ICES CIEM

1.6.6.2   OSPAR request on indicator assessment of coastal bottlenose dolphins

Advice summary

ICES has collated all available relevant data on coastal bottlenose dolphins, *Tursiops truncatus*, in the OSPAR Regions II, III, and IV. Most data are from small-scale surveys at particular sites within the bottlenose dolphin assessment units (AUs). A large variation in the intensity and coverage of survey effort leads to strong spatial biases in data availability, making assessment at an AU scale challenging. Only five sites have sufficient data to allow assessment of trends in abundance. One of the sites with sufficient data showed a decline beyond the target threshold. Abundance estimates for bottlenose dolphins typically have wide confidence limits, and the power to detect even relatively strong trends may be limited. If the abundance of coastal bottlenose dolphins is to be used as an indicator, then either monitoring will need to increase to cover the entirety of each assessment unit at frequent intervals, or the relationship between the abundance of local groups and that of the assessment units would need to be determined. Both of these options would require the investment of further resources.

Request

ICES is requested to support OSPAR in the delivery of common indicator assessment of Cetaceans through:
> *i. The collation on estimates of coastal bottlenose dolphin abundance in the assessment units identified, over an appropriate time frame;*
> *ii. To assess trends in abundance (and where possible distribution within range) of coastal bottlenose dolphins in the assessment units identified, against targets proposed;*

Elaboration on the advice

Data on bottlenose dolphin abundance is available in each of the coastal AUs proposed for the species. Data are patchy, however, and in some cases robust data are only available for a limited number of animals that use small areas within an AU. As a consequence, data derived from small-scale surveys that relate to a discrete group of animals may not always be a robust measure of abundance at the AU scale. Abundance estimates typically have wide confidence limits; the power to detect even relatively strong trends may thus be limited. Additionally, where the coastal and offshore populations mix, it is often difficult to identify which population is being surveyed. The bottlenose dolphin is a relatively long-lived slow reproducing species and problems in reproduction and the effects of sub-lethal anthropogenic pressures may show significant time lags before being detected. In addition, the relationships among groups both within and between coastal AUs and between coastal and offshore populations remain unclear (Rosel *et al*., 2009; Toth *et al*., 2012; Richards *et al*., 2013; Louis *et al*., 2014).

Currently coastal bottlenose dolphins occur within each of the assessment units. In past centuries, the species occupied the southern North Sea and a number of estuaries where they now do not occur, or occur only as an uncommon visitor.

Of the available datasets only five sites had sufficient repeated abundance estimates to allow any assessment of trends in abundance (see below). At four of these sites the abundance estimates appeared stable.

In one case (the Sado estuary, Portugal) fine-scale data clearly demonstrated a local decline of a single resident group beyond the proposed target threshold. However, overall this may not be reflected at the scale of the Coastal Portugal AU.
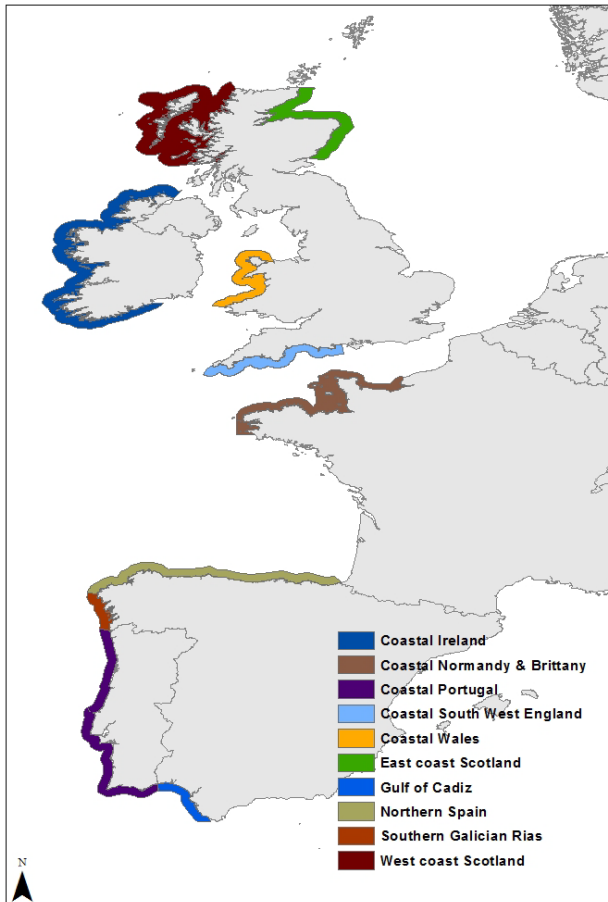
Assessment of trends in abundance by assessment unit

Figure 1.6.6.2.1   Assessment units for bottlenose dolphins in the OSPAR Area (ICES, 2014).
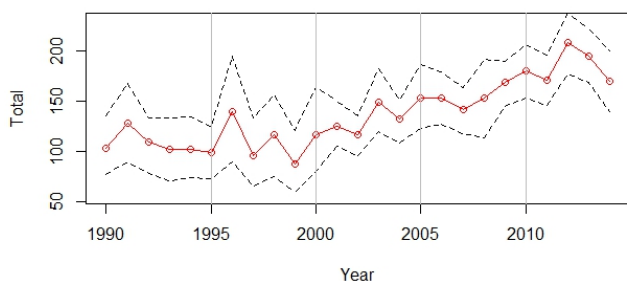
West Coast Scotland AU

This area is used by a small number of animals that belong to two discrete groups: a very small resident group of about 15 animals inhabiting the vicinity of the Sound of Barra in the Outer Hebrides (Grellier and Wilson, 2003; Cheney *et al.,* 2013) and a group of 30 animals ranging mainly around the Inner Hebrides (Cheney *et al.,* 2013). There are insufficient data to determine the population trends at this time, although the Barra population appears to be stable.

