Nocturnal migration during construction of an offshore windfarm: comparison of stationary and mobile radar detection

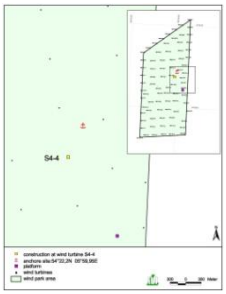
Conference on Windpower and Environmental Impacts

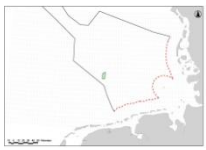
Helmut Wendeln, Brigitte Hielen, Dieter Todeskino*

Background

In the German EEZ 7 offshore windfarms are under construction and further 21 approved, erection starting next years. Whereas during pre-construction ship based investigations have to be performed according to fixed methodological standards, using platforms is recommended during construction and operation. During the monitoring of bird migration in the construction stage of the first commercial German offshore wind farm "BARD Offshore 1" we used vertically rotating ship radars from a platform within the park and simultaneously from a vessels close to the construction site and compared nocturnal migration rates at the two close by sites. The intention of this poster is to highlight advantages and disadvantages of stationary (platform) and mobile detection (from vessels) for construction and operational monitoring.

Study site and radar device





The offshore wind farm „BARD Offshore 1" is located in the German EEZ (right, top). It is currently under construction (right, bottom; 80 turbines in completed park). The data presented in this poster come from 2011 to 2012. The figure left side shows the situation during investigation from 8 to 10th November 2011

On the platform inside of the windfarm a vertically rotating radar works permanently. Simultaneously, trips with vessels are performed equipped with a radar (also vertically operating). The anchoring site ideally was 0,5 to 1km from the currently active construction site (see Fig. Above for site S4-4). Both radars (Bridgemaster) had 25 kW power output and worked with same settings (e.g. 1,5 km range, medium pulse...). The radar images were stored and bird echoes detected on the screen. Before analyses, the data were corrected for distance dependent detectability (programm DISTANCE, Buckland et al. 2004: Advanced Distance Sampling: estimating abundance of biological populations, Oxford University Press) and the orientation of the radar beam relative to the anticipated migration direction (SW in autumn). Migration traffic rates (MTR, echos*h^{-1}*km^{-1}) were calculated.

Results

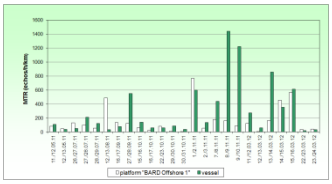


Fig. 1. Average MTR per night on platform and on vessel (close to construction site)

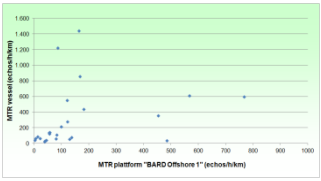


Fig. 2. Correlation of MTR on platform and on vessel (close to construction site)

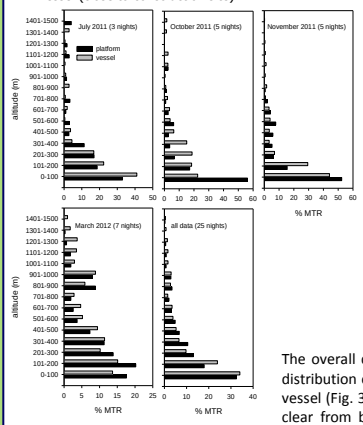


Fig. 3. Altitude distribution on a monthly basis comparing data from platform and vessel (construction site)

On 25 nights during autumn 2011 and spring 2012 migration traffic rates of nocturnal migration from both radar systems are compared. Fig. 1 demonstrates an expressed variation of migration intensity in the course of the 25 days. The median of the platform data did not differ signifcantly from median data on vessel (platform: 85, vessel: 116; Wilcoxon-Test for related samples: ns). Within single nights MTRs at the close by sites can differ, however the overall correlation of MTRs is significant (Spearman-Correlation: r=0.512, p=0.009, Fig.2). The causes of the differences is adressed below with the example night from 8 to 9th November 2011 with MTRs of >1,000 close to the construction site and 100-200 near the platform.

