

**Connectivity of Bottlenose Dolphins in Welsh Waters:
North Wales Photo-Monitoring Report**



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1. Introduction

The bottlenose dolphin (*Tursiops truncatus*) is a protected species under the 1992 EU Habitats and Species Directive (92/43/EEC). Two Special Areas of Conservation (SACs) have been formally declared in Welsh waters in 2004 to protect them: the Cardigan Bay and the Pen Llŷn a'r Sarnau SACs. Although it was previously thought that the population of Cardigan Bay was composed of animals with strong site fidelity and small home ranges (Morris, 1991; Bristow and Rees, 2001) and therefore that the dolphins might not leave the Bay during their lifetimes, there is now clear evidence that a substantial part of the population is much more mobile and moves in and out of the Bay, including part if not all of the Irish Sea in their home ranges (Pesante *et al*, 2008; Feingold & Evans, 2014). In the waters off North Wales, sightings have become more frequent in recent years (although this could reflect greater awareness and observer effort), and observations of large groups numbering up to 100 individuals have been made. Many of these individuals are also seen in Cardigan Bay although some have been recorded only within North Wales. Whether these are part of an offshore population is not known, and shedding light on this matter formed the basis of this project.

Information on bottlenose dolphin distribution and ranging movements is required in order to deal with casework enquiries and strategic environmental assessments (SEAs) at a time when there is great pressure for development in the region, particularly of renewable energy. Any photographic matches with individuals from the two SACs with Cardigan Bay would inform conservation management measures for this population, whilst understanding linkage between sites is an important backdrop to assessing condition of dolphins on those sites.

The project aimed also to assist in reporting on the status and condition of bottlenose dolphins in Welsh waters generally by developing an understanding of the relatedness and connectivity between the SACs (an important consideration within NATURA 2000), and for assessing whether to treat the Welsh dolphin population as a single entity or several subpopulations. Without this project, the possibilities to adequately report on CSM (Common Standards Monitoring) attributes are limited.

2. Methods

A large network of cetacean watchers was involved in the project, including people watching from land and fishermen working at sea. Once a bottlenose dolphin group was spotted in the area, the observers would give the alert and, weather permitting, a local boat was chartered with the aim of finding the dolphins and collecting information on their position, group size, composition, behaviour and, most importantly, to perform photo-identification. Central to responding to reports were the regular watches made in Anglesey by Dave Powell and the telephone contacts established by Jon Shaw. All information collected was validated and then stored on a database, and the pictures were compared with existing catalogues from Cardigan Bay and other areas of Wales (within the Euroflukes project) to look for any possible matches.

2.1 Study area

The boat surveys were conducted out of the harbours of Amlwch or Menai Bridge on Anglesey (mainly the former port), and in recent years in particular, aimed at locating dolphin groups that had been recently reported by local observers. Thus vessel movements were limited. Nevertheless, some trips covered a wider area around the island of Anglesey, mainly the north and east coast from Cemlyn across to the mainland coast around Great Orme Head and Llandudno (Figure 1).

2.2 Photo-identification

Dolphin groups were approached to a distance of 20-50 metres following the guidelines outlined in the photo-identification licence granted to Sea Watch Foundation by Natural Resources Wales (NRW) (previously known as Countryside Council for Wales (CCW)). Photo-identification sessions lasted until all the dolphins in the group were identified, moved away or showed signs of disturbance. The photo-identification protocol followed Würsig and Jefferson (1990), and the equipment used were primarily Canon EOS digital cameras with 17-85mm, 18-200mm, 70-200mm or 75-300mm zoom lenses. All those dolphins that moved in the same direction or were engaged in the same activity within a spatial proximity of 100 metres or less, were classified as forming a group (Wells *et al.*, 1987).

