Agenda Item 14.3

Implementation of the ASCOBANS Triennial Work Plan (2007-2009)

Review of New Information on Bycatch and Other Causes of Mortality

Document 37

Spatio-temporal interactions between harbour porpoise (*Phocoena phocoena*) and fisheries in the German Bight 2002-2006: Preliminary results

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Spatio-temporal interactions between harbour porpoise (*Phocoena phocoena*) and fisheries in the German Bight 2002-2006: Preliminary results

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Summary

Interactions between small cetaceans and fisheries are a major concern of fisheries management. Both strive for the same resource fish. Incidental by-catch and competition for food are considered as main interactions. The occurrence of porpoises in relation to fisheries were compared both temporarily and spatially. VMS data from 2006 and fisheries surveillance data from 2002-2006 were acquired to describe fishing effort. Aerial survey data from 2002-2006 were analysed to evaluate porpoise distribution. Harbour porpoise distribution and abundance proved to be positively correlated with sand eel fisheries during all seasons. Association also appears to be positive with gill net fisheries and negative with large beam trawl fisheries in summer. Overlaps with gill net and sand eel fisheries bear the potential of impact on harbour porpoises, both in terms of incidental by-catch and competition for food in particular during summer.

Introduction

Adverse effects of fisheries on small cetaceans include their by-catch (Jefferson & Curry 1994), food depletion (Dayton et al. 1995, DeMaster et al. 2001), entanglement in ghost nets (Fertl & Leatherwood 1997), pollution (Scheidat & Siebert 2003), noise pollution (Jepson et al. 2003, Scheidat & Siebert 2003) and stress (Aubin 2002). In turn, marine mammals may have a negative impact on fisheries in terms of resource competition and depredation (DeMaster et al. 2001, Bearzi 2002). Both sides of the interaction have been the cause for major concern in past decades (DeMaster et al. 2001, Bearzi 2002).

The only abundant cetacean species in the German North Sea is the harbour porpoise (*Phocoena phocoena* L.). In Europe, it is among the species listed in Annex II of the EC Habitats Directive (Council Directive 92/43/EEC) and thus deserves particular attention with respect to conservation issues, e.g. when Marine Proteced Areas (MPAs) are designated, or the construction of offshore wind farms is authorized. Since the 1990s, interactions of fisheries and harbour porpoises have been a focus due to high by-catch mortalities of porpoises in trammel nets, tangle nets and bottom set gill nets over most of their range (Perrin et al. 1994, Northridge & Hammond 1999, Vinther 1999, Vinther & Larsen 2004), but especially in British and Danish waters (Berggren & Carlström 1999; Northridge and Hammond 1999; Vinther 1999, Vinther & Larsen 2004). Recently, interaction analyses have concentrated on assessing by-catch rates, evaluating the impact of certain gear types on harbour porpoise and defining appropriate limits to by-catch levels (ICES 2007). Areas of potential conflict, as indicated by the overlap in distribution of fishing activities and porpoise abundance, have found little attention.

Both cetaceans and fisheries are attracted by areas of high fish density (Fertl & Leatherwood 1997). Thus, temporal and spatial overlap between the two is inevitable. Interactions are likely when species targeted by both are the same. Seasonal variation in prey preference and a changing availability of fish may lead to temporary and spatially changing overlap between fisheries and harbour porpoise

In this study, we present preliminary results of an analysis of high resolution porpoise and fisheries data to reveal spatial and temporal interaction patterns between the two.

Material & Methods

Fisheries data

Fisheries data were aggregated in parcels of app. 6 by 6 nm. Small beam trawlers, operating mainly inshore, were not considered in this analysis. Three types of fisheries data were considered and regarded as proxies for actual effort in a specific fishery. First, effort was calculated from VMS (Vessel Monitoring System) data for the year 2006. Effort was separated by gear type and season for vessels using large bottom trawls (TBBL), gill nets (GN) and unspecified trawling gear (TX) according to the protocol developed by Fock (2008). VMS data were likely to represent the complete set of fisheries data for vessels larger than 15 m in the German Exclusive Economic Zone (EEZ). VMS positions were available from all vessels, independent of their nationality. As analysis was vessel-based, vessels lacking log-book information were classified according to fishing patterns, speed profiles and expert information (ICES 2007, Fock 2008). This was possible as, despite some inter-annual variability, the basic fishing pattern of respective vessel types are consistent over time (Fock 2008).

