

2022 UPDATE IN BRIEF

WADDEN SEA QUALITY STATUS REPORT



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FOREWORD

From the early days of the Trilateral Monitoring and Assessment Programme (TMAP), the concept envisioned an integrated ecosystem monitoring approach that considered the Wadden Sea as ecological entity and recognised issues of concern including human activities in the coastal region. TMAP is the basis for the Wadden Sea Quality Status Reports (QSRs) and was recognised as one of the cornerstones of the successful inscription on the UNESCO World Heritage list in 2009.

Even the best programme eventually surpasses its prime and must face new realities. Therefore, the German Presidency 2018-2022 set a priority to “ensure that the TMAP is fit for the future and meets the with the requirements of European nature and marine conservation and protection directives”. New pressures and impacts such as pollutants, micro-plastics, non-native species, and climate change were listed as relevant to be added to TMAP. This is of crucial importance to maintain a sound and future-proof

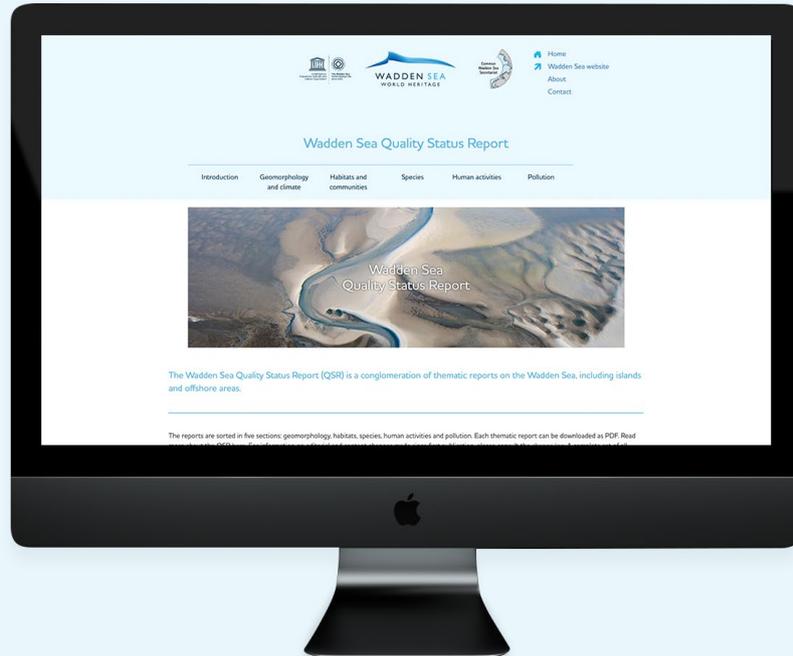
programme that enables an effective state-of-the-art ecosystem assessment. Furthermore, it was acknowledged that improving on handling of the treasure of the TMAP data, which became partly neglected over time, was indispensable in order to make the TMAP information widely recognisable and usable, for instance, for the public-at-large or schools.

Parallel to the process of renewal, nine QSR Thematic Reports were substantially updated. More than 80 experts were involved. Three further reports are in a final development phase and will be published in due course (status end of 2022). The newly introduced idea of a continuous QSR update system with delivery based on data availability during the reporting cycles as well as other ad-hoc drivers from the outside, provides the avenue to an up-to-date data analysis. Further streamlining of the processes and, even more importantly, sufficient regional support are inevitable for consistency. The success of TMAP should be made widely visible by

applying web-based technologies for QSR and data visualisation. Any resulting products have to be guided by the needs of the users, scientists, stakeholders, administrators, and decision makers, as well as the public. ~~~

Adi Kellermann,
Chair of Task Group
Management & Assessment





QUALITY STATUS REPORT

The Wadden Sea Quality Status Report (QSR) is a conglomeration of thematic reports reflecting the continuous monitoring and evaluation of the ecological status of the Wadden Sea, including islands and offshore areas. The compiled information traditionally feeds into the International Scientific Wadden Sea Symposia (ISWSS) and the Trilateral Governmental Conferences (TGC), both held in 3-4-year intervals, and was first issued in 1999 based on the Trilateral Monitoring and Assessment Programme (with follow-ups in 2004 and 2009). In 2017, the QSR was upgraded from a monograph and later PDF files to the widely accessible online

portal qsr.waddensea-worldheritage.org with the aim of integrating updates to the thematic reports directly into the platform. Now in 2022, nine thematic reports received complete updates, displaying assessments on birds, marine mammals, alien species, and fish populations, as well as on subtidal habitats, energy, and tourism.

The Quality Status Report is not a straight-forward publication. Each thematic report is written by a handful of experts and peer-reviewed by an editorial board. A lengthy but essential process to get a viable review of Wadden Sea data. Altogether over

100 experts from the Wadden Sea region and beyond work on the QSR.

