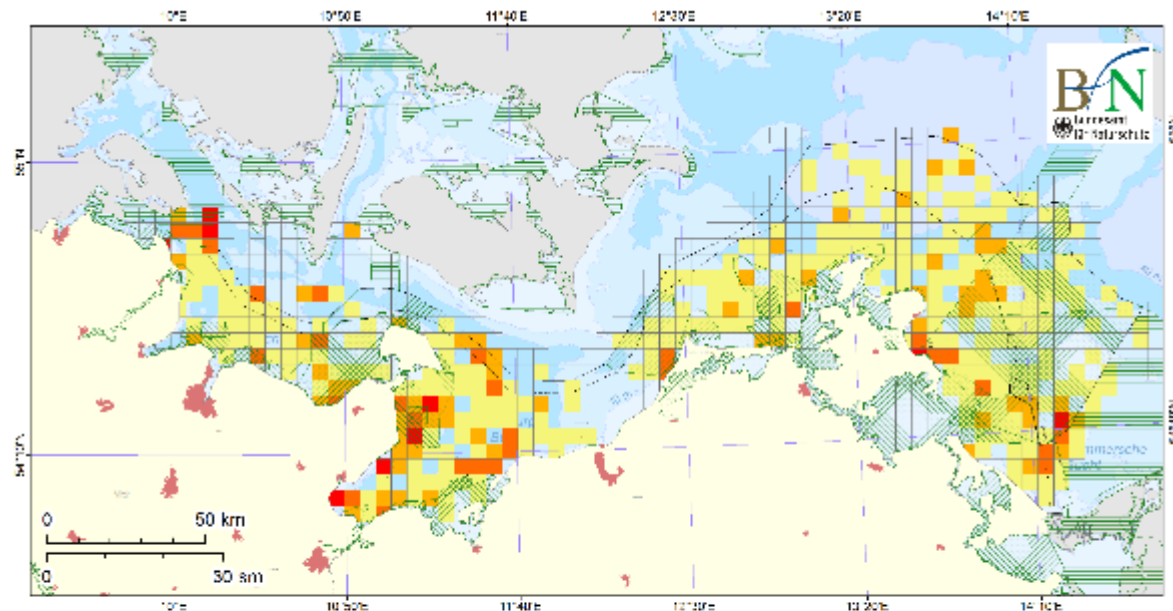


from: Garthe et al. (2015), Vogelwarte

Distribution, seasonal dynamics



Winter



Meeresnaturschutzgebiete

- Natura 2000-Gebiet gem. FFH-RL
- Natura 2000-Gebiet gem. VRL
- Natura 2000-Gebiet (Nachbarstaat)

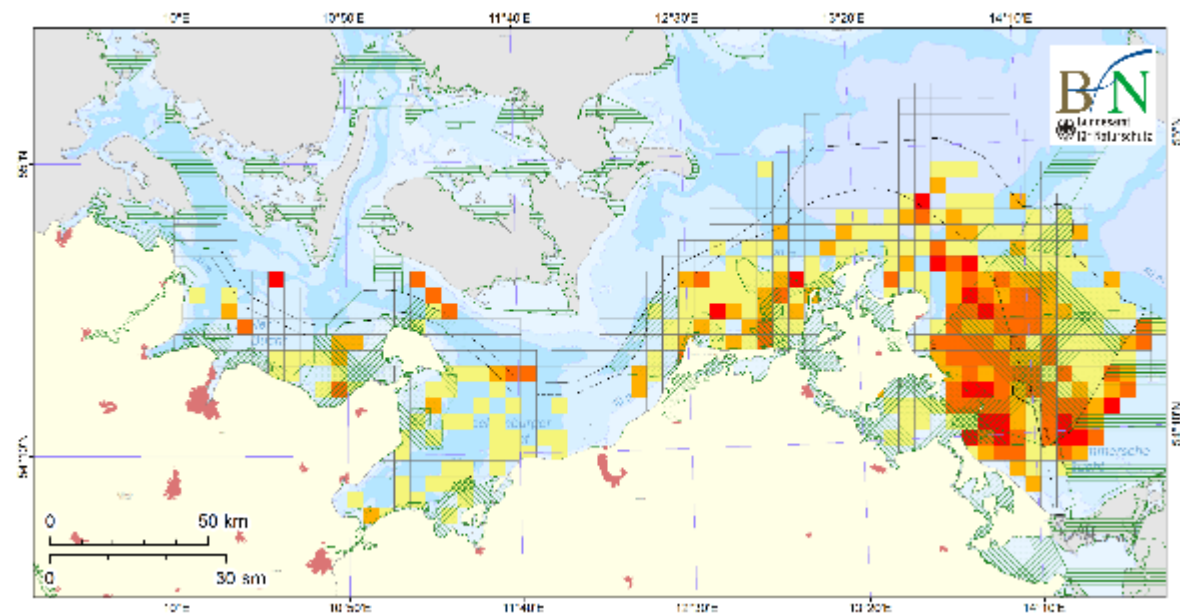
Seegrenzen

- Deutsche AWZ
- Deutsches Küstenmeer

Sternauer [Ind./km²]

Koordinatenreferenzsystem:
ETRS 89 LAEA (EPSG: 3035)

Spring



Population sizes, population trends



Population sizes



Tab. 1: Bestandsgrößen von Seetauchern insgesamt sowie von Sterntauchern und Prachttauchern in der deutschen Nordsee im Frühjahr 2002 bis 2013. Die Zahlen wurden auf Hunderter gerundet. – *Population size of total divers, Red-throated Divers and Black-throated Divers in the German North Sea in spring 2002 to 2013. Values were rounded to the next 100.*

	Summe Seetaucher <i>Total divers</i>	Sterntaucher <i>Red-throated Diver</i>	Prachttaucher <i>Black-throated Diver</i>
AWZ <i>Exclusive Economic Zone (EEZ)</i>	15.200 Ind.	14.000	1.200
Schleswig-Holstein	3.400 Ind.	3.100	300
Niedersachsen	1.600 Ind.	1.500	100
Gesamtbestand deutsche Nordsee <i>Total population size German North Sea</i>	20.200 Ind.	18.600	1.600

from: Garthe et al. (2015), Vogelwarte

Tab. 10-3: Population sizes of Red-throated Divers wintering in the German part of the Baltic Sea and the EEZ derived from aerial and ship-based transect counts (FTZ unpubl.; base period: 2000-2007) and in the SPA "Pomeranian Bay" derived from ship-based transect counts (SONNTAG et al. 2006; base period: 2000-2005). Size classes (according to standard data sheet): **III**: 11-50 individuals.

	Population size German Baltic	Proportion of biogeogr. pop. (%)	Population size German EEZ Baltic	Proportion of biogeogr. pop. (%)	Population size SPA "Pomm. Bay"	Proportion of biogeogr. pop. (%)
Spring	9,000	3.0	2,200	0.7	750	0.3
Summer	III	<0.1	III	<0.1	III	<0.1
Autumn	210	0.1	III	<0.1	0	0.0
Winter	3,200	1.1	550	0.2	III	<0.1

from: Mendel et al. (2008), Profiles of seabirds ...