Four age categories were used, based upon the size of the animal relative to an adult, the swimming pattern, skin coloration, presence of foetal folds and the proximity of the mother. These were: adult, juvenile, calf, and newborn (Bearzi *et al.*, 1997). Group size was determined in the field, but if the photo-identification estimate resulted in a larger group size value, this latter estimate was used in the analysis. Matching was performed using Adobe Photoshop 7.0 and/or ACDSSee Pro, and followed the techniques described by Defran *et al.* (1990) and Würsig and Jefferson (1990). In order to avoid false positives

or false negatives, only high quality pictures were used to confirm the identity of a dolphin, and matches were confirmed by a second person (see Hammond, 1986; Scott *et al.*, 1990; Stevick *et al.*, 2001).

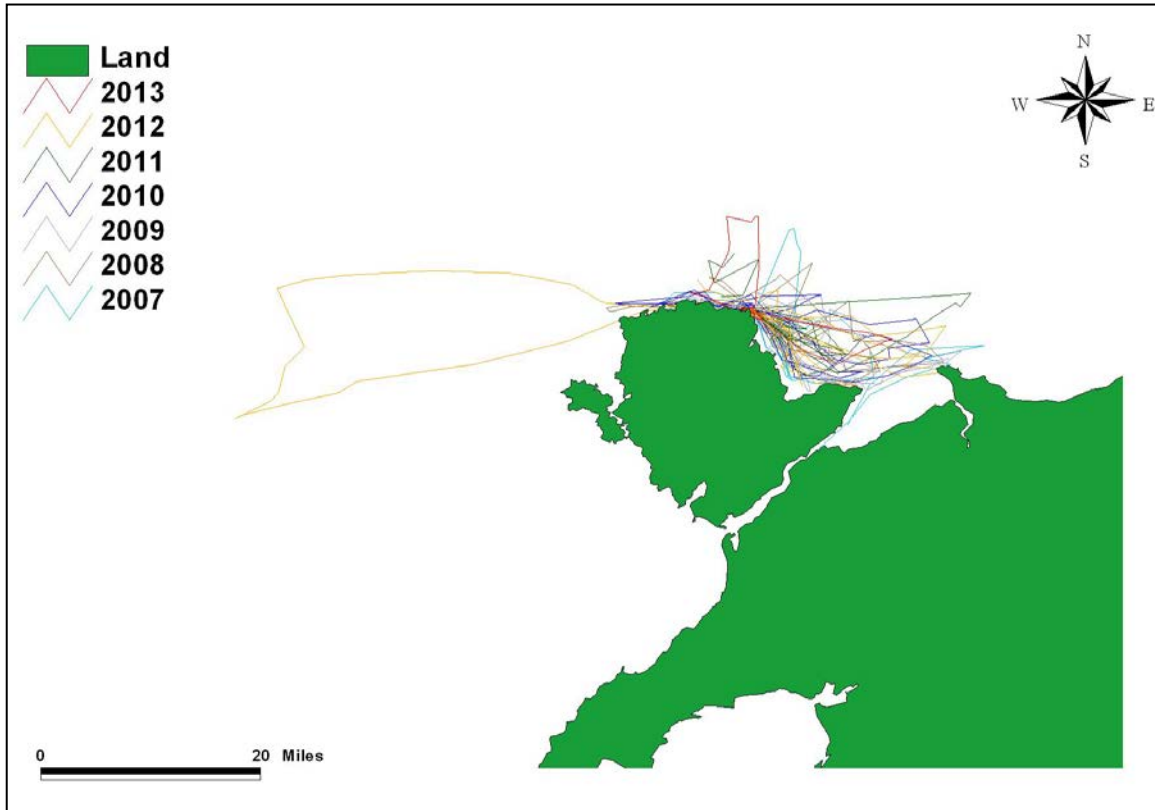


Figure 1: Track lines from dedicated Anglesey surveys conducted between 2007 and 2013

3. Results and Discussion

Between April 2007 and 2013, fifty-two sightings of bottlenose dolphins were recorded off Anglesey that resulted in photo ID sessions. When sightings of bottlenose dolphin were reported by local observers, and weather conditions were favourable, the 11 metre catamaran *Seekat C* was launched from Amlwch, Isle of Anglesey (other vessels were also used sporadically). The vessel travelled directly to the site where dolphins had been reported. Once dolphins were detected, photographic images were collected for identification using the protocols outlined by the photo ID licence granted by Natural Resources Wales (NRW). In addition, there were four encounters of bottlenose dolphins off the Isle of Man, the images of which were kindly forwarded by Manx Whale and Dolphin Watch (MWDW). Images were matched to the Sea Watch Foundation (SWF) Irish Sea Photo ID Catalogue (Feingold and Evans, 2012; Table 1, Figure 2).

