Agenda Item 6.1 Project Funding through ASCOBANS
Progress of Supported Projects

Document 6-06

Preliminary Project Report: Understanding harbour porpoise (*Phocoena Phocoena*) and fishery interactions in the north-west Iberian Peninsula

Action Requested

- Take note of the report

Submitted by Secretariat / University of Aberdeen

NOTE:
IN THE INTERESTS OF ECONOMY, DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

Understanding harbour porpoise (*Phocoena Phocoena*) and fishery interactions in the north-west Iberian Peninsula

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Project objectives

The present project aimed to:

1. Quantify life history parameters (age structure, age and length at sexual and asymptotic maturity, pregnancy rate, etc) in harbour porpoises in the Northwest Iberian peninsula (NWIP).
2. Use age-at-death data to estimate total and fisheries mortality rate for porpoises in the NWIP.
3. Examine evidence for temporal trends in age at sexual maturity, reproductive output and mortality rates in porpoises in the NWIP.
4. Compare life history parameters for Iberian porpoises with those from northern Europe.
5. Investigate seasonal, geographic, annual and ontogenetic variation in the diet of NWIP in relation to prey abundance and thus define their trophic role in the area.
6. Provide recommendations on conservation of porpoises in the NWIP.

Introduction

- The North West Iberian Peninsula (NWIP), as defined for the present project, consists of Galicia (north-west Spain), and north-central Portugal.
- The NWIP is one of the world's main fishing areas, with an estimated 1.5 million fishing trips per annum. The fishing industry in the NWIP is of considerable social and economic importance to the area.

- The NWIP has one of the highest rates of marine mammal strandings in Europe and a high number of by-catches, including by-catches of harbour porpoises (*Phocoena phocoena*) making it an important area for cetacean-fishery interactions to be monitored (Lopez et al., 2002).
- At present, Spain and Portugal are ASCOBANS Range States but not Member States.
- The NWIP harbour porpoise has recently been recognised as forming a genetically distinct population (Fontaine, 2008). The only population estimate is from SCANS-II in 2005 which estimated 2600 porpoises in the Iberian Peninsula (Hammond et al., 2008).
- Previous dietary studies on cetaceans in the NWIP show that commercially important fish species constitute a significant part of the diet (e.g. Silva, 1999; Santos et al., 2007) although there are no detailed published results for porpoises in the area.
- To provide context for information on by-catches, baseline information is required on population dynamics and life history parameters (including birth and mortality rates) and ecology (e.g. diet), information which currently exists in scattered form in grey literature sources or is entirely lacking for harbour porpoises in Galicia.
- Cetacean by-catch in Galicia is likely to substantially exceed limits recommended by ASCOBANS (ASCOBANS, 1997) and the International Whaling Committee (IWC) (IWC, 1995).

Materials and Methods

Necropsies and sample collection

This project utilized porpoises collected by the northern Portuguese and Galician strandings monitoring networks, coordinated by Sociedade Portuguesa de Vida Selvagem (SPVS) in cooperation with Instituto de Conservação da Natureza e Biodiversidade and Coordinadora para o Estudio dos Mamíferos Mariños (CEMMA) respectively. The networks have been operational since 2000 and 1990 respectively.

When sufficiently fresh carcases can be accessed, stranded and by-caught harbour porpoises are necropsied and cause of death and evidence of fisheries interactions are recorded when possible, following the European Cetacean Society protocols (Kuiken and Hartmann, 1991; Kuiken, 1994). Basic biometric data ware recorded and samples collected for life history and diet analysis (among other studies). Samples of teeth and stomach contents are stored in 70% alcohol and reproductive tracts (ovaries and testes) are stored in 10% buffered formalin until further analysis.

Age estimation

Teeth were prepared following an adapted protocol of (Hohn and Lockyer, 1995) whereby the teeth were formalin-fixed for 24 hours and then thoroughly rinsed in water. Teeth were

