

Bottlenose dolphins of the Hebrides



A summary report from five years of research
(2001-2005)

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Executive Summary

Historical sightings indicate that bottlenose dolphins (*Tursiops truncatus*) are widespread throughout the Hebrides (Shrimpton and Parsons, 2001). However, despite their documented presence in this region, little is known about the abundance, distribution, range or movements of these dolphins. This study presents preliminary results from five years of field research (2001-2005) on the distribution and abundance of bottlenose dolphins around the Hebrides from a combination of sightings data and photo-identification data. These data were collected primarily with opportunistic sampling methodologies. Sightings data were obtained through a public sightings network and were collated into a central database. These data proved useful in demonstrating the regular presence of bottlenose dolphins in this region, as well as general areas of annual return. Bottlenose dolphins were reported throughout most of the study area. Most sightings were close to the coast and were highest around Argyll and the Islands. Sightings were reported in all months of the year, suggesting possible year-round residency.

Photo-identification data were collected on an opportunistic basis from three sub-regions in the Hebrides (Skye, mid-Argyll and south Argyll) between 2001 and 2005 covering a distance of approximately 190 nautical miles. A total of 28 individuals were identified during 27 encounters of which 50% had long-term recognizable markings (dorsal fin nicks). Marked individuals were identified in 14 of the 27 encounters and number of marked individuals in each encounter ranged from 1 to 4. Each marked individual was re-sighted an average of 3.6 times (range 1-6). Movements of individuals extended across the entire study area. Twelve (46%) individuals were re-sighted in more than one sub-region in the same year and nine (34%) individuals were re-sighted in more than one sub-region between years. The rate of discovery of new individuals was very low, consistent with a small number of dolphins using the area. Group sizes reported from both the sightings and photo-identification datasets suggest small groups of between 6 and 12 individuals are most common. Larger groups of between 20 and 30 individuals are less frequently reported. Group sizes over 30 individuals were not documented in either dataset. Re-sightings data indicate that these larger aggregations are formed from combinations of the smaller sub-groups suggesting that the social structure of this population is extremely dynamic. The sightings and photo-identification data combined have provided some initial insights into the characteristics of the bottlenose dolphin population on the west coast of Scotland. Despite the temporal and spatial inconsistencies in the sampling effort, both types of data are consistent in their finding that the west coast of Scotland is host to a small, wide-ranging and probably resident population of bottlenose dolphins.

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Introduction

Bottlenose dolphins are listed under Annex II of the European Habitats Directive (Council Directive 92/43/EEC), which refers to species ‘whose conservation require the designation of Special Areas of Conservation’. The bottlenose dolphin has a worldwide distribution. It occurs in tropical and temperate seas of both the southern and northern hemispheres and in a wide range of habitats, including shallow estuaries and bays, continental shelf edges and deep, open oceans. In coastal waters, the species often occurs near large river estuaries, headlands or sandbanks, where there is uneven bottom relief and/or strong tidal currents (Lewis and Evans 1993; Liret *et al.* 1994; Wilson *et al.* 1997).

In the north-east Atlantic, bottlenose dolphins have been regularly documented off the coasts of Spain, Portugal, north-west France and the Channel, western Ireland, the Irish Sea (particularly Cardigan Bay) and north-east Scotland (especially the Moray Firth). In deeper waters, the species occurs near the shelf break off south-west Ireland southeastwards towards the French coast. Sightings of groups have been observed at various locations offshore including near the Rockall Bank and over the Wyville Thomson Ridge and the Ymir Ridge (Reid *et al.* 2003).

Several resident (but highly mobile) groups of bottlenose dolphins have been identified around the UK coast, for example in the Moray Firth (*c.* 130 animals; Wilson *et al.* 1997), in Cardigan Bay (130–350 individuals; Lewis 1992, Arnold *et al.* 1997), and in the Channel (including north-west France, at least 85 animals; Liret *et al.* 1998).

Historical sightings indicate that bottlenose dolphins (*Tursiops truncatus*) are widespread throughout the Hebrides (Shrimpton and Parsons, 2001). However, this species has been rarely recorded in previous cetacean surveys carried out in the region (Macleod, 2001; Reid, 2003), perhaps reflecting small group sizes and high mobility of dolphins in this area. As a result, little information on bottlenose dolphins in the Hebrides exists in the scientific literature. With the exception of a study of a group of bottlenose dolphins in the Sound of Barra, Outer Hebrides between 1995 and 1998 (Grellier and Wilson, 2003), no other previous dedicated research has been carried on this species off the west coast of Scotland. Without baseline information on frequency, seasonality of occurrence, estimates of abundance or distribution patterns, the status and ecological significance of these dolphins cannot be assessed either locally or nationally. This could have negative impacts for the overall conservation of this species.