Positions of inspected industrial fishing vessels for sand eel were aggregated from fisheries surveillance reports to grid cells for the period 2002-2006 (Fig. 1). VMS fishing positions of vessels known to be industrial fishing vessels were aggregated in the same way for the year 2006. Even so, data on inspected sand eel fishing vessels and VMS fishing positions were incomplete, since not all industrial fishing vessels are inspected. The category TX is likely to comprise much of the sand eel fisheries in the German Bight, mainly carried out by Danish vessels for which log book information was not available. A comparison of TX patterns and those from the inspected sand eel fisheries was undertaken to solicit this assumption. We were unable to resolve seasonal patterns in the sand eel fishery and of industrial fishing vessels due to the limited temporal coverage of the data.

Porpoise data

Data on porpoise distribution were available from aerial surveys conducted by the Research and Technology Centre Westcoast (FTZ) of the University of Kiel from 2002 to 2006. Line transect distance sampling surveys (Buckland et al. 2001) covering the entire German North Sea have been conducted by the FTZ in the context of several projects analysing porpoise distribution with respect to both the position of future offshore wind farms and the nomination of FFH (Flora-Fauna-Habitat) conservation areas. Data were obtained according to standard line transect distance sampling procedure (Buckland et al. 2001). Sighting condition related strip width and g(0) estimation allowed for precise effort correction. Sighting and effort data of all 5 years were pooled and aggregated to the same 6 by 6 nm grid as the fisheries data. Mean animal densities were calculated for each grid cell for spring (March-May) summer (June-August) and autumn (September-November). Coverage during winter months was not sufficient due to unfavourable weather conditions.

Results

Seasonal patterns of fishing effort and porpoise density

Large beam trawlers (TBBL) constituted the largest single fleet spending 105,000 hours fishing in offshore waters of the German Bight in 2006. Large beam trawlers comprise vessels of engine power higher than 300 HP usually operating 2 beam trawls, each of 12 m width. Their area of operation is restricted to offshore waters. With modified gear and engine power, permissions may entitle vessels to also fish closer inshore. In spring 2006, the outer parts of the German EEZ were fished, concentrating in particular on the Dogger tail end and the area west of the Sylt Outer Reef. During summer and autumn 2006, an intensive fishery in the centre of the German Bight developed (Fig. 2 A).

Gill net fishing effort was only indirectly represented by means of vessel based effort estimates. The Dogger tail end and areas east of Borkum Reef ground and north of Sylt Reef ground were targeted in spring 2006. Fishing switched to Sylt Outer Reef and the coastal zone up to Borkum Reef ground in summer and autumn 2006 (Fig. 2 B).

Unspecified trawling (TX) in summer (Fig. 2 C) resembled the pattern of sand eel fisheries (Fig. 1). During spring 2006, effort was concentrated on the Dogger tail end, whereas in summer Sylt Outer Reef, Borkum Reef ground and the area around Helgoland, were targeted. These regions are typical fishing grounds for industrial fisheries.

Porpoise distribution and abundance in the German North Sea proved to be subject to strong seasonal changes. Harbour porpoises occurred in large numbers within the EEZ in spring, with well defined areas of particularly high densities. The area of Sylt Outer Reef was the largest aggregation zone, Borkum Reef ground off the island of Borkum a smaller one. Other high density areas were found at the Dogger tail end (Fig. 3A). Overall porpoise density in the German EEZ reached its maximum in summer. Highest densities were again found around Sylt Outer Reef, while the aggregation around Borkum Reef ground had disappeared. Areas of high density also remained at the Dogger tail end (Fig. 3B).