decalcified using the commercial decalcifying agent *Rapid Decalcifier* (RDO©) until they were slightly pliable. Decalcification time ranged from 1 hour for neonates to around 8-10 hours for adults. Once decalcified, the teeth were rinsed thoroughly in water for at least 8 hours. Teeth were sectioned at 25 µm using a cryostat set at -12°C. Sections were stained with Mayer's haematoxylin (modified by Grue) and 'blued' in a weak ammonia solution. The best sections (those cut through the centre point of the crown and pulp cavity) were selected and mounted on glass slides using DPX. One tooth from each individual was sectioned parallel to the mandible (the 'porpoise cut') and a second was sectioned perpendicular to the mandible (the 'dolphin cut'). Age was estimated by counting growth layer groups (GLGs) in the dentine of the tooth sections using a binocular microscope (x10-50 magnification). Duplicate age estimates were conducted by two independent readers without reference to biological data. If the age estimates obtained differed by more than 1 year, readings were repeated. If the increments were difficult to count, both readers discussed the interpretation and either reached an agreed age or judged the tooth to be unreadable. Individuals for which age could not be determined or estimated age was considered to be unreliable were excluded from further analysis.

Female reproductive status

Females were examined at the time of necropsy for evidence of pregnancy and/or lactation. Formalin-fixed ovaries were weighed, measured and sectioned at 5 mm intervals along the broad ligament. The presence of mature follicles, *corpora lutea* and *corpora albicantia* was recorded and these structures were measured to determine individual reproductive status and history. Females were classified into 5 reproductive status classes based on recommendations by the IWC (Perrin et al., 1984): 1) sexually immature, 2) pregnant with foetus, 3) pregnant and lactating, 4) lactating and recently pregnant, and 5) resting mature. Standard paraffin-embedded histological samples were processed. Sections were made at 5-8 µm and stained with Mayer's hematoxylin and eosin. Microscopic examination was conducted to confirm macroscopic findings.

Male reproductive status

Testes with attached epididymis were measured and weighed, and a central cross-section was formalin-fixed. Standard paraffin-embedded histological analysis was conducted. Sections were cut at 5-8 µm and stained with Mayer's haematoxylin and eosin. Microscopic analysis was conducted to measure the diameter of seminiferous tubules and to record cell activity (sertoli cells, interstitial tissue, and germinal cells such as spermatogonia, spermatocytes, spermatids and spermatozoa). Males were classified into 4 reproductive status classes based on Murphy et al. (2005): 1) immature, 2) pubescent, (3) active mature and (4) resting mature.

Diet analysis

Stomach contents were rinsed in water. Eyes and cephalopod beaks were stored in 70% alcohol and fish otoliths and bones were air dried and stored dry. Prey items were identified and counted.

Original sizes were estimated by taking standard measurements on hard parts (fish otoliths and bones and cephalopod beaks) following a standard protocol (Santos et al., 2001).

Data analysis

The final report will contain detailed information on data analysis and conclusions in relation to:

- Age and length at sexual maturity
- Life tables and estimated mortality rate
- Relative frequency of different causes of death and implications for fisheries mortality rate
- Diet analysis

Preliminary Results and discussion

Strandings

Between 1990-2010 a total of 324 harbour porpoises were recorded as stranded in the NWIP, an annual mean of 22 harbour porpoises per year. Between 1990-1999 only the Galician network was operational and although some older data exist for Portugal they are not strictly comparable. Considering the extension of the study area to include north-central Portugal from 2000 and the increase in public awareness of marine mammals and strandings in the last 20 years, it is surprising that no long-term increase in recorded strandings rate is observed. It may even be speculated that there was an underlying decline in the number of porpoise strandings.

Age, reproduction and maturity status

Age was estimated for 147 harbour porpoises, 69 females and 75 males. Maturity status was obtained for a total of 45 females and 37 male harbour porpoises in the NWIP. No overall trend over time in age-at-death was observed, although it appears that more older animals were aged during 2006-2010 than in previous years. The relatively small number of samples available means that the statistical power available to detect small or variable trends in average age, and hence in mortality rate, is low.

Iberian harbour porpoises are much larger than other studied populations (Learmonth, 2006 and references therein). Average age at sexual maturity was ~6 years and 5 years for females and males respectively. This appears to be higher than in other studied harbour porpoise populations although small sample size is an issue. A high mortality of harbour porpoises occurs before attainment of sexual maturity. Over 60% of stranded animals for which age was established were 3 years old or younger. This has also been observed in other studied populations, e.g. in the UK (Lockyer, 2003; Learmonth, 2006).

Based on age-at-death data, there is an estimated annual mortality rate of 18% of the population. The validity of this estimate depends on the representativeness of the strandings data but it is similar to results obtained for Scotland (Pierce et al., unpublished data).

