First specific biodiversity assessment in the Portuguese Pilot Zone for marine renewables

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Introduction

The Portuguese Pilot Zone (PPZ) was created in 2008 (Decree-Law n. ° 5/2008, January 8th) and is comprised by an area of ca. 320 km^2, between the 30m and 90m water depth and located at the west coast of São Pedro de Muel, central Portugal. The PPZ was created to support the deployment of marine renewable energy in Portugal. The integration of biodiversity into the PPZ's environmental management strategy is a key-factor and efforts have been made to characterize and produce baseline information that can be used in the decision-making process.

Methods

Birds and marine mammal surveys were carried out between May and June of 2011 using the Portuguese oceanographic vessel Almirante Gago Coutinho. Methodologies include ESAS (European Seabirds at Sea) techniques for seabird surveys, and dedicated marine mammals sighting surveys (Camphuysen *et al*., 2004, Maclean *et al*., 2009, SMRU, 2010). Observations were undertaken approximately 12 hours per day and both surveys were carried out by trained and experienced observers: ESAS-accredited and Marine Mammal Observers (MMO). The research vessel followed parallel transects running approximately north/north-east to south/south-west across the PPZ, between 80 and 200 m apart. Perpendicular transects were also surveyed running approximately east/south-east to west-north-west across the site at a distance of ca. 1.5 km apart. The survey route was recorded using a hand-help GPS at all times and navigational information (including position and speed) was also recorded at 30 minute intervals.

All bird species detected were recorded along with details of, number and precise time of day. Additional information regarding age, sex and behaviour were recorded whenever possible, as well as associations between birds, or between birds and dolphins.

For each mammal sighting the following data were recorded: species, number or best estimate of group size, number of calves, distance and bearing from the vessel, precise time of day, and additional information regarding behaviour (i.e. swim, breaching, feeding) and cue for sighting (i.e. splash, blow, associating seabirds) and any behaviour in relation to the survey vessel.

In terms of data analysis, densities and population sizes of the four most commonly observed bird species within the PPZ were estimated using a design-based methodology (software Distance, v. 6.0). For birds observed in flight, a conventional strip transect methodology was used, providing an estimate of the number of birds present over the entire region of interest. For birds on the sea, individuals recorded in the final distance band (>300m) were excluded from the distance sampling analysis because the average

distance of individuals within an unbounded category cannot be calculated. This truncation was necessary for accurate density estimation. A half-normal detection curve was fitted to the count data for the four bounded distance bands (0-50m, 50-100m, 100-200m and 200-300m) and used to produce estimates for densities and population size across the PPZ.

Results and discussion

Birds and Marine Mammals

Fifteen seabirds species were observed during the surveys, but only three can be considered as being abundant on the study area during May/June, namely Balearic shearwater (*Puffinus mauretanicus*, ca. 125 ind. in flight and 306 on sea), gannet (*Morus bassana*, ca. 98 ind. in flight and 281 on sea) and yellow-legged gull (*Larus michaelis,* ca. 136 in flight and 106 on sea). Cory's shearwater (*Calonectris diomedea,* ca. 58 in flight and 45 on sea) was also found in relatively high numbers. These species represent ca. 96% (n=15) of seabirds recorded during the surveys.

Density plots were used to determine distribution patterns for each species within the PPZ, however any particular distribution pattern was found. Two relevant facts were detected: i) the consistent presence of yellow-legged gull in the NW area of the PPZ and ii) the more regular and abundant presence of Balearic shearwater in transects closer to the coast.

Regarding height distributions, only three of the species recorded during the survey were observed flying at collision risk height (20-200 m band): i) gannet, ii) great skua (*Stercorarius skua*) and iii) lesser black-backed gull (*Larus fuscus*).

Balearic shearwaters only breed on the Balearic Islands, but birds start leaving the breeding grounds from May, when most birds enter the Atlantic and fly north (Arcos, 2011). This means that birds recorded may be a mix of post-breeding and non-breeding birds. The number of Cory's shearwaters in the temperate North Atlantic is also swelled in May-June by non-breeding birds (Snow *et al.* 1998). In the Portuguese Red Data Book, Balearic shearwater is classified as critically endangered and Cory's shearwater is classified as a vulnerable species. Regarding gannet, immature (non-breeding) birds are abundant along the Portuguese coast, which provides an important feeding area for this species (Ramírez *et al.* 2008). Also the yellow-legged gull is a common breeding bird along the Portuguese coast. This is reflected in the number of yellow-legged gulls recorded during the survey.

The only marine mammal species recorded during the survey was the common dolphin (*Delphinus delphis*). A total of 313 common dolphins, in 72 separate groups, were counted within the PPZ. This included a minimum of nine calves (in six of the groups). Common dolphins showed a widespread distribution within the PPZ. This was expected considering that they are a mobile species widespread and abundant along the Iberian coast.