In autumn, harbour porpoises were more evenly dispersed throughout the EEZ. Aggregations like in spring and summer were not apparent. Overall porpoise density was much lower than in spring and summer. Highest densities were still found in the area of Sylt Outer Reef and at the Dogger tail end. In comparison to summer, more porpoises were found in the southern part of the study area, although the overall density was much lower than in spring or summer (Fig. 3C).

Relationships to fisheries

Considerable overlap with porpoise distribution was found for gill net fisheries and unspecified trawling in summer. Given the high resemblance between TX and sand eel fisheries during summer, the temporal and spatial agreement of TX, sand eel fisheries and harbour porpoise suggests a seasonal dependency of both on the same resource, i.e. sand eels (*Ammodytes* spp.). The sand eel fishery is the largest single-species fishery in the North Sea (Furness 2002). It is the fishery with the largest potential for competition with harbour porpoise. Sand eels form an important part of the diet of harbour porpoise, and for most other top predators (Greenstreet et al.1998, Wright et al. 2000, Furness 2002, Fredriksen et al. 2006), especially in summer (quarters 2 and 3) (Santos et al. 2004) when sand eels are exceptionally rich in energy (Hislop 1991). They are more easily available for predators compared to the rest of the year when they spend much time feeding in the upper layers of the North Sea (Furness 2002, Vorberg & Breckling 1998).

Evidence for a similar relationship between harbour porpoise and gill net fisheries during summer remained equivocal. Our analysis either suggests a preference for similar target species/diet in summer by fisheries and cetaceans, or in turn potential depredation of harbour porpoise on gill nets. Next to sand eel and herring harbour porpoise feed extensively on gadids (Aarefjord et al. 1995, Santos et al. 2004) in the North Sea, which are among the target species of gill net fishing.

Little overlap was found between activities of large beam trawlers and porpoise distribution.

Conclusion

Potential impacts on the harbour porpoise population

Porpoises in the German EEZ face a variety of anthropogenic impacts (Hutchinson et al. 1995, Kaschner 2001, Scheidat & Siebert 2003), the cumulative effects of which remain unknown. Mit dem folgenden Satz konnte ich mich nicht einverstanden erklären. In der Abänderung ist er ok. (Fields of potential conflict between human activities and porpoises are known(Scheidat & Siebert 2003) but it is difficult to assess what impact a possible conflict might have on harbour porpoise. We have analysed three major fisheries in the North Sea in order to identify to what extent these fisheries might have an impact on harbour porpoises.

About 20 % of the Dutch gill netters report by-catches of 1 or more porpoises per year (Osinga et al. 2007). Vinther (1999) estimated an annual by-catch of 6785 porpoises by bootstrapping in various Danish gill net fisheries in the North Sea and the Skagerrak-Kattegat from 1992 to 1998. The German bottom – set gill net fishery in the North Sea is comparatively small. Its by-catch was estimated at 30 porpoises per year in 2003 (Kock and Flores 2003). Our results underlined that a close relationship between gill net fisheries and harbour porpoise distribution in the North Sea exists especially in summer. As the overlap occurs mainly in summer temporary restricted conservation measures may reduce the risk of by-catch.

Competition for the same resource may be considered as another area of potential conflict with respect to sand eel fisheries. Danish catches of sand eel in the North Sea amount to 500,000 - 900,000 metric tonnes and constitute a major removal of fish biomass from the ecosystem (Nielsen & Mathiesen 2006). The absence of sand eel in Scottish waters was associated with increased starvation of porpoises (Macleod et al. 2007) and a failure in breeding success of seabirds (Mavor et al. 2005). Given their limited capacity to store energy harbour porpoises have to feed regularly without longer periods of fasting (Koopman et al. 1996). A temporary shortage of prey could thus negatively impact on the animals. A potential competition between fisheries and porpoises for sand eels should be considered with concern and requires further investigation. Measures, such as the establishment of a “sand eel box” like in Scottish waters (Monaghan 1992, Nielsen & Mathiesen 2006) may be considered as one means to reduce future competition between the two.