The aim of this report is to summarise results from five years of bottlenose dolphin research conducted by the Hebridean Whale and Dolphin Trust (HWDT) and to highlight the presence of a group of bottlenose dolphins inhabiting an area where little dedicated research has been carried out on this species.

Two datasets have been created over a five year period (2001-2005):

- 1) A sightings database, providing information on occurrence and distribution

- 2) A photo-identification catalogue, containing information on individuals, population size and movements.

Methods

Sightings data

Given the unpredictable nature of bottlenose dolphin sightings in the Hebrides and the geographic complexity of surrounding coastline, there are several logistic limitations on dedicated monitoring. For this reason, data were pooled together from a number of different sources; sightings data were collected during boat-based and land-based surveys by trained observers and boat-based surveys were conducted from a number of different platforms, for example, fishing vessels, commercial passenger ferries, whale watching boats and HWDT research vessel 'Silurian'. In addition to sightings collected by trained observers, incidental sightings reports from members of the general public were also collected. They include fishermen, fish farmers, coastguards, ferry personnel, local wildlife operators, holidaymakers and ornithologists. By pooling together resources in this way, the amount of available data was maximised and monitoring capacity increased.

A standard sightings form was created requiring the following information about the sighting; date and time of sighting, species location (latitude and longitude), approximate group size and direction of travel. Finally, the observer had to give a confidence score on their species identification (possible =1, probable =2, definite = 3). In order to minimize bias due to species misidentification, only reports scoring 'definite' were included in the database. The sightings data were used to create distribution maps and to investigate occurrence within the study area (Figure 1).

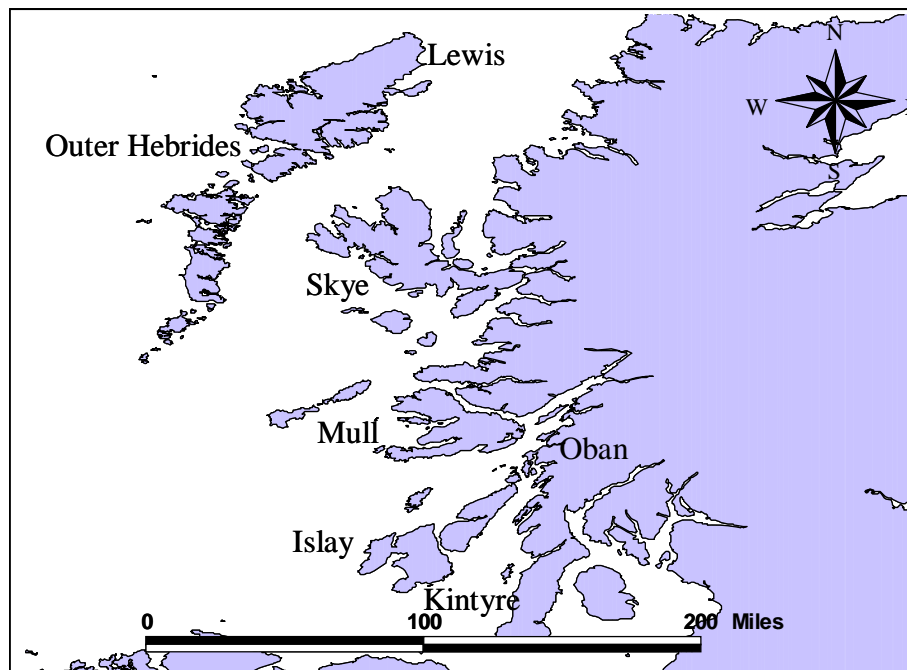


Figure 1. Map of study area.

Photo-Identification

Data collection

In order to gain a better insight into distribution and abundance of bottlenose dolphins in the Hebrides, a photo-identification project was launched in 2001. Photo-identification or photo-ID is a technique commonly used to study free-ranging populations of bottlenose dolphins. This technique uses individually distinctive natural markings on the surface of the dorsal fin and flanks to identify different individuals within the population (Würsig and Würsig, 1977). Photo-ID can provide valuable information on individual movement patterns, home ranges and habitat use (Hammond et al, 1990).

Identification photographs were collected from different sites in the Hebrides during a period of five years (2001-2005). The majority of these data were collected during opportunistic encounters, for example from whale-watch boats. Whenever dolphins were encountered they were counted, their locations and activities recorded and if possible photographic pictures of their dorsal fins and flanks taken. The sampling protocol was to photograph as many individuals as possible in the group, from both left and right sides. However, due to the opportunistic nature of much of the sampling, weather, light conditions and behaviour of the dolphins this was not always possible.