Table 1: Bottlenose dolphin photo ID encounters from the Isle of Anglesey (and the Isle of Man, conducted by MWDW) between 2007 and 2013

No	Encounter number	Date	Geographic position	Group size	Adults	Juveniles	Calves (including newborns)
1	2007-0se	25/1/2007	53°25.817N, 4°17.572W	13	13	0	0
2	2007-1se	10/08/2007	53°25.851N, 4°17.346W	20	16	2	2
3	2007-2en	07/10/2007	53°22.185N, 4°46.842W	40	25	10	5
4	2007-20se	12/11/2007	53°20.5N, 4°5.8W	10	8	0	2
5	2007-21se	12/11/2007	53°22.7N, 4°8.9W	13	11	0	2
6	2007-22se	12/11/2007	53°23.9N, 4°13.4W	16	13	0	3
7	2008-6se	12/02/2008	53°22.322N, 4°11.761W	60	47	10	3
8	2008-14se	28/02/2008	53°22.293N, 4°13.909W	8	8	0	0
9	2008-8se	3/6/2008	53°25.099N, 4°19.816W	12	11	0	1
10	2008-9se	3/7/2008	53°25.28N, 4°17.249W	7	7	0	0
11	2008-1an	13/7/2008	53°16.383N, 4°38.416W	1	1	0	0
12	2008-2an	15/7/2008	53°18.887N, 4°4.533W	3	3	0	0

13	2008-21se	10/9/2008	53°25.779N, 4°27.202W	35	31	1	3
14	2008-38se	12/10/2008	53°22.091N, 4°12.81W	64	53	0	11
15	2008-1im	3/12/2008	54°3.5N, 4°44.5W	35	35	0	0
16	2008-42se	24/12/2008	53°25.758N, 4°18.256W	10	8	0	2
17	2008-51se	24/12/2008	53°22.353N, 4°3.09W	45	43	0	2
18	2009-2se	6/1/2009	53°25.029N, 4°16.017W	23	13	7	3
19	2009-31se	2/7/2009	53°22.035N, 4°13.0917W	20	15	5	0
20	2009-34se	9/11/2009	53°21.795N, 4°13.4467W	75	65	3	7
21	2009-36se	10/12/2009	53°21.638N, 4°8.403W	40	34	3	3
22	2009-21 (im)	10/12/2009	54° 3.910W, 4° 33.910N	c. 80	NR	NR	NR
23	2009-39se	28/12/2009	53°19.864N, 4°9.427W	36	28	2	5
24	2010-2se	17/2/2010	53°22.569N, 3°58.624W	41	40	0	1
25	2010-7se	11/4/2010	53°23.61N, 4°11.58W	35	28	5	2
26	2010-8se	21/4/2010	53°21.344N, 4°42.703W	20	20	0	0
27	2010-18se	24/4/2010	53°42.23N, 4°36.4W	29	28	0	1
28	2010-22se	23/10/2010	53°25.035N, 4°14.078W	50	40	4	6
29	2010-26se	11/12/2010	53°25.295N, 4°13.139W	45	40	2	2
30	2011-1sh	10/04/2011	53°25.75N, 4°33.35W	19	17	2	0
31	2011-2se	14/04/2011	53°23.82N, 4°13.41W	13	12	0	1
32	2011-4se	20/06/2011	53°20.12N, 4°6.17W	68	55	2	11
33	2011-2sh	07/08/2011	53°24.94N, 4°17.16W	44	40	2	2
34	2011-8se	27/10/2011	53°28.41N, 4°7.10W	68	56	5	7
35	2011-1im	06/11/2011	54°7.66N, 4°28.57W	45	NR	NR	NR
36	2012-2se	06/01/2012	53°24.15N, 4°14.49W	20	13	6	1
37	2012-1im	13/01/2012	54°10.10N,	65	55	5	5

