87 Using AIS tracking to assess recreational pressures in relation to ecologically sensitive areas in coastal marine environments

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In nature rich coastal areas, increasing numbers of recreationists may exceed ecological capacities. At the same time, recreation in such areas may increase nature awareness and appreciation by the general public, ultimately leading to a more sustainable landscape management (Libosada, 2009). In order to balance nature-based tourism and natural values, careful monitoring of visitor flows is a prerequisite for nature and recreational management (Meijles et al, 2014). The monitoring traditionally takes place based on visual observation and patrolling, but this is time consuming and does not provide full temporal coverage or overview of the entire coastal area. With this paper, we show how recreational boating can be monitored throughout the recreational season using the globally available data from the automatic identification system (AIS) for vessels. We have developed a method to convert AIS data to easily interpretable information on visitor flows and investigated whether AIS can provide insightful visitor monitoring information by overlaying ship movement data with nature conservation policy targets and ecological value maps.

For this study, we have used the Dutch sector of the Wadden Sea UNESCO Natural World Heritage Site as research area. The area is characterised by a shallow sea with tidal flats and deeper tidal natural channels (Elias, 2017). The salt marshes, tidal flats, mussel banks and sublittoral areas provide a high availability of food to large numbers of migratory and ground-breeding birds, of which some are protected under the Natura 2000 regulations. They are susceptible to human disturbances during feeding, moulting and roosting (Kloepper et al, 2017). The Wadden Sea also is home to two seal species, functioning as reproduction area for the harbour seal in summer and for the grey seal in winter. They forage in the area and rest on the edges of the tidal flats at low tide. Seals run the risk of being disturbed by people coming close during low tide at haul-out sites and in periods when females are suckling young.

Because of its beauty, the scenic landscapes and the high ecological values, popular recreation activities in the Wadden Sea include sailing, anchoring, mudflat hiking, looking for mussels/oysters, and seal and bird watching (Sijtsma et al., 2012). Typical for this region is tidal flat mooring (‘droogvallen’ in Dutch), in which flat-bottomed boats rests on the tidal flats at low tide, providing the opportunity to get off board and to explore nature in the surroundings (Meijles et al., 2021). However, this may disturb resting seals or foraging birds, and therefore, this should preferably not take place in or close ecologically sensitive areas. The monitoring of tourism is reasonably well established in the area and policy programmes are in place to combine tourism and nature protection in a sustainable way (Van Roomen et al, 2012). However, much of the monitoring is based on direct observation and patrolling, and the area would benefit from full seasonal spatiotemporal patterns of recreational ships at the landscape scale as a baseline assessment for recreational pressure on ecological values. Therefore, the region is a relevant case for researching spatiotemporal dynamics of recreation in sensitive marine natural areas.

For our research, we used high-resolution AIS data (nearly 9 million data points) of recreational ships to create spatiotemporal patterns for the recreation season May-September 2018. We combined this with data about shipping lanes, bathymetry and tides. Using a GIS-based hotspot analysis including tidal conditions, we mapped areas with relatively high recreational shipping densities and tidal flat mooring locations for the full study area at the seasonal scale. Subsequently, we overlaid AIS data with ecological data, such as seal resting places, bird high water resting places, important shore bird foraging locations and Marine Protected Areas (MPAs).

We showed that most of the recreational traffic is concentrated around the tidal channels. We were able to map popular tidal flat mooring locations and observed that there is a relatively high rate of tidal flat mooring activities in only a few Marine Protected Areas. In addition, we showed that in most of the seal resting places, recreational vessels stay at a distance. Most ships generally stay away from seal resting places, but in a couple of areas, ships regularly come closer than official regulations. In general, the vast majority of tidal flat mooring activities stay away from the mussel banks, which with their direct surroundings are important foraging places for shore birds. However, particularly in the eastern part of the Wadden Sea, we have observed some 'hotspots' of tidal flat mooring relatively close to mussel banks. Although this provides opportunities for recreations to go bird-watching, off-board activities may disturb foraging birds, running the risk that they miss their low tide window of opportunity here. The hotspot maps therefore provides localised insights in potential disturbance problems at the seasonal time scale and could thereby provide an important lead for patrolling specific focus areas. Further visual observation is needed here more regularly to see to what extent the proximity of recreational ships may lead to disturbance.

We can conclude, that combining AIS data with ecological indicators can provide valuable information on recreational activities at the seasonal scale for the entire Dutch sector of the Wadden Sea and where these may conflict with ecological values or nature protection policies. Such information may be useful to steer visitors away from ecological sensitive areas or in sensitive periods, where at the same time it can be used to inform recreationists where nature can be best experienced. Future research by combining AIS analysis with field patrolling data would provide insight into the effectiveness. In addition, using AIS, possibly enriched with radar data, may be useful to study the relationship between recreationists and ecological values in focus areas on shorter time scales.

References

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