Population trends

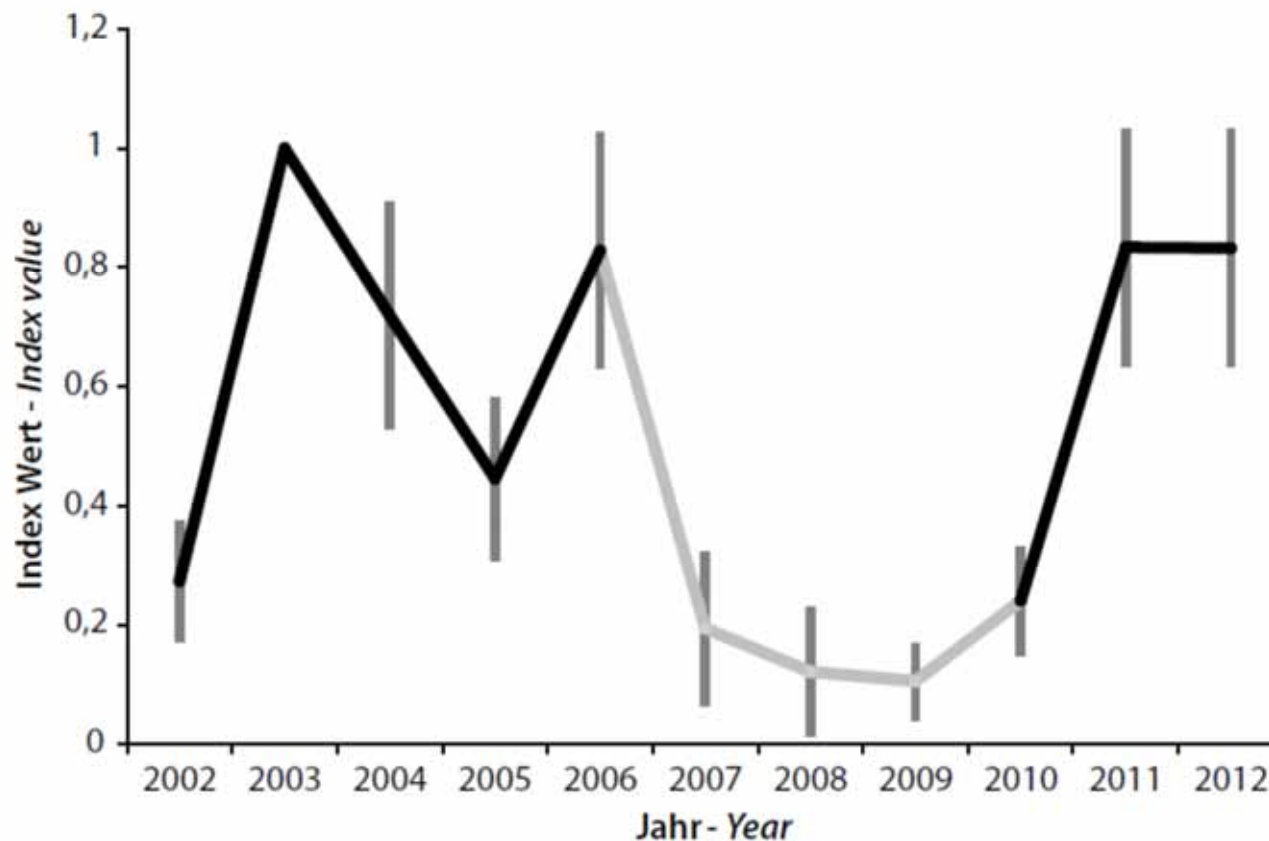


Abb.25: Modellbasierte Bestandstrends der Seetaucher im Frühjahr (März bis April) in der Deutschen Bucht von 2002 bis 2012. Für das Frühjahr 2003 wurde die Bezugsgröße = 1 gesetzt. In Grau sind Jahre bzw. Trends mit nur geringer Abdeckung des Hauptvorkommens der Seetaucher markiert. – *Model-based population trends of divers in spring (March to April) in the German Bight from 2002 to 2012. Spring 2003 was set to 1 as reference value. Years and trends shown in grey illustrate poor coverage of the core study area.*