			4°25.348W				
38	2012-5se	28/01/2012	53°24.66N, 4°15.72W	100	80	12	8
39	2012-1sh	1/6/2012	53°21.703N, 4°13.928W	20	20	0	0
40	2012-38se	12/8/2012	53°20.004N, 4°1.91W	18	14	0	4
41	2012-15IOpm	14/10/2012	53°22.682N, 4°11.064W	40	35	0	5
42	2012-16IOpm	14/10/2012	53°25.425N, 4°11.458W	12	10	0	2
43	2012-13IOpm	14/10/2012	53°24.537N, 4°12.471W	32	29	0	3
44	2012-23se	30/10/2012	53°23.305N, 4°14.463W	30	22	2	6
45	2012-29se	16/11/2012	53°20.541N, 4°53.401W	9	8	0	1
46	2012-30se	16/11/2012	53°20.591N, 4°51.395W	30	24	3	3
47	2012-36se	30/11/2012	53°20.878N, 4°11.228W	8	4	2	2
48	2012-37se	30/11/2012	53°23.229N, 4°12.21W	30	20	0	10
49	2013-1se	24/1/2013	53°26.201N, 4°23.669W	90	73	7	10
50	2013-20se	22/11/2013	53°19.721N, 4°12.351W	25	22	1	2
51	2013-21se	24/11/2013	53°22.206N, 4°13.272W	56	40	0	16
52	2013-26se	28/11/2013	53°23.713N, 4°10.25W	28	24	0	4