The reports analyse trends and the direction of change as well as long-term trends while considering the shifting environmental factors, pressures, and human activities. More than 80 scientists were involved in the creation of the 2022 updates and are part of a vital science and research community in the Wadden Sea. This brochure displays the major findings of the updated thematic reports. 



Seal counting flight © Casper Tybjerg



Crucibles aligned for determination of ash free dry mass of macrozoobenthos © Jan Drent

TRILATERAL MONITORING AND ASSESSMENT PROGRAMME

The Trilateral Monitoring and Assessment Programme (TMAP), the joint monitoring programme of the Wadden Sea countries, was launched in 1997. The programme spans a broad range of topics, such as morphology, ecological processes, wildlife, and human activities. TMAP covers the entire Wadden Sea Area including islands and offshore areas. It is the foundation for the ecological assessment of the Wadden Sea Area and provides a unique knowledge base. Monitoring the Wadden Sea as an ecological entity was also a prerequisite for the inscription on the UNESCO World Heritage List. The programme combines various approaches and instruments for management, monitoring, and assessment. TMAP also complies with the requirements

of relevant European and international law, such as the EU Water Framework Directive (WFD), the Habitats and Birds Directives, the Marine Strategy Framework Directive (MSFD), and the World Heritage Convention. One priority of the German presidency 2018–2022 was to help ensure that TMAP is fit for the future and meets the requirements arising from the European nature and marine conservation directives. The trilateral Task Group Management & Assessment (TG-MA) reviewed the existing programme and discovered only minor gaps in the monitoring activities. To assure that TMAP keeps up with recent developments, proposals for new parameters, e.g., on fish, alien species, and dark sky, have been developed and are ready for further processing and a possible

integration into the TMAP parameter suite. Other parameter options on different topics will be explored in the future. All proposals must follow realistic, practical, and efficient approaches and should take into account the monitoring already in place in the regions. Furthermore, severe problems with the trilateral data provision were tackled by the relevant trilateral Task and Expert Groups, with strong support of international advisors, such as the International Council for the Exploration of the Sea (ICES) and the Danish Environmental Portal. A new proposal for a future-proof and effective TMAP data handling was developed and will be further elaborated towards a functioning system in the period to come. 



Salt marsh monitoring field work © Martin Stock

SCIENTIFIC COOPERATION

The Quality Status Report depends on data from TMAP and further external sources, but also on high-class scientific expertise. In order to also meet the challenges of future developments, which have an impact on the conservation status of the Wadden Sea World Heritage Site and sustainable development of the Wadden Sea region, the Trilateral Wadden Sea Cooperation fosters the exchange and

cooperation with science and research. The Trilateral Research Agenda, which has been developed by independent scientists is an important basis on which the Trilateral Programming Committee for Wadden Sea Research (TPC-WSR) developed the basis of a trilateral research call which now needs to be implemented in cooperation with the national funding agencies. Furthermore, a regular trilateral summer school, developed

by the Partnership Hub at the Common Wadden Sea Secretariat, is envisaged, and should start in 2023. It is planned to be installed also as an important spark for the next generation of Wadden Sea scientists and should educate on the unique ecology, geomorphology, and on topics related to humanities and policy science interaction and World Heritage. 



Numbers, distribution & trends since 1991

27 rare and colonial breeding bird species



Total count annually

Numbers, distribution & trends since 1991

8 common breeding bird species



Count in census areas annually. Total count once every 5–6 years: 1991, 1996, 2001, 2006, 2012

Breeding success since 2009-10

Selection of 10 representative species



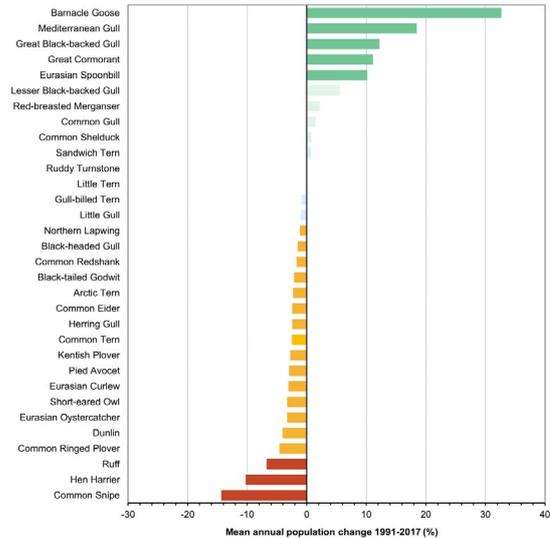
Samples sites annually

Contaminant in bird eggs since 1998

Selection of 2 representative species



Samples sites annually



Setup of the TMAP monitoring scheme for breeding birds in the Wadden Sea

Summary of trend in numbers of breeding birds in the Wadden Sea

QSR 2022 THEMATIC REPORTS

BREEDING BIRDS

K. Koffijberg, T. Bregnballe, J. Frikke, B. Hälderlein, M. Bentzon Hansen, J. Meyer, G. Reichert, J. Umland & T. van der Meij

