Local Birds in and around the Offshore Wind Park Egmond aan Zee (OWEZ) (T1)

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Cover Photo: Great Cormorant in the wind farm OWEZ (Hans Verdaat, IMARES).

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Contents

Summary

This report gives a first summary of results of seabird counts conducted in and around the OWEZ wind farm, after this offshore wind farm became operational in the Dutch sector of the North Sea. Six separate surveys were carried out, along ten pre-determined transect lines running from E-W through a survey area of about 20x20 nm, with the wind farm situated centrally. The rationale for this survey set-up is given and demonstrated by conducting an alternative "quick and dirty" be it defendable smaller set-up (January 2008 survey). Such smaller survey set-ups may yield highly deceptive results, due to underlying larger-scale distribution patterns that cannot be appreciated from small-scale survey designs.

OWEZ appears to be situated in an area that is neither inshore nor fully offshore and this transition zone has low natural (T-zero) seabird densities. In that sense, OWEZ appears to have been situated optimally: low local bird densities mean that only few birds, if any, can be disturbed or displaced by the wind farm in operation.

Some avoidance was found however, but also one species (the Great Cormorant) was clearly attracted to the wind farm and most gulls seem indifferent. Most remarkably, some birds, of species considered to be highly wary of wind farms (Guillemots and particularly divers) have already been spotted (feeding) amidst the turbines; a likely sign of habituation.

Assignment

This study has been commissioned by Noordzeewind. Noordzeewind operates the first offshore wind farm in Dutch North Sea waters. This 'T-1' study is a follow up of the 'T-0' study, commissioned by the Dutch government and aims at determining reactions of local (sea)birds to the wind farm, during its operational phase.

Quality Assurance

IMARES utilises an ISO 9001:2000 certified quality management system (certificate number: 08602-2004-AQ-ROT-RvA). This certificate is valid until 15 December 2009. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. The last certification inspection was held the 16-22 of May 2007. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2000 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2009 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation, with the last inspection being held on the 12th of June 2007.

Introduction

The Dutch consortium "NoordzeeWind" operates the first offshore wind farm in Dutch North Sea waters. The park, consisting of 36 turbines on monopiles, is located NW of IJmuiden harbour, some 8 NM off the Dutch mainland coast. Named after the nearest town ashore, the park will be known as "Offshore Wind farm Egmond aan Zee" (OWEZ; Figure 1).

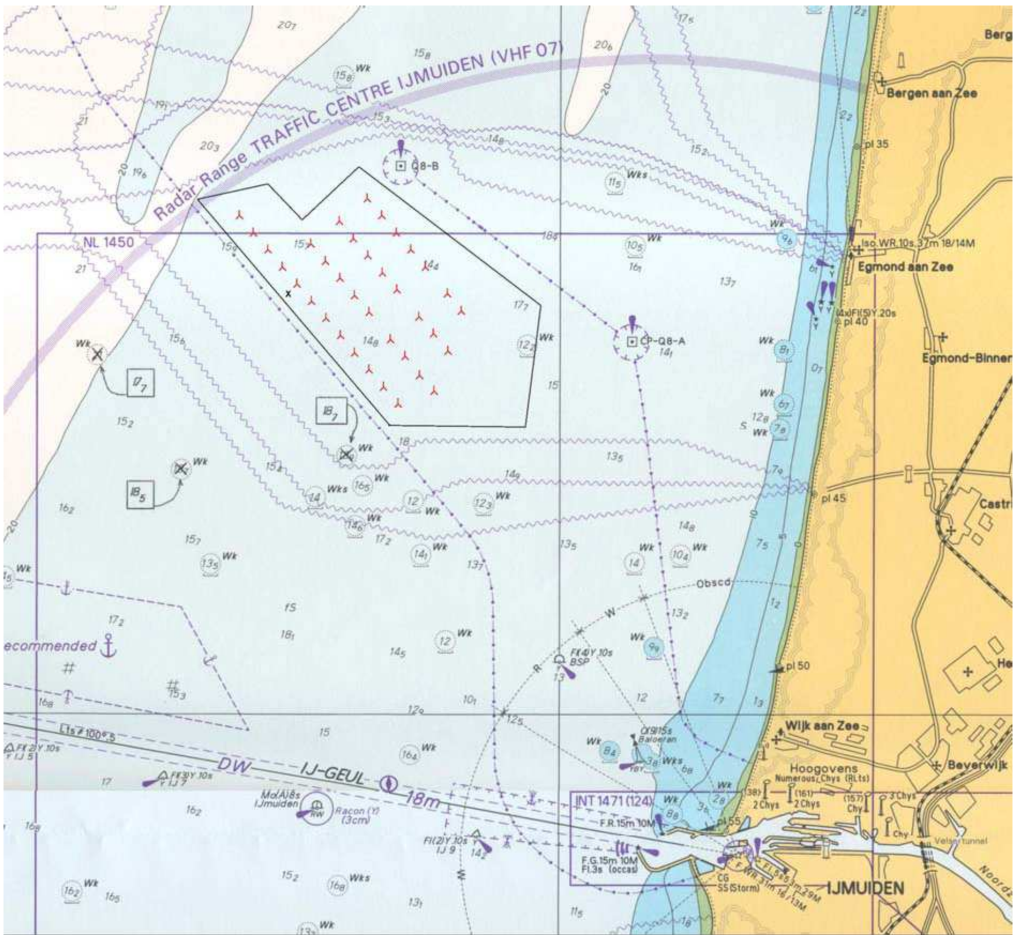


Figure 1. Location of OWEZ (polygon off Egmond aan Zee) with the 36 turbines (NoordzeeWind).

The OWEZ site has 36 turbines (at 70 m asl), each equipped with three rotor blades (reaching up to 115 asl, NoordzeeWind 2003). Electricity cables trenched into the sea floor connect the turbines to each other and the wind farm to the mainland. Operations also involve frequent servicing, using small, fast personnel ships and large maintenance ships, barges and cranes; aerial supervision by the Dutch coastguard (by low-flying planes and helicopters) and, during the first years of operations, scientific research visits (by various ships). Both the moving turbines and the aircraft and ships connected to the wind farm may impact local seabirds. These impacts may range from attraction to deterrence from the site and, in a worst case scenario (collisions), to the death of some individuals.

An offshore wind farm is a foreign body at sea, impacting its openness, adding structure both under water and above the water's surface. Shipping, most importantly fisheries, is no longer permitted within the safety perimeter of the wind farm and this may also enhance fish densities; on the other hand, fisheries discards (undersized fish, entrails of fish and unwanted fish and other so-called by-catch is no longer produced in the park and seabirds feeding on discards must go elsewhere to obtain this food) Under water, the monopiles that are embedded in rocks may attract fish that in turn may attract fish predators. The turbines, situated high above sea level, produce sound from mechanical friction that is transported downward and into the water through the monopiles. This may impact (scare off) both fish and fish predators, e.g. seabirds that dive under water to pursue fish.

Seabirds spend most of their time above the water's surface, and many species are wary to some extent to large moving objects such as ships or low flying aircraft. Some of the more vulnerable species may thus be expected to be wary of moving wind turbines as well, in an environment that has long been free of tall man-made or natural structures, i.e. the open sea. Migrant birds, including seabirds tend to avoid a wind farm that lies in their path (Kahlert et al. 2004a,b) but local seabirds may show several different reactions. Preliminary studies around the Danish North Sea wind farm Horns Rev have indicated that some birds (divers, auks, gannet) tended to keep well clear of the operational wind farm (avoidance found to at least 4 km from the wind farm), while others (gulls, terns) might have been attracted (Elsam Engineering & Energi, 2005; Elsam Engineering, 2005). Seaduck initially avoided the wind farm but might have adapted and recent observations found increasing numbers of Common Scoters within the wind farm (Petersen & Fox 2007). These authors found no such habituation in divers, still considered the birds that are most prone to disturbance from wind farms.

The OWEZ wind park is the first to be operated within Dutch North Sea waters. Although the site is situated well away from known seabird hotspots and other site of special ecological interest (Skov et al. 1995, 2007) the general area may still hold important numbers of seabirds at certain times of year. The site may be within reach of birds breeding on the Dutch shores (including protected species and nature reserves); may be within the coastal migration route of other (protected) seabirds and may provide an important habitat to birds migrating offshore and wintering offshore ('offshore' meaning here: outside the most turbid, nearshore waters, generally outside the -20m isobath). The Dutch government, NoordzeeWind and other parties developing plans for more offshore wind farms in Dutch waters were thus keen to learn more about possible effects of this first wind farm on the local seabirds and this study addresses this problem during the post-construction, or operational phase of OWEZ.

Study Methods

This 'T-1' study builds on the so-called T-zero study (Leopold et al. 2004) and follows the same methods as much as possible. Seabird distributions are known to be patchy, and highly variable in time. Studying possible effects of a wind farm needs to take these sources of variation into account. Seabird distribution and abundance (of all species present) was first assessed before the construction of OWEZ, during 8 surveys in the course of the year, covering all major seabirds 'seasons': breeding, chick phase, dispersal of first year birds, migration, wintering. These data can now be compared to the situation in which OWEZ is operational, the T-1 phase. Given that seabirds' distribution and abundance are also variable between years, an increase or decrease of local seabird numbers is no proof of impact of a wind farm. To show an impact, if present, reference areas need to be studied as well, where the wind farm does not impact local seabirds. The traditional approach in such studies is the 'BACI' approach: Before-and-After-Control-Impact, that usually compares one impact area (OWEZ in this case) with several reference areas that are all followed for some time (Underwood 1994; Paine 1996; Drewitt & Langston 2006). There is a risk, however, of aberrant reference areas that behave, for some reason, different from the impact area. For that reason, many reference areas are required, the number of which is dependent on the expected heterogeneity of the data. This is usually not fully understood before the study needs to start and selecting reference areas that are likely to be(have) in a similar manner as the impact zone is *a priory* difficult. Therefore, a slightly different approach was followed (Leopold et al. 2004).

A comparatively large area, of about 885 km², with OWEZ more or less at its centre was selected for study. Within this area, ten survey lines were drawn that were to be surveyed during each subsequent seabirds survey (A-J from north to south, equidistant). Post-hoc stratification into several blocks (impact and reference blocks) would also be possible, for instance as indicated in Figure 2. Such a stratification into blocks would not break up the large-scale patterns that might exist in the general area, and that might be important to understanding seabird distribution in the T-1 phase.

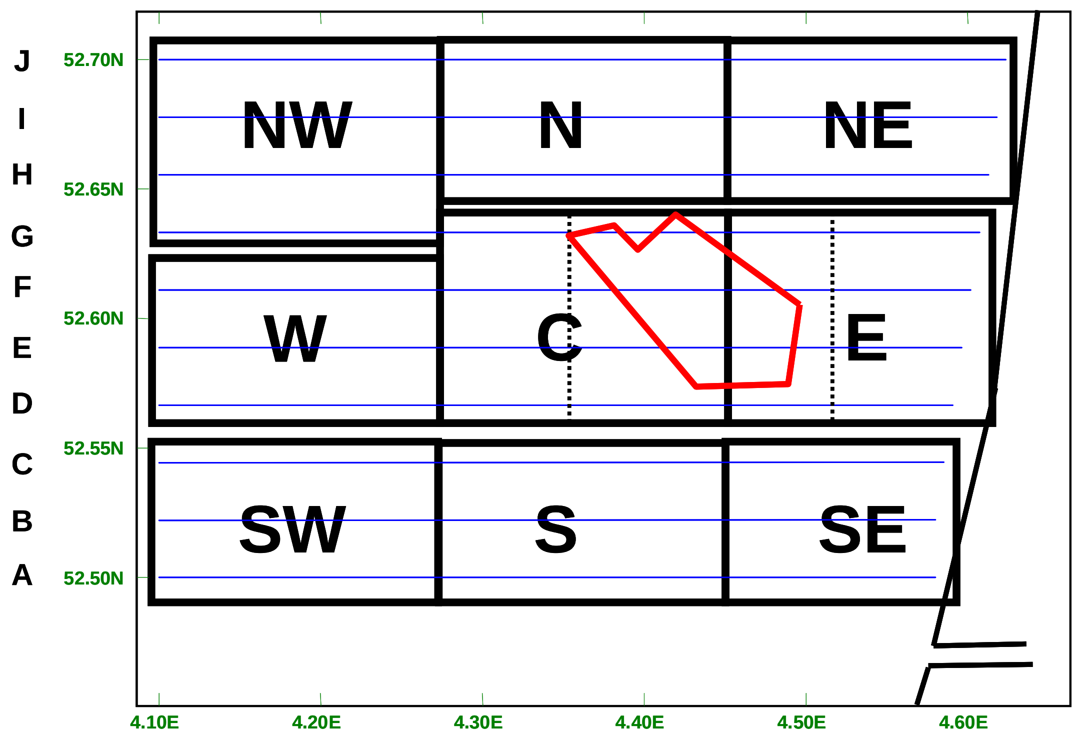
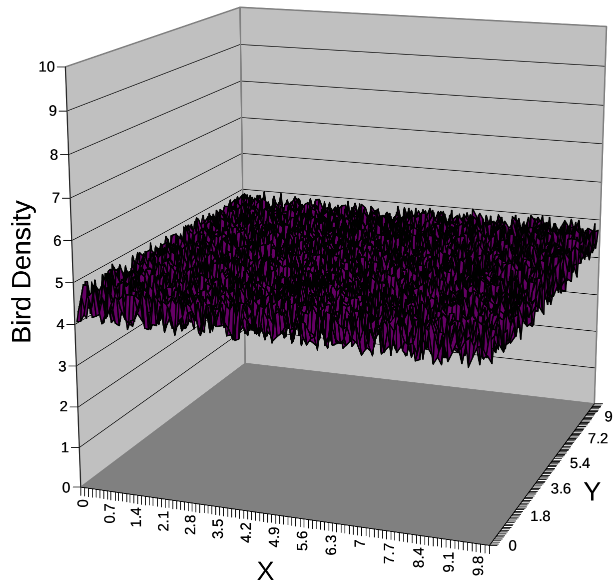


Figure 2. The situation of OWEZ (red polygon) within the survey area. The ten principal survey lines are drawn in blue and run from E to W. A tentative subdivision of survey blocks (NW to SE) is indicated, but any subdivision is later possible: an equal effort over the entire area facilitates many different schemes.