Identification of individuals from photographic data

Only good quality photographs (in focus, un-obscured, with the dorsal fin relatively perpendicular to the plane of the photograph, and with the dorsal fin large enough to identify distinctive markings, if present) were used for analysis. Individuals were identified by features such as nicks, scratches from tooth rakes and scarring from lesions on both their dorsal fins and flanks (Figure 2). Mark types were classified into five categories (0 = no marks; 1 = nicks; 2 = white fringes; 3 = deformities; 4 = lesions/pigmentation patterns; 5 = scars/scratches). Those individuals with dorsal fin nicks were assumed to be recognizable in the long term and are hereafter referred to as 'marked' animals (Wilson et al, 1999). Individuals without dorsal fin nicks can often be identified within and between encounters based on other features (e.g. lesions/pigmentation patterns, scars/scratches).

The best left- and right-side picture of each individual from each encounter was filed in the archive. If only one side of an individual's dorsal fin was photographed, then provided the image quality was good and the dorsal fin contained some obvious natural markings so that it could be reliably recognized again in future encounters, the individual was included in the archive for subsequent matching. Photographs from all subsequent encounters were compared with left- and right-sided images of dorsal fins in the archive. As many features as possible were used to confirm matches and reduce the possibility of false positives. Animals that could not be matched were given a new identification code. The proportion of marked individuals in the collection was estimated using a simple ratio of marked individuals to the total number of individuals identified during the study period. The total number of individuals excluded calves (due to lack of stable distinctive markings). The frequency of re-sightings of all individuals in the archive was calculated

and the locations and groups sizes of matched individuals were noted in order to investigate distribution, individual movement patterns and social structure.



Figure 2. Photo-identification picture of a bottlenose dolphin illustrating types of mark used for identification.

Rate of discovery

The cumulative number of unique individuals identified was plotted against the cumulative number of identified individuals to give the rate of discovery of new individuals (Wilson, 1999). This provides an indication of abundance, as the rate of discovery of new individuals slows as a greater proportion of the population is identified. The rate of discovery was examined separately for marked animals and unmarked animals.

Results

Sightings

A mean of 143 sightings were reported per year (range 91-193; Table 1). Sightings were widely distributed throughout the study area (Figure 3). The most northerly sightings were off the coast of northwest Sutherland and the most southerly sighting was off the tip of the Kintyre peninsula. The majority of sightings were reported in coastal areas. Sightings were highest around Islay in 2001 and were consistently high in all years in the Sound of Mull and around the Mull coast. Sightings were reported in all months of the year. Group sizes ranged from 1 to 30 and the most common group size was 7 individuals

(Figure 4). Sightings of solitary dolphins were reported in all years but were highest in 2003 (Table 1).