East Coast Scotland AU

Monitoring of bottlenose dolphins in the inner Moray Firth started in 1990, and was later extended to a wider part of the Firth. During the early 1990s, bottlenose dolphins ranged only along the north and south coasts of the Moray Firth, but in the mid-1990s the species started extending its range around the Northeast Scottish coast (Evans *et al.,* 2003; Wilson *et al.,* 2004). Bottlenose dolphins now occur regularly off the east coast of Scotland, particularly off Aberdeen harbour and the coast of Fife (Weir and Stockin, 2001; Cheney *et al.,* 2013).

Mark–recapture estimates of the East Coast Scotland population vary in the range of 87–208 ind., with the latest estimate (2014) being 170 ind. (95% highest posterior density intervals (HPDI): 139–200 ind.). Despite interannual variability, the

population is considered to be stable or increasing, with no decline ≥30% in any ten-year period (Figure 1.6.6.2.2; Cheney *et al.,* 2014).
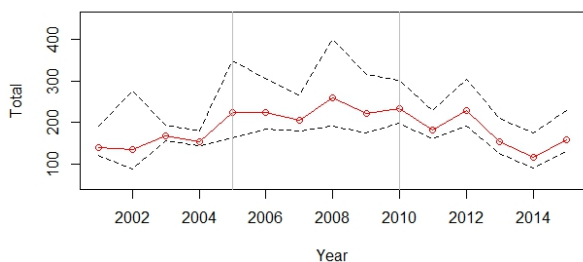

Figure 1.6.6.2.2   Estimates of bottlenose dolphin abundance (number of individuals) in the East Coast Scotland AU. Dashed lines indicate 95% HPDI.

Although bottlenose dolphins are occasionally recorded offshore in the North Sea and in coastal waters off Northeast and Southeast England, northern France, Belgium, the Netherlands, and Germany, there is no evidence that these are anything but transient animals, most likely from the East Coast of Scotland population or from further away (Evans *et al.,* 2003; Camphuysen and Peet, 2006; ICES, 2014).

Coastal Wales AU

Annual monitoring of bottlenose dolphins in the Cardigan Bay Special Area of Conservation (SAC), West Wales, began in 2001. This was extended to incorporate the wider Cardigan Bay area from 2005 onwards. In addition, since 2007, there have been opportunistic photo-identification surveys in the coastal waters of North Wales, and occasionally around the Isle of Man and in Liverpool Bay (Pesante *et al.,* 2008; Feingold and Evans, 2014a; Norman *et al.,* 2015). A proportion of the population inhabiting Cardigan Bay in summer ranges more widely between November and April, occurring particularly off the northern coast of Anglesey, the mainland coast of North Wales, and further north around the Isle of Man (Feingold and Evans, 2014b). Summer mark–recapture estimates for Cardigan Bay SAC have varied in the range of 116–260 ind. The latest estimate (2015) is 159 ind. (95% confidence interval (CI): 130–228 ind.). For the wider Cardigan Bay (including both SACs), summer mark–recapture estimates have varied in the range of 152–342 ind., with the 2015 estimate being 222 ind. (95% CI: 184–300 ind.). Abundance within the Coastal Wales AU appears stable, with no decline ≥30% in any ten-year period (Figures 1.6.6.2.3 and 1.6.6.2.4). The estimates in recent years have been amongst the lowest recorded; however, due to the variability in the estimates it is too early to determine whether this represents a decline.

Figure 1.6.6.2.3   Estimates of bottlenose dolphin abundance (number of individuals) in the Cardigan Bay Special Area of Conservation. Dashed lines indicate 95% confidence intervals.
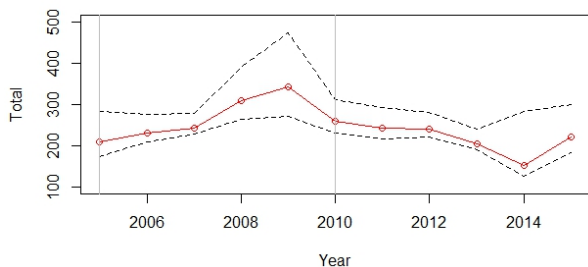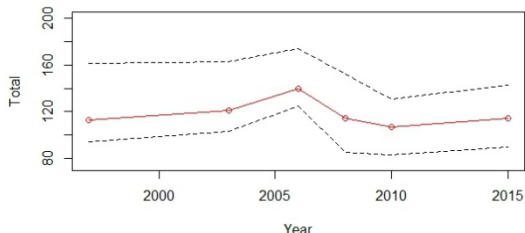
Figure 1.6.6.2.4   Estimates of bottlenose dolphin abundance (number of individuals) in the wider Cardigan Bay. Dashed lines indicate 95% confidence intervals.