Another possibility for analysis is, to look for anomalies in the data during the T-1 phase, corrected for any persistent geographical anomalies during the T-0 phase (correction for the point of departure). Figure 3a.b sketches this possibility for analysis for an ideal situation, in which there is no structural variation in the data, other than variation around the mean (white noise).



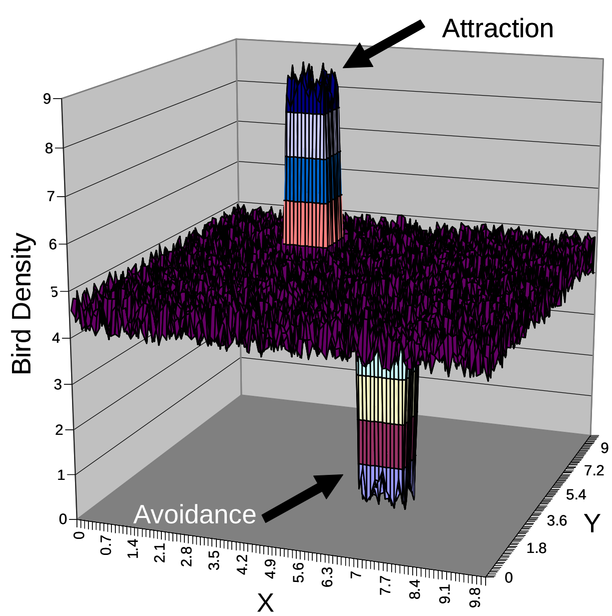


Figure 3A (Top panel). Hypothetical seabird density in an area (X,Y). Densities vary between 4 and 5, without a spatial trend.

Figure 3B (Bottom panel). Same pattern as in Figure 3A, but with a local concentration of birds and an area where very few birds are found: and area that is apparently avoided.

During the T-0 surveys, repeatedly a pattern was found that deviated from a random or a regular distribution. Some bird species, e.g. divers, grebes, clearly concentrated in nearshore waters, and hardly reached OWEZ. Some other birds, like Northern Fulmars clearly preferred offshore waters. Some birds, however, including gulls, razorbills and guillemots preferred both the offshore and the inshore thirds of the study area, but tended to avoid the central part. This left a central streak of the survey area, running more or less from NNE to SSW with low densities of seabirds, during most surveys. This is highly significant to the T-1 situation because such a distribution pattern found in isolation during T-1, would strongly suggest an analomy (avoidance) caused by the wind farm that is situated centrally within the study area.

Results: completed surveys

During the first full year of T-1 seabirds studies, six surveys have been completed (Table 2). The principal survey vessel was the Vos Baltic, hired from Vroom Offshore Services in Den Helder. Company and ship are the successors of the company (Seaworx) and ship (Orca) used during most of the T-zero surveys. When the Vos Baltic was unavailable, another ship was hired that met the safety requirements of NoordzeeWind and was fit for survey work; replacement ships were hired from Drijver Vis BV in Oosterend, Texel. The principal observers (Mardik Leopold and Kees Camphuysen were the same as during the T-zero survey).

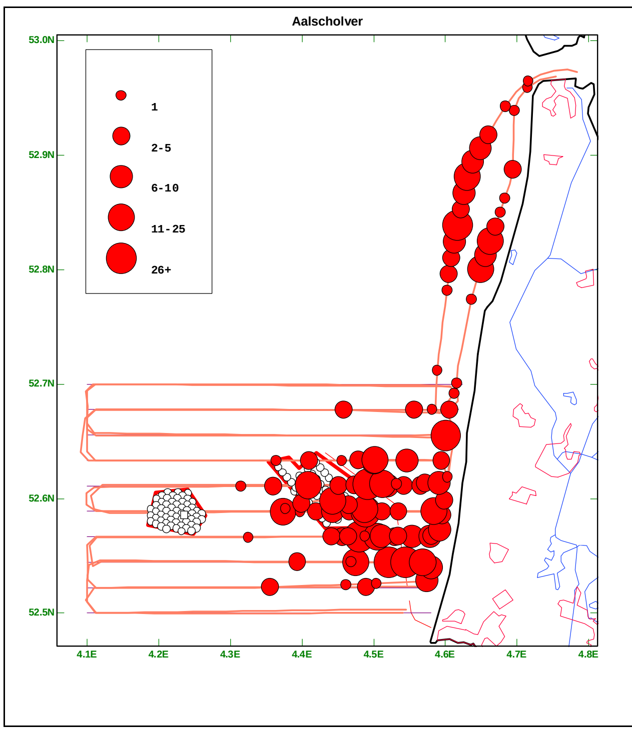
Survey	**from**	**to**	**Survey vessel**
April 2007	9/04	12/04	Vos Baltic
June 2007	27/06	29/06	Vos Baltic
August 2007	19/08	22/08	SC41 (Osterems)
September 2007	24/09	27/09	SC41 (Osterems)
November 2007	5/11	6/11	Vos Baltic
November 2007	20/11	24/11	Vos Baltic
January 2008	14/01	18/01	TX33 (Maarten Cornelis)

Most surveys were hampered by bad weather, particular high winds that prevented even the summer survey in June to be completed as planned. The aim was to survey all ten transect lines within the study area twice, keeping watch on both sides of the ship (port and starboard). However, high winds prevented this on many days, and cut some surveys short. This inevitably resulted in some data loss, but the minimum requirement, that during each survey, each transect line was covered at least once, was met in every survey.

The April survey

The first survey of the series was carried out during good weather (3-4 Beaufort winds) and all transect lines were surveyed in full, twice. Most remarkable results were the distribution and numbers of Great Cormorants and Lesser Black-backed Gulls and feeding behaviour of several seabirds, such as Common Gulls.

Cormorants (Figure 4) used the park for resting and feeding. We observed constant trafficking between OWEZ (but not to the next park, Q7, under construction) and two mainland colonies, Zwanenwater (Petten) and Hoefijzermeer (Castricum). Resting was mostly done on the metmast to the west of OWEZ, but also on the base of several turbines. Such an offshore presence of Cormorants has never been observed in Dutch waters before the onset of OWEZ construction (the metmast was the first structure to be erected and this quickly attracted the first Cormorants (Leopold et al 2004); this situation clearly developed further: a case of obvious attraction.



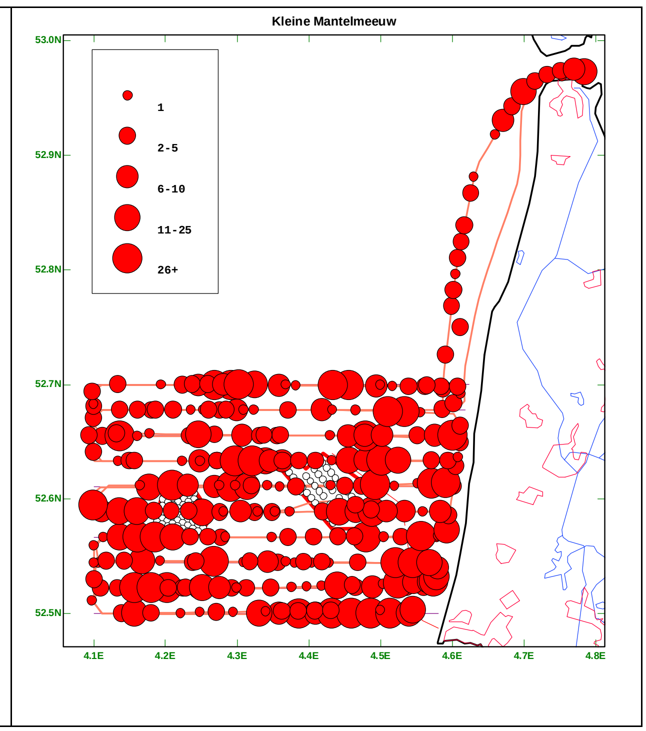


Figure 4. Great Cormorant, April 2007 survey.

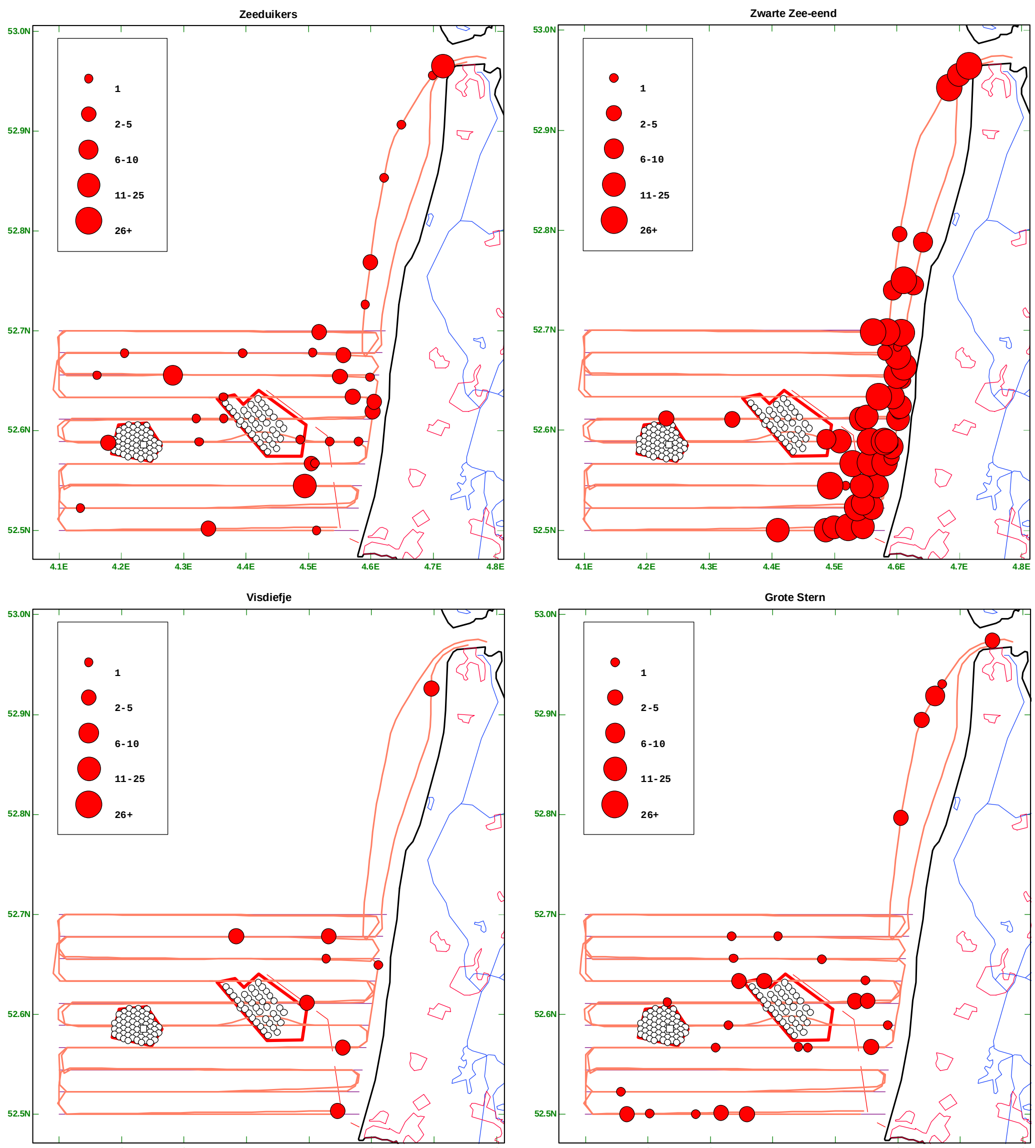
Figure 5. Lesser- Black-backed Gulls, April 2007 survey.

Lesser Black-backed Gulls were found all over the study area, but slowed a marked avoidance of the central (NNE-SSW) part of the study area (as indicated above). The presence of a foreign object at sea did add a little to this remarkable pattern, given the apparent partial avoidance of both OWEZ and Q7, but Lesser Black-backed gulls did enter either park during this survey (Figure 5).

Many gulls were seen to feed on 5-10 cm long reddish objects. Upon closer inspection, these turned out to be swarming worms (*Nereis succinea*), a polychaete that spends most of its time in the sediment, at the seafloor. In order to reproduce, these worms perform mass swimming that probably makes them very attractive to the opposite sex, but also very vulnerable to seabirds fly overhead. Common Gulls were the most cunning worm-eaters, snatching one after the other from the water's surface (Figure 6).