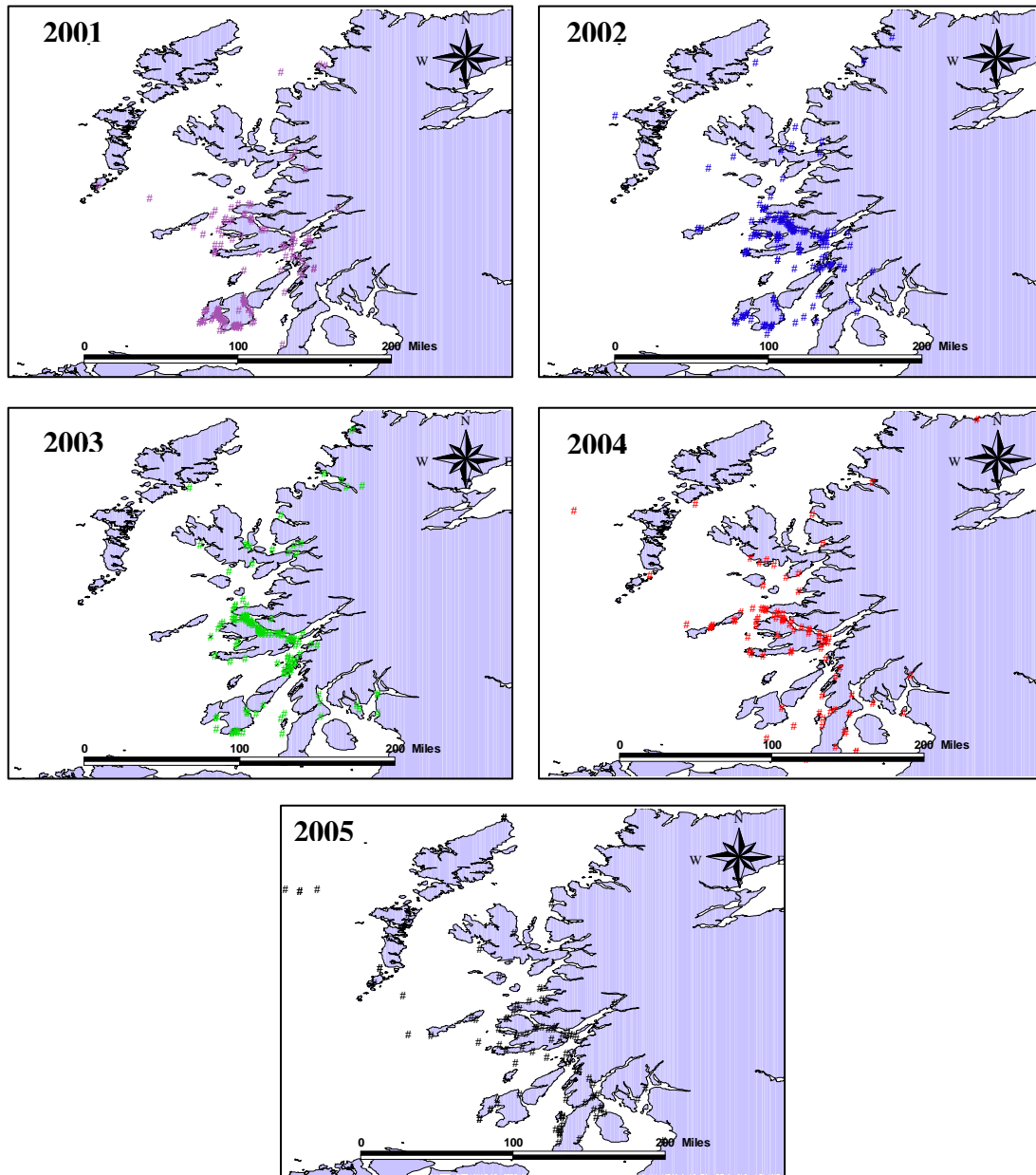


Figure 3. Annual distribution of bottlenose dolphin sightings off the west coast of Scotland 2001-2005.

Year	2001	2002	2003	2004	2005
No. of sightings	193	175	157	101	91
Mean group size (excl. solitary)	6.8	7.5	8.3	11.3	10.5
No. of solitary BND sightings	12	10	26	10	12

Table 1. Number of bottlenose dolphin sightings, mean group sizes (excluding sightings of solitary dolphins) and number of solitary bottlenose dolphin sightings recorded per year

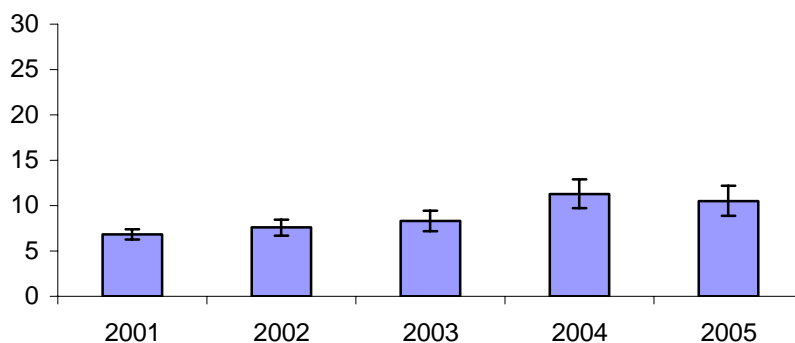


Figure 4. Mean group size per year from public sightings database

Photo-Identification

Between 2001 and 2005, approximately 1080 frames were taken during 27 encounters. A maximum of 28 individuals (excluding calves) was identified. The number of encounters varied between years (Table 2); the highest number was in 2004 (n=9) which was also the year with the highest number of newly identified individuals and re-sightings of archived individuals (Figure 5). Despite the low number of encounters in 2005 (n=2), a relatively high number of individuals were matched. This was due to the high number of good quality images obtained during the two 2005 encounters. The number of encounters was also low in 2003 (n=3) which was the least productive year in terms of matches. This can be attributed to two out of three encounters in 2003 being of a solitary dolphin.

Marked individuals were identified in 14 of the 27 encounters. Number of marked individuals identified in each encounter ranged from 1 to 4. Of the 28 individuals in the archive, left- and right-side dorsal fin pictures were collected for 16 animals. 14 of these had long-term recognisable markings (dorsal fin nicks). The rest of the individuals in the archive were identified based on other features such as pigmentation patterns and scarring (Figure 6). Twelve individuals were photographed on either the left- or right-side of the dorsal fin (Table 3).

	2001	2002	2003	2004	2005
No. of encounters per year	6	7	3	9	2
Cumulative no. of new individuals ID'd	6	10	11	23	28
No. of matches within year	6	2	1	16	8

Table 2. Number of new individuals identified and subsequently re-captured in each year.

	2001	2002	2003	2004	2005
L-side	3	0	0	1	1
R-side	2	0	0	3	3
Both	1	5	1	8	1
Min Individ ID'd	4	4	1	10	3
Max Individ ID'd	6	4	1	12	5

Table 3. Number of new individuals archived per encounter in each year (left-side, right-side and both sides).