Coastal Ireland AU

Bottlenose dolphins are regularly recorded throughout the west and southwest coast of Ireland and belong to two separate populations; one is mainly resident within the Shannon SAC and the other ranges more widely along the coast (Ingram *et al.,* 2001, 2003; Ó Cadhla *et al.,* 2003; O'Brien *et al.,* 2009). There are a number of mark–recapture population estimates for animals using the west coast of Ireland, but at different spatial scales, and there is currently insufficient information to measure population trends. A multi-site model estimated abundance for the northwest coastal area of Ireland to be 151 ind. (95% CI: 140–190 ind.) for 2014 (Nykanen *at al*., 2015). This mobile population appears to range widely, with seasonal and patchy habitat use.

Bottlenose dolphins inhabit the Shannon Estuary year round, and genetic studies indicate that they form a discrete population separate from those occurring elsewhere along the west coast of Ireland (Mirimin *et al.,* 2011). Six mark–recapture population estimates have been made between 1997 and 2015, ranging from 107 to 140 individuals (Ingram, 2000; Berrow *et al.,* 2010, 2012). The latest population estimate (2015) is 114 ind. (95% CI: 90–143 ind.) (Rogan *et al.,* 2015) suggesting that the population is stable, with no decline ≥30% in any ten-year period (Figure 1.6.6.2.5).
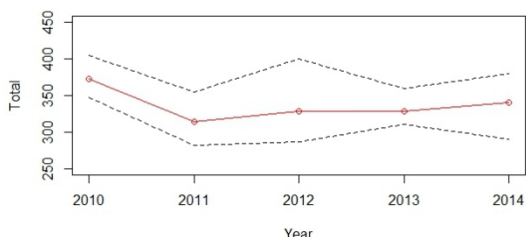

Figure 1.6.6.2.5   Estimates of bottlenose dolphin abundance (number of individuals) in the Shannon Estuary Special Area of Conservation. Dashed lines indicate 95% confidence intervals.

Coastal Southwest England AU

Bottlenose dolphins have regularly inhabited the south and southwest coasts of England since the 1990s, being commonest around Cornwall but rare east of Dorset (Wood, 1998; Evans *et al.,* 2003; Brereton *et al.,* in review). No systematic photo-identification surveys have been undertaken, but Brereton *et al.,* (in review) have reported maximum abundance estimates for southwest England coastal waters, using two mark–recapture methods ranging between 102 and 113 ind. (95% CI: 87–142 ind.) over the combined period 2008–2013. There are insufficient data to assess trends against the proposed target.

Coastal Normandy and Brittany AU

A resident population inhabits the Gulf of St Malo, ranging between the French coast of Normandy and the Channel Islands (Couet, 2015a, 2015b; Louis *et al.,* 2015). Mark–recapture estimates of this population in 2010 indicated it numbered 372 ind. (95% CI = 347–405 ind.), with a 2014 estimate of 340 ind. (95% CI = 290–380 ind.) (Couet, 2015a, 2015b; Louis *et al.,* 2015), thus indicating a stable population (Figure 1.6.6.2.6). There are insufficient data to assess trends against the proposed target.

Figure 1.6.6.2.6   Estimates of bottlenose dolphin abundance (number of individuals) in the Gulf of St Malo. Dashed lines indicate 95% confidence intervals.

Two small populations exist in the Iroise Sea, one around the Île de Sein and the other around the Molene archipelago, which appear to be distinct. Photo-identification surveys have been undertaken in the vicinity of Île de Sein since 2001, with at least five separate counts, ranging from 20[*] ind. in 2001 to 29 ind. in 2014. An earlier estimate for this population was 14 animals in 1992, thus indicating an increase, with no decline ≥30% in any ten-year period (Figure 1.6.6.2.7; Liret, 2001; Liret *et al.,* 2006).
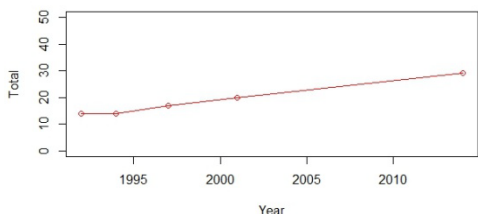
Figure 1.6.6.2.7   Estimates of bottlenose dolphin abundance (number of individuals) in the vicinity of l'île de Sein.

Around the Molene Archipelago, a mark–recapture estimate of 29 ind. (95% CI = 28–42 ind.) was made from photographs taken between 1999 and 2001 (Le Berre and Liret, 2004; Liret *et al.,* 2006; Louis and Ridoux, 2015). A new photo-identification study is currently being undertaken (V. Ridoux, pers. comm.). It is currently not possible to assess this population.

Northern Spain AU

In northern Spanish waters, only model-based abundance estimates exist, derived from line-transect surveys conducted between 2003 and 2011. These encompass both coastal and offshore animals (López *et al.,* 2013) and thus extend beyond the AU. The annual uncorrected abundance estimate in the study area is of 10 687 individuals (95% CI: 4094–18 132 ind.). Estimated abundances for the different areas are: (1) Euskadi 1931 ind., (2) Cantabria 744 ind., (3) Asturias 1214 ind., (4) Galicia 703 ind., (5) Galician Bank 108 ind., and (6) Aviles 234 ind. Although the distribution is homogeneous throughout the waters of the northern peninsula, there is a clear gradient in density, this being higher in eastern areas of the Bay of Biscay where the largest groups have been recorded (López *et al.,* 2013). There are insufficient data at this time to assess this AU.