Figure 6. Common Gull snatching a bright red *Nereis succinea* from the water's surface. Photo: Hans Verdaat, Wageningen IMARES.

Seabird species, considered prone to turbine disturbance were all comparatively rare during the survey. Most divers had already left the area (as opposed to the situation during the last T-0 April survey) and none of those still migrating along the Dutch coast crossed the wind farm. Common Scoters migrated north over nearshore waters, well inshore of OWEZ. Sandwich and Common Terns migrated further offshore, but like the divers, avoided the OWEZ turbines (Figures 7-10).



Figures 7-10. Red-throated and Black-throated Divers (combined, top left panel), Common Scoters (top right), Common Terns (lower left) and Sandwich Terns (lower right), April 2007 survey.

The June survey

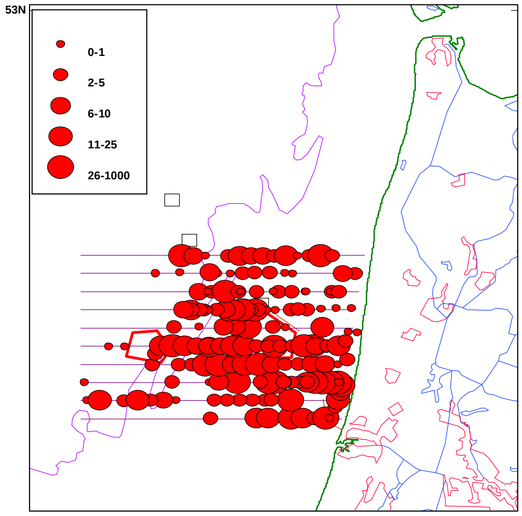
Weather conditions were unexpectedly harsh for mid-summer (winds up to 9 Bft and a lot of rain) and the start of the survey had to be postponed to Wednesday morning (rather than Monday morning). Long summer daylight hours made it possible to complete the survey in the remaining three days of the week, still during poor weather conditions mostly. The Friday had increasing rain and wind again, developing into continuous rain, high winds (SW 8 Bft) and increasing swell. Further surveying was considered unsafe and altogether pointless, but survey coverage was by that time considered adequate. However, seabird distribution and particularly behaviour at sea was probably quite different from a 'normal' summer situation (such as witnessed during the T-0 surveys). This risk of running into aberrant weather, or at least into very different weather than experienced during the T-0 surveys, is one of the reasons for conducting T-1 surveys during two successive years.

The birds breeding relatively close to OWEZ, Great Cormorants and Lesser-Black-backed Gulls, did not seem deterred by the weather (Figures 11-12). In fact, the Cormorants ventured further offshore than in April, reaching Q7 in appreciable numbers, just crossing the -20 m isobath. Lesser Black-backed Gulls were abundantly present throughout the entire study area, without a gap in the central part (this may be wind-related).

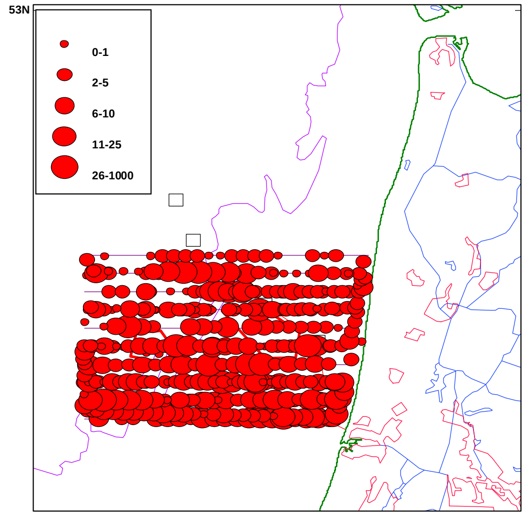
Divers had now left the area (no map); terns were not very abundant anymore with Common Terns staying mostly nearshore (Figure 13) and Sandwich Terns occurring scattered throughout the study area (but always outside OWEZ and Q7; Figure 14). Common Scoters (Figure 15) were not seen on the water in any numbers but were mostly seen flying in small groups low over the water, into westerly directions. These migrating seaduck, in all likelihood on their way to moulting sites in the UK or Ireland, were never seen to pass through either OWEZ or Q7 but stayed well clear of the wind farms.

Figures 11-15 (overleaf, from top-left to lower right): Great Cormorants, Lesser Black-backed Gulls, Common and Sandwich Terns and Common Scoters, June 2007 survey.

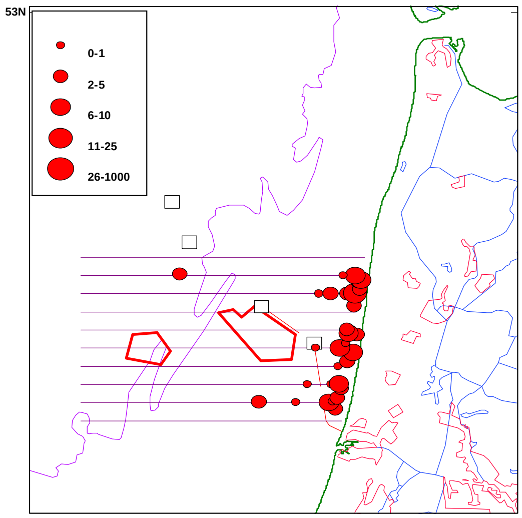
Aalscholver



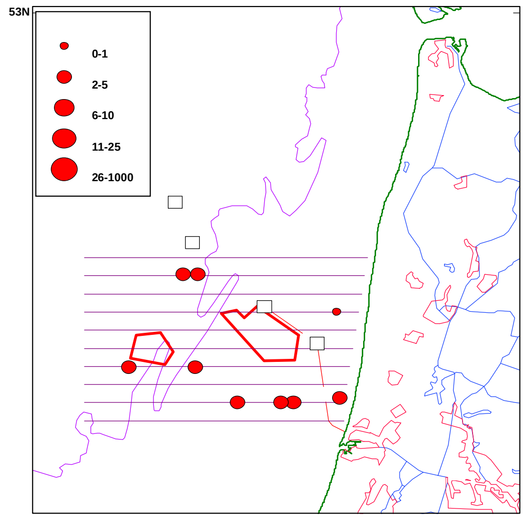
Kleine Mantelmeeuw



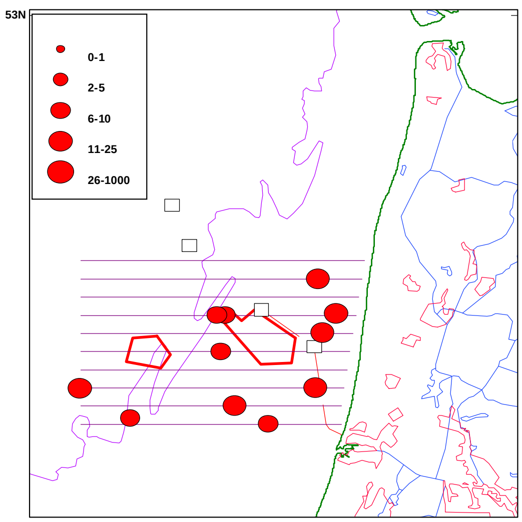
Visdiefje



Grote Stern



Zwarte Zee-eend



The August survey

The survey in August had excellent (0 Bft) to poor weather conditions (5-6 Bft) that allowed a full coverage of the study area. Maintenance crews also took advantage of the weather and a large maintenance ship, as well as several smaller crew tenders were operating in the area.

This may have increased levels of disturbance of OWEZ, but at this time of year, the dominant birds were Cormorants and gulls, that are not known to be very sensitive to disturbance. The Q7 wind farm (under construction) had an even higher number of working vessels: up to eight ships working here at the same time.

Figure 16. The large maintenance vessel 'Sovereign' in OWEZ (Photo Dick de Haan, Wageningen IMARES). Inset: one of the smaller crew tenders at one of the OWEZ turbines (Photo Rutgert Oosterhuis, Het Sop).

Fisheries activities were also prominently present, particularly in the zone between OWEZ and the mainland coast. Here, we observed many flags of bottom-set gill nets, operated by small fishing vessels. Two or three of these were Danish and shot many kilometers of netting at any one time (Figure 17).

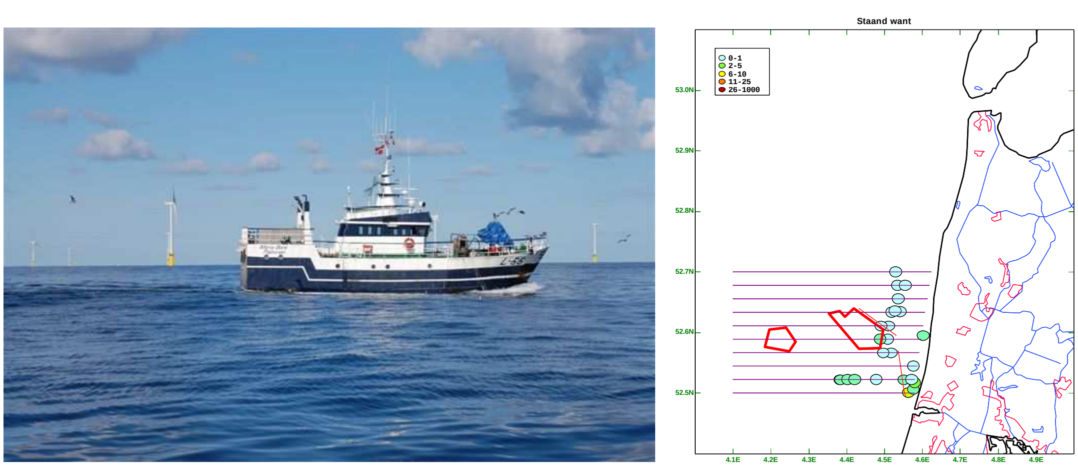
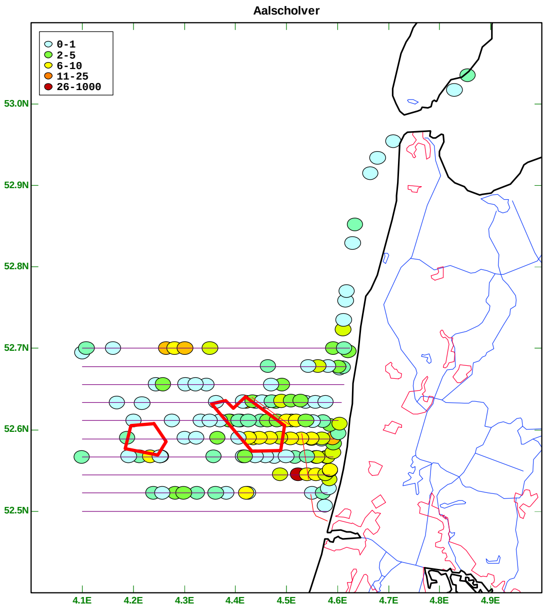
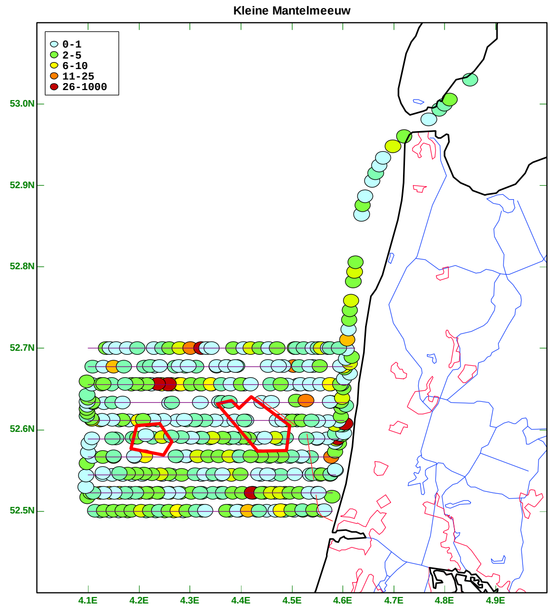
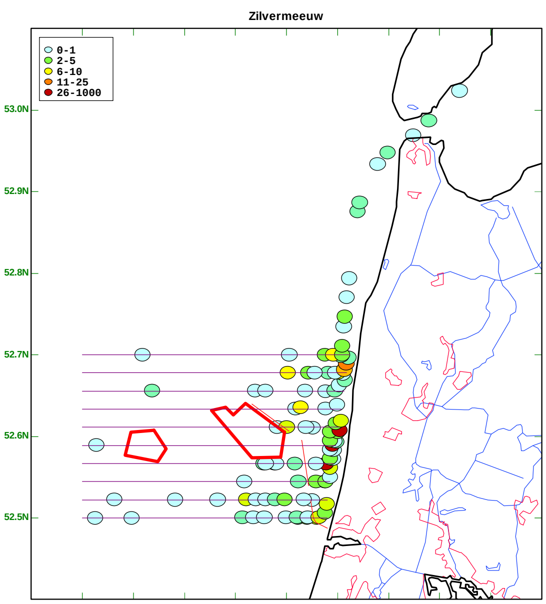


Figure 17. A Danish bottom-set net vessel to the east of OWEZ (left; photo Rutgert Oosterhuis, Het Sop). Right: distribution of set nets (flags) during the August survey.