from: Garthe et al. (2015), Vogelwarte

Diet



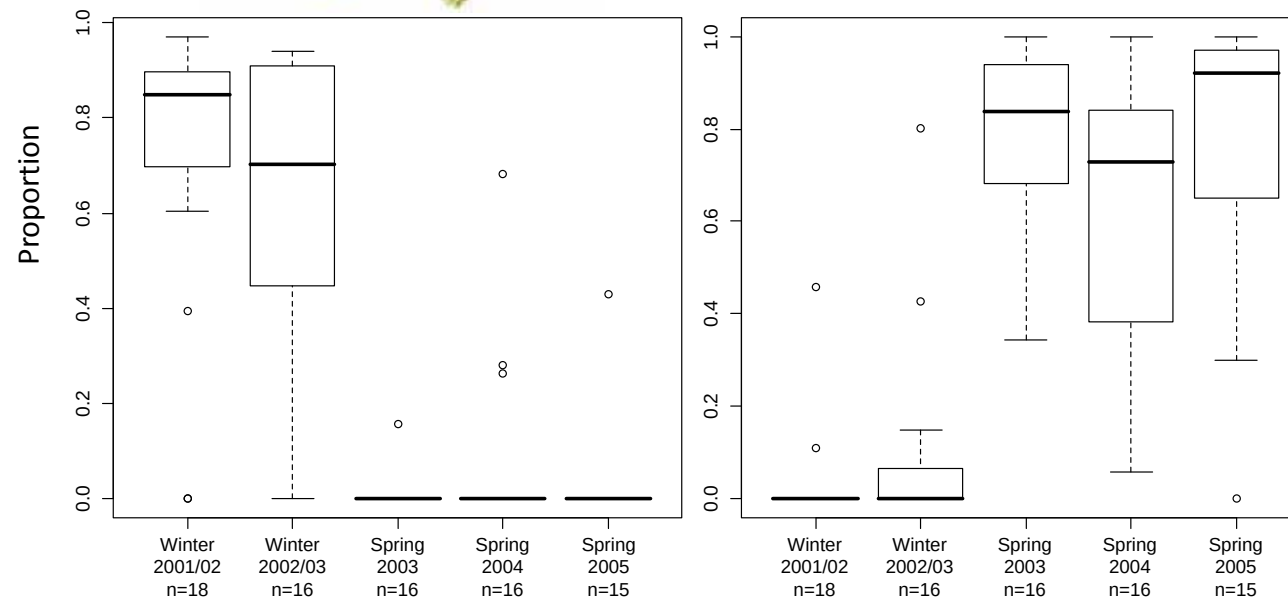


Diet of divers in SW Baltic Sea



Red-throated Diver

Relative proportions of prey biomass

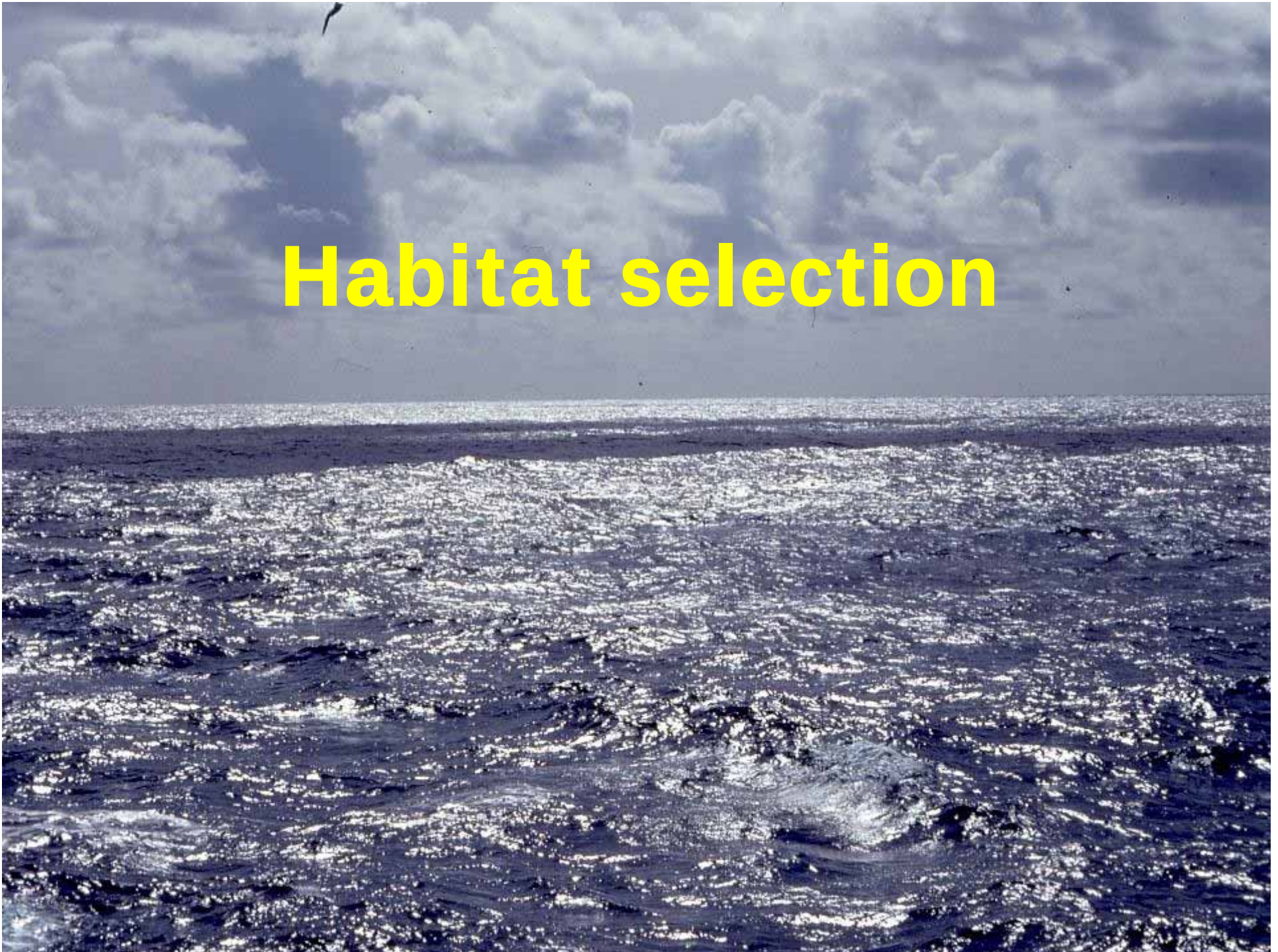


Significant seasonal changes in dietary choice

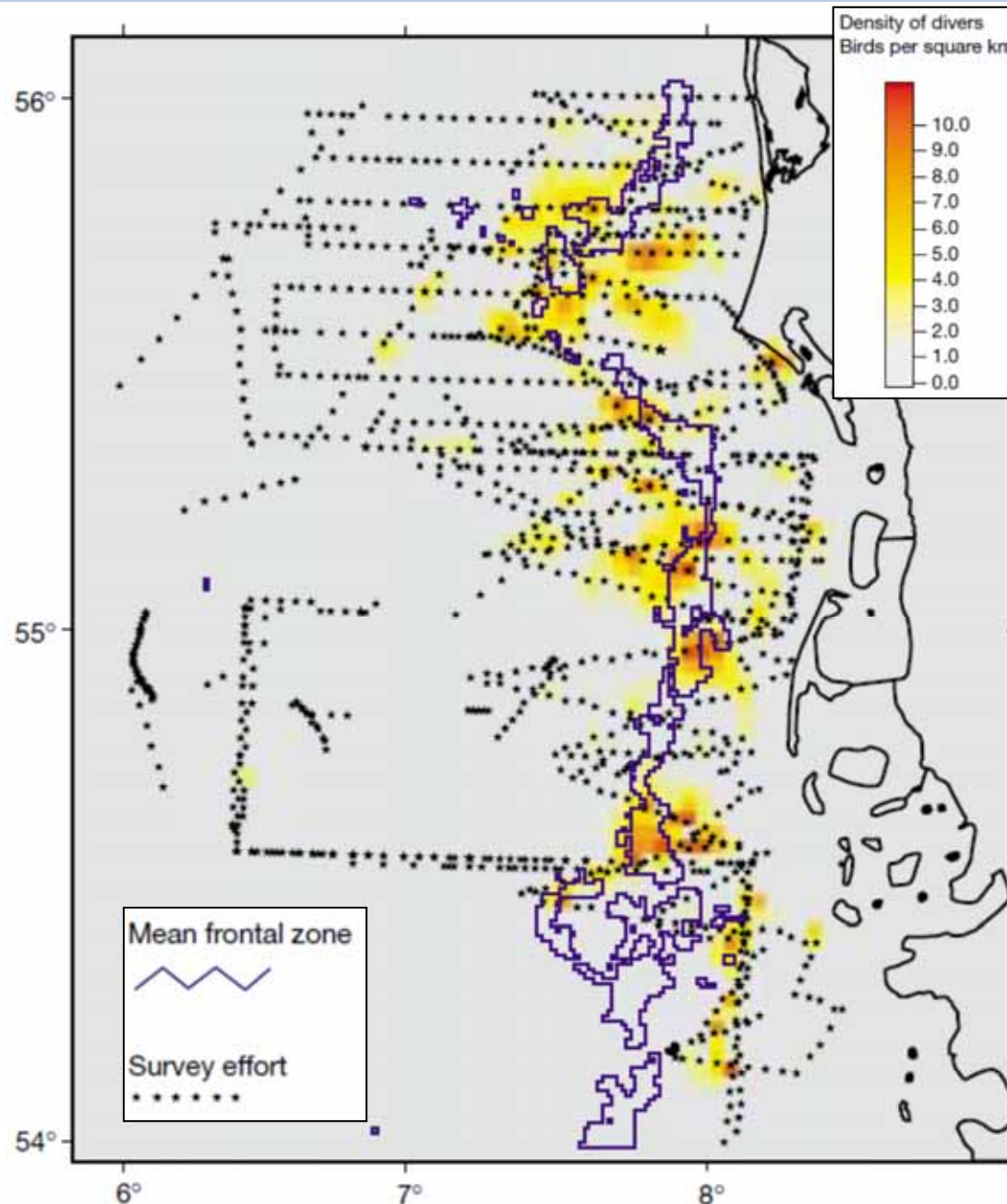
- **Main prey winter:** young Zander 70% + 15% Ruffe
- **Main prey spring:** spawning Herring 77%