Southern Galician Rias AU (Spain)

Along the Galician coast, photo-identification surveys have been conducted between 2006 and 2009, resulting in the identification of 255 individuals (García *et al.,* 2011). A third of these photo-identified individuals (n = 76) were considered to form the resident population inhabiting the Southern Galician Rias, as revealed by recapture histories, genetics, and stable isotope analysis (Fernández *et al.,* 2011a, 2011b; García *et al.,* 2011). Movements of individuals were recorded between Galicia and Euskadi in the Bay of Biscay (García *et al.,* 2011). It is not possible to make an assessment of the population in this AU at this time.

Coastal Portugal AU

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[*] Version 2: Figure corrected from 14 to 20

Bottlenose dolphins occur widely along the coast of Portugal as well as offshore. Photo-identification surveys undertaken over two time periods have been used to derive mark–recapture population estimates of bottlenose dolphins in the coastal Setúbal Bay (Martinho, 2012; Martinho *et al.,* 2015). Bottlenose dolphins identified in 1998–2001 had an abundance of 106 ind. (95% CI: 69–192 ind.) and were considered a closed and a more cohesive group than those from 2007–2011, which seemed to be composed of an open group of 108 ind. (95% CI: 83–177 ind.).

A wider-scale analysis of animals photographed in the central west coastal Portugal from Nazaré and Sétubal Bay between 2008 and 2014 resulted in an estimate of 352 individuals (95% CI: 294–437 ind.) (Martinho, 2012; Martinho *et al.,* 2015).

The longest sequence of counts for a coastal bottlenose dolphin population in Europe is associated with the resident population in the Sado Estuary, where an annual census has been undertaken since 1986 (Gaspar, 2003; Lacey, 2015; Carvalho, personal comment). Over this period the population has shown a long-term decline, from 39 individuals in 1986 to 27 individuals in 2015 (Figure 1.6.6.2.8). This population exceeded the proposed target, with a decline of 30% relative to the baseline defined as the level at the start of the time-series (see basis of advice below).
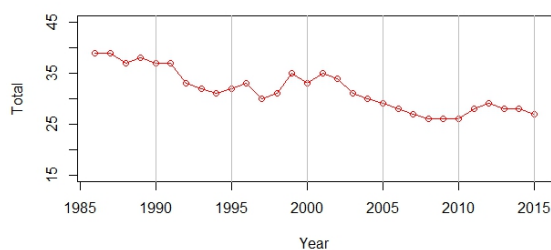
Figure 1.6.6.2.8   Estimates of bottlenose dolphin abundance (number of individuals) in the Sado Estuary.

Gulf of Cadiz AU

Mark–recapture estimates of bottlenose dolphin abundance in the coastal Gulf of Cadiz have been determined for two periods: 2005–2006 and 2009–2010 (MAGRAMA, 2012). There were an estimated 347 individuals (95% CI: 264–503 ind.) in 2005–2006 and 397 ind. (95% CI: 300–562 ind.) in 2009–2010, suggesting a stable population. A much larger population apparently occupies the offshore Gulf of Cadiz, estimated at 4391 ind. (95% CI: 2373–8356 ind.) during 2009–2010 (MAGRAMA, 2012). It is not possible to make an assessment at this time.

A bottlenose dolphin population also inhabits the area around the Strait of Gibraltar, on the edge of OSPAR Region IV. Photo-identification surveys in 2010 resulted in a mark–recapture population estimate of 297 individuals (95% CI: 276–332 ind.) (Portillo *et al.,* 2011). It is not possible to make an assessment at this time.

Basis of the advice

Background

Bottlenose dolphins in OSPAR Regions II, III, and IV belong to several coastal populations that inhabit coastal waters close to shore, and a much larger "offshore" population ("offshore" bottlenose dolphins are included in ICES Advice, Section 1.6.6.3). Assessment units have been determined on the basis of a combination of spatial separation, lack of photo-identification matches, and genetic differences (ICES, 2014, Figure 1.6.6.2.1). Monitoring of bottlenose dolphins has been ongoing for decades, but for most coastal populations it is recent, or consists only of unpublished information. Within the AUs most of the available data relating to abundance (and therefore for examining trends) are from photo-identification studies of small localized resident groups, which are often related to monitoring the numbers of animals in protected areas. ICES acknowledges that there are more groups of coastal bottlenose dolphins besides the ones in the assessment units proposed by ICES (2014); however, the relationships of these with other groups are at present uncertain. Should further research reveal either changes

in boundaries to the current assessment units or additions to them, OSPAR should consider amending the list of assessment units.

Methods

Available literature was collated to examine abundance information relating to bottlenose dolphins in OSPAR regions II, III, and IV. In addition, researchers were contacted directly via email to enquire about recent relevant but unpublished analyses of abundance in these regions. In order to examine trends only sites with at least four estimates calculated over a ten-year period were considered.