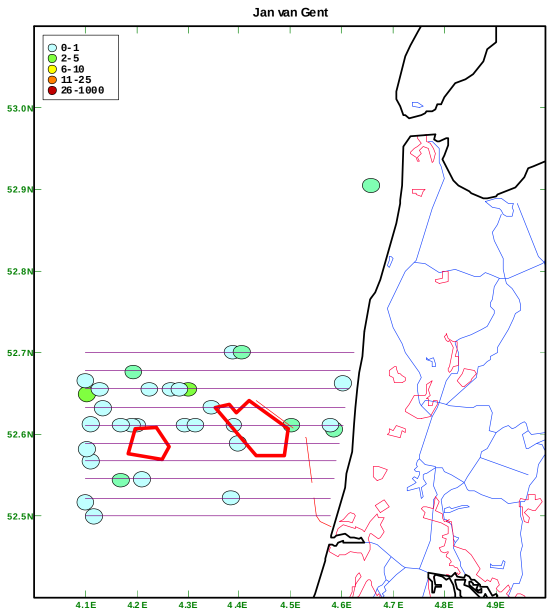




Figures 18-20: Great Cormorants, Lesser Black-backed Gulls, and Herring Gulls, August 2007 survey.

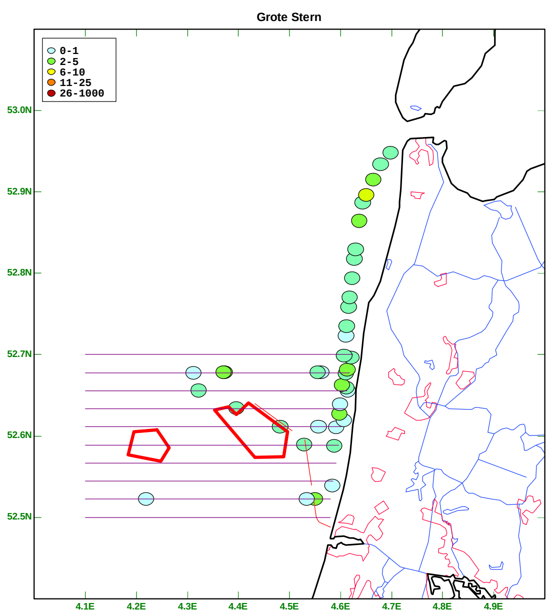
Great Cormorants now reached their maximum range in the study area and were seen at the very end of two transect lines (Figure 18). At this western extreme of the study area, some Cormorants were even seen flying further west. In the northwest corner of the study area, a group of cormorants came flying to the survey vessel (a rented fishing vessel) from poles in Q7, to start foraging in the wake of our ship. These birds probably mistook the survey vessel for a genuine fishing vessel, expecting to find bycatch in the wake. This observation illustrates how the Cormorants make use of the vantage points in the wind farms, to exploit a wider area of sea around these resting places. Note also (Figure 18) how Cormorants were seen at the periphery of Q7 only. Here, the birds were resting on the outermost poles and avoided the activity of the fleet of working vessels in the park itself.

Lesser Black-backed Gulls were still very numerous and wide-spread (Figure 19) and freely entered OWEZ. Herring Gulls (Figure 20) are more or less tied to land in late summer, when they moult their flight feathers (Camphuysen & Leopold 1994). Although the gulls retain their capability of flight during moult, they seem reluctant to venture too far away from land and do not reach OWEZ in significant numbers.



Avoidance was seen in Gannets and terns. Gannets (Figure 21) and terns (Figures 22 and 23) all occurred both inshore and offshore from OWEZ (and Q7) but were not seen to fly through any of the parks. Rather, they would follow the outer rim of a wind farm, if turbines were in their line of flight.

Figure 21. Gannets during the August survey.



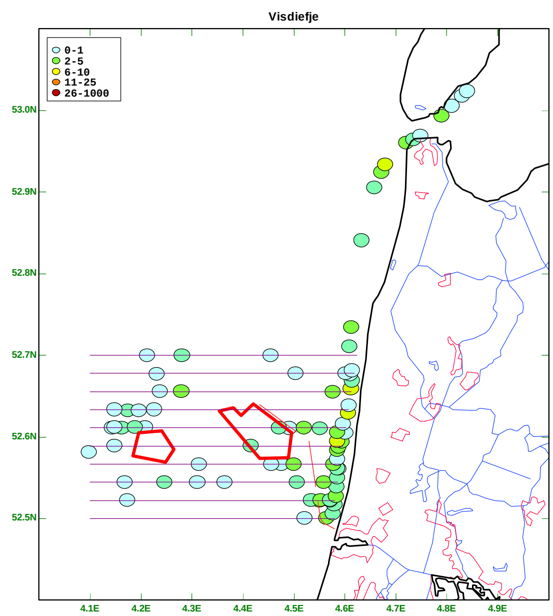


Figure 22 and 23: Sandwich Terns (left) and Common Terns during the August survey.

The September survey

Weather conditions once more were unexpectedly harsh. Most of the survey work had to be conducted in seastates 6-8 Beaufort. Under these conditions, it was not possible to survey along tracklines going into the wind as spray and often more than just spray crashed over the top of the survey vessel. Winds (and waves!) coming in from the side made that side unsurveyable too. Therefore, surveying was only possible while going more or less with the wind and only the leeward side of the vessel. This greatly reduced the area of sea that could be surveyed, as much time was lost getting back to upwind positions, before surveying could be resumed while only one side of the trackline could be surveyed when on effort. Still, all survey lines could be covered (once) and the whole study area was seen. Forecasts for the last day of the survey week (Friday) were winds increasing to 9 Bft so the survey was terminated late on Thursday as it was deemed unsafe to remain at sea, around wind farms. By that time, however, coverage of the survey area was considered adequate. Given the weather conditions, the nights were spent in port (IJmuiden).

Gulls, Cormorants, Gannets and auks (both Guillemots and Razorbills) were numerically dominant components of the avifauna during the September survey. Red-throated Divers had not yet arrived; some late terns were still present.

In a sense, it was good to be in the OWEZ area in stormy conditions. Bird behaviour might be different when it is windy, but few observers have been able to record this. Even radar observations of seabird movement over the sea have largely been restricted to calm weather conditions (Krijgsveld et al. 2008). We noted, for instance, several Gannets and Sandwich Terns flying through OWEZ, while earlier observations in calmer conditions (both in OWEZ and in the Horns Rev wind farm) had indicated that these birds tended to circumvent an offshore wind farm. Apparently, in high winds, these birds may feel more confident, or are more ignorant, than in calm conditions when most surveys are conducted.

Great Cormorants were also still present, and were concentrated around the two wind farms in the study area (Figure 24).

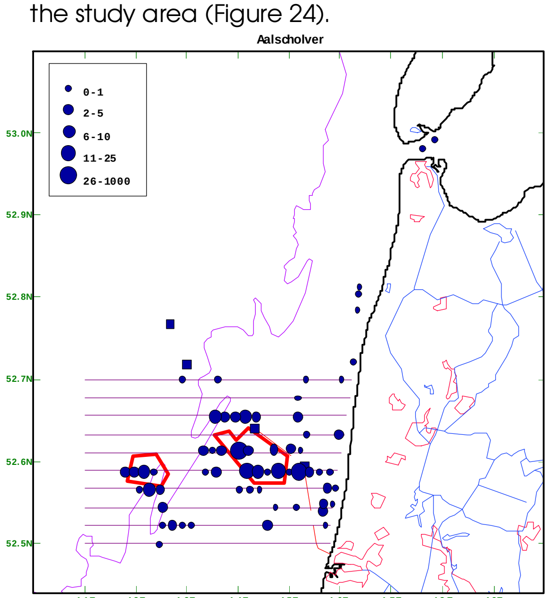


Figure 24. Cormorants during the August survey.

Gannets were common in the area, they only seemed to avoid the SE corver of the survey area. They tended to be more abundant offshore within the primary study area, but were also frequently seen nearshore, along the track going from Texel to the study area. This was the first OWEZ Local Birds survey that recorded Gannets flying through the wind farm (Figure 24). However, they were not seen to fly through Q7, where turbines (or rather, monopiles as this park was yet being built) are more densely packed.

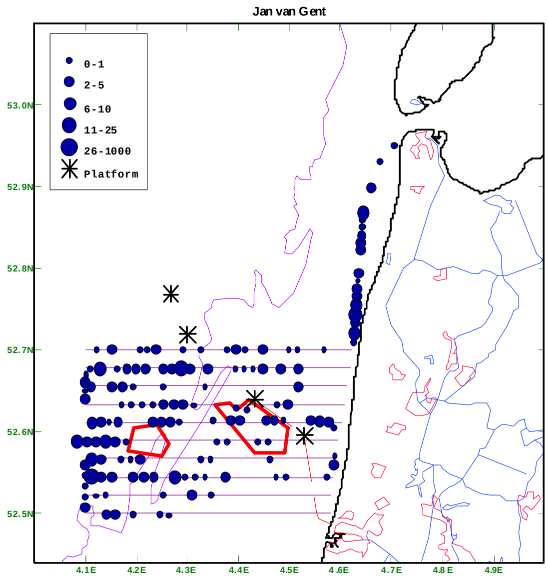
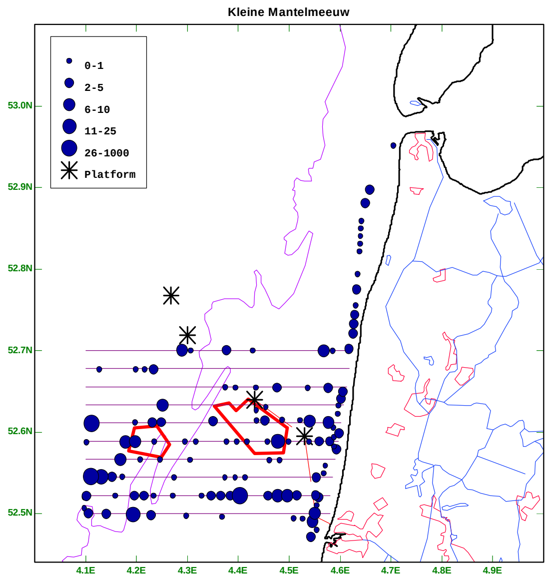


Figure 25. Gannets during the August survey.



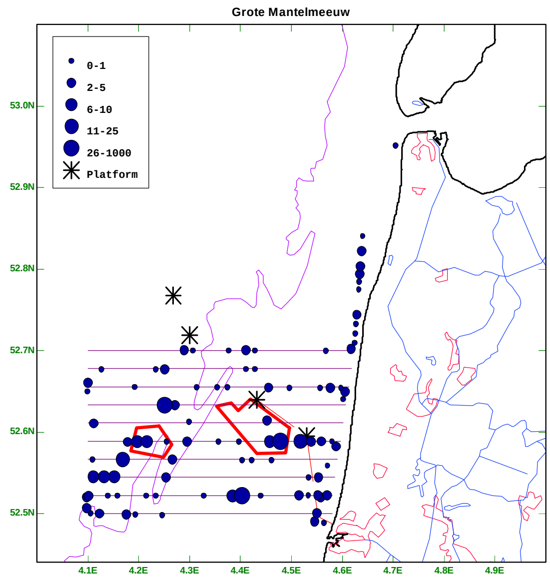


Figure 25 and 26. Lesser Black-backed Gulls (left) and Greater Black-backed Gull (right) during the September survey.

Lesser and Greater Black-backed Gulls overlapped in their distribution at this time of year. The Lesser Black-backed Gulls winter in southern Europe and northern Africa and were about to leave, while the Greater Black-backed Gulls were arriving in the study area from their northerly breeding sites, to winter in the SE North Sea. Both species occurred in the study area in a similar pattern, showing the "traditional gap" in the mid-section of the study area (Figures 26 and 27).

Razorbills and Little Gulls showed a similar distribution patterns (Figures 28 and 29). Little Gulls were often seen accompanying Razorbills, probably to feed on small prey driven to the surveys by the Razorbills. Such an association was not seen with Guillemots, a seemingly very similar species. Razorbills and Little Gulls occurred in a band that ran parallel to the coast and between the most nearshore waters (that were avoided) to the -20 m depth line. Further offshore, both species were rare.

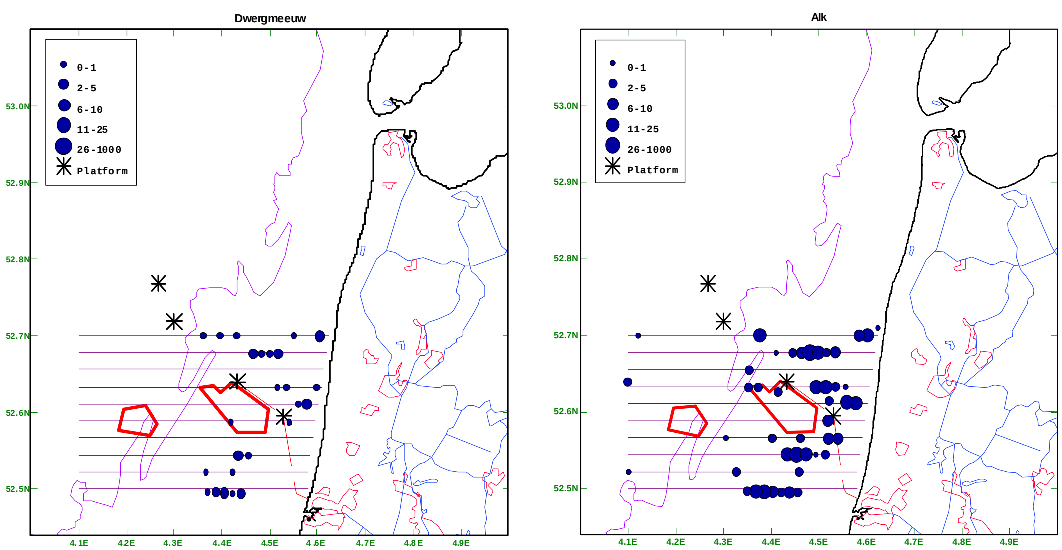


Figure 28 and 29: Little Gull (left) and Razorbill during the September survey. Note similar distributions patterns and an avoidance of OWEZ.