Source: Guse et al. 2009 J Sea Res

Habitat selection



Habitat selection



PC estuarine front explained 52% of variance in diver densities

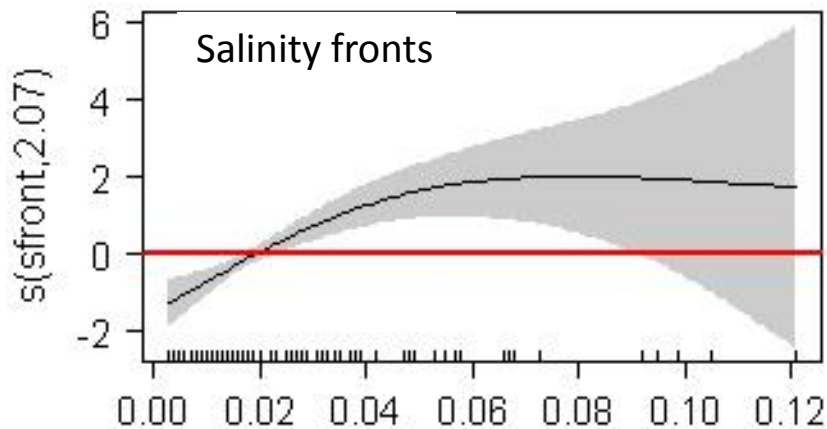
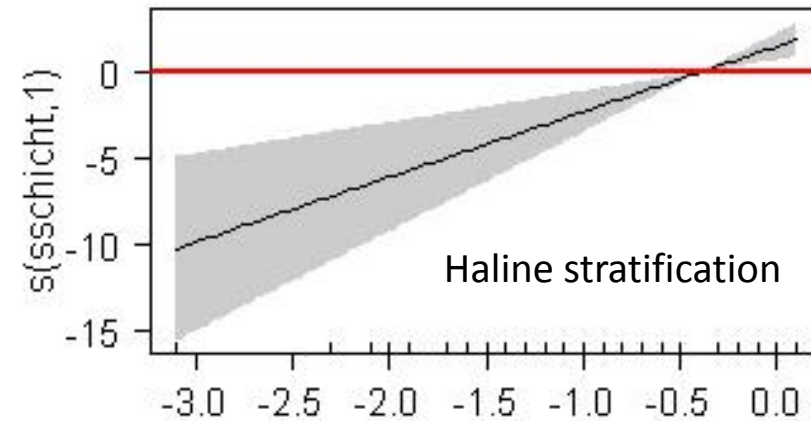
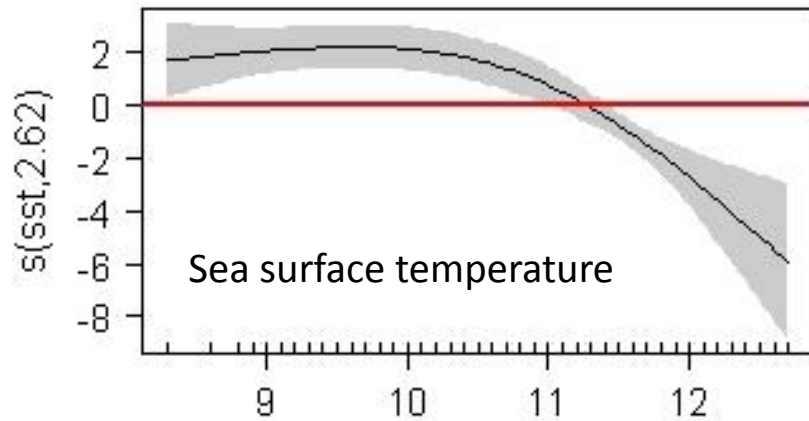
High densities confined to areas within 5 km distance from the mean frontal zone

Persistent link (recorded during all cruises)

from: Skov & Prins (2001)



Relevant habitat variables



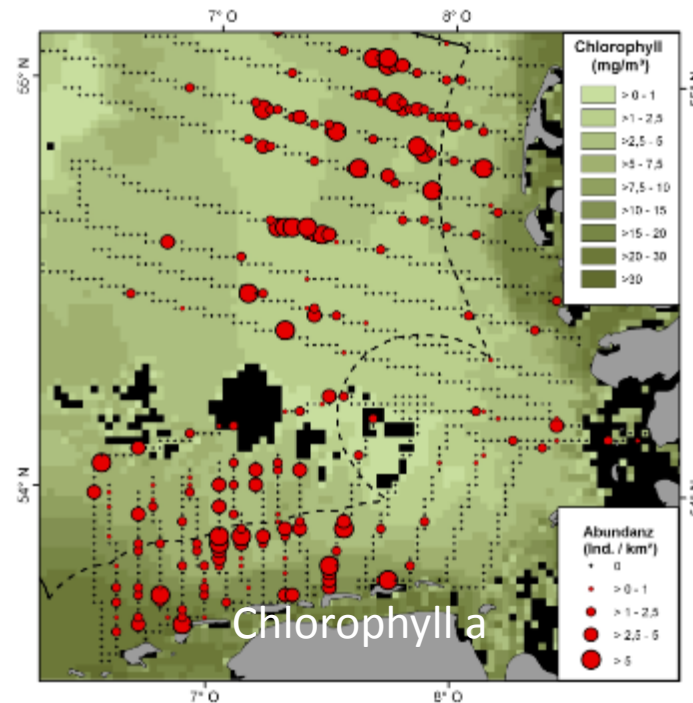
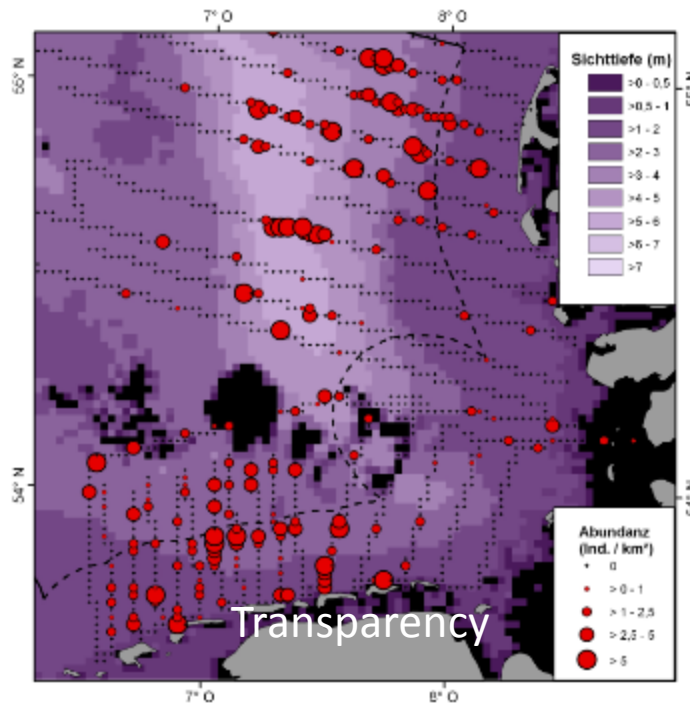
Variable	edf	F	Level of significance
Sea surface temperature	2.619	9.512	***
Wind speed	2.97	9.978	***
Air pressure change	1	3.949	*
Haline stratification	1	9.788	***
Temperature fronts	2.952	3.417	*
Salinity fronts	2.069	8.559	***

Generalized Additive Model (GAM), Variance expl.: 66%, Ship-based survey Winter

from: Markones et al. (2014), project report



Relevant habitat variables



Variable	edf	F	Significance level
Sea surface temperature	7.062	6.243	***
Transparency	8.797	11.432	***
Yellow substance	5.896	1.863	0.08
Chlorophyll a	8.759	8.775	***
Water depth	8.729	6.048	***
Sediment type	2.689	3.366	*

Aerial survey Spring

Generalized Additive Model (GAM)

Variance explained: 29%

from: Markones et al. (2014), project report

Human pressures: Set net fisheries



Set net fisheries



The order of magnitude of reported bycatch estimates and countries with the most frequent bycatch of waterbird species in the Baltic Sea and the North Sea and the respective wintering numbers (from Skov et al., 2007).