Annex 1 contains collated data on bottlenose dolphin abundance. These data are taken from a wide range of sources, very often from counts covering only one site. ICES (2014) advised on a series of assessment units for bottlenose dolphins, covering sections of the coast in OSPAR Regions II, III, and IV where the species occurs. The collated data are sorted by these assessment units, but it is important to note that in only a few cases do the data represent the total number of bottlenose dolphins within one assessment unit.

Evidence of trends was evaluated by examining abundance estimates at specific sites within the AUs where sufficient data exist. Abundance estimates were made largely using capture–recapture methods applied to photo-identification data, and an indication is given about the trend in the population since the start of monitoring: stable, declining, increasing, or unknown. At least four abundance estimates from different years were required before the population trend was assessed. On occasions, pooled estimates have been calculated from a period of years. Some small discrete populations were assessed by a full census of individuals (e.g. the Sado estuary, Portugal). Trends were assessed against the proposed targets detailed in ICES (2014) advice to OSPAR, which suggested that a suitable indicator target for coastal bottlenose dolphins could be "*For each assessment unit, maintain inshore bottlenose dolphin population sizes at or above baseline levels, with no decrease of ≥30% over any ten-year period.*"

There are no data prior to human impacts in these areas, so it is not possible to set a historical baseline. Moreover, the historical abundance and distribution is unknown but there is good evidence that the species was once more widely distributed around these coasts. ICES therefore advises that the start of the data time-series for each AU should be used as the baseline, with indicator assessment thresholds set as a deviation against the proposed target of ≥30% over any ten-year period from that baseline value. The term "over any ten-year period" means that the minimum period required to assess a trend is ten years.

Sources and references[*]

Berrow, S., O'Brien, J., Groth, L., Foley, A., and Voigt, K. 2010. Bottlenose Dolphin SAC Survey. Report to the National Parks and Wildlife Service, 1–24.

Berrow, S., O'Brien, S., Groth, L., Foley, A., and Voigt, K. 2012. Abundance estimate of Bottlenose Dolphins in the Lower River Shannon candidate Special Area of Conservation, Ireland. Aquatic Mammals, 38(2): 136–144. doi: 10.1578/AM.38.2.2012.136.

Brereton, T., Jones, D., Leeves, K., Lewis, K., Davies, R., and Russell, T. In review. Population structure, mobility and conservation of Common Bottlenose Dolphin off southwest England from photo-identification studies. Journal of the Marine Biological Association of the United Kingdom.

Camphuysen, C. J., and Peet, G. 2006. Whales and dolphins in the North Sea. Fontaine Uitgevers, Kortenhoef, the Netherlands.

Cheney, B. J., Thompson, P. M., Ingram, S. N., Hammond, P. S., Stevick, P. T., Durban, J. W., *et al*. 2013. Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. Mammal Review, 43: 71–88.

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[*] Version 2: References have been updated

Cheney, B., Corkrey, R., Durban, J. W., Grellier, K., Hammond, P. S., Islas-Villanueva, V., *et al.* 2014. Long-term trends in the use of a protected area by small cetaceans in relation to changes in population status. Global Ecology and Conservation, 2: 118–128.

Corkrey, R., Brooks, S., Lusseau, D., Parsons, K., Durban, J.W., Hammond, P.S., and Thompson, P.M. (2008). A Bayesian capture–recapture population model with simultaneous estimation of heterogeneity. *Journal of the American Statistical Association*, 103: 948–960.

Couet, P. 2015a. From identification to models: reassessment of usual methods for populations monitoring. The case of bottlenose dolphin (*Tursiops truncatus*) inhabiting the English Channel. Poster presented at the international Workshop "Bottlenose dolphin conservation and monitoring in the North-western Mediterranean Sea" in Marseille, France.

Couet, P. 2015b. De l'identification des animaux aux modèles mathématiques: une remise en question des méthodes usuelles de suivi des populations. Le cas de la population de grands dauphins (*Tursiops truncatus*) en mer de la Manche. MSc thesis, Centre d'Ecologie Functionnelle and Evolutive. Université de Nice Sophia-Antipolis, 164 pp.

Evans, P. G. H., Anderwald, P. and Baines, M. E. 2003. UK Cetacean Status Review. Report to English Nature and the Countryside Council for Wales. Sea Watch Foundation, Oxford. 160 pp.

Feingold, D., and Evans, P. G. H. 2014a. Bottlenose Dolphin and Harbour Porpoise Monitoring in Cardigan Bay and Pen Llyn a'r Sarnau Special Areas of Conservation 2011–2013. Natural Resources Wales Evidence Report Series No. 4. 124 pp.

Feingold, D., and Evans, P. G. H. 2014b. Connectivity of Bottlenose Dolphins in Welsh Waters: North Wales Photo-Monitoring Report. Natural Resources Wales Research Report. 15 pp.

Fernández, R., Santos, M. B., Pierce, G. J., Llavona, A., López, A., Silva, M. A., Ferreira, M., *et al*. 2011a. Fine-scale genetic structure of bottlenose dolphins, *Tursiops truncatus*, in Atlantic coastal waters of the Iberian Peninsula. Hydrobiologica, 670: 111–125.

Fernández, R., Garcia-Tiscar, S., Santos, M. B., López, A., Martinez-Cedeira, J. A., Newton, J., and Pierce, G. J. 2011b. Stable isotope analysis in two sympatric populations of bottlenose dolphins *Tursiops truncatus*: evidence of resource partitioning? Marine Biology, 158: 1043–1055.