A different picture emerged for the Guillemot. These occurred far more widespread, throughout the study area. Only nearshore waters were avoided, like Razorbills did. Their offshore distribution component also held low densities of Kittiwakes (Figures 30 and 31), generally and offshore gull species (Camphuysen & Leopold 1994).

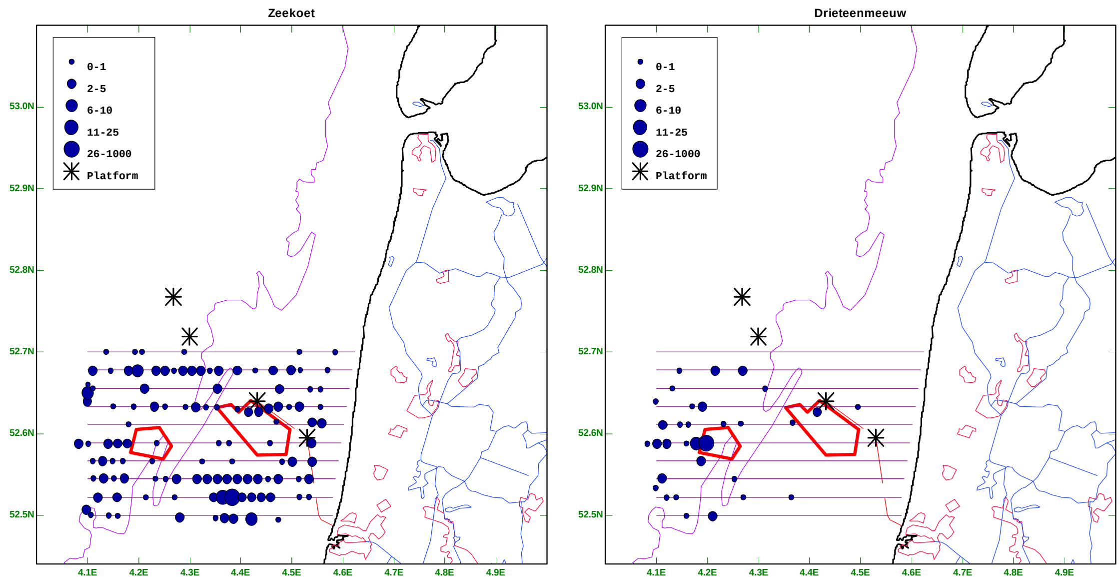


Figure 30 and 31: Guillemot (left) and Kittiwake during the September survey.

Guillemots appeared reluctant to enter OWEZ but some birds were seen close to the periphery of the wind farm and one group had actually swam a little way into the park (Figure 30).

Avoidance was seen in Common Scoters. The pattern in this species was similar to that found in August. Small parties were seen migration to the British Isles, steering clear of the two wind farms in the study area.

The November survey

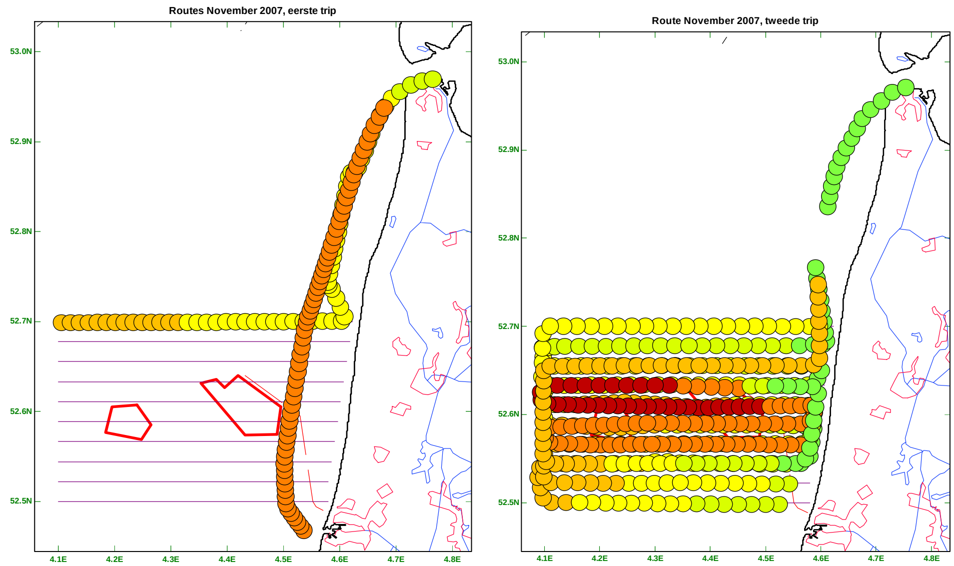


Figure 31. Survey effort during the first attempt to count seabirds in the study area *(left) and during the second (successful) attempt some days later. Depicted are seastate conditions, ranging from good (green) to bad (red).

The November survey started as planned, with weather forecasts of 6-7 Bft all week. In fact, we were blown off by a full-scale storm (9-10 Bft) on the second day of the survey and had to give up surveying that week. A second attempt was made some days later, with better results, despite highly variable conditions, ranging from 2 Bft (green in Figure 31) to 7 Bft (red). Full coverage was achieved, with some central lines receiving double coverage.

The data gathered during the first two days of the survey are ignored in the distribution maps below. Maps are presented for the second, full survey only, for divers, Gannets, gulls and auks. Cormorants and seaduck were both too rare to warrant mapping in this report.

A remarkable feature of this survey was the large numbers of Pomarine Skuas (Figure 34). These birds breed in the high Arctic and winter off West Africa, but usually migrate over the Atlantic, to the west of the British Isles. Only rarely get large numbers blown into the northern North Sea and continue south from there, passing over Dutch waters (e.g. Camphuijsen & van IJzendoorn 1988; Camphuysen 1999).

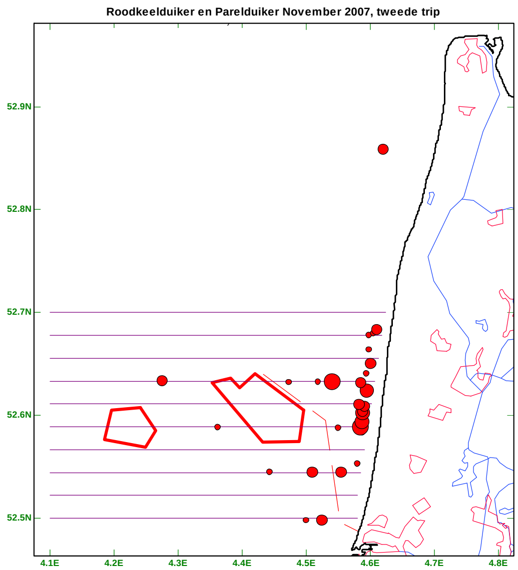


Figure 32 Red- and Black-throated Divers in November.

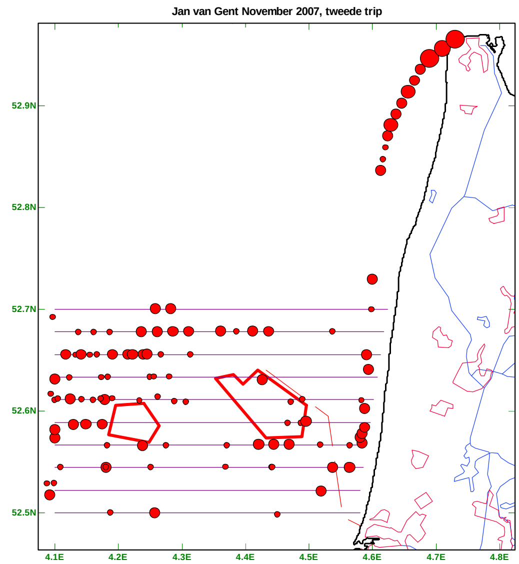


Figure 33. Gannet in November

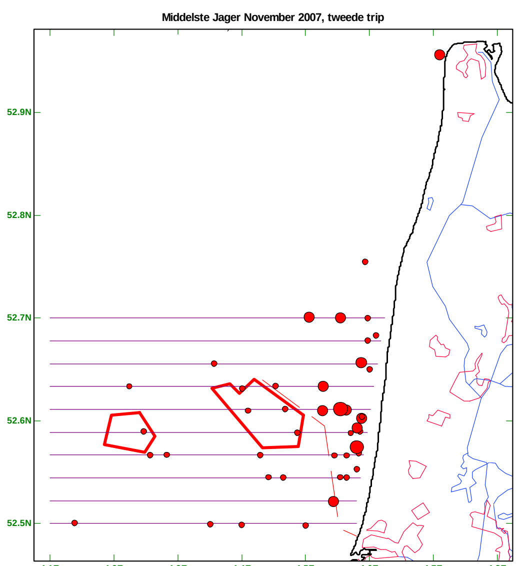


Figure 34. Pomarine Skua in November.

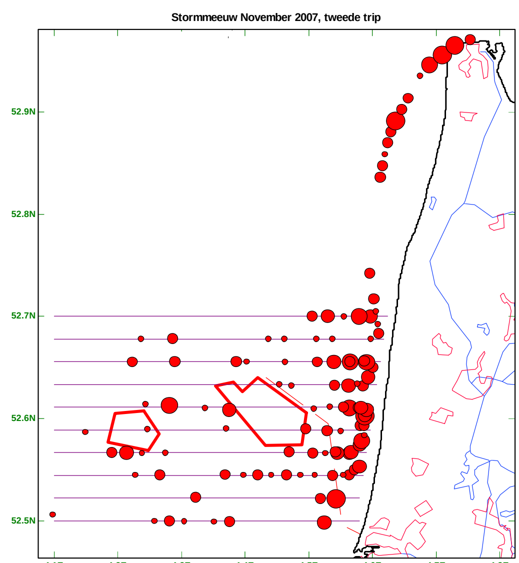


Figure 35. Common Gull in November

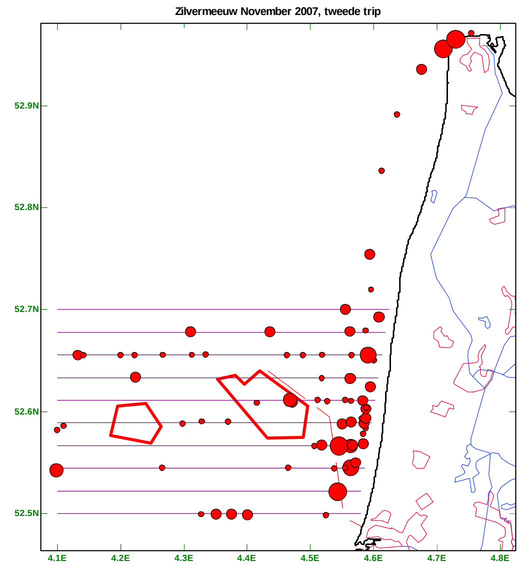


Figure 36. Herring Gull in November.

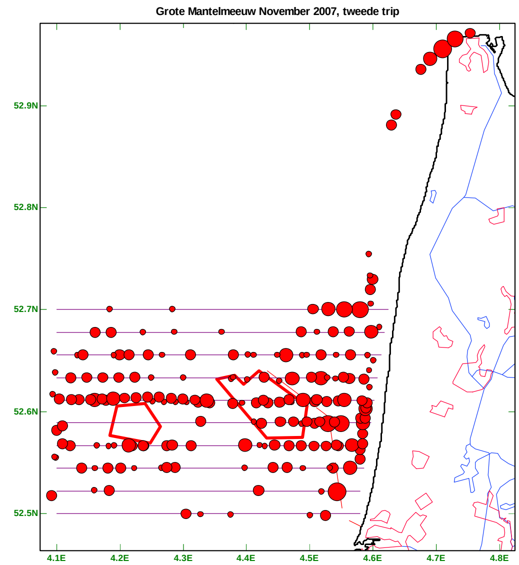


Figure 37. Greater Black-backed Gull in November

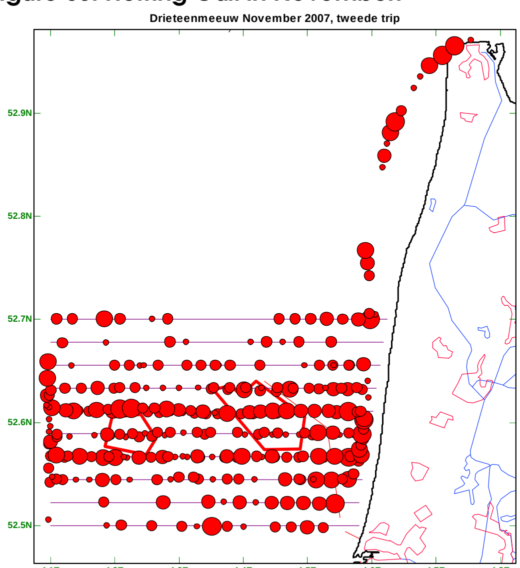


Figure 38. Kittiwake in November.

