Progress report: studies of marine mammals in the Cardigan Bay cSAC carried out by Sea Watch Foundation Cymru, January 2005

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Introduction and acknowledgments

This report summarises the research work carried out by Sea Watch Foundation (SWF) in the Cardigan Bay cSAC, Wales during the period April-December 2004. With exemptions of studies V and VI (acoustics), the descriptions presented in this report (pages 6-9) are based on abstracts submitted to the 18th international conference of the European Cetacean Society, to be held in La Rochelle in April 2005.

Our main research goal is to estimate the abundance of bottlenose dolphins and other marine mammals in the Cardigan Bay cSAC, using line-transect surveys and photo identification. The preliminary results of this work are summarised in studies I and II.

During 2003 and 2004, we have compiled a photo identification database for bottlenose dolphins (study II). Janet Baxter, from Friends of Cardigan Bay and Mick Baines, from SWF, provided with ID photographs and data that allowed a study of large temporal scope on the resident patterns of the bottlenose dolphins of Cardigan Bay (study III). Two volunteers, Eleanor Stone and Sergi Perez, and a student, Rob Lott, did much of the work comparing the ID photographs used in study III, which was incorporated into part of Rob Lott's MSc thesis for the University of Wales, Bangor. The other part of this thesis consisted on analyses of the social structure of the dolphins (study IV), with basis on the photo identification database.

Malene Simon, a bio-acoustician, tested the potential of the area for acoustic studies of bottlenose dolphins (study V). Sound recordings were made with support from the University of Aarhus, Denmark and Environment Wales. Malene also liaised with Mike Camplin, from the Countryside Council for Wales (CCW), to carry out a pilot study to monitor bottlenose dolphins and harbour porpoises using T-PODs, which are instruments that log the occurrence of cetacean echolocation clicks (study VI).

The last study presented in this report (study VII), a combined visual-acoustic survey to investigate the presence of dolphins in New Quay Bay, was carried out by Jennifer Lamb, as part of her MSc thesis for the University of Wales, Bangor.

At sea, on land by the sea and in the office, a small army of volunteers gave us thousands of hours of work. Without their input, the projects presented here would not have been possible. Besides helping to carry out the studies described in this report, our volunteers collected and entered data for the national SWF database of cetacean sightings and effort and for the long-term land based monitoring of bottlenose dolphins carried out by the Ceredigion County Council. Tom Felce was the volunteer responsible for coordinating the input of all the sightings and effort data into computer, which was a considerable task.

Steve Hartley, from the Cardigan Bay Marine Wildlife Centre, provided with boat and assistance in the field for all the studies mentioned above.

A considerable part of the work presented in this progress report was funded by CCW.

Work investment

The following tables summarise the number of boat trips in which data were collected (tables 1 and 2), the number of sightings of the different species (tables 3 and 4) and the amount of data used in distance-sampling and photo identification analyses (tables 4 and 5). A more detailed breakdown of boat trips, and the cost of surveys, can be found in appendix 1. In addition to the trips summarised in tables 1 and 2, sightings and effort data were collected during 121 trips along the Ceredigion Heritage Coast, which last approximately 2 hours.

Table 1. Dolphin-watching trips, provided by Steve Hartley, in which data was collected. In this table, one 8 hr and one 4 hr trips were added to the regular dolphin-watching trips; see appendix 1, costs of surveys for an explanation.

Trip duration	**Distance sampling & photo ID**	**Photo ID only**	**Total**	**Equivalent in 8 hr days**
8 hr[1]	1	4[2]	5	5
4 hr	9	17[3]	26	13
			Total	**18 days**

Table 2. Dedicated surveys and training surveys funded by CCW through SWF. In this table, one 8 hr and one 4 hr surveys were subtracted from the trips funded by CCW/SWF; see appendix 1, costs of surveys for an explanation.

Trip duration	Distance sampling & photo ID	Photo ID only	Total	Equivalent in 8 hr days
8 hr survey	7	1	8	8
4 hr survey	1	3	4	2
4 hr training	1	10	11	5.5
2 hr training	2	8	8	1
		Total		**16.5 days**

Table 3. Sightings of groups of marine mammals

Type of trip → / Species ↓	**Distance sampling & photo ID**	**Photo ID only**	**2 hr along Heritage Coast**	**Total**
Bottlenose dolphin	52	111	209	**372**
Harbour porpoise	94	39	11	**144**
Grey seal	91	49	305	**445**
Total	**237**	**199**	**525**	**961**

[1] The 8 hr trips were chartered by the University of Swansea, the British Geological Survey and CCW (for training of personnel).
[2] This includes one 8hr trip to compensate for paying passengers in dedicated surveys (see appendix 1)
[3] This includes one 4hr trip to compensate for paying passengers in dedicated surveys (see appendix 1)

Table 4. Data collected in 2004 and used for distance sampling estimates of abundance