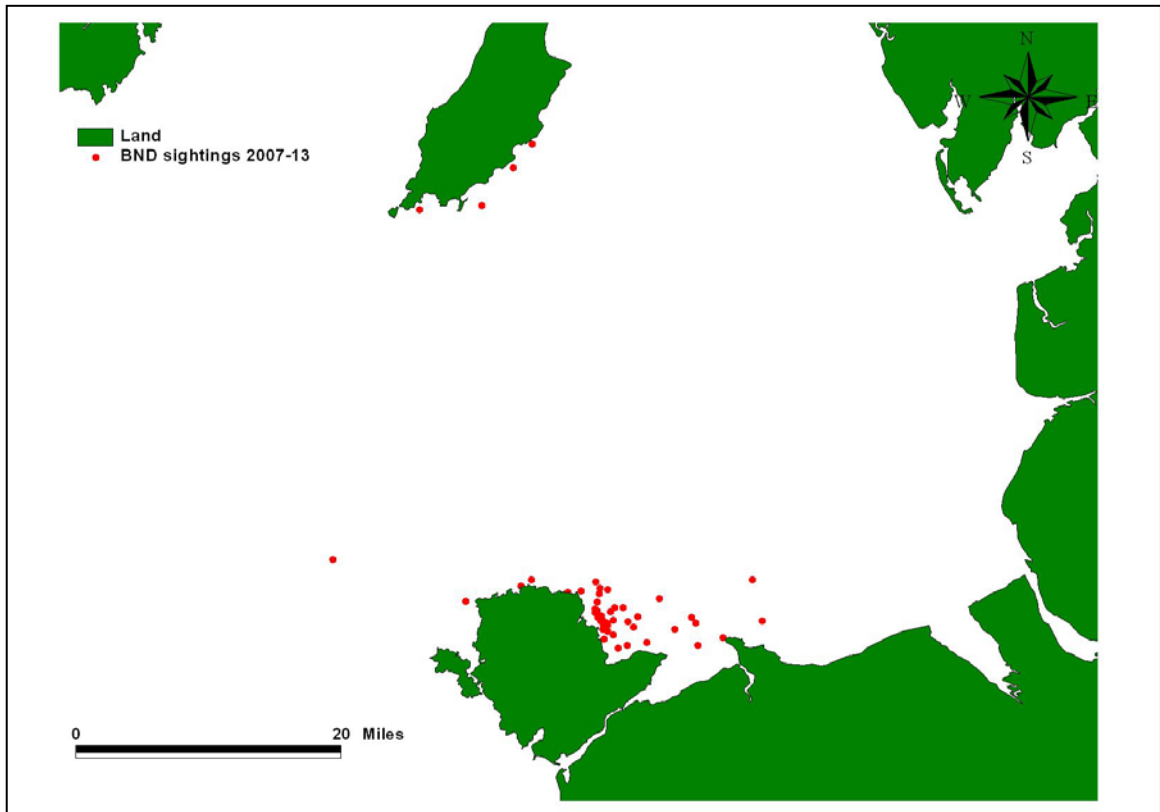


Figure 2: Bottlenose dolphin sightings recorded from vessels north of the Llŷn Peninsula between 2007 and 2013

3.1 Group Size

Mean group size between 2007 and 2013 was 26.4 individuals (Range 2-100, SD=24.5, n=44), calculated from vessel-based surveys in North Wales. This is over six times larger than the mean of 4.23 (Range 1-33, SD = 4.08, n= 1,862) reported for Cardigan Bay (Feingold and Evans, 2014). Group sizes around Anglesey varied on a yearly basis but with no significant differences between years ($X^2 = 3.17$, $df = 6$, $p=0.787$) (Fig. 3).

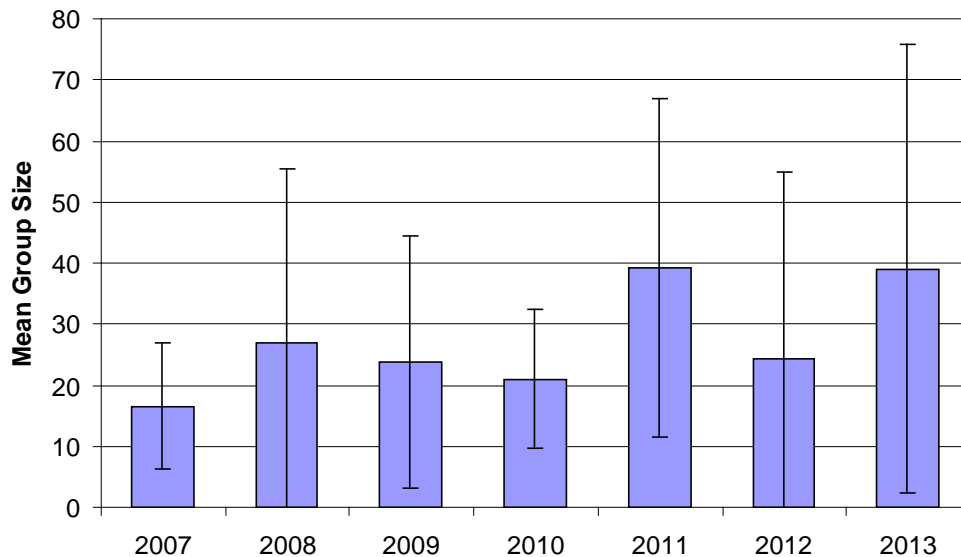


Figure 3: Bottlenose dolphin mean group sizes (\pm SD) during vessel-based surveys in North Wales between 2007-13