Acknowledgements

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Figures

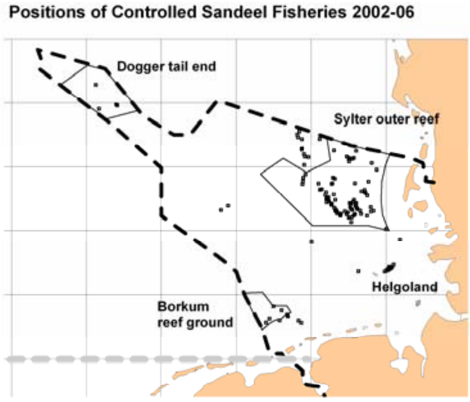


Fig 1 : German Bight with German Exclusive Economic Zone (EEZ). Seaside border is indicated by bold broken line. Designated marine protected areas under the EC Habitats Directive (Council Directive 92/43/EEC) are outlined. Positions of controlled sand eel fisheries are indicated by small squares.

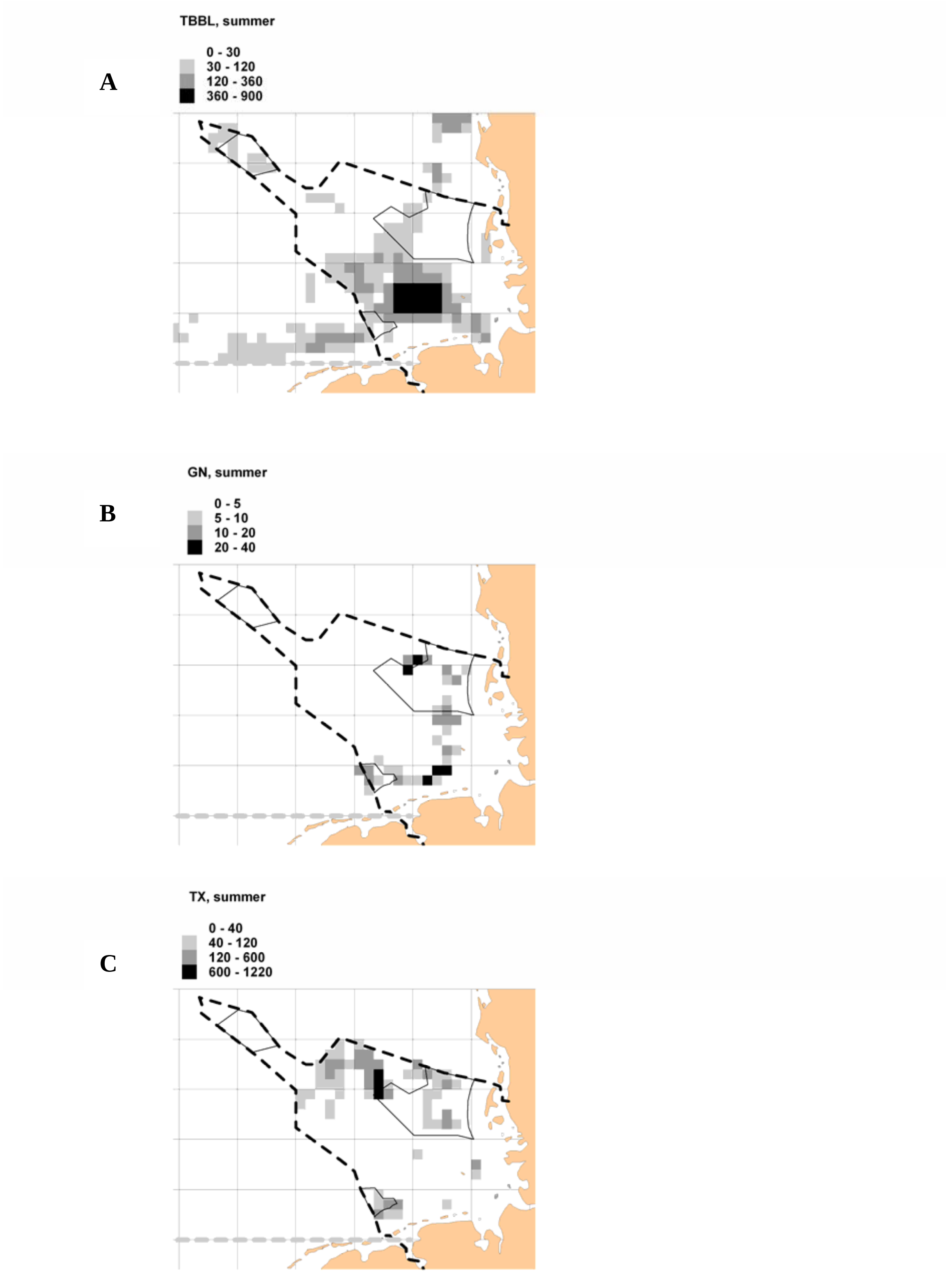
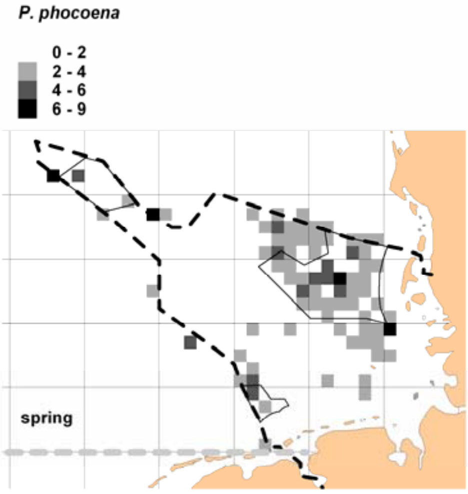