García, N., Caldas, M., Palacios, G., Moldes, M., Leal, A., and López, A. 2011. Photoidentification and population movements of bottlenose dolphins *Tursiops truncatus*, along the Galician coast, NW Iberia. Poster presented at the 25th Annual Conference of the European Cetacean Society, 21–23 March 2011, Cadiz, Spain.

Gaspar, R. 2003. Status of the Resident Bottlenose Dolphin Population in the Sado Estuary: Past, Present and Future. Doctoral Thesis. University of St. Andrews, Scotland. 194 pp.

Grellier, K., and Wilson, B. 2003. Bottlenose dolphins using the Sound of Barra Scotland. Aquatic Mammals, 29: 378–382.

ICES. 2014. OSPAR request on implementation of MSFD for marine mammals. *In* Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 1, Section 1.6.6.1.

Ingram, S. N. 2000. The ecology and conservation of bottlenose dolphins in the Shannon Estuary, Ireland. PhD thesis, University College Cork, Ireland. 213 pp.

Ingram, S. N., Englund, A., and Rogan, E. 2001. An extensive survey of bottlenose dolphins (*Tursiops truncatus*) on the west coast of Ireland. Heritage Council Report no. WLD/2001/42. 17 pp.

Ingram, S. and Rogan, E. (2003). *Estimating abundance, site fidelity and ranging patterns of bottlenose dolphins (Tursiops truncatus) in the Shannon Estuary and selected areas of the west-coast of Ireland.* Report to the National Parks and Wildlife Service**,** 1-28.

Ingram, S. N., Englund, A., and Rogan, E. 2003. Habitat use, abundance and site-fidelity of bottlenose dolphins (*Tursiops truncatus*) in Connemara coastal waters, Co. Galway. Heritage Council Wildlife Grant #12314. 27 pp.

Ingram, S., Kavanagh, A., Englund, A., and Rogan, E. (2009). *Site assessment of the waters of northwest Connemara. A survey of bottlenose dolphins* (Tursiops truncatus). Report to the National Parks and Wildlife Service**,** 1-33.

Lacey, C. 2015. Current status of the resident bottlenose dolphin population in the Sado Estuary, Portugal. MSc dissertation, University of Edinburgh.

Le Berre, N., and Liret, C. 2004. Capture-Recapture method to assess population size: the bottlenose dolphins of the Molene Archipelago. European Research on Cetaceans, 15: 431.

Liret, C. 2001. Domaine vital, utilization de l'espace et des ressources: les grands dauphins, *Tursiops truncatus*, de l'île de Sein. Thèse de doctorat de l'Université de Bretagne Occidentale, Brest. 155 pp.

Liret, C., Baines, M. E., Evans, P. G. H., Hammond, P. S., and Wilson, B. 2006. Atlantic bottlenose dolphins: conservation and management. Oceanopolis, Brest, France. 56 pp.

López, A., Vázquez, J. A., Martínez, J., Cañadas, A., Marcos, E., Maestre, I., Ruano, A., *et al*. 2013. New abundance estimates for harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*) in Northern Spanish Cantabrian and adjacent waters of Bay of Biscay (2003–2011). Poster presented at the 27th European Cetacean Society Annual Conference, 8–10 April 2013, Setúbal, Portugal.

Louis, M., Gally, F., Barbraud, C., Béesau, J., Tixier, P., Simon-Bouhet, B., Le Rest, K., and Guinet, C. 2015. Social structure and abundance of coastal bottlenose dolphins, *Tursiops truncatus*, in the Normano-Breton Gulf, English Channel. Journal of Mammalogy, doi:10.1093/jmamma/gyv053.

Louis, M., and Ridoux, V. 2015. Suivi des grands dauphins et des petits cétacés dans le Parc naturel marin d'Iroise. Rapport Convention n° 920/UMS 3462/PNMI.

Louis, M., Viricel, A., Lucas, T., Peltier, H., Alfonsi, E., Berrow, S., Brownlow, A., *et al*. 2014. Habitat-driven population structure of bottlenose dolphins, *Tursiops truncatus*, in the North-East Atlantic. Molecular Ecology, 23: 857–874.

MAGRAMA. 2012. Estrategias Marinas. Grupo Mamíferos Marinos. Evaluación inicial y buen estado ambiental. Technical report. 445 pp.
http://www.magrama.gob.es/es/costas/temas/proteccion-medio-marino/estrategias-marinas/em_documento_marco.aspx.

Martinho, F. 2012. Residency and behavioural patterns of coastal bottlenose dolphins (*Tursiops truncatus*) in the Arrábida and Tróia shores (Portugal). MSc thesis, Faculdade de Ciências da Universidade de Lisboa, Portugal. 80 pp.

Martinho, F., Pereira, A., Brito, C., Gaspar, R. and Carvalho, I. 2015. Structure and abundance of bottlenose dolphins (*Tursiops truncatus*) in coastal Setúbal Bay, Portugal. Marine Biology Research, 11: 144–156.