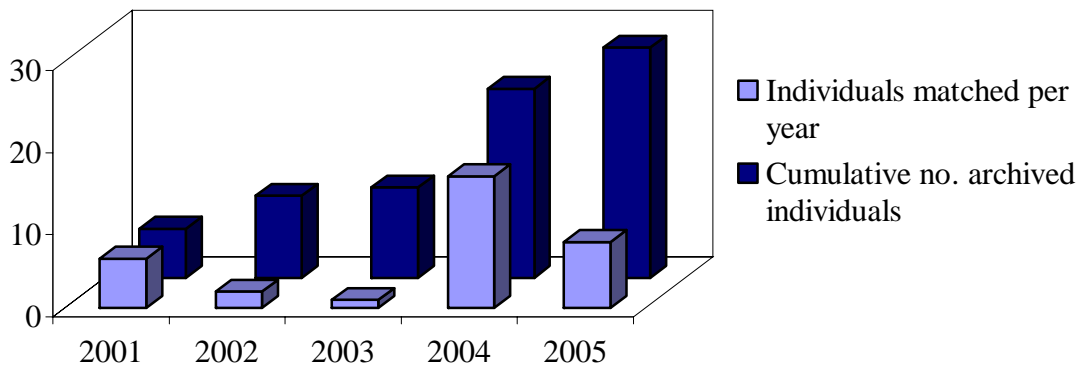


Figure 5. Number of individuals matched with archived animals in each year

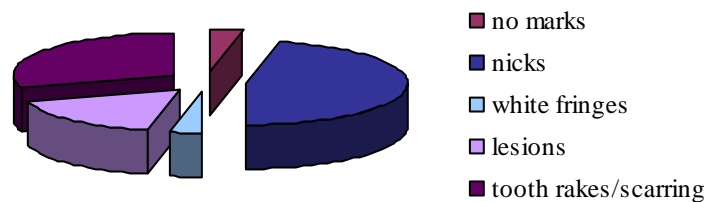


Figure 6. The proportion of different mark type in identified individuals

Distribution of encounters

Identification photographs were collected from three sub-regions in the study area (Skye, Mid-Argyll and South Argyll) covering a distance of approximately 190 nautical miles (Figure 7). Over the five year period, each marked individual was re-sighted a mean of 3.6 times (range 1-6). Movements of individuals extended across the entire study area. Twelve (46%) individuals were re-sighted in more than one sub-region in the same year and 9 (34%) individuals were re-sighted in more than one sub-region between years (Figures 7, 8 and 9).

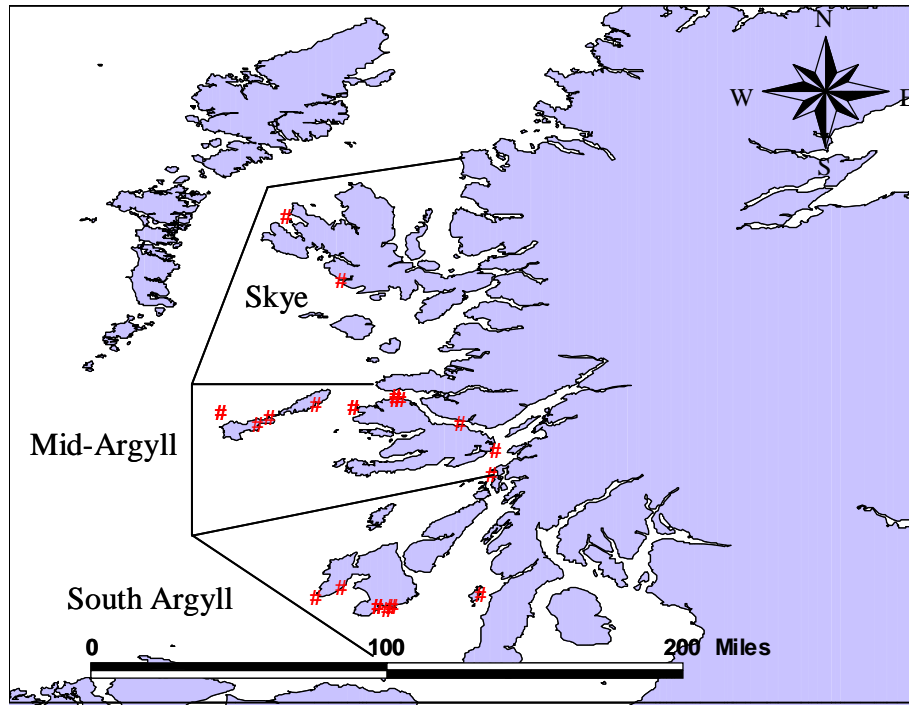


Figure 7. Locations of encounters with bottlenose dolphins throughout the study area 2001-2005.