Item	Amount
Distance covered on effort	696 km
Number of transect lines	51
Sightings of dolphins	18
Sightings of porpoises	50
Sightings of grey seals	28

Table 5. Data used for photo identification analyses

Item	Amount
Dolphin groups photographed	119 groups
Films taken	70 films
Analogue pictures taken	2,520 pictures
Digital pictures taken	2,709 pictures

Abstracts of studies carried out in 2004-2005

Study I: Abundance estimation of marine mammals in the Cardigan Bay cSAC from line-transect surveys using a small boat

Our goal was to estimate the densities of marine mammals in this area in the Cardigan Bay cSAC. Our budget allowed for 16 distance-sampling/photo-identification surveys per year, from a 10m vessel (observation height, 3m). In 2003, a pilot study indicated that an increase in effort was needed to improve confidence intervals in abundance estimations based on the distance-sampling methodology (Ugarte *et al* 2003). In order to increase the survey effort during 2004, we incorporated distance-sampling methodology into dolphin-watching trips. Using Distance software, we estimated densities of 0.2 grey seals/km^2 (%CV 23.32) and 0.5 harbour porpoises/km^2 (%CV 23.08). These estimates were consistent with the ones obtained during 2003 and confirm the importance of the area for the conservation of these species. The density estimated for bottlenose dolphins was unrealistically low (0.12 dolphins/km^2, %CV 39.72), probably due to a small sample size combined with the detection function being skewed by atypical sightings.

Study II: Photo identification of bottlenose dolphins in the Cardigan Bay cSAC

We are creating a database of identification photographs and sighting histories of naturally marked bottlenose dolphins. As this database develops, estimates of the numbers of dolphins in the Cardigan Bay cSAC are carried out. The flattening of a discovery curve showed that a large proportion of well-marked animals had been identified. Based on the size of our catalogue, the minimum number of dolphins utilizing the area is 119. Based on the proportion of well-marked animals present in encountered groups (72%, SD=0.41, N=75 group counts), it was estimated that approximately 138 dolphins inhabit the study area. This number is consistent with the high dolphin density estimated during the pilot distance-sampling study of 2003 (0.3 dolphins/km^2, %CV 36.58).

Study III: Site fidelity of bottlenose dolphins in Cardigan Bay

Cardigan Bay, Wales, is one of the three places in the UK and Ireland where bottlenose dolphins can be seen regularly. Boat-based photo-identification surveys have been carried out in this area since the late 1980's. Photo identification effort has focused on an area of approximately 1,000 km^2 that was designated as the Cardigan Bay candidate Special Area of Conservation (cSAC) in 1996. In this study, we compared identification catalogues of bottlenose dolphins that were obtained by different research teams. The data sets include catalogues from two available reports (Arnold et al. 1997, Gregory 2001) and three sets of unpublished identification pictures. The study periods were 1990-1993, 2001 and 2003-2004. Sighting patterns were separated into 3 categories: 1) animals seen in all three periods (N= 12), 2) animals seen in 2001 and 2003-2004 (N= 29) and 3) animals only seen 2003-2004 (N=88). Re-sightings of dolphins range from 4 to 42 times. When possible, tentative sex, birth dates and reproductive histories were allocated to identified dolphins. Plots

of locations where dolphins identified more than 20 times were seen indicated that certain individuals exhibited a preference for specific areas within Cardigan Bay. The present study demonstrated for the first time that there is a population of bottlenose dolphins in Cardigan Bay whose long-term seasonal residency extends over more than 15 years. In addition, we provided information, such as cross-referenced identification catalogues, sightings histories and demographic data, which are useful for future management and monitoring programmes.

Study IV: Social structure of bottlenose dolphins in Cardigan Bay

The social organisation of bottlenose dolphins (*Tursiops truncatus*) in British and Irish waters has been studied in the Moray Firth, Scotland and the Shannon Estuary, Ireland (Wilson 1995, Ingram 2000). We sought to investigate, for the first time, the social associations of bottlenose dolphins in Cardigan Bay, Wales, the third place in British and Irish waters where sizeable populations of bottlenose dolphins are known to occur. A total of 72 photo-identification surveys were made during 2003, resulting in 134 dolphin encounters. Fifty-two identified dolphins were selected based on their number of sightings. Individuals accompanied by calves were categorized as females and extensively scarred animals as males. Associations were studied using half-weight indices and cluster analysis. In addition, temporal analyses of associations were made plotting changes in the standardised re-association rate over time. The social organisation was characterised by relatively fluid association patterns, with little stability over periods longer than a few days. Some longer-term companions were evident. Permutation tests revealed the presence of preferred and/or avoided companions. Both males and females interacted with a large number of other individuals. In contrast to studies from the Moray Firth and the Shannon Estuary, we found significantly stronger associations between certain male pairs. As in the Shannon Estuary and in the Moray Firth, we found no evidence of stable female bands. The low risk of predation in these three areas may reduce the need for stable female cohorts, such as those observed in more tropical waters, while the shallow waters of Cardigan Bay may favour the male alliance strategy in coercing reproductive females. Six loosely defined clusters of dolphins, including animals of both sexes, were identified. These clusters could reflect the existence of preferred geographical ranges that influence the dolphins' social networks. A similar situation has been hypothesised in the Shannon Estuary. This degree of site fidelity highlights the fact that monitoring based on photo-identification needs a good geographical spread.