Species	Order of magnitude of reported bycatch numbers	Wintering numbers (1987–1995) ^a	Countries with the most frequent bycatch ^b
Red-throated diver <i>Gavia stellata</i> and Black-throated diver <i>Gavia arctica</i>	Hundreds	>100,000	SE, LV, LT, PL, DE

from: Zydelis et al. (2009), Biol. Conserv.

Set net fisheries



Table A1. Bird species recorded as bycatch

Species	Main food ^a	Usedom 1990–2005	Usedom 2006–2009	Remaining coast 2006–2009	Lagoons 2006–2009
Divers					
Red-throated diver <i>Gavia stellata</i>	F	733	104	11	0

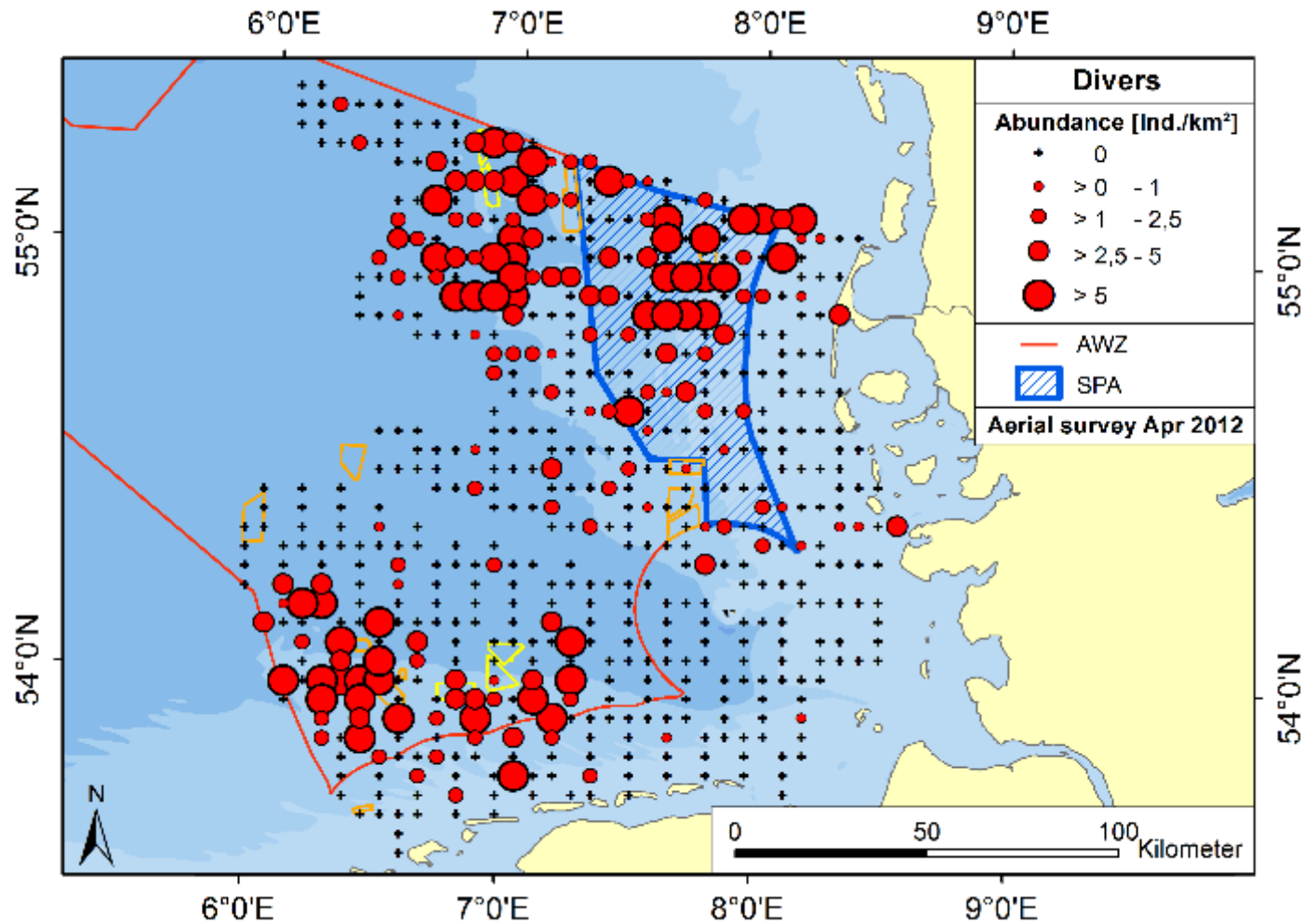
from: Bellebaum et al. (2013), Aquatic Conserv. Mar. Freshw. Ecosyst.