qsr.waddensea-worldheritage.org/reports/breeding-birds

Birds have always been considered key species of the Wadden Sea and have been surveyed in the framework of TMAP and previously existing regional monitoring programmes since 1991. The abundance of 35 coastal breeding bird species has been monitored during the breeding season in the Wadden Sea, using standardised methods in each country and largely harmonised counts among the countries. Even though many of the breeding birds are migrants and winter along the East Atlantic Flyway (e.g., in the Mediterranean or Africa), their abundance on breeding sites in the Wadden Sea is closely related to the local conditions and therefore also associated with local management regimes. When com-

paring islands and mainland breeding sites, it becomes clear that the islands (including the Halligen in Schleswig-Holstein) hold the largest share of the breeding bird populations. Overall, 75% of all breeding pairs in the Wadden Sea are found on the islands and Halligen, and this percentage has hardly changed since 1996.

The breeding bird populations in the Wadden Sea still show considerable downward trends with 18 out of 33 species (55%) having experienced significant declines. The offspring rates, being the basis to maintain a stable population, have been negatively affected by increased predation risk, flooding, disturbance, and food availability.

Given the large number of declining breeding bird species and the reported failure of breeding success in many species, only a limited number of breeding birds in the Wadden Sea is currently thriving. Instead, most species show a downward trend and did not show clear signs of a recovery in recent years (albeit some examples do exist, e.g., the Kentish Plover in coastal wetlands in Schleswig-Holstein). 

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Thematic Report
Breeding birds online.





Dunlin (*Calidris alpina*) flock near St. Peter-Ording, Germany © Martin Stock

Species	33 year trend 1997/98 - 2019/20	10 year trend 2010/11-2019/20	Flyway trend 2011-2020
Great Cormorant	↑↑	→	↑↑
Eurasian Spoonbill	↑↑	↑↑	↑↑
Barnacle Goose	↑↑	↑↑	↑↑
Brent Goose	↓	→	→
Common Shelduck	↓	→	↓
Eurasian Wigeon	→	↑	→
Common Teal	→	↑	→
Mallard	→	↓	↓
Northern Pintail	↑	↑	↑
Northern Shoveler	↑	↑	↑↑
Common Eider (29y trend)	↓	→	—
Eurasian Oystercatcher	↓	↓	↓
Pied Avocet	↓	→	→
Common Ringed Plover	↑	↑	X
<i>C. p. guineanodroma</i>	↑	↑	→
<i>C. p. hiaticula</i>	→	→	→
Kentish Plover	↓	—	—
European Golden Plover	—	—	X
Grey Plover	→	→	↓
Northern Lapwing	→	→	↓
Red Knot	↓	→	X
<i>C. c. islandica</i>	↓	→	↓
<i>C. c. corsicus</i>	→	→	—
Sanderling	↑	↑	→
Curlew Sandpiper	→	—	↓↓
Dunlin	→	↓	↓
Ruff	↓	↑	X
Bar-tailed Godwit	→	→	X
<i>L. l. lapponica</i>	→	→	→
<i>L. l. toympensis</i>	→	→	↓
Whimbrel	→	→	→
Eurasian Curlew	→	→	→
Spotted Redshank	→	↓	—
Common Redshank	→	→	X
<i>T. t. totonus</i>	↓	↓	→
<i>T. t. britannica</i>	↓	↓	↓
<i>T. t. robustus</i>	↓	→	↑
Common Greenshank	→	↓	—
Ruddy Turnstone	→	↑	X
NE Canada and Greenland Fennoscandia and NW Russia	↑	↑	→
<i>C. Black-headed Gull</i>	→	→	→
Common Gull	→	→	↓
European Herring Gull	↓	→	↓
Great Black-backed Gull	↓	→	→

↓↓ strong decrease
 ↓ moderate decrease
 → stable
 — uncertain

33-year and ten-year trends of 34 species and their flyway trends

MIGRATORY BIRDS

The Wadden Sea is of great importance as a staging, wintering, and moulting area for migratory birds along the East Atlantic Flyway. For more than three decades, the Trilateral Wadden Sea Cooperation has monitored the numbers of 39 populations of 34 migratory waterbird species. The monitored species breed in a large part of the Northern hemisphere, including Greenland, Canada, Fennoscandia, and Russia, but also in the Wadden Sea. The bilaterally organised bird counts were initiated in 1980 and in 1987/1988 a revised and improved counting scheme was established. As a result, monitoring of 34 migratory waterbird species, with sufficiently large numbers in the Wadden Sea to allow analyses on numbers and trends, has

taken place for 33 years. The trends displayed in the current report reflect the use of the Wadden Sea by the respective bird species and therefore indicate the status of the migratory bird populations of the East Atlantic Flyway population in the Wadden Sea. As there is an obvious connection between the topics of migratory birds and the East Atlantic Flyway, a comparison between the ten-year Wadden Sea trends and the East Atlantic Flyway trends, as depicted in the thematic report “East Atlantic Flyway”, can help in evaluating if local or global drivers were causing changes in numbers using the Wadden Sea.