Mirimin, L., Miller, R., Dillane, E., Berrow, S. D., Ingram, S., Cross, T. F., and Rogan, E. 2011. Fine-scale population genetic structuring of bottlenose dolphins in Irish coastal waters. Animal Conservation, 14: 342–353.

Norman, E. B., Dussan-Duque, S., and Evans, P. G. H. 2015. Bottlenose dolphins in Wales: Systematic mark-recapture surveys in Welsh waters. Natural Resources Wales Evidence Report Series No. 85. Natural Resources Wales, Bangor. 83 pp.

Nykanen, M., Ingram, S. D., and Rogan, E. 2015. West coast dolphins (*Tursiops truncatus*): abundance, distribution, ranging patterns and habitat use. Report to the National Parks and Wildlife Service. 33 pp.

O'Brien, J. M., Berrow, S. D., Ryan, C., McGrath, D., O'Connor, I., Pesante, G., Burrows, G., *et al*. 2009. A note on long-distance matches of bottlenose dolphins (*Tursiops truncatus*) around the Irish coast using photo-identification. Journal of Cetacean Research and Management, 11: 69–74.

Ó Cadhla, O., Englund, A., Philpott, E., Mackey, M. and Ingram, S. N. 2003. Marine mammal monitoring in the waters of Broadhaven Bay and Northwest Mayo: 2001–2002. Report to Enterprise Energy Ireland Ltd. 74 pp.

Pesante, G., Evans, P. G. H., Baines, M. E., and McMath, M. 2008. Abundance and Life History Parameters of Bottlenose Dolphin in Cardigan Bay: Monitoring 2005–2007. CCW Marine Monitoring Report No. 61. 75 pp.

Portillo, C., Jiménez-Torres, C., Pérez, S., Verborgh, P., Gauffier, P., Esteban, R., Giménez, J., *et al*. 2011. Survival rate, abundance and residency of bottlenose dolphins in the Strait of Gibraltar. Poster presented at the 25th Conference of the European Cetacean Society, 21–23 March 2011, Cádiz, Spain.

Richards, V. P., Greig, T. W., Fair, P. A., McCulloch, S. D., Politz, P., Natoli, A., Driscoll, C. A., *et al*. 2013. Patterns of population structure for inshore bottlenose dolphins along the eastern United States. Journal of Heredity, 104: 765–778.

Rogan, E., Nykanen, M., Gkaragkouni, M., and Ingram, S. N. 2015. Bottlenose dolphin survey in the lower River Shannon SAC, 2015. Report to the National Parks and Wildlife Service. 21 pp.

Rosel, P. E., Hansen, L., and Hohn, A. A. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molecular Ecology, 18: 5030–5045.

Toth, J. L., Hohn, A. A., Able, K. W., and Gorgone, A. M. 2012. Defining bottlenose dolphin (*Tursiops truncatus*) stocks based on environmental, physical, and behavioral characteristics. Marine Mammal Science, 28: 461–478.

Weir, C. R., and Stockin, K. A. 2001. The occurrence and distribution of bottlenose dolphins (*Tursiops truncatus*) and other cetacean species in the coastal waters of Aberdeenshire, Scotland. Sea Watch Foundation, Aberdeen. 68 pp.

Wood, C. J. 1998. Movement of bottlenose dolphins around the south-west coast of Britain. Journal of Zoology, 246 (2): 155–163.

Wilson, B., Reid, R. J., Grellier, K., Thompson, P. M., and Hammond, P. S. 2004. Considering the temporal when managing the spatial: a population range expansion impacts protected areas-based management for bottlenose dolphins. Animal Conservation, 7: 331–338.

Annex 1[*]

Table 1.6.6.2.1.a Bottlenose dolphin - population abundance estimates by assessment unit. HPDI = Highest Posterior Density Interval (Bayesian estimate), CI = Confidence Interval, M-R = Mark–recapture).

Year	EAST COAST SCOTLAND			CARDIGAN BAY SAC			WIDER CARDIGAN BAY			SHANNON SAC		
	Total	95% HPDI		Total	95% CI		Total	95% CI		Total	95% CI	
1986												
1987												
1988												
1989												
1990	103	77	135									
1991	128	89	167									
1992	109	78	133									
1993	102	71	133									
1994	102	74	134									
1995	99	73	125									
1996	139	89	195									
1997	96	65	133							113	94	161
1998	116	75	156									
1999	87	59	121									
2000	116	80	164									
2001	125	105	150	140	121	192						
2002	116	95	135	135	88	275						
2003	149	119	182	167	155	194				121	103	163
2004	132	108	151	153	143	180						
2005	153	123	186	223	164	349	210	174	284			
2006	153	127	179	223	184	307	230	210	275	140	125	174
2007	141	117	163	206	179	266	243	228	279			
2008	153	113	191	260	192	401	310	264	391	114	85	152
2009	168	144	189	221	175	315	342	271	474			
2010	180	153	206	234	199	302	259	231	311	107	83	131
2011	171	146	196	182	160	228	243	217	292			
2012	208	177	237	229	191	305	240	220	280			
2013	194	168	222	153	126	211	205	189	241			
2014	170	139	200	116	91	175	152	126	282			
2015				159	130	228	222	184	300	114	90	143
Method	M-R			M-R			M-R			M-R		
References	Cheney *et al.*, 2014; Corkrey *et al.*, 2008			Feingold and Evans, 2014a; Norman *et al.*, 2015; Pesante *et al.*, 2008			Feingold and Evans, 2014a; Norman *et al.*, 2015; Pesante *et al.*, 2008			Berrow *et al.*, 2010; Ingram and Rogan, 2003; Rogan *et al.*, 2015		

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[*] Version 2: Table captions, formatting and referencing updated

Table 1.6.6.2.1.b Bottlenose dolphin – population abundance estimates by assessment unit. CI = Confidence interval. M-R = mark–recapture.