3.2 Connectivity data

Two hundred and eleven individual dolphins were considered for further analyses. These individuals were all recorded between 2007 and 2013. Of those, 84 (40%) were identified in both Cardigan Bay and Pen Llŷn a'r Sarnau SAC's and north of the Llyn Peninsula, and 55 (26%) individuals were identified both in Cardigan Bay SAC and north of the Llŷn Peninsula (Figure 4). Figure 4 shows that the majority of the population (at least 66%) migrate between Cardigan Bay and North Wales. Some individuals are spotted in Cardigan Bay SAC, Pen Llŷn a'r Sarnau SAC and North Wales (Figure 5) whereas others are spotted in Cardigan Bay SAC and North Wales (Figure 6). Forty-five individuals from the SWF catalogue have been recorded off the Isle of Man. During a first dedicated survey in Liverpool Bay, which took place in July 2013, nine (50%) of the individuals in the encounter were matched to the SWF catalogue, strengthening the hypothesis of further migration outside of Welsh waters.

Some individuals within the population may have a more localised range, since fifteen individuals (7%) have only ever been seen in Cardigan Bay SAC, and seventeen individuals (8%) only ever seen north of the Llŷn Peninsula, suggesting there is a small proportion of the population with rather small home-ranges and strong site fidelity to certain areas. Only six (3%) individuals were recorded in Pen Llŷn a'r Sarnau SAC alone, although this may well be due to relatively low effort in that area (Figure 4).

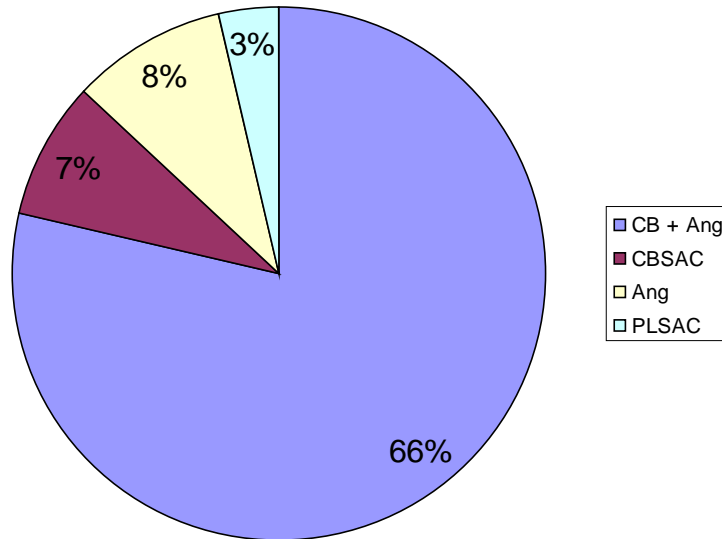


Figure 4: Range movements of bottlenose dolphins between 2007-13 ('CB+Ang-dolphins encountered in the Cardigan Bay and north of the Llŷn Peninsula; 'CBSAC'- dolphins recorded in Cardigan Bay SAC only 'Ang'- animals only recorded north of the Llŷn Peninsula; 'PLSAC'- dolphins recorded in Pen Llŷn a'r Sarnau SAC only)