Long-term trends of migratory birds are still of concern. Besides the unchanging numbers

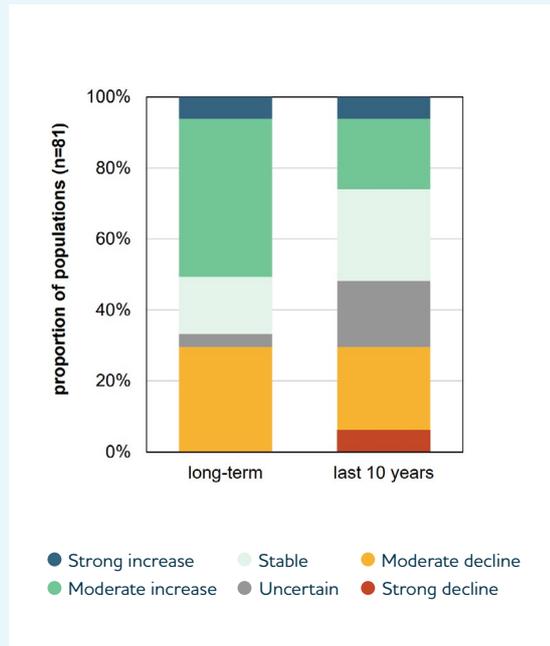
of 14 species comprising worms, benthic, and invertebrate’s feeders, an increase in the number of seven species, including fish and plant-eating species, has been recorded. However, 13 species including shellfish feeders witnessed a decline. ~~~~~

R. Kleefstra, T. Bregnballe, J. Frikke, K. Günther, B. Hälterlein, M.B. Hansen, M. Hornman1, J. Meyer & G. Scheiffarth

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Thematic Report
Migratory birds online.





Proportions of increasing, stable or decreasing flyway population trends along the East Atlantic Flyway



The East Atlantic Flyway © CWSS

EAST ATLANTIC FLYWAY

Most of the waterbird species found in the Wadden Sea are migratory, meaning that for them the Wadden Sea is only one site in a network of sites along the eastern shores of the Atlantic Ocean and adjacent seas usually referred to as the East Atlantic Flyway. The fact that bird populations within the Wadden Sea are also influenced by conditions elsewhere along the flyway formed the rationale behind the establishment of the Wadden Sea Flyway Initiative (WSFI). This initiative was launched after the recognition of the Wadden Sea as a World Heritage Site, aiming for improved cooperation, knowledge exchange, and management along the flyway. The thematic report on the East Atlantic

Flyway is based on the outcomes of the accompanying monitoring programme as a cooperation of the WSFI, Wetlands International and BirdLife International. Since 2013, annual counts of birds have been carried out. In addition, environmental conditions were registered at selected sites in Western Africa to add to what was already done in Western Europe. The thematic report provides a summary of the trends in bird numbers, distribution patterns, and pressures along the flyway. The majority of flyway species show stable or increasing population trends, with the exception of Arctic breeding and long-distance migratory waders, which are decreasing. The decline is a result of the negative effects

van Roomen, M., Agblonon, G., Citegetse, G., Crowe, O., Langendoen, T., Nagy, S., Schekkerman, H., van Winden, E.

qsr.waddensea-worldheritage.org/reports/east-atlantic-flyway

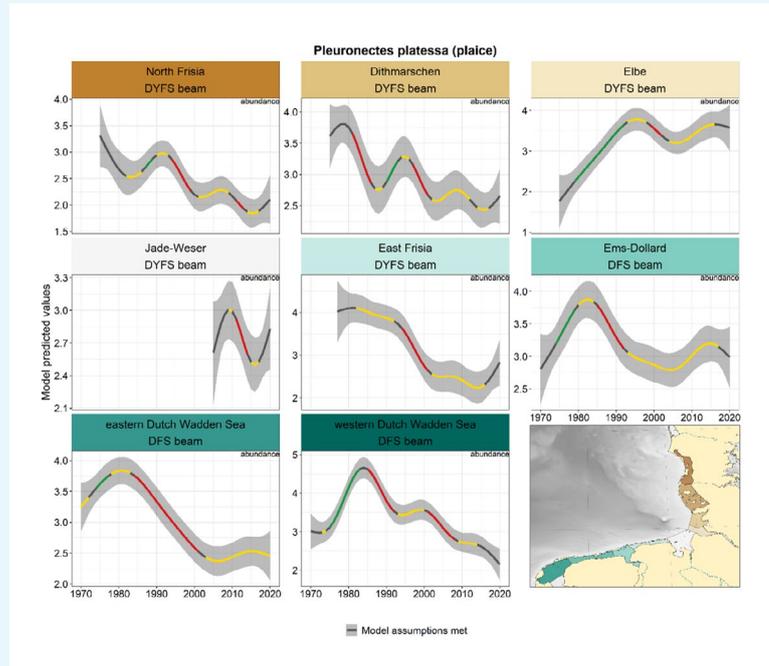
of fishing, disturbance by tourism, agricultural use, and interference with human constructions. Also, the effects of climate change are more frequently mentioned than in the past with negative impacts, especially on populations breeding in the Arctic where warming is recorded as more rapid compared to temperate regions. 