Human pressures: Offshore wind farms





Monitoring survey pre-construction

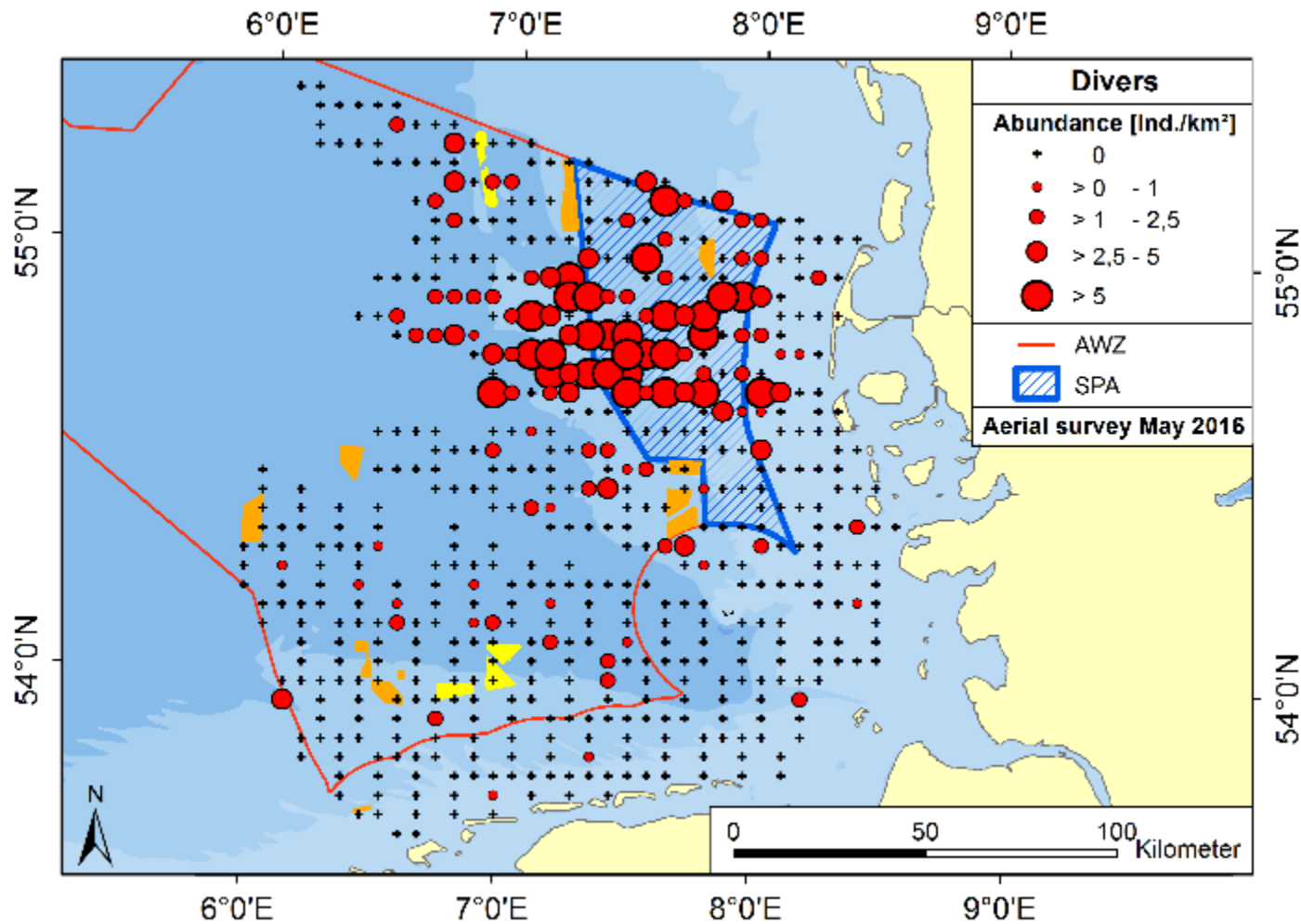


Offshore seabird monitoring FTZ
On behalf of Federal Agency for Nature Conservation BfN