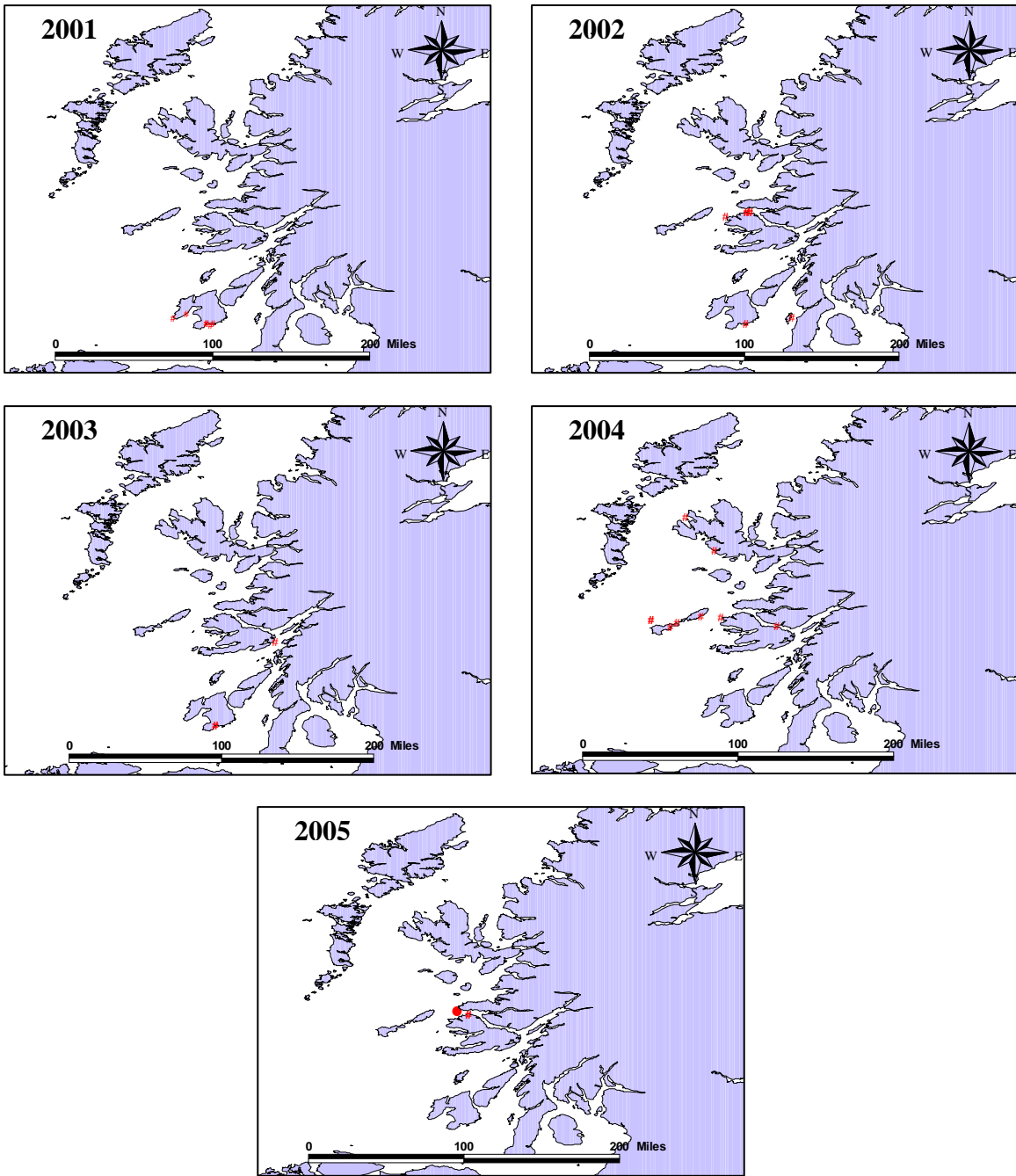


Figure 8. Distribution of photo-identification encounters per year

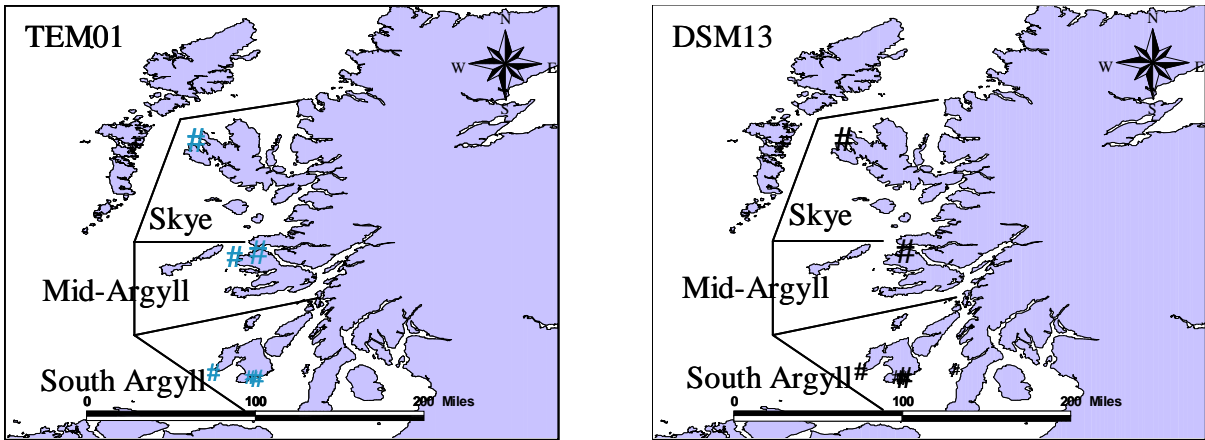


Figure 9. The distributional range of two individual dolphins, TEM01 and DSM13, sighted in all three sub-regions of the study area in a five year period.

Group sizes

Estimated group sizes ranged between 3 and 25 individuals, excluding encounters with solitary dolphins (median = 9, mean = 11.6, SD = 7- Figure 10). The same individuals were identified in groups of different sizes (Figure 11).

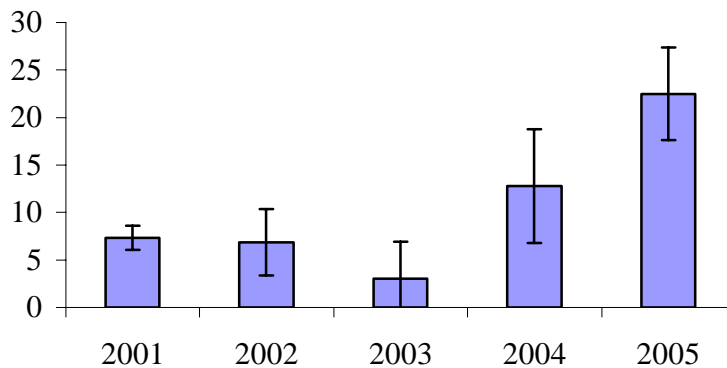


Figure 10. Mean group sizes per year (95% confidence limits)

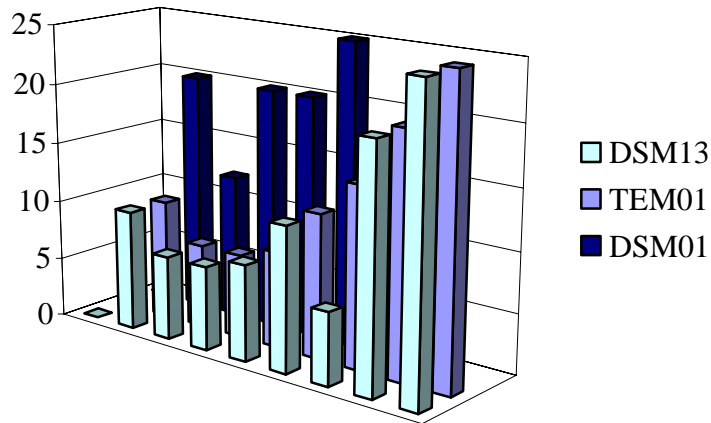


Figure 11. Variations in group size on encounters with three different individuals

Discovery Curves

The rate of discovery of new individuals declined remarkably rapidly, with 12 of the 14 marked individuals identified in just over half of cumulative