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Thematic **East Atlantic**
Flyway online.





Two young plaices (*Pleuronectes platessa*) hiding on top of the sediment © Robert Jak / IMARES



Trends in modelled predicted abundance/probability of occurrence of plaice in the different areas

FISH

The Wadden Sea has been recognized as an important area for many fish species playing an important role in the food web. The shallow coastal area forms the transition between the estuaries and the North Sea. Fish make use of and occur in the Wadden Sea in many different ways: At a post-larvae stage to spend their juvenile phase; migrating through the area at different phases of their life cycle; or as residents over the entire year. The thematic report on fish lists all species observed in long-term monitoring programmes during the last decade and is based on existing national long programmes (at least ten

years) conducted in the regions. Moreover, a dedicated monitoring for fish under TMAP is currently proposed by the Expert Group Swimway.

Status and trends of Wadden Sea fish in the past decade revealed a total of 124 different species, with varying trends in abundance. This variation concerns the different ecological guilds, e.g., marine juveniles, estuarine residents and species migrating between fresh and marine waters (diadromous). The nursery function of the Wadden Sea appears to have declined since the 1980s and has stabilised during the last decade. The report

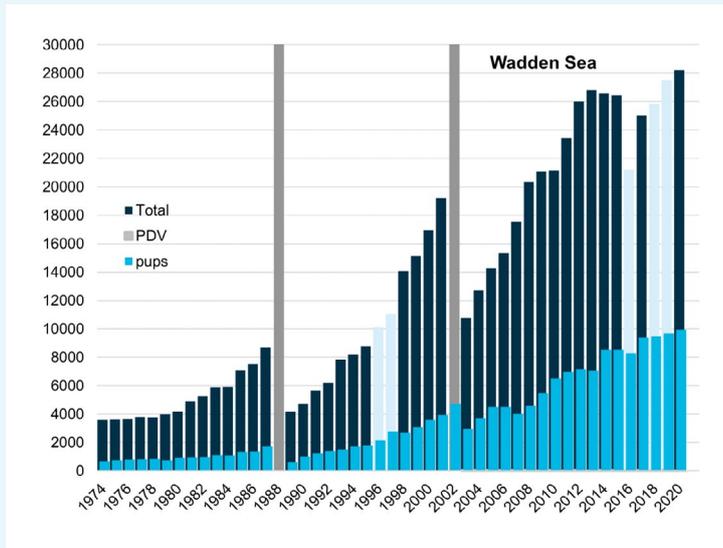
highlights findings also based on historical observations: The Wadden Sea may be an important (nursery) area for elasmobranch species (skates and sharks), based on anecdotal information as not covered by monitoring programmes. 

I. Tulp, L. Bolle, Chun Chen, A. Dänhardt, H. Haslob, N. Jepsen, A. van Leeuwen, S. Poiesz, J. Scholle, J. Vrooman, R. Vorberg, P. Walker

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Fish online





The total number of harbour seals counted in the Wadden Sea



Grey seal (*Halichoerus grypus*) © ITAV / Abbo van Neeff



Harbour seal (*Phoca vitulina*) © ITAV / Abbo van Neeff



Harbour porpoise (*Phocoena phocaena*) © ITAV / Abbo van Neeff

MARINE MAMMALS

The thematic report on marine mammals highlights their current status and developments in the Wadden Sea and suggests improvements in management measures and monitoring approaches. Three marine mammal species occur regularly in the Wadden Sea: the harbour seal, grey seal, and the harbour porpoise are thus considered as indigenous. In their function as top predators in the food web of the Wadden Sea and adjacent areas, they are also considered as sentinels for ecosystem health. The harbour porpoise is the most abundant cetacean species in the North Sea, but the integrated assessment of harbour porpoises within the marine mammals report shows

overall downward numbers. In contrast, the harbour seal population seems to have stabilised and is estimated at around 40,000 animals with varying animal numbers over the years and regions.

After having been absent for several centuries, grey seals started to recolonise the Wadden Sea around the middle of the last century. In 2021, a total of more than 9,000 grey seals were counted during the moulting period. These numbers have grown at an average annual rate of 13% over the past five years. These numbers are derived from a mixture of animals breeding locally and animals from neighbouring areas, primarily the United Kingdom.