Year	NW CONNEMARA			GULF OF SAINT MALO			GULF OF SAINT MALO			ILE DE SEIN
	Total	95% CI		Total	95% CI		Total	95% CI		Total
1986										
1987										
1988										
1989										
1990										
1991										
1992										14
1993										
1994										14
1995										
1996										
1997										17
1998										
1999										
2000										
2001										20
2002										
2003										
2004										
2005										
2006										
2007										
2008										
2009	171	*100*	*294*							
2010				319	*310*	*327*	420	*331*	*521*	
2011				337	*324*	*349*				
2012				369	*343*	*431*				
2013				378	*365*	*385*				
2014				391	*372*	*413*				29
2015										
Method	M-R			M-R			M-R			CENSUS
References	Ingram *et al.*, 2009			Couet, 2015a; Couet, 2015b			Louis *et al.*, 2015			Liret, 2001; Liret *et al.*, 2006

Table 1.6.6.2.1.c Bottlenose dolphin – population abundance estimates by assessment unit. CI = Confidence interval. M-R = mark–recapture. SE=Standard Error.

Year	MOLENE ARCHIPELAGO			SADO ESTUARY		SETUBAL BAY			COASTAL GULF OF CADIZ			STRAIT OF GIBRALTAR		
	Total	95% CI		Total	Population Estimate	Total	95% CI		Total	95% CI		Total	95% CI	
1986				39	N/A									
1987				39	42 (0.5)									
1988				37	41 (0.7)									
1989				38	39 (0.3)									
1990				37	41 (0.7)									
1991				37	38 (0.2)									
1992				33	38 (0.4)									
1993				32	35 (0.5)									
1994				31	33 (0.0)									
1995				32	32 (0.0)									
1996				33	34 (0.3)									
1997				30	34 (0.3)									
1998				31	33 (0.3)									
1999				35	37 (0.4)									
2000				33	38 (0.5)									
2001	29*	28*	42*	35	37 (0.3)	106**	69**	192**						
2002				34	39 (0.6)									
2003				31	36 (0.4)									
2004				30	32 (0.0)									
2005				29	34 (0.7)									
2006				28	33 (0.7)				347^	264^	503^			
2007				27	30 (0.2)									
2008				26	28 (0.0)									
2009				26	27 (0.0)									
2010				26	29 (0.4)				397^^	300^^	562^^	297	276	332
2011				28	29 (0.0)	108***	83***	177***						
2012				29	30 (0.0)									
2013				28	30 (0.0)									
2014				28	29 (0.0)									
2015				27										
Method	M-R			CENSUS	M-R (SE)	M-R			M-R			M-R		
References	Le Berre and Liret, 2004; Liret *et al.*, 2006; Louis and Ridoux, 2015			Gaspar, 2003; Lacey (2015)	Lacey, 2015	Martinho, 2012; Martinho *et al.*, 2015			MAGRAMA, 2012			Portillo *et al.*, 2011		

*1999–2001 (Pooled estimates), **1998–2001 (Pooled estimates), ***2007–2011 (Pooled estimates), ^2005–2006 (Pooled estimates), ^^2009–2010 (Pooled estimates).

Table 1.6.6.2.1.d Bottlenose dolphin – population abundance estimates by assessment unit. CI = Confidence interval. M-R = mark–recapture. CV=Coefficient of Variation.

Area	Sources
Barra, UK	15 (Cheney *et al.*, 2013)SW ENGLAND:
Inner Hebrides, UK	30 (Cheney *et al.*, 2013
SW England, UK	max. 102 / 113 for 2008–13 (Brereton et al., in review) – M-R estimates
Northern Spanish waters	10,687 (95% CI: 4,094-18,132) pooled estimate for 2003–11 from line transect vessel surveys: regional estimates – Euskadi (1,931), Cantabria (744), Asturias (1,214), Galicia (703), Bank (108), Aviles (234) (López *et al.*, 2013)
Southern Galician Rias, Spain	76+ for 2000–2010 (cumulative number of identified individuals from photo-identification from vessel surveys) (García *et al.*, 2011)
Rest of Galicia, Spain	179+ for 2000–2010 (cumulative number of identified individuals from photo-identification from vessel surveys) (García *et al.*, 2011)
Central west coastal Portugal (between Nazare and Setubal, incl. Setubal Bay)	CENTRAL WEST COASTAL PORTUGAL (BETWEEN NAZARE AND SETUBAL including SETUBAL BAY): 352 (95% CI: 294-437) for 2008–14 (Martinho, 2012; Martinho *et al.*, 2015) – M-R estimates
Offshore Gulf of Cadiz, Spain	OFFSHORE GULF OF CADIZ: 4,391 (33% CV) pooled estimate for 2009–2010 from vessel surveys (MAGRAMA, 2012)