The overall data from 25 nights showed a very similar altitudinal distribution comparing the situation on the platform and near the vessel (Fig. 3). On a monthly basis, characteristics of migration get clear from both data sets (e.g. expressed migration at altitudes from 800 to 1,000 m in March 2012 or very low migration in November 2011).

Advantages/disadvantages

(most important issues, not complete)

	advantage		disadvantage	
	mobile	**stationary**	**mobile**	**stationary**
mobility	measuring at the site of interest; important during construction (being where effects may occur), but also during monitoring (different investigation sites according to season)			measurements are restricted to one site. In not every wind park project platforms have suitable locations (e.g. within wind farm) for measuring bird migration. Seasonal variation in migration patterns can not be adressed
data quality		a fixed position improves data quality. Also advanced radar technique can be applied	due to movements of vessels, data quality is restriced (changing detection area, high reflection from water surface); currently, no advanced radar technique works on vessels	
	on vessels, ornithologists are at place. Behaviours like attraction/avoidance influencing local migration can be seen; interpretation of data is much better			on platforms, device is usually remotely operated. Even with automatic visual devices the interpretation of local situation is limited. This may cause artefacts like shown here
		on platforms radars can work permanently covering the whole season	with vessels only a sample of migration activity can be monitored on research trips	

Tab. 1 shows characteristics of nocturnal migration during five nights of highest migration intensities. The two nights in November 2011 with MTRs > 1,000 were characterized by low visibility and fog. The observers on the vessel noted an attraction of birds to the construction site and many birds close to the strongly lighted jack-up barge. Bird call activity at the vessel was even low. Accordingly, the very high migration rates were artefacts caused by attraction. Even at very small scale (distance between vessel and platform about 3 km) differences in MTRs can be measured. A validation of the situation is only possible by visually monitoring the sites. In other nights with strong migration situation can differ between no bird calls heard (migration at high altitude in March 2012, see also Fig. 3) and very high number of calls in nights with migration at low altitudes (e.g. 1./2.11.2011).

Tab. 1. Characteristics of five nights with the highest MTR in autumn 2011 and spring 2012 (measured on vessel, sorted by decreasing MTR; species: songbirds listed, further species comprise gulls/wader)

night	8./9.112011	9./10.11.2011	13./14.03.2012	15./16.03.2012	1./2.11.2011
MTR	1,438	1,220	857	611	596
% < 200 m	91	77	24	40	79
visibility (km)	5	2	10	6	7
wind speed (bft)	4	3	3	4	3
ind direction (°)	132	147	278	167	180
clouds(1/8)	8	8	8	3	8
Precepitation	no	no	1 h	no	2 h
remarks protocol (observer on vessel)	many bird echoes around the construction site (obviously attraction)	again many birds around the construction site (again attraction)	no comment	no comment	no comment
	due to the fog construction site made the impression of a lighted canvas; many birds seen there by binoculars (thrushes, small songbirds, waders)	same situation like the night before			
bird calls (birds/h/night)	22.9	39.7	1.0	6.3	261.7
species/number during night according to bird calls	robin: 12 redwing: 5 blackbird: 6 song thrush: 4	robin: 10 redwing: 24 blackbird: 17 song thrush: 10	no birds	robin: 4 redwing: 1 blackbird: 11	robin: 104 redwing: 411 blackbird: 278 song thrush: 88

Conclusions

The results show that from vessels reliable data on bird migration can be measured with respect to intensities and altitudinal distribution. Local effects like attraction by light can cause artificial data that can only be discovered by visual observation. Placed at an appropriate site (in relation to wind farm), platforms give the opportunities to apply radar techniques (also advanced techniques) for continuous measurements with high quality. Due to the mobility of vessels the location of measurements can be optimized. Both systems (mobile and platform based) have their egilibility and should ideally be used in combination. Platform data enable the identification of nights with mass migration, whereas with measurements from vessels behavioural aspects should be in focus. Further, efforts should be made to improve data quality from vessels (currently used vertically rotating ship radars or other radar techniques).

Contact: IBL Umweltplanung GmbH
Bahnhofstraße 14a
D-26122 Oldenburg
*wendeln@ibl-umweltplanung.de

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