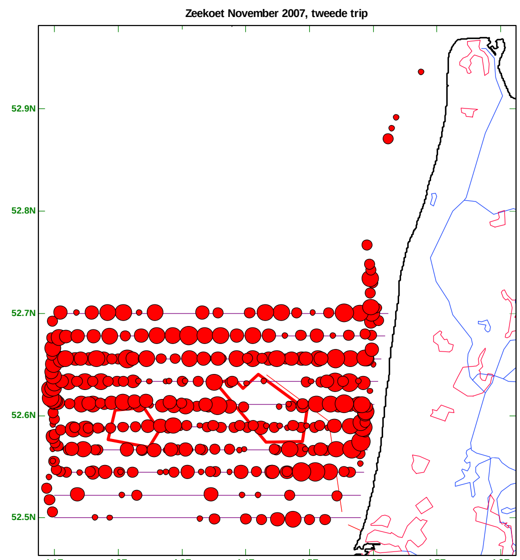


Figure 39. Guillemot in November

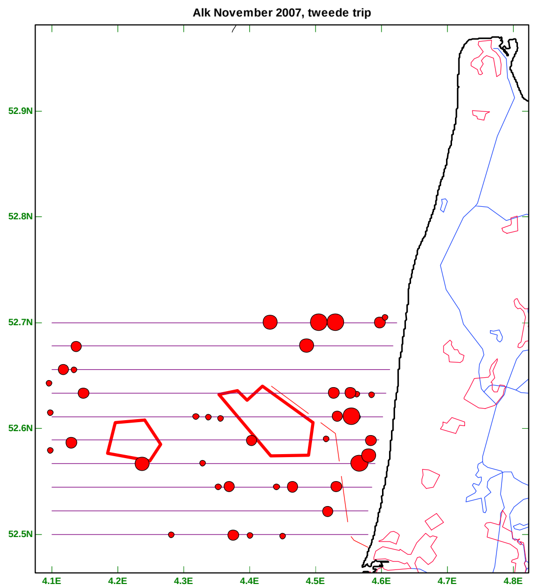


Figure 40. Razorbill in November.

Divers were returning to the study area. Most were found nearshore, some further offshore but no divers were seen inside the OWEZ contour (Figure 32.

Gannets and Greater Black-backed Gulls had distribution patterns that had dispersed concentrations both in nearshore and in offshore waters, with the known (from previous surveys, including T-zero surveys) low density area in the mid-section (Figures 33 and 37. Common Gulls (Figure 35) and Herring Gulls (Figure 36) mainly resided nearshore; Kittiwakes were found over the entire study area (Figure 38). Guillemots were also numerous and wide-spread but were more reluctant than the Kittiwakes (or other gulls) to enter OWEZ, although during this survey several Guillemots were found within the OWEZ perimeter (Figure 39). Razorbills showed a similar distribution pattern as the Guillemots, but, possibly due to their low overall numbers, none were found within OWEZ (Figure 40).

The January survey

The first winter survey met high temperatures and (once again!) high wind speeds. Weather conditions were poor to impossible. Most of the survey work had to be conducted in seastates 5-7 Beaufort. Weather reports prior to the survey had predicted conditions of 5-6 Beaufort and for this reason, a sturdy and very stable platform was hired for this particular survey: a large commercial beam trawler, the TX 33 Maarten Cornelis (41.2 m long with a draft of 5 m). Wind direction was S to SW, that is more or less sideways along the E-W running transects and this combination of factors made that surveying was possible going either way, on 4 out of 5 survey days. Only on 15 January, when a 9-10 Bft gale passed through the area, all survey work had to be suspended. This gale too was from the SW, and did not result in major swells so that survey work could be resumed the next day. Skies were largely overcast, some rain was experience every day. Temperatures were unusually high, at around 9°C. Days are very short in mid-January, preventing survey work before 08:45 and after 16:45h.

Special additional survey

There is only limited daylight in January and the weather further limited survey possibilities. Survey work was altogether impossible during one day of the survey week and these factors combined prevented a double coverage of all ten transect lines. Rather than surveying some lines twice and others only once, the time remaining after completion of all ten principal transect lines was spent along an alternative sailing pattern. Three parallel lines were surveyed on the final day of the survey, running along the length-axis of the park, from NW to SE and vice versa. The OWEZ turbines are situated in four parallel lines in this orientation, leaving three clear passage ways through the park in this direction. The transect lines were 15 miles long each, with about 6 miles running NW from the park, 3 miles through the park and another 6 miles to the SE of the park. Target animal was the Guillemot, the most stationary of the common birds in the area (mostly swimming, rather than flying around). Guillemots are supposed to be wary of offshore turbines and this survey should give us an approximate disturbance zone around the park, if birds were distributed evenly or randomly in the area, in the (theoretical) absence of a wind farm. See Figure 41 for effort; each symbol signifies a five minute sailing stretch during which Guillemots (and all other birds) were counted.

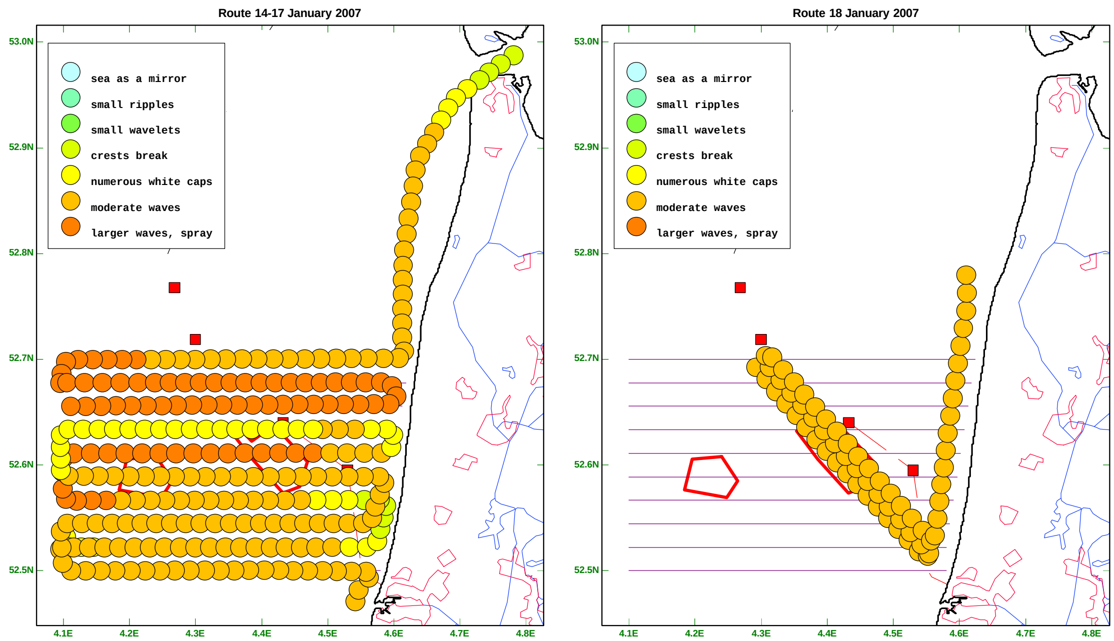


Figure 41. Survey effort during the regular survey in January 2008 (left) and during the extra survey (right, see Box). Red squares in maps are offshore gas production platforms.

Divers and grebes were now abundantly present in nearshore waters. In contrast to the grebes, considerable numbers of divers had dispersed further offshore, beyond OWEZ and out to the -20 m isobath (Figure 42). Most remarkably, some birds had moved into OWEZ and at least two individuals were seen feeding inside the wind farm.

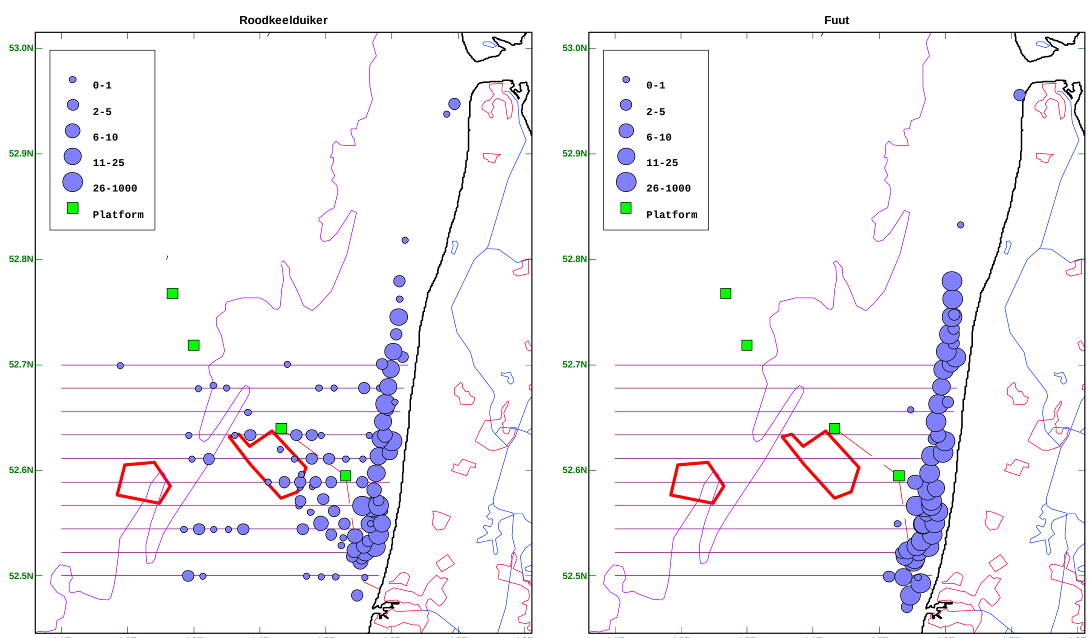


Figure 42 Red-throated Diver (left) and Great Crested Grebes (right) during the January survey.

Some Cormorants had apparently chosen to remain in the area during the winter. A maximum of 9 birds together were seen resting on the metmast and more were seen resting in the two wind farms and feeding in and around the parks. Flying birds were mostly seen heading towards the two wind farms, or back to a presumed resting place on land. Gannets and Fulmars were rare during this winter survey, only some 22 and 11 sighting were made for these species respectively (none within any wind farm). Very few Pomarine Skuas (4 sightings) remained from the large November influx. These birds should have moved on to wintering grounds off west Africa and were probably not fit enough to attempt this long journey, but had at least survived until midwinter at these northern latitudes. None were seen in the wind farms.

Terns had all left the study area. Lesser Black-backed Gulls also winter mostly south of the study area, but some wintering birds (or birds returning early?) were seen during this survey. Numbers were, however, insignificant. Yellow-legged Gulls breed in France and further south (replacing the Herring Gull), although some birds now also breed in the Netherlands. At least one adult was seen (during several days, so possibly more individuals were involved) and one sub-adult bird.

No major concentrations of seaduck were found in the study area. Few birds were seen flying up or down the coast, and only one small (80 birds) flock of Common Scoters was found on the water's surface, along the homeward track at the end of the survey, that was deliberately sailed closely inshore.

Razorbills and Little Gulls were both rare wintering birds in the study area, without a clear pattern in their distributions. During this survey, there was no clear connection between these two species.

Common Gulls were found scattered throughout the study area, with a slight tendency of concentrating in nearshore waters. Some birds were seen within OWEZ; birds following our survey ship did not leave when we entered the park (Figure 43A). Herring Gulls had a distribution pattern that was quite similar to that of Common Gulls and also did not seem to have any problems either, moving into the wind farms in the study area (Figure 43B). Both Greater Black-backed Gulls (Figure 43C) and Kittiwakes (Figure 43D) were quite numerous at sea with a slight tendency to be most abundant offshore. Very few fishing vessels were working in the study area, resulting in dispersed distribution patterns of all gulls, rather than in large concentrations.