Unger, B., Baltzer, J., Brackmann, J., Brasseur, S., Brüggmann, M., Diederichs, B., Galatius, A., Geelhoed, S.C.V., Huus Petersen, H., IJsseldijk, L.L., Jensen, T. K., Jess, A., Nachtsheim, D., Philipp, C., Scheidat, M., Schop, J., Siebert, U., Teilmann, J., Thostesen, C.B., van Neer, A.

qsr.waddensea-worldheritage.org/reports/marine-mammals

Marine mammals in the North Sea face a wide range of threats such as underwater noise, fishing, and pollution (contaminants and litter) which can affect their health and influence their distribution. 

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Pacific amphipod
Aoroides semicurvatus
© Björn Nadarzynski

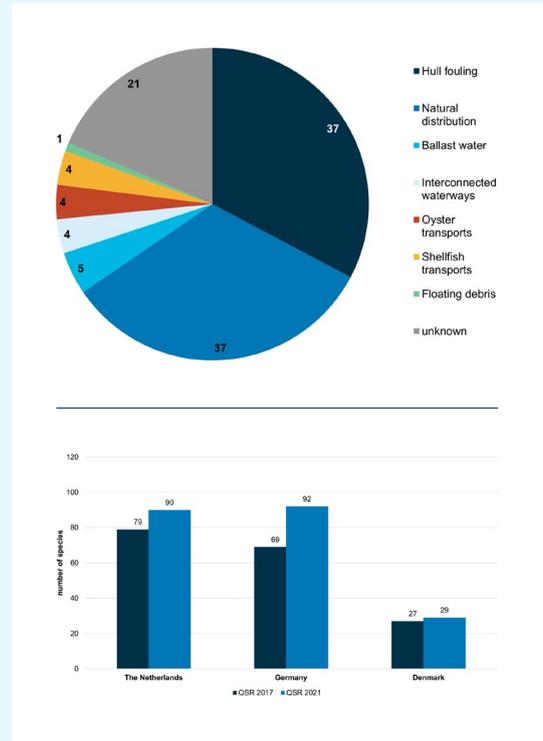
Marine yellow-green algae *Vaucheria* cf. *velutina*
© Karsten Reise



Racoon dog *Nyctereutes procyonoides*
© Michael Gäbler

Egyptian goose *Alopochen aegyptiaca*
© Armin Rose

Possible introduction vectors of marine alien species in the Wadden Sea Area including records up to 2020 © Gittenberger



Number of alien benthic species on the trilateral alien species list © Gittenberger

ALIEN SPECIES

The spread of organisms is in principle a natural process, which is limited by natural geographical barriers. However, human activities have breached those barriers and have – intentionally and unintentionally – transferred species into areas beyond their natural range. Most alien species became inconspicuous residents and cannot be removed without causing collateral damage to the ecosystem, and more alien species are likely to come. As a compilation of all detected alien species in the Wadden Sea, the trilateral alien species list encom-

passes 113 marine species. The alien species assessment report reveals the addition of 20 species to the trilateral alien species list in the past decade which results in almost a doubling of the introduction rate compared to the former period starting in 1990. Most of these marine alien taxa originate from the Pacific or from the Atlantic. Major introduction vectors are transoceanic shipping and aquaculture; intentional or unintentional introduction is the most important pathway for terrestrial plants. Although the introduced species have not caused the extinction

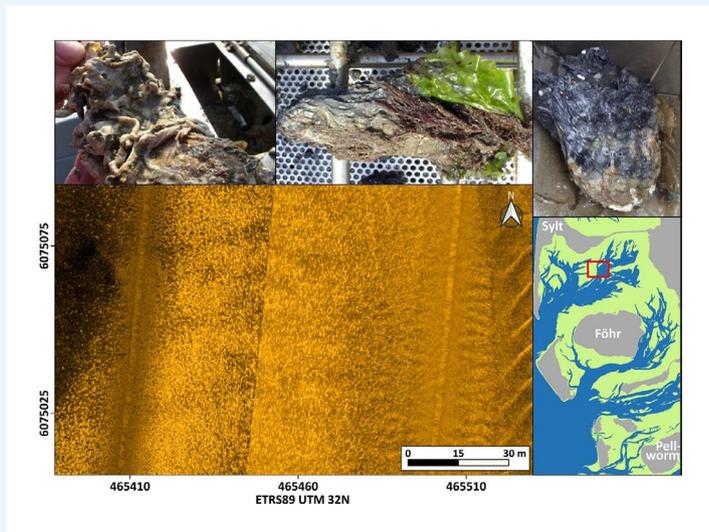
Büttger, H., Christoph, S., Buschbaum, C., Gittenberger, A., Jensen, K., Kabuta, S., Lackschewitz, D.