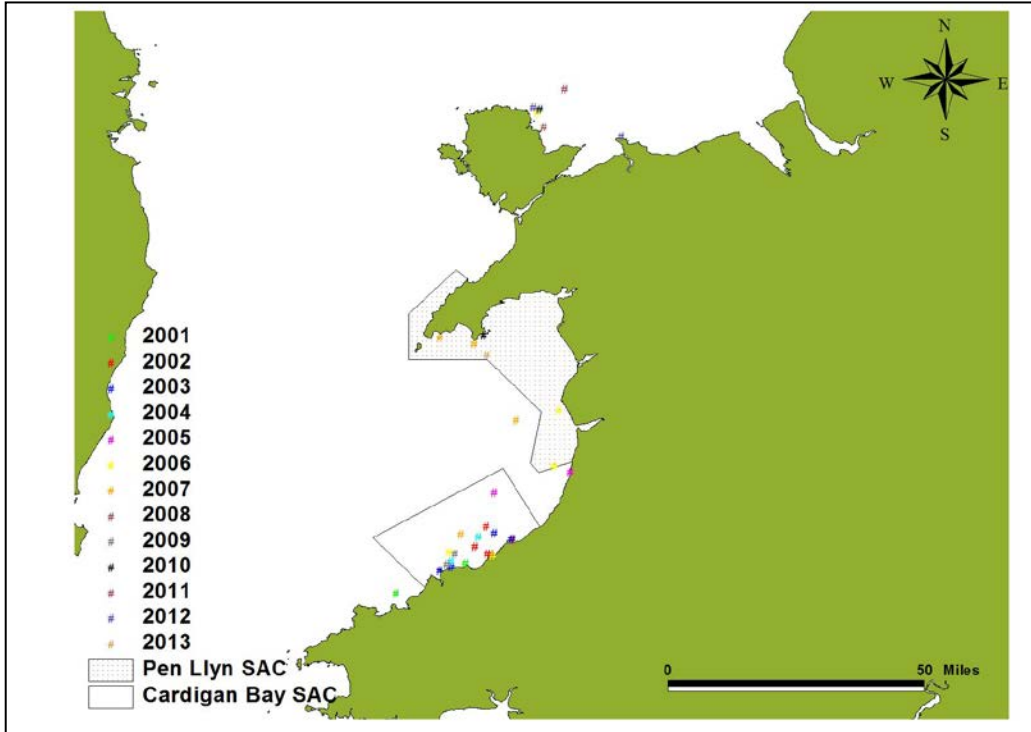


Figure 5: Dolphin 082-01W spotted in Cardigan Bay SAC, Pen Llŷn a'r Sarnau SAC and North Wales between 2007-13

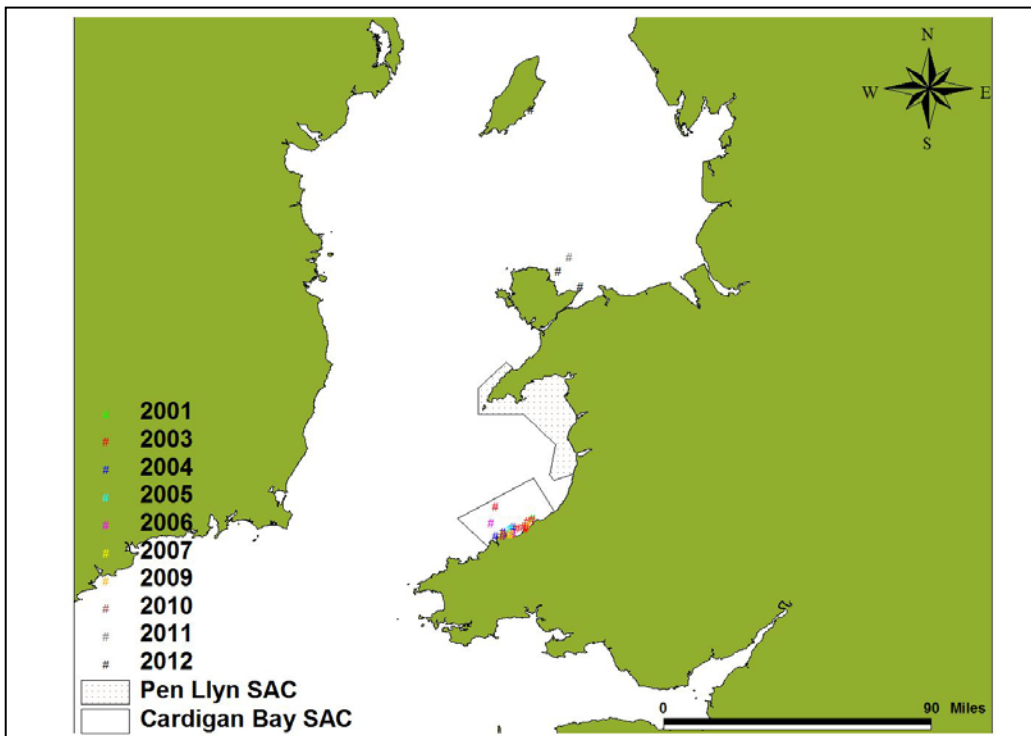


Figure 6: Dolphin 006-01W spotted in Cardigan Bay SAC and North Wales between 2007 and 2013