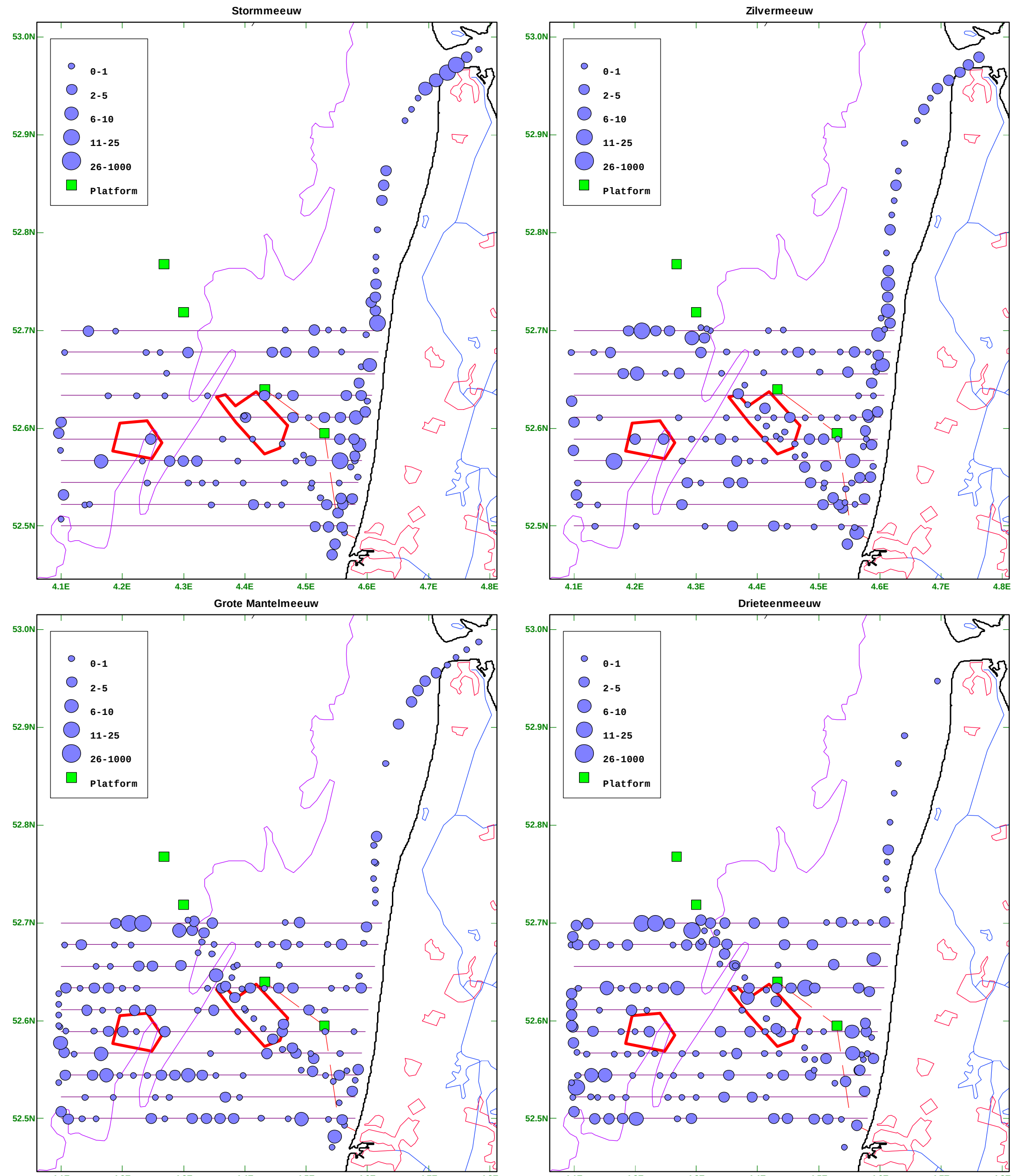


Figure 43A-D (from left to right and form top to bottom): Common Gull, Herring Gull, Greater Black-backed Gull and Kittiwake during the January survey.

Guillemot during the regular survey and during the additional special survey.

Guillemots showed a marked bimodal distribution pattern during the regular survey, with a concentration of birds in a narrow inshore strip and a much larger concentration of birds in the NW quadrant of the survey area (Figure 44). This distribution pattern has been found during several earlier surveys, including T-zero surveys. This suggests that the presence of wind farms has relatively little to do with this pattern. Closer inspection of the distribution shows that OWEZ is situated in the relative "Guillemot-void" in the central part of the study area. Some Guillemots were found in this zone, however, and some were also found within OWEZ. Q7 sits at the edge of the NW distribution component and also had a few Guillemots within its perimeter. Although densities were relatively low within, and immediately west of Q7, similar low density areas were also observed north and southwest of Q7.

The main survey thus reveals a clear-cut, be not understood distribution pattern that is similar to the T-zero situation observed before, with OWEZ sitting in the central area that has "natural" low densities of Guillemots.

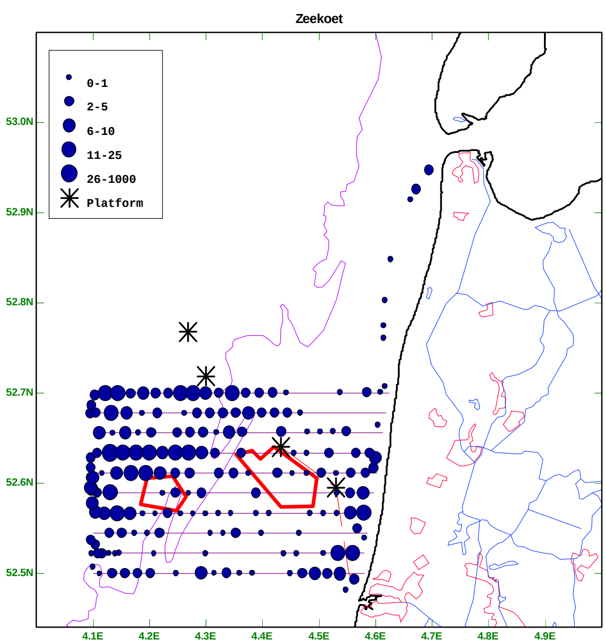


Figure 44. Distribution of Guillemots during the main survey (14-17 January 2007), showing an inshore concentration and a much larger concentration in the NW corner (west of the -20 m isobath) of the study area. Note that the ten transect lines were only surveyed once and that a second run might have filled in some to the gaps within this distribution pattern.

A very different conclusion would probably have been reached from a survey set-up that would have concentrated more on surveying OWEZ and some neighbouring "reference areas", at the expense of covering a wider area (see: Study Methods). As an illustration, an alternative survey set-up was followed that completely ignored the knowledge so far gathered and only took turbine configuration into account. Note that such a set-up may be contemplated in a situation were an understanding of wider-ranging distribution patterns is absent. This set-up uses three replicate lines through the longest axis of the wind farm, to obtain maximum coverage within the park; two equally long (3 nm) buffer zones adjacent to the park at either side, and two reference areas three miles further out (Figure 45). Length of transects on either side of the wind farm is thus 6 nm and 3 miles within the park, with three repetitions. Guillemots were counted on the water, to 300 m perpendicular distance, on both sides of the ship as it steamed along these transect lines (see Figure 45).

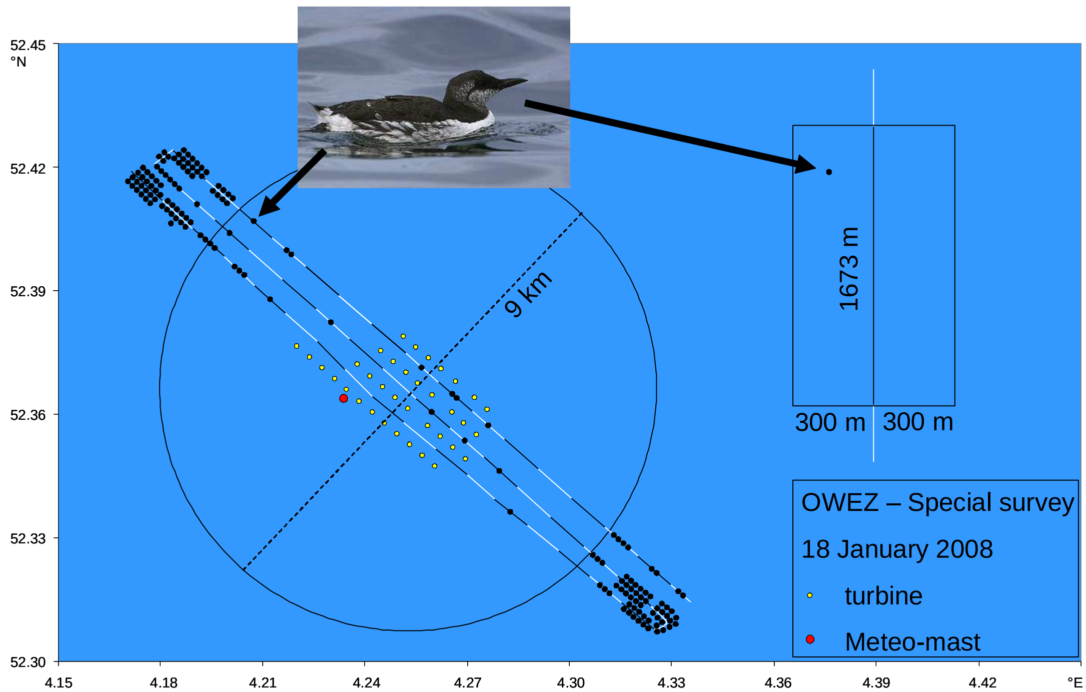


Figure 45. Guillemots (black dots) seen at sea within 300 m of the survey ship along three transects running from NW through OWEZ to the SE. Each transect line is broken up in 5 minute segments (alternating black and white), each 1673 m long (on average). An area of about 1 km² was surveyed per 5 minutes of sailing (1.673 x 0.6 km). The 36 OWEZ turbines are marked (yellow dots), as is the metmast (red dot). At the time of the survey, 18 of the 36 turbines were not rotating. Low densities of Guillemots were seen in and near OWEZ, suggesting a disturbance zone of approximately 18 km in diameter. Guillemot densities ranged from 0 per 5 minutes (= 0 per km²) to 23 Guillemots per 5 minutes (= 23 per km²).

In actual fact, the three replicate transect lines were just long enough to run from the nearshore concentration of Guillemots, via the low-density area in the central part of the larger study area, into the other high-density area in the NW sector of the larger study area. Note that these are actual results, and that transect line orientation was governed solely by turbine alignment and that transect length was chosen on the basis of the size of OWEZ only, i.e. 5 times (2+1+2) times the length of this wind farm.

We conclude that these results give a false impression of the actual situation, that is of Guillemot distribution in relation to the presence at sea of 36 OWEZ turbines and that wider-ranging surveys are necessary to properly appreciate local bird distribution patterns.

Discussion and Conclusion

This report describes the preliminary results of the first year of T-1 Local Bird surveys around the OWEZ wind farm. No in-depth analysis has yet been undertaken and results should therefore be considered preliminary. A second round of T-1 surveys is planned for 2008/9, to double the amount of data gathered so far. One year of T-1 data cannot yet give an impression of year to year variation (other than in comparison to the T-zero surveys). Many surveys were hampered by bad weather, although in each case all pre-determined transect lines were sailed at least once. Total effort so far, however, was less than during the comparable surveys during T-zero. Nevertheless, some preliminary conclusions can be drawn:

1. Wide-ranging surveys are necessary to appreciate seabird distribution patters in and around an impact zone, such as a offshore wind arm. It is very risky to put in minimum effort, i.e. compare only the impact zone with the immediate surroundings or with a limited number of reference areas.

2. Large-scale features, for known and unknown reasons, govern seabird distribution patterns. Some birds have clear inshore distributions (grebes); some are inshore most of the time but sometimes disperse further out (divers); some have clear offshore distributions (Fulmar) and many have both offshore and inshore components to their distribution patterns. OWEZ is located in the zone that is mostly to the west of the zone of nearshore birds and sits within an area that mostly has the lowest overall densities. This is good news in one way as low bird densities mean that few birds can be disturbed. In another way it is bad news, as it will be very hard to demonstrate clear avoidance patterns (if present) in a situation with low overall densities and a considerable patchiness of the few birds present.

3. Avoidance was more or less evident in several local bird species that occurred in the OWEZ area, but as bird densities were generally low here, total numbers of displaced birds were probably not very high.

4. Attraction was also clearly demonstrated in one species, the Great Cormorant. This species has recently increased in numbers in many coastal colonies, at the expense of inland colonies. It has learned to exploit coastal waters, by forming dense rafts for feeding on small pelagic schooling fish; by following trawlers, looking for discards, by feeding individually and dispersed or in concentrations at presumed rich areas such as coastal fronts (all these behaviours have been recorded in the course of this project). This provided a basis for a successive colonization of OWEZ (and later, of Q7 as well). Cormorants have a wettable plumage, and need to get out of the water shortly after feeding. This may be done by flying back to land (limiting the radius of feeding excursions) or by adopting resting possibilities as these are presented. OWEZ and the metmast in particular, have provided an excellent vantage point that is used by Cormorants to exploit the food in and around the wind farm.

5. Some birds, particularly gulls seem indifferent to the presence of a wind farm. Ship followers did not hesitate to keep following into the wind farm and on many occasions gulls were seen flying through OWEZ, at altitudes that were no different from those recorded outside the park.

6. Some first signs of habituation to the OWEZ park have been documented. Gannets and terns were seen in low numbers to fly through the park; Guillemots were first seen on the rim of the park and later inside OWEZ and finally, a few Red-throated Divers were seen (diving and apparently feeding) in the central part of OWEZ.

References

Camphuysen C.J. 1999. Jagers in de Nederlandse kustwateren. Graspieper 19: 53-65.

Camphuysen C.J. & Leopold M.F. 1994. Atlas of seabirds in the southern North Sea. IBN Research report 94/6, NIOZ Report 1994-8, Institute for Forestry and Nature Research, Netherlands Institute for Sea Research and Dutch Seabird Group, Texel.

Camphuijsen C.J. & van IJzendoorn E.J. 1988. Influx of Pomarine Skua in northwestern Europe in autumn 1985. Dutch Birding 10: 66-70.