qsr.waddensea-worldheritage.org/reports/alien-species

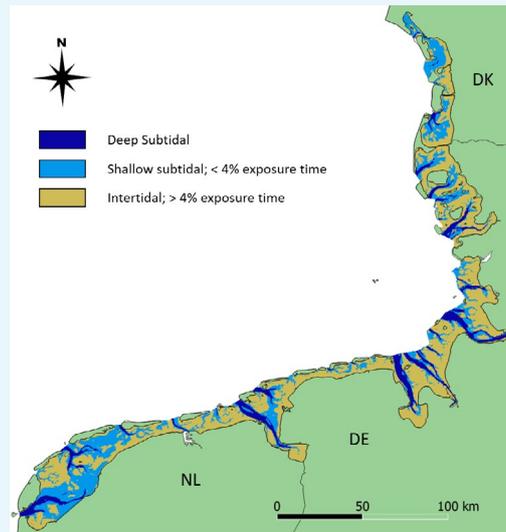
of native species in the Wadden Sea so far, some alien species have the potential to alter dominance structures, habitats, and trophic regimes, which are fundamental for the ecosystem. 

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Thematic Report **Alien**
species online





Side-scan sonar mosaic of a Pacific oyster (*Magallana gigas*) bed on fine sandy to muddy-sandy sediments



Distribution of deep and shallow subtidal (dark and light blue, respectively) and intertidal (yellow) areas in the trilateral Wadden Sea. based on the ecotopes provided in Baptist et al. (2021)

SUBTIDAL HABITATS

Subtidal habitats are the deeper parts of the Wadden Sea, which are more than 96% of the time submerged and constitute a total share of 44% of the overall area of the Wadden Sea. These habitats are subject to a variety of natural and anthropogenic influences and stresses. For example, the natural redeposition of sediments can significantly alter a seabed area. Further, the OSPAR Commission identifies eutrophication and especially physical disturbances due to fishing with bottom contacting gears as major human impacts on seabed habitats. The assessment of habitats and species composition and their variability over space and time is the subject of ongoing research. In

general, sandy areas cover by far the largest part of the subtidal sea floor. Although not evaluated yet, this most probably applies to the entire Wadden Sea. Because of ongoing sediment dynamics, and associated bedforms, this habitat is used by a relatively small number of species. Hard substrates, geogenic, and especially biogenic reef structures, occupy significantly less area. However, here the species diversity is significantly higher making them particularly valuable habitats that should be highly protected. For a better understanding of the functioning of the subtidal Wadden Sea, much can be gained from combining the best practices of species sampling campaigns and hydroacoustic sur-

Ricklefs, K., Franken, O., Glorius, S., Mascioli, F., Nielsen, P., Reimers, H.-C., Trampe, A.
qsr.waddensea-worldheritage.org/reports/subtidal-habitats

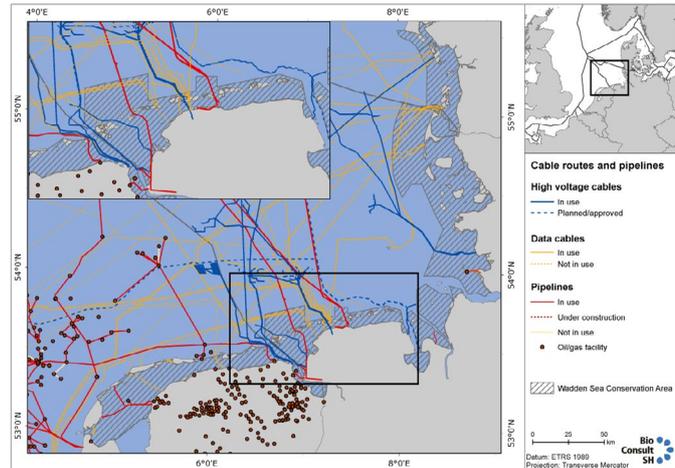
veys from individual countries. If combined in a trilateral survey, this information could lead to extended knowledge of the subtidal Wadden Sea. The effort and methodology of mapping the subtidal zone were differently pronounced in Denmark, Germany, and the Netherlands. Generally, the activities show an increase in quality and quantity over the last six years. 

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Thematic Report **Subtidal
habitats** online





The vibration cable plough is a laying tool utilized for tidal flats
© Bohlen & Doyen



Cable and pipeline routes which traverse the Wadden Sea © Bundesamt für Seeschifffahrt und Hydrographie, EMODnet Human Activities and Cogea srl (falco@cogea.it, apititto@cogea.it, Rijkswaterstaat Noordzee and TNO (www.nlog.nl), Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein, 2021

ENERGY

Energy production in Europe is based on fossil, nuclear, and renewable energy. The burning of fossil fuels releases large amounts of greenhouse gases and is mainly responsible for global warming, which is a major threat to the environment. This is particularly true for the sensitive Wadden Sea area, which will suffer especially from sea level rise. Fossil and renewable energy production take place in proximity to or within the Wadden Sea. The development of offshore wind energy in the Netherlands, Germany, and Denmark has been rapid in the last decades and will even speed up in this decade and this expansion of offshore wind energy utilization can lead to impacts on habitats and species. Up to now, more than