Fig 2 : Summer fishing effort for (A) large beam trawlers (TBBL), (B) gill net fisheries (GN) and (C) unspecified trawling (TX) in the German Bight. Values inside the EEZ comprise all

vessels, values outside the EEZ represent German vessels only. Effort calculations based on VMS data. Effort in hours per parcel per year. Designated MPAs are indicated (see Fig. 1).

A



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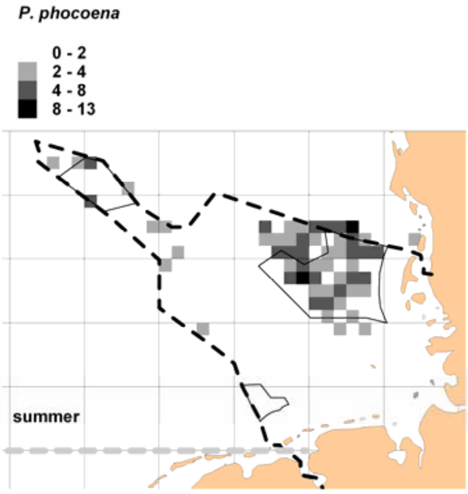

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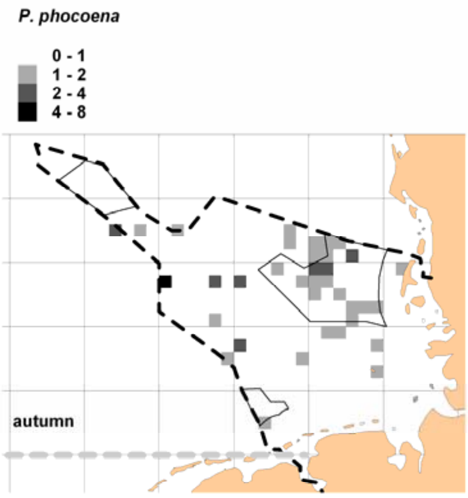

Fig 3 : Distribution of harbour porpoise in the German EEZ. Density in animals per km² for each cell. Note that scale is different for autumn figure.