Study V: Underwater sounds of bottlenose dolphins in Cardigan Bay

Dolphins and porpoises use echolocation to navigate and to find objects, such as prey and group members. In addition, bottlenose dolphins can use signature whistles, which are individually unique signals, used to keep contact with group members, especially important for mother-calf pairs. Sound pollution is an extensive problem in marine habitats. Coastal species, such as bottlenose dolphins and harbour porpoises, are especially affected because they live in habitats where an increasing amount of pleasure crafts operate. Fast boats usually make sounds in the same frequency band as

the ones dolphins use. This can have potential effects such as loss of contact with group members and reduced feeding success.

The physical characteristics of the sounds made by captive bottlenose dolphins have been well described. However, remarkably few studies exist of the physical characteristics of sounds made by dolphins in their natural environment. This is despite the fact that dolphins are able to vary the frequency, intensity and duration of their sounds. A thorough understanding of the physical characteristics of the sounds used by the dolphins is necessary to mitigate underwater acoustic pollution and to carry out acoustic monitoring of the animals. During 2004, we experimented with a high frequency array to investigate the physical characteristics of the sounds made by the dolphins. We obtained recordings of a few echolocation clicks suitable for further analysis and are now able to use this technique in future studies.

In addition, we have created a database of sounds produced by bottlenose dolphins in Cardigan Bay. This database consists of sound files, spectrograms and relevant data, such as recording time and place and size and behaviour of the dolphin group, as well as cross references to the photo identification database. It is our hope that this database will expand with time and become a useful tool for monitoring, research and education projects.

Study VI: Acoustic monitoring of cetaceans using T-PODs in the Cardigan Bay cSAC

A T-POD is an autonomous, self-contained unit, which can be left in the seabed for extended periods of time to log the occurrence of click sounds. The information can then be downloaded to a computer. It records the time when clicks with pre-defined characteristics were detected and can, to a certain extent, discern between echolocation clicks produced by dolphins and clicks produced by porpoises. During 2004 we carried out a pilot project to test the deployment, mooring, retrieval and data handling of T-PODs in the Cardigan Bay cSAC, for the monitoring of bottlenose dolphins and harbour porpoises. The performance of 4 T-PODs was evaluated by placing them in close proximity, attached to a lobster pot in the bottom of New Quay Bay until we were certain that they had been in proximity of bottlenose dolphins. The three functioning T-PODs differed in sensitivity, a fact that should be taken into account when comparing data from the locations where the different T-PODs were deployed. From July to October, we deployed the T-PODs close to the headlands of New Quay, Ynys-Lochtyn and Aberporth. Maintenance and re-deployment were carried out at intervals ranging from 1 to 6 weeks. The mooring system performed satisfactorily, even though the T-PODs were exposed to extremely bad weather. Preliminary analyses of the data show that both, bottlenose dolphins and harbour porpoises extensively used the three areas.

Study VII: Relationships between bottlenose dolphins, environmental variables and boat traffic; visual and acoustic surveys in New Quay Bay

The use of New Quay Bay, within the Cardigan Bay candidate Special Area of Conservation, by the resident bottlenose dolphins (*Tursiops truncatus*) was investigated by visual and acoustic means. A land-based visual survey conducted

from May 1st to August 7th 2004 and a T-POD acoustical survey conducted from June 14th to August 7th 2004 were used to investigate which natural factors affect the presence of the dolphins and also the possible impact of boat traffic in this area. A total of 497 hours of visual data and 1077 hours of acoustic data were collected. Comparisons of the two data sets were made to determine any potential differences between the two techniques. Both bottlenose dolphin presence and boat traffic were found to peak in August. Dolphin presence throughout the day varied inversely with boat traffic. Peak use of the bay by dolphins was at midnight, whereas greatest boat traffic was observed at 1pm. The tidal cycle was significantly correlated with bottlenose dolphin presence, indicating greater presence during the ebb phase of the tide as compared to the flood phase. The reaction of dolphins during boat interactions varied significantly. Most encounters resulted in the dolphin either changing its behaviour or disappearing from view. Fast moving boats such as motorboats and speedboats appeared to cause greatest disturbance to the animals. Visual and acoustic methods revealed broadly similar patterns in most instances. The combined use of both techniques compensated to an extent for the drawbacks inherent to each survey. Precautionary measures such as codes of conduct for marine vessels may help to reduce disturbance experienced by bottlenose dolphins and other marine wildlife, due to increased boat activity in the area. Further study is necessary to determine any long-term impacts of disturbance caused by boat traffic.

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