2,000 wind turbines have been built offshore in the North Sea within the territorial waters and the EEZs of the three countries. Although the Wadden Sea conservation area is exempt from wind farm development, the grid connections and interconnectors traverse the Wadden Sea, thus affecting the area directly. Although the expansion of regenerative energy is necessary to combat climate change, all kinds of energy production can also have effects on the environment. Impacts are construction-related, operational, or plant-specific. All forms of energy production cause an increase in ship and aerial traffic due to the construction and maintenance of facilities with scary effects for birds and marine mammals and an increased risk of

Christoph, S., Büttger, H., Bauer, M., Baer, J., Nehls, G.
qsr.waddensea-worldheritage.org/reports/energy

accidents. There are numerous international and national guidelines for the promotion, regulation, and spatial planning of renewable energy (construction and grid connections) and for the exploitation of oil and gas in force, both in the adjacent areas and within the territorial waters. The thematic report on energy gives an overview of the most important policies and regulations regarding the Wadden Sea. 

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Typical beach scenery in the Wadden Sea Area © Andreas Falk

	Netherlands	Germany		Denmark
		Lower Saxony	Schleswig-Holstein	
Population	1,386,623	928,703 ^[3]	300,398 ^[4]	206,298
Area (km²)	6,230	6,742 ^[5]	3,511 ^[5]	3,377
Visitor arrivals (million)	Approx. 3 ^[6]	3.3 ^[3]	2.1 ^[7]	
Overnight stays (million nights)	11.3 ^[8]	15.3 ^[3]	11.9 ^[7]	7.9 ^[9]
Average length of stay (nights)	4-5 ^[10]	7.4 (8.4 days) ^[3]	4.8 (5.4 days) ^[11]	8-9 ^[12]
Tourism intensity (overnight stays/1,000 inhabitants)	8,149 ^[13]	16,461 ^[13]	39,559 ^[13]	38,294 ^[14]
Foreign visitors in %	Mainland and Ameland: 14-19.5% Other islands: 5% ^[15]	2.0 ^[3]	2.2 ^[16]	71.6% ^[17]
Day visits (million)		2.0 ^[2]		3.5 (estimated) ^[18]
Bed capacity	151,115	112,871 ^[1]	88,982 ^[5]	25,002 ^[17]
Bed capacity utilization	30-70% ^[20]	38.2% ^[3]	37.5% ^[13]	21% ^[21]
Daily spending (commercial operations) in EUR	Overnight tourists: 55-70 Day visitors: 50-70	Overnight tourists: 84.10 ^[2] Day visitors: 29.40 ^[2]	7300 ^[1]	Overnight tourists: 124 ^[22] Day visitors: 60
Tourism revenue – overnight tourists (million EUR)	500-510 ^[23]	1,557 ^[2]	1,311 ^[24]	982 ^[25]
Tourism revenue – day visitors (million EUR)	1,600-1,700 ^[26]	58.5 ^[2]	357.2 ^[24]	205 ^[27]
Total tourism revenue (million EUR)	2,100-2,210 ^[28]	1,615 ^[2]	1,699 ^[24]	1,187 ^[29]
Tourism employment	42,610 ^[30]	Income equivalent 38,367 ^[2]	Income equivalent 35,800 ^[24]	10,866 ^[31]
Repeat visit	Island: 75-85% ^[32]			56% ^[33]
Visitor satisfaction	Dutch islands: score of 8.6-8.7 on a scale of 1-10.			87% satisfied and very satisfied ^[34]

An overview of the current status of tourism in the Wadden Sea World Heritage based on the latest available numbers for 2019/2020

TOURISM

Throughout the region, tourism is a well-developed economic sector and thus a major pillar for socio-economic development, liveability, and well-being, particularly on many of the Wadden Sea's islands. Revenues are created to contribute to economic stability as well as a positive attitude towards nature conservation, given that outstanding and intact nature is understood to be the region's main competitive factor. Balancing the positive and negative impacts of tourism, with the aim of maximising the former, and minimising the latter, is a key task for tourism managers. Tourism rep-

resents a major economic force in the entire Wadden Sea region, accounting for total revenues of EUR 6.7 billion in the Netherlands, Germany, and Denmark combined. This economic significance must be taken into consideration when critically assessing tourism's role and potential impacts on the Wadden Sea's Outstanding Universal Value. Tourism numbers that exceed the local carrying capacity sometimes referred to as overtourism, pose a risk to ecologically sensitive environments. One of the main challenges lies in the collection and communication of up-to-date, consistent, and comparable data across the

three countries of the trilateral Wadden Sea region. Currently, statistics for the three countries are often not comparable due to the different methodologies, regional bases, base years, and differences in the availability of data.

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