Drewitt A.L. & Langston R.H.W. 2006. Assessing the impact of wind farms on birds. Ibis 148: 29-42.

Elsam Engineering 2005. Elsam offshore wind turbines - Annual status report for the environmental monitoring programme. 1 January 2004 - 31 December 2004. Available from: www.hornsrev.dk.

Elsam Engineering & Energi E2 2005. Review Report 2004. The Danish offshore windfarm demonstration project: Horns Rev and Nysted offshore windfarms environmental impact assessment and monitoring. Report for the Environmental Group. Available from: www.hornsrev.dk.

Kahlert J., Petersen I.K., Fox A.D., Desholm M. & Clausager I. 2004a. Investigations of birds during construction and operation of Nysted offshore wind farm at Rødsand, Annual status report 2003, NERI report, Kalø.

Kahlert J., Desholm M. & Clausager I. 2004b. Investigations of migratory birds during operation of Nysted offshore wind farm at Rødsand: preliminary analysis of data from spring 2004, NERI note, Kalø.

Krijgsveld K.L., Fijn R.C., Heunks C., van Horssen P.W., Poot M.J.M. & Dirksen S. 2008. Effect studies Offshore Wind Farm Egmond aan Zee. Draft Progress report on fluxes and behaviour of flying birds. Bureau Waardenburg report nr 08-028; Noordzeewind report nr OWEZ_R_231_T1_20080131 draft.

Leopold M.F., Camphuysen C.J., van Lieshout S.M.J., ter Braak C.J.F. & Dijkman E.M. 2004. Baseline studies North Sea wind farms: Lot 5 marine birds in and around the future site Nearshore Windfarm (NSW). Alterra-rapport 1047: 198 p.

Paine M.D. 1996. Repeated measures designs. Environmental Toxicology and Chemistry 15: 1439-1441.

Petersen I.K. & Fox A.D. 2007. Changes in bird habitat utilisation around the Horns Rev 1 offshore wind farm, with particular reference on Common Scoter. NERI Report, 36p.

Skov H., Durinck J., Leopold M.F. & Tasker M.L. 1995. Important bird areas in the North Sea, including the Channel and the Kattegat. BirdLife International, Cambridge, 156p.

Skov H., Durinck J., Leopold M.F. & Tasker M.L. 2007. A quantitative method for evaluating the importance of marine areas for conservation of birds. Biological Conservation 136: 362-371.

Underwood A.J. 1994. On beyond BACI: sampling designs that might reliably detect environmental disturbances. Ecological Applications 4: 3-15.

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Referees and Authors

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Project Number: ~number~

This report has been professionally prepared by Wageningen IMARES. The scientific validity of this report has been internally tested and verified by another researcher and evaluated by the Scientific Team at Wageningen IMARES.

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Appendix to report: OWEZ_221_R_T1_20080219

To whom it may concern
Within the framework of the Off shore Wind farm Egmond aan Zee project, on the order of Dutch Government and with their financial support, an extensive environmental monitoring program is carried out. Research area's are birds, marine mammals, fish, benthos, solid substrate and public opinion.
The report at hand is written within the framework of the monitoring program and reports the work done in 2007 on one of the research topics. Before publication, the reports were reviewed by Dutch energy agency SenterNovem and the Waterdienst, a department of the Dutch water authority Rijkswaterstaat. The questions raised and comments of the researchers can be found in this appendix, however the text is available only in Dutch.

Aan de lezer van dit rapport

In het kader van het project Off shore Windpark Egmond aan Zee wordt, in opdracht van en met financiële ondersteuning van de Nederlandse rijksoverheid, een milieu monitoring programma uitgevoerd. Onderwerpen van onderzoek zijn vogels, zeezoogdieren, vis, benthos, hard substraat en publieke opinie.
Het rapport dat voor u ligt is gemaakt in het kader van dat programma en doet verslag van het werk dat in 2007 aan één van deze onderwerpen is uitgevoerd. Voorafgaand aan publicatie is dit concept rapport voorgelegd aan SenterNovem en de Waterdienst van Rijkswaterstaat die namens de overheid het monitoringprogramma begeleiden. Hun vragen bij dit rapport en de reactie van de onderzoekers treft u aan in deze bijlage bij het rapport.

Vragen en opmerkingen van de overheid op dit rapport:
Het rapport is zeker meer dan een voortgangsrapport. Beschreven zijn de introductie, methoden en resultaten. Echter, daarmee is het op dit moment nog geen 'definitieve' rapportage. Zo zijn bijvoorbeeld de resultaten beperkt tot het weergeven van stippenkaarten en een globale interpretatie hiervan. Belangrijke zaken die ontbreken zijn:

- *a) beschrijving van data-analyse bij de methoden*
- *b) feitelijke data-analyse in de resultaten*
- *c) 'waarde' van de verzamelde gegevens om aan de vragen te kunnen voldoen (bv via een power analyse; dit lijkt ons niet onbelangrijk om tijdig nog te 'kunnen sturen')*

Op dit moment zijn de resultaten weergegeven als stippenkaarten en die zijn 'op het oog' geanalyseerd. Dichtheden zijn niet berekend (analoog aan T0) noch zijn er modellen op de data losgelaten. Ook is niet aangegeven hoe men dit later (volgend) jaar aan wil pakken.

Ondanks dat trekken de auteurs wel de stellige conclusie (discussie &conclusie & samenvatting) dat er voor de verschillende soorten vermijding, aantrekking en tevens ook habituatie optreedt. De habituatie wordt gezien in het feit dat er tijdens een telling zeekoeten en duikers in het park zijn gezien. Deze conclusie(s) worden ons inziens niet gedragen door de data/resultaten; het lijkt ons eerder een kwestie van 'het willen zien' (maar men kan er ook andere patronen in zien).

Daarnaast trekken de auteurs de conclusie dat NSW in een zone ligt die van nature weinig vogels heeft (niet echt offshore; ook niet echt inshore) Men verwijst daarbij naar de T0-studie. Grotere dichtheden zijn verder offshore te vinden en dichter bij de kust. Deze conclusie (dat NSW in een zone ligt met weinig vogels) komt echter niet uit het T0 onderzoek naar voren. Op basis van de figuren in T0 zou wij deze conclusie niet willen trekken.

Tevens zouden wij een aantal punten uit de discussie in het T0-rapport graag ook in dit rapport terugzien. In de discussie van T0 wordt aangegeven dat er met deze methode geen binnen-maand variatie is aan te geven, geen jaar effect (behalve de twee jaren post constructie). Daarnaast geeft men aan dat de variatie in de tijd (dag, maand, jaar) enorm is. Als gevolg daarvan verwacht men dat er alleen veranderingen in de grootte van 50-100% kunnen worden aangetoond. In ecologische zin is dat natuurlijk enorm. In de discussie staat tevens "Power analyses may be used to optimise survey design in this respect for the T1 studies to come". Interessant is om te weten of deze analyse heeft plaatsgevonden.

Ook wordt in de discussie van de T0 aangegeven dat er nog een andere methode is die volgens de auteurs nuttig kan zijn voor het bepalen van de effecten op de zeevogels. Het wordt niet duidelijk of deze methode hier is toegepast.

Ook zijn wij benieuwd of er in de T1 nog rekening wordt gehouden met andere omgevingsparameters die invloed hebben op zeevogelverspreiding zoals watertemperatuur, zoutgehalte en voedselaanwezigheid. In de T0 wordt erop gewezen dat het belangrijk is dat deze ook gemonitord worden. Mocht dit niet het geval zijn dan rijst de vraag in hoeverre dat invloed heeft op de interpretatie van de resultaten en de conclusies?

Om uiteindelijk iets te kunnen zeggen over het effect van een operationeel windpark is het van belang om te weten of het ook daadwerkelijk operationeel was (draaiden de molens)?.

Op pagina 32 en 33 wordt aangegeven dat de zeekoeten een bimodale verspreiding hebben; een concentratie langs de kust en een concentratie buiten de 20 meter diepte lijn. De auteurs geven aan dat deze verspreiding ook is gevonden tijdens de T0 metingen en dat dat aangeeft dat de bouw van het park weinig te doen heeft met het gevonden verspreidingspatroon tijdens de T1.

Als men echter kijkt naar de figuren van de zeekoet van de T0 meting dan kunnen wij die bimodale verspreiding er niet in terug vinden. Sterker nog; er is een figuur (oktober) geplot van een dichtheidsmodel waarbij de strook met de grootste dichtheid dwars over OWEZ loopt (kustlangse richting).

Vervolgens wordt aangegeven dat als er via een andere methode was gemonitord (kleinschaliger) men foutief tot de conclusie hadden kunnen komen dat het windpark wel degelijk effect hadden gehad.

De T0 situatie is zeker niet gelijk aan het bimodale verspreidingspatroon dat in de T1 wordt gepresenteerd (in geen van de 6 metingen).
Evengoed kan betoogd worden dat het patroon een effect is van vermijding van het windpark.
Mogelijk drijven de zeekoeten met de reststroom mee richting het park en proberen dat te vermijden zodat er een druppelvorm met een lage dichtheid rondom het park ontstaat (en een verdichting langs die 'vermijdingszone' = druppelvorm; precies zoals het waargenomen patroon).

Deze visie wordt ondersteund door de gegevens van trektellen.nl; er werden die dagen tijdens de T1 (14- 18 jan 2008) bij de trektelpost (trektellen.nl) Egmond aan Zee bijzonder veel zeekoeten gezien richting zuid (dit komt overeen met de grote aantallen die tijdens de T1 aan de kust zijn gezien). In vergelijking met andere jaren trektellen bij Egmond aan Zee is het een echte 'piek' in 2008 (uitgedrukt als uurgemiddelden).

Daarnaast komt de lengte van de 'vermijdingszone' uit figuur 45 sterk overeen met gevonden vermijdingsafstand van de deense studies (2 km significant; 4 km ook vermijding maar niet significant). Men zou dan zelfs kunnen zeggen dat het surveygebied mogelijk niet groot genoeg is geweest om grootschalige vermijdingszones vast te kunnen stellen.

Reactie van de onderzoekers:

Dit interim rapport dient primair om te laten zien wat er tijdens het eerste jaar T-1 waarnemingen is gedaan en om een eerste indruk te geven van de mogelijke resultaten. Er is nog geen diepgaande analyse uitgevoerd van de eerste data, omdat er na februari 2008 nog een tweede jaar data verzameld moest gaan worden. De daadwerkelijke analyse wordt momenteel uitgevoerd aan de T-1 dataset van 2007 en 2008 (Inmiddels is besloten ook in 2009 veldwerk te doen en aansluitend zal een analyse op de dan drie jarige dataset worden uitgevoerd).

De gestelde vragen en suggesties zullen bij de analyse ruimschoots aan bod komen. Inmiddels is Imares aan deze analyses begonnen en in de tweede interim-rapportage zal veel meer analyse worden getoond, grotendeels langs de door SenterNovem en de Waterdienst geschetste lijnen. In de komende rapportage zal ondermeer worden ingegaan op:

- *Verschillen tussen de T-nul en de T-1;*
- *Verschillen tussen de twee jaren T-1 en de problemen die dit met zich meebrengt voor de interpretatie inclusief een power analyse;*
- *De vraag in hoeverre slechts 1 jaar T-nul data voldoende is voor een inschatting van "de" T-nul situatie;*
- *De vraag of vogels a priori twee-piekig over het onderzoeksgebied waren verspreid en in hoeverre een dergelijke tweepiekigheid aantoonbaar versterkt is geraakt door de bouw van twee windparken in het centrum van het gebied;*
- *Of op grond van de verzamelde data aangetoond kan worden of windparken een verstorende werking hebben, of dat aanvullende en/of scherpere waarnemingen nodig zijn.*

Ten aanzien van de vraag of er in de T1 nog rekening wordt gehouden met andere omgevingsparameters die invloed hebben op zeevogelverspreiding zoals watertemperatuur, zoutgehalte en voedselaanwezigheid, kunnen wij melden dat dit inderdaad zal gebeuren, maar dat t.a.v. deze parameters tijdens de T-1 surveys geen aanvullende metingen zijn gedaan. Op grond van de data die tijdens de T-nul zijn verzameld neemt Imares aan dat clinale verschillen in zoutgehalte, watertemperatuur en diepte alle steeds en zeer sterk correleren met afstand tot de kust, dan wel afstand tot de -20m dieptelijn. Om die reden is bij de analyse van de T-nul data indertijd dan ook besloten om alleen te relateren aan de afstand tot de -20m lijn (of de afstand tot de kust). Een dergelijke werkwijze wordt ook tav de T-1 data gevolgd.

Tijdens alle surveys draaide de grote meerderheid van de windturbines (behoudens zeldzame windstilte). Soms waren enkele molens voor onderhoud stilgezet maar dit betrof altijd een minderheid.

Terecht wordt opgemerkt dat het rapport nog geen definitieve rapportage is en dat een aantal zaken, die voor analyse in aanmerking komen, nog niet zijn uitgevoerd. Wij zijn het daarmee eens. Uw mening dat op basis van "op het oog analyses van stippenkaarten" wel stellige conclusies worden getrokken kunnen wij niet delen. In de inleidende tekst van het conclusiehoofdstuk komt drie keer het woord "preliminary" voor. Daarmee maken wij naar onze mening een duidelijk voorbehoud ten aanzien van de rest van de tekst.