Diet

Results of the 56 stomach contents analysed showed a varied diet. The main prey (in percentage reconstructed weight) is *Trisopterus* spp. (32.2%) followed by blue whiting (*Micromesistius poutassou*) and *Trachurus* sp. (20.8% and 17.6% respectively). Remains of neritic cephalopods (*Alloteuthis* sp. and sepiolids) were found in some stomachs but they contributed very little to the overall prey weight due to their small size. Crustaceans were also found in the diet but in a few stomachs.

Causes of mortality and importance of fisheries interactions

No age difference between by-caught and non-by-caught animals was observed and males and females appear to be equally likely to be by-caught.

Cause of death could be determined for 40 % of harbour porpoise strandings in the NWIP, of which 60% of mortality is attributed to fisheries interactions. Therefore, assuming unbiased sampling, 18% × 60% = 11% of the Iberian harbour porpoise population dies annually due to fisheries interactions. Even if we assume that none of the undiagnosed deaths was due to by-catch the mortality rate due to fisheries interactions is 18% × 60% × 40% = 4.3%. Although it is not possible to rule out biases in the data (e.g. strandings are not necessarily representative of the living population etc), these rates are considerably higher than the maximum by-catch rates recommended by the IWC and ASCOBANS.

Preliminary Conclusions

- No long-term trends in harbour porpoise strandings are observed in the NWIP but the low number of strandings means that only strong trends would be likely to be detected.
- Porpoise have a varied diet including several commercially important fish species.
- Trends in age-at-death need to be further investigated.
- The estimated annual population mortality rate is 18%.
- 60% of strandings with a known cause-of-death were attributed to fisheries interactions.
- No age- and sex-related variation in by-catch rates was indentified.
- The rate of by-catch mortality is most likely very high (potentially 11%) and unsustainable.
- A dedicated by-catch study needs to be implemented in the NWIP and mitigation methods investigated.

Dissemination of Results

Data generated from the present project were presented at both the European Cetacean Society and Society for Marine Mammalogy conferences and at the SAFESEA project conference during 2011.

Iberian harbour porpoise ages will also be used for studying age-related patterns in stable isotope signatures and contaminant bioaccumulation as part of the PhD of Paula Méndez Fernandez from the University of La Rochelle, France and the University of Minho, Portugal.

Conference presentations

By-catch mortality and conservation of the Iberian harbour porpoise population. Fiona L. Read, Ángel F. González, Marisa Ferreira, Alfredo López, José Vingada, Begoña Santos and Graham J. Pierce. 19th Biennial Conference on the Biology of Marine Mammals, Tampa, USA. December 2011. Oral presentation.

Life History data from harbour porpoises stranded in the Iberian Peninsula. Fiona L. Read, Ángel F. González, Marisa Ferreira, Alfredo López, José Vingada, Begoña Santos and Graham J. Pierce. 'Sustainability of local fishing arts and the promotion of a safer sea for cetaceans' SAFESEA conference, Figueira do Foz, Portugal. April 2011. Invited oral presentation.

The importance of long-term datasets for conserving the Iberian harbour porpoise population. Fiona L. Read, Ángel F. González, Marisa Ferreira, Alfredo López, José Vingada, Begoña Santos and Graham J. Pierce. 25th European Cetacean Society Conference, Cadiz, Spain, March 2011. Oral presentation.

Collaborative projects

Long term ecological segregation among the NW Iberian Peninsula odontocete species as evidence using ecological tracers. Paula Méndez Fernandez, Paco Bustamante, Tiphaine Chouvelon, Marisa Ferreira, Ángel González, Alfredo Lopez, Graham Pierce, Fiona Read, Begoña Santos, Jérôme Spitz, José Vingada and Florence Caurant. 'Sustainability of local fishing arts and the promotion of a safer sea for cetaceans' SAFESEA conference, Figueira do Foz, Portugal. April 2011. Invited oral presentation. (Extended version of the latter presentation).

Long-term ecological segregation among the NW Iberian Peninsula odontocete species as evidenced using ecological tracers. Paula Méndez Fernandez, Paco Bustamante, Tiphaine Chouvelon, Marisa Ferreira, Ángel González, Alfredo Lopez, Graham Pierce, Fiona Read, Begoña Santos, Jérôme Spitz, José Vingada and Florence Caurant. 25th European Cetacean Society Conference, Cadiz, Spain, March 2011. Oral presentation.

Acknowledgements

We thank CEMMA and SPSV for provision of samples and necropsy reports.

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