4. Conclusions and Recommendations

The high proportion (68%) of dolphins identified as occurring in Cardigan Bay and Anglesey, mostly photographed during the winter months of November to March, clearly shows that the bottlenose dolphin population that we know inhabits the two Special Areas of Conservation in Cardigan Bay particularly in summer, ranges far outside these protected areas, particularly in winter. Several surveys in North Wales in the summer months of 2011, along with the latest sighting in Liverpool Bay (July 2013) suggest that the population is now inhabiting these waters also in summer. Their presence in waters east of Anglesey towards Liverpool Bay has very important conservation management implications. Along the coasts of North-east Wales there is intensive recreational activity - water sports of various kinds. Pile driving activities have been conducted in the construction of neighbouring Gwynt y Mor and Rhyl Flats wind farms, and there are plans now for a large wind farm, the Rhiannon Array, to be constructed between Anglesey and the Isle of Man. Whereas in the past it was thought that harbour porpoises were likely to be the only cetacean species exposed to pile driving to any great extent, this conclusion clearly now needs revision. Finally, Liverpool Bay has long been one of the most heavily polluted inshore sea areas in the UK, due to the heavy chemical based industry in the area (Doody, 1996; Fowler *et al.*, 1996; Crumpton *et al.*, 1996; Vane *et al.*, 2007). Many marine organisms have been shown to have elevated levels of persistent hydrocarbons such as PCBs as well as heavy metals such as mercury, all of which are known to have a detrimental effect on marine mammals (Morris *et al.*, 1989; Law *et al.*, 1991, 1995). These recent findings may help to explain the unusually high levels of contaminants obtained from bottlenose dolphins in Cardigan Bay. Indeed, a dead baby bottlenose dolphin from Aberaeron in Cardigan Bay, found in 1988, had one of the highest levels of PCBs (290 ppm), dieldrin (74 ppm) and DDT (150 ppm) ever recorded in the blubber of a small cetacean in UK (Morris *et al.*, 1989). A four year old was tested in 1989 and a 23 year old in 1991, both of which carried similar high loads of PCBs and DDT (Law *et al.*, 1995).

Our photo-ID studies in Cardigan Bay indicate that although a significant portion of the population occurs every summer in the area, there is also substantial turnover with new individuals entering the population each year, and others leaving it (Feingold and Evans 2014). At present, we remain unclear of the full extent of the local bottlenose dolphin population, how much their movements are seasonal, and how far individual animals may range. In order to better answer these questions, it is important that photo-ID surveys are conducted not just in winter but at other times of the year, and that they cover as wide an area as possible. It may well be that individuals from the Cardigan Bay population spend part of their lives in the northern Irish Sea. In order to ascertain this, surveys should take place in those areas.

The bottlenose dolphin is placed within Annex 2 of the EU Habitats & Species Directive (1992), giving it special protection through the establishment of a network of protected areas, referred to as Natura 2000. If such protection is to be at all effective, it is necessary to determine long-term home ranges for individual dolphins, better establish the population structure and the extent of movements between areas.

5. Acknowledgements

We are grateful to Natural Resources Wales (previously known as Countryside Council of Wales) for funding the project. This project would not have been possible also without the network of fishermen and other observers who reported sightings of bottlenose dolphins in the study area. We are therefore extremely grateful to all of them, and in particular to Jon Shaw for his range of contacts and for skippering the boat that was chartered for these surveys. We also thank Scott Waterman and Dylan Evans for one of the boat charters. Many thanks go to all the volunteers that have spent hours collecting sightings from land, and to the other observers, particularly Pia Anderwald (Sea Watch Foundation), Nia Haf Jones and Paola Dyboski (Marine Awareness North Wales), who gave their time onboard the earlier vessel surveys to assist in data collection at sea.

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