Potential effects and generic threats

The development of offshore renewable energy facilities raises important questions about the potential effects and threats on the marine environment. The degree of incidence and communities affected varies depending not only on the status of the receiving environment but also on the type of technology and foundation installed, as well as the project development phase. We identified and analyzed the potential impacts of the deployment of several technologies for energy exploration in the PPZ, linking them with the observed species and their ecological requirements. Among the observations and analysis performed during this study, the most probable impacts that stand out are i. habitat loss/disturbance, ii. barrier effect

and collision risk and iii) noise impacts (marine mammals). However, positive impacts such as their capacity to act as artificial reefs and fish aggregation devices as well as the contribution to reduce carbon emissions must also be taken into account.

During the survey period (May-June) the PPZ is important for non-breeding Balearic shearwaters and gannets but considering the results obtained, shearwaters and gulls were the only species to be registered on the site that may be likely to meet the nesting period. The barrier effects have differing impacts on breeding and migratory birds. Birds that would normally fly on a daily basis through the site between their breeding colonies and feeding area will face an additional energy cost, if they have to fly around rather than through the site. This impact may be lower in birds passing through the site on migration, which will only face the barrier twice a year (in spring and autumn). Additionally, the risk of collision with structures (e.g. turbines) depends on the flight heights at which a particular species usually flies. Considering the species observed in the PPZ during the study, only gannet, great skua and lesser black-backed gull should face this threat. However, although the risk of a collision may be small, when it does happen it will almost certainly result in a fatality. Additional species may be present at other times of the year that could be at collision risk.

The dolphins were the only species of marine mammals observed in relatively high numbers. Its occurrence in the study area is likely to be throughout the year, even though this species has great mobility and may not be resident. Common dolphin is widely dispersed and abundant along the Iberian coast, so any barrier or displacement effect caused by the development of PPZ should only be small and on a local scale. A potentially more significant threat is the increased risk of collision with ships or underwater structures, noise impacts (Patricio *et al.* 2009) as well as the occurrence of electromagnetic fields.

On the other hand, projects offshore have the potential to create additional habitat (artificial reefs), to attract marine organisms, to increase long-term prey availability and to decrease pressure from fishing activity. It seems possible that in general, effects on marine fauna will also be positive.

Once the PPZ is located in the middle of two areas with conservation interest (Natural Reserve of Berlengas' Islands and Figueira da Foz Marine IBA, actually overlaps partially the last), we developed a simplified approach to cross the expected impacts in the PPZ with the objectives of conservation of species found on both PPZ and protected areas. The approach revealed the conditional compatibility or compatibility of most of the bird and marine mammals' conservation objectives, given the negative effects of deployment technologies of offshore renewable energy exploration. On the other hand, we observed very high levels of compatibility between the positive effects and objectives of conservation, even for species whose occurrence in the area was not observed in this campaign.

Lessons learned and guidance

Since the occurrence of impacts is expected, it is essential that all identified natural values are considered and monitored during the various stages of the process: construction, operation and decommissioning. A selective and careful choice of location for deployment, an adequate layout and effective baseline knowledge of local descriptors (biological, hydrological, etc.) will naturally lead to a smaller number of impacts.

It is important to gather as much information as possible on the natural resources using a solid and extensive monitoring plan across the project life cycle. This means having a two year baseline monitoring period. On the earlier phase of the project (pre-implementation), baseline information is crucial to ensure the best location and, consequently, to reduce potential negative impacts significantly.

The results obtained for the PPZ clearly indicate the need for future characterization studies. It is highly recommended to monitor bird and marine mammal population throughout the rest of the year, especially in migratory seasons, in case of birds. Extended sampling periods are also important for marine mammals, to allow other important species that are likely to occur within this region to be registered, such as bottlenose dolphins (*Tursiops truncatus*) and harbour porpoises (*Phocoena phocoena*). Furthermore, it is also important for future studies to develop monitoring programs for other biological groups, such as phytoplankton, macroalgae, benthic and fish communities and marine turtles. This is very important considering (i) the wide variety of impacts that are to be expected due to the diversity of technologies that might be implemented, and (ii) that different offshore renewable energy technologies (wind, wave, tidal, etc) have specific impacts on each community.

Considering the proximity to areas with conservation interest, a spatial sampling expansion of the study area to the surroundings is also recommend due to the possible connectivity between them and the area's potential function as an ecological wildlife corridor.

The effects associated with the implementation of offshore renewable energy harvesting technologies are compatible or conditionally compatible with conservation objectives of the species that occur in the PPZ and the nearby area. It may be possible to promote all the conservation objectives, including maintenance of population size and/or its increment. To achieve this, (i) additional baseline characterization studies should be implemented, as well as studies aimed at analysing the distribution, diet and reproduction of various species in the area over a full annual cycle; (ii) mitigation measures should be implemented; (iii) construction work should not be implemented during the critical nesting seasons.

In conclusion, every project assessment should include various procedures, namely: (i) the execution of baseline characterization studies and a previous diagnosis study, prior to the installation phase, which should consider several biological groups; (ii) a ecological clerk of works during the construction phase to identify and minimize the potential and temporary negative impacts that may have irreversible consequential effects; and (iii) a monitoring phase during the operational period, to identify potential long term alteration to the ecological system as a consequence of the project's exploration, allowing the efficacy of mitigation measures to be assessed.

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