total identifications (Figure 12). The extremely flat rate of discovery of new individuals (for all animals and for animals with long-term markings) at the beginning of the study period can be explained by a period of residency of a small group of bottlenose dolphins around Islay in 2001, and sustained sampling effort directed at this group throughout this period. The rate of discovery for all identified individuals continued to increase throughout the study, though at a low rate. This is likely a reflection of the difficulty in recognising unmarked individuals rather than of a substantially larger population (Wilson, 1999).

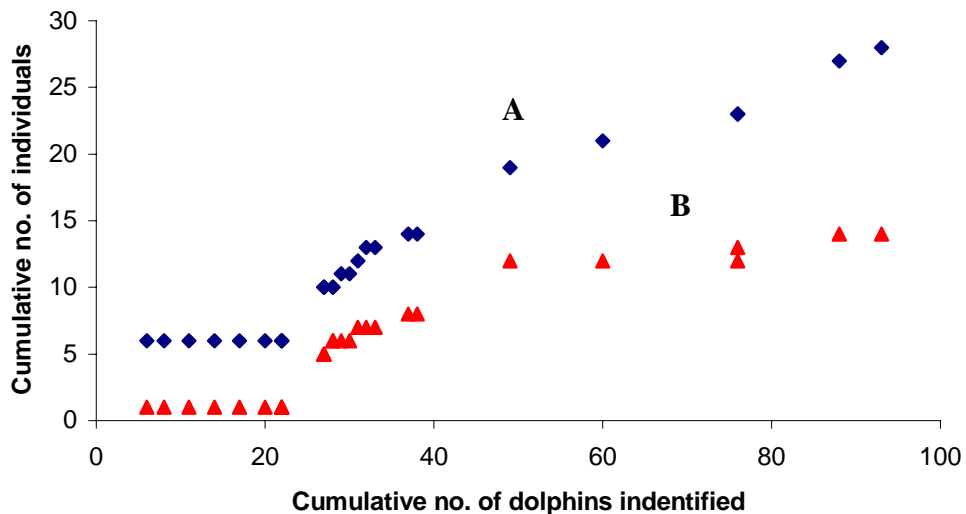


Figure 12. Discovery curves showing cumulative number of all individuals identified against the cumulative number of dolphins identified during the study period. Line A (blue) is the curve for all animals. Line B (red) is for animals with long-term markings (dorsal fin nicks).