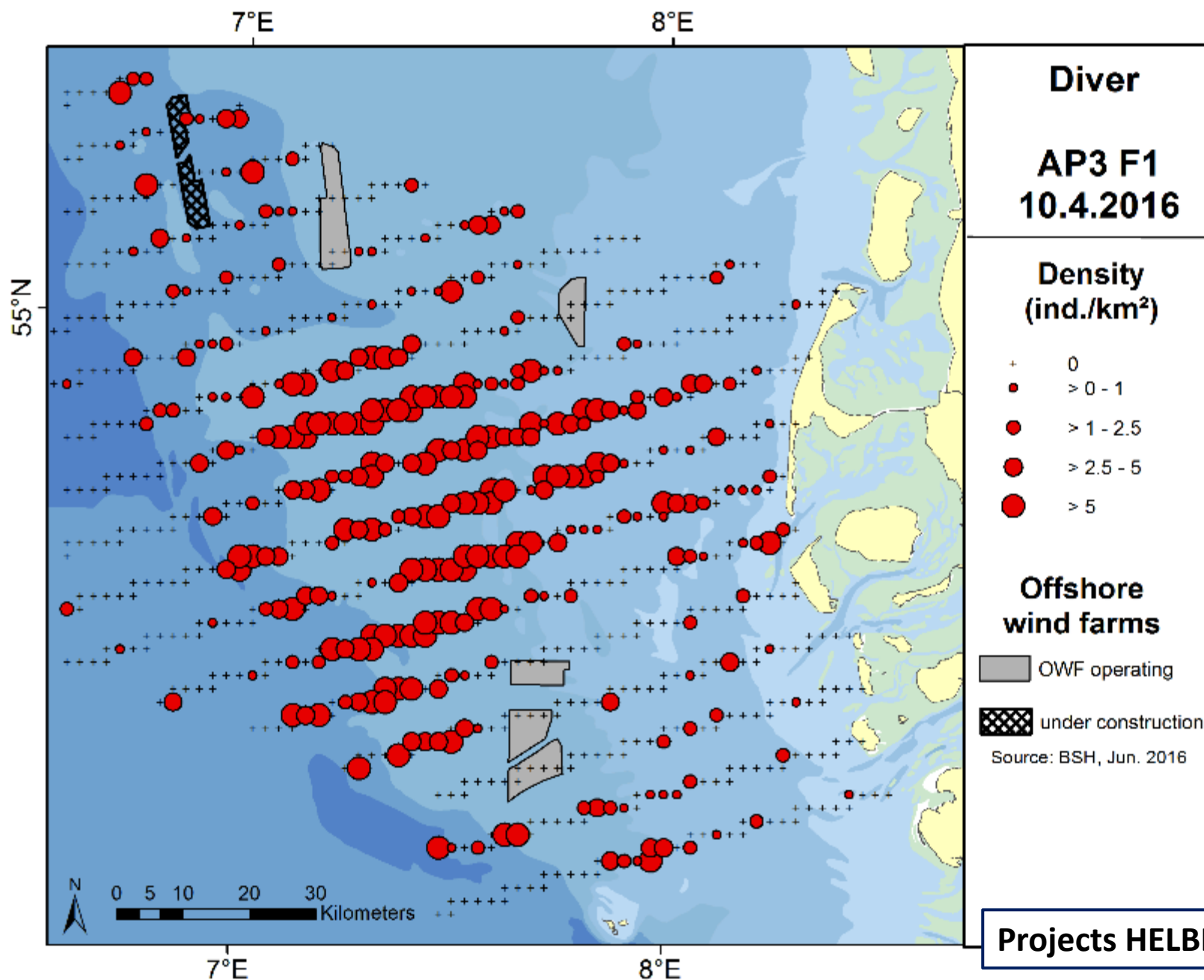
Monitoring survey post-construction



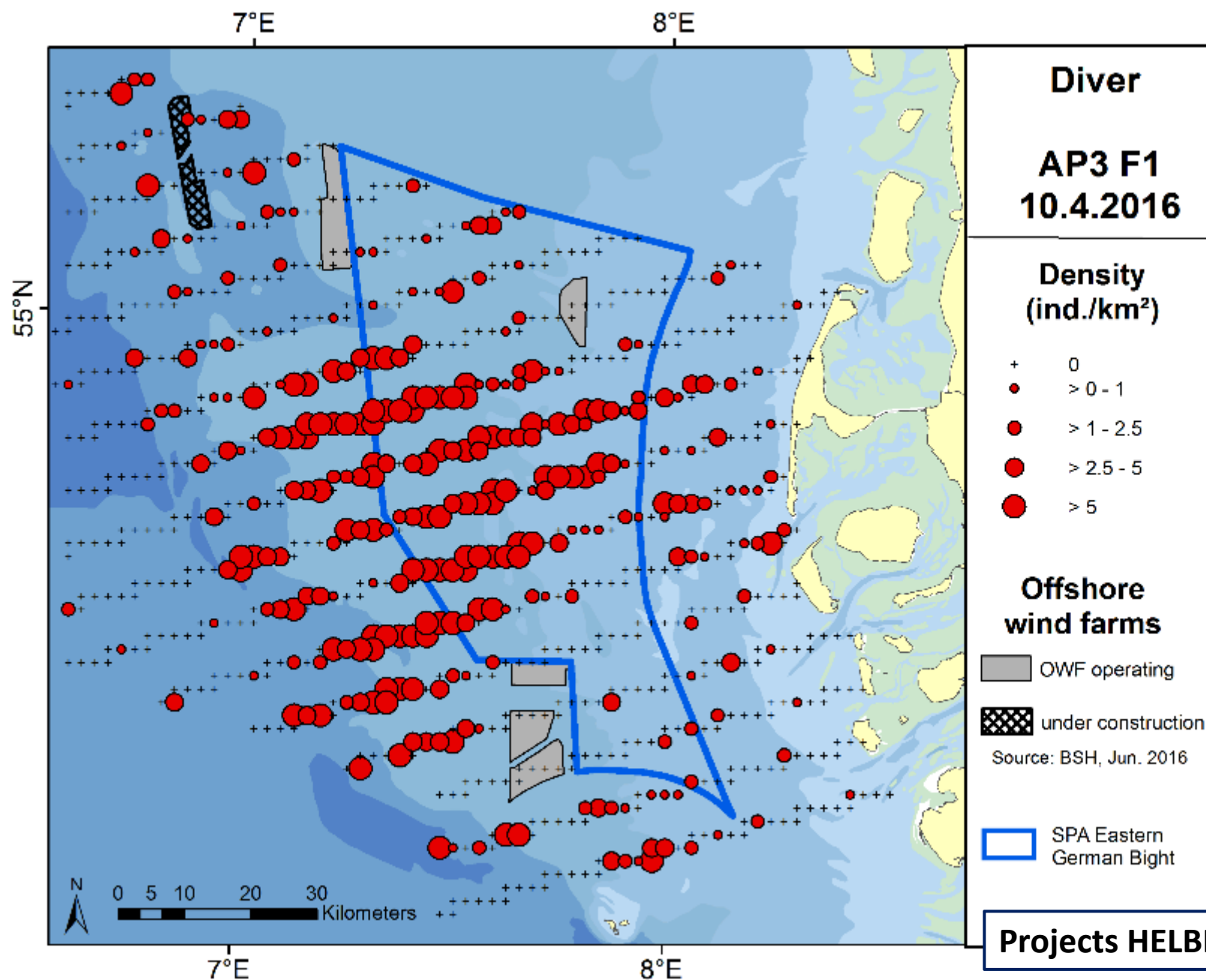
Offshore seabird monitoring FTZ
On behalf of Federal Agency for Nature Conservation BfN