Conclusions

Despite their conservation status as a priority species, little is known about the bottlenose dolphins inhabiting the west coast of Scotland. This study investigated their distribution and abundance in this area during a five year study period (2001-2005) using a combination of dedicated and opportunistically collected photo-identification data and sightings data assembled from a public sightings database. The public sightings data proved to be a successful way of obtaining a broad picture of bottlenose dolphin occurrence throughout the area. Photo-identification complemented the sightings data by providing insights into movement patterns and population size.

Sightings were reported in all months of the year and were widespread throughout the area but were particularly prevalent in the mid-section of the study area (Argyll and the Islands). The majority of sightings were close to the coast although there were a few sightings reported in the open sea (Sea of Hebrides and the Minch) as well as further offshore (west of the Outer Hebrides). However, it must be emphasised that the lack of effort associated with data collection in this study means that the sightings are difficult to interpret and may not accurately reflect distribution. For example, the dense concentration of sightings around Mull, in particular the Sound of Mull is likely to be a result of greater numbers of people reporting in this area. In addition, animals are more likely to be reported in narrow stretches of water such as the Sound of Mull as they are more readily visible from the coast. Similarly, the apparent changes in distribution between years are just as likely to reflect shifts in effort rather than shifts in distribution. Nevertheless, despite the temporal and spatial variations in observer effort, these data have been valuable for highlighting the regular occurrence of bottlenose dolphins off the west coast of Scotland. Moreover, these data have generated a useful source of baseline data from an area where relatively little species information existed and where coverage from dedicated surveys was not possible.

Photo-identification data were collected from three sub-regions in the Hebrides (Skye, mid-Argyll and south Argyll) and a total of 28 individuals were identified during the five year period. Half of the identified individuals were marked and assumed to be recognizable in the long-term (dorsal fin nicks). The remaining 'un-marked' animals were identified based on distinctive body scarring or pigmentation patterns. As a result, twelve individuals were identified based on either the left or right side of their dorsal fin. It is therefore likely that there is duplication of some of these individuals in the current archive (if a proportion of the right-side photographs belong to the same individual to that of the left-side photographs or vice versa).

Movements extended across the entire study area with individuals identified in all three sub-regions suggesting that these are wide-ranging dolphins. Because the study spanned five years, the population was not closed, and the rate-of-discovery curve cannot be used to estimate abundance in these circumstances. However, the slow rate of discovery of

new marked individuals is consistent with a small population in the area, probably in the region of tens of individuals.

The group size data obtained from both the sightings and photo-identification datasets suggest that the dolphins are most commonly associated in small groups of between 6 and 12 individuals. Larger group sizes of between 20 and 30 individuals were less frequently reported. Group sizes over 30 individuals were not documented in either dataset. The photo-identification data show that the larger aggregations are formed from the smaller sub-groups coming together. This provides some initial evidence about the social structure of this population, which seems to be extremely dynamic with group sizes varying constantly. This type of 'fission-fusion' population dynamic appears to be typical of bottlenose dolphins, and has been observed in other bottlenose dolphin populations throughout their range (Wursig and Wursig 1979; Wells et al. 1987; Connor et al. 2000).

The sightings and photo-identification data combined have highlighted the presence of a group of bottlenose dolphins inhabiting the west coast of Scotland, an area where, little dedicated research on this species has been carried out. Despite the temporal and spatial inconsistencies in the sampling effort, both types of data are consistent in their results and indicate that the west coast of Scotland is host to a small, wide-ranging and probably resident population of bottlenose dolphins. The apparent low density of bottlenose dolphins around the west coast of Scotland is surprising, given the size of the area. Furthermore, this population is not thought to be contiguous with other populations which may increase its vulnerability to environmental threats.

The high percentage of marked individuals in this population suggests that continued photo-identification efforts in this area and further afield would be effective in determining whether individuals have ranges that extend outside the current study area or travel to other known bottlenose dolphin habitats across the UK. Further dedicated sampling throughout the area would also increase our knowledge of 'core' areas or critical habitats. From a conservation perspective, a more in depth knowledge of these 'core' areas of occurrence is essential for the effective management of this small, isolated population.

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