Offshore wind farms

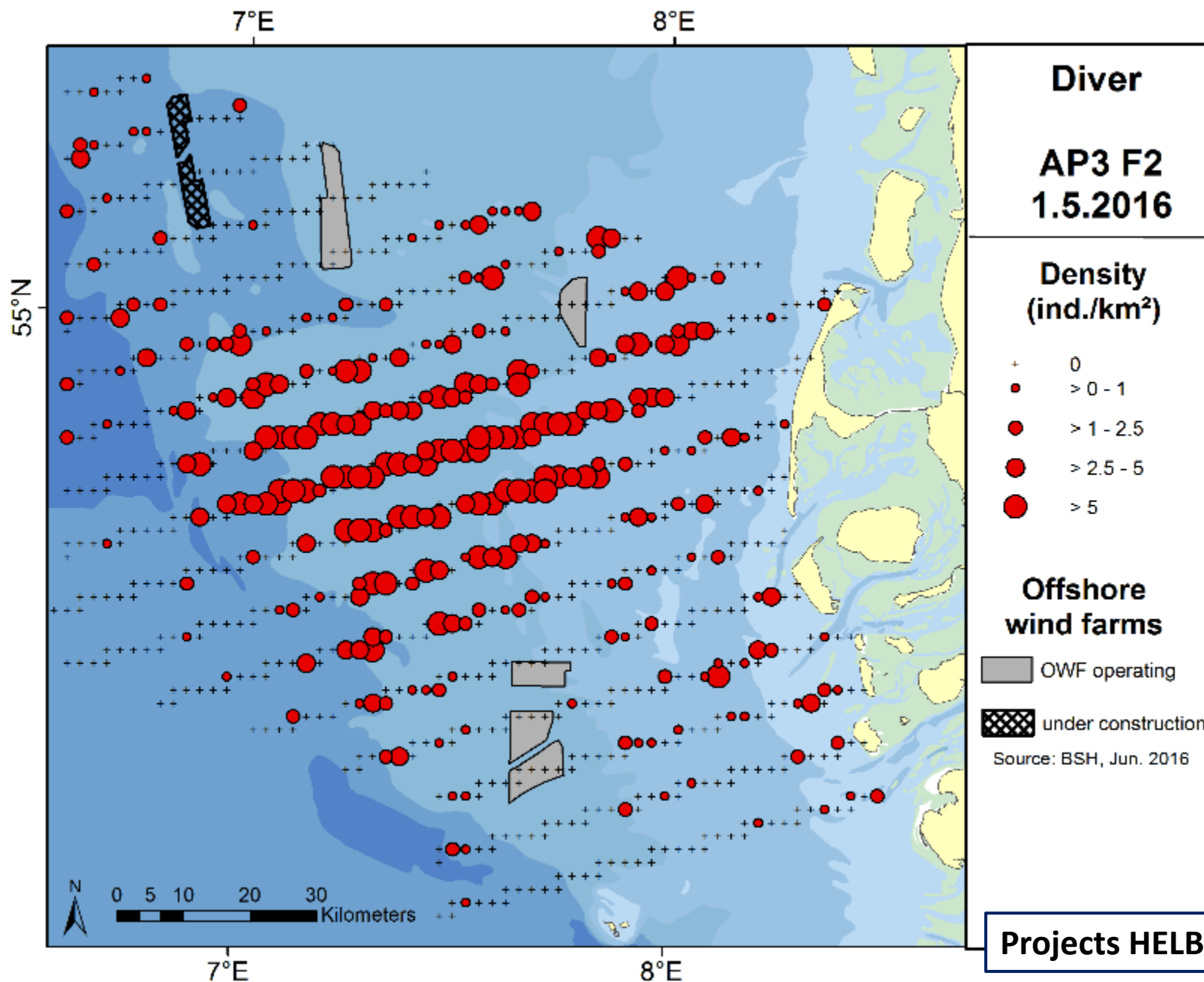


Offshore wind farms



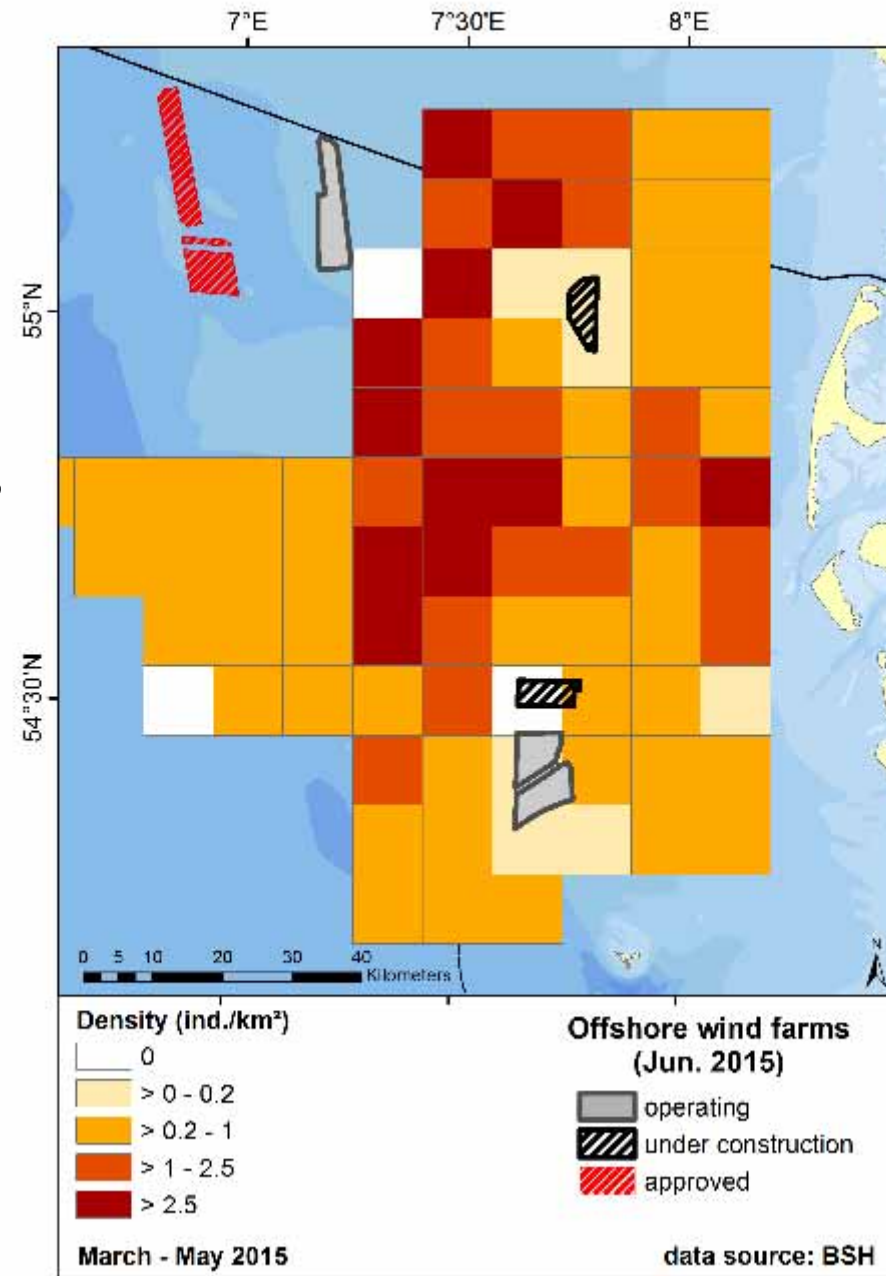
Projects HELBIRD/DIVER

Offshore wind farms





Data:
environmental impact
and monitoring-studies



Human pressures: Ship traffic



Ship traffic

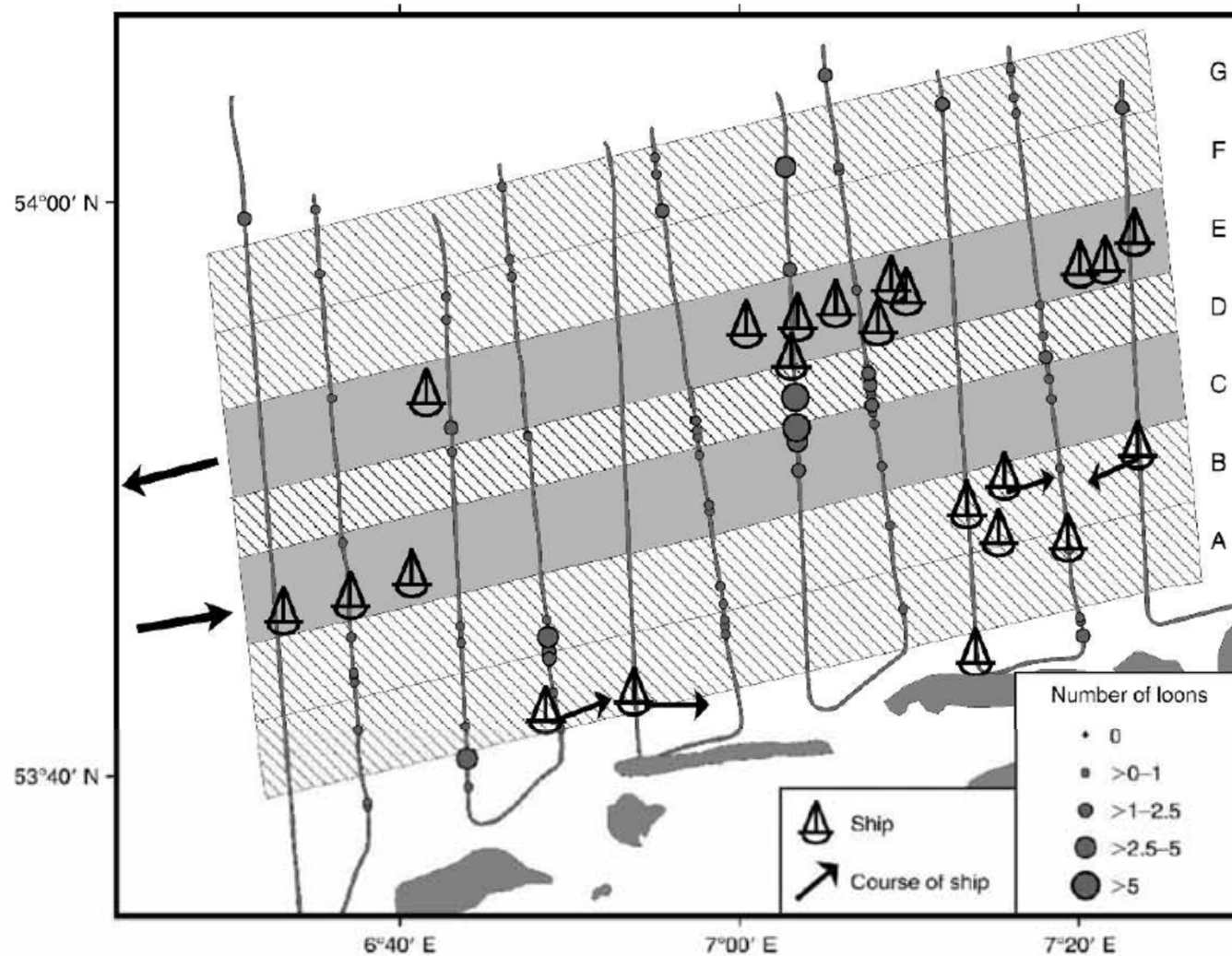


FIG. 2. Example of the distribution of loons recorded during an aerial survey flight in April 2006 (see light-gray rectangle in Fig. 1b) within seven zones (A–G) used for computing avoidance or preference values (see Table 1). Light gray zones (C and E) are areas of intense channeled shipping; diagonally hatched zones are areas of lower shipping intensity. Positions and (in several cases) courses of the ships recorded during the survey are shown.

from: Schwemmer et al. (2011), Ecol. Appl.



**Digital
aerial
Survey,**

31 March 2016

