Boat-based Visual Surveys for Bottlenose Dolphins in the West Connacht Coast SAC in 2021

SIMON BERROW, MAGS DALY, STEPHANIE LEVESQUE, SIBÉAL REGAN AND JOANNE O'BRIEN

Irish Whale and Dolphin Group, Merchants Quay, Kilrush, Co Clare V15 E762

Contents

Executive Summary

The West Connacht Coast SAC (Side Code 002998) was designated in 2013 with bottlenose dolphins as the sole qualifying interest. Dedicated line transects were carried out **over seven days** on fixed, pre-determined routes in the SAC **between June and August 2021**. The survey area was divided into two discrete areas consistent with the boundaries of the SAC; namely the **Northern Component** and the **Southern Component.** Both Northern and Southern Components of the SAC were surveyed on the same day with two different teams. The survey design involved travelling along the coast and inside the islands at both sites informed by previous work that suggested bottlenose dolphins were rarely found >3km offshore.

A total of 358 nmls (663km) of survey effort was carried out in the Northern Component and 596 nmls (1104km) in the Southern Component, making a total of 955 nmls (1,767km). Surveys were largely carried out in good (≤ seastate 2) sea conditions. Bottlenose dolphins were encountered on five of the seven surveys (71%) in the Southern Component but none on effort in the Northern Component. Bottlenose dolphins in the Southern Component were exclusively observed in the mouth of Killary Harbour, Ballinakill Bay and off Cleggan. From mean group sizes estimates in the Southern Component, a total number of 181 individuals were encountered and of these images were obtained of 163 (91%) dolphins that could be identified individually. From these a total of 114 individual dolphins were identified including Severity Grades 1-3 and were used to build capture histories. In addition 18 calves were observed, including 5 juveniles, 11 calves and 2 neonates, but these were not included in the mark-recapture modelling. Discovery curves of the number of new dolphins recorded as the total number of individually recognisable dolphins photographed showed some evidence that the curves were starting to plateau out, but that not all dolphins in this survey area were captured.

A total of 78 individual dolphins were used in the models. Of these 69 (88%) were of Severity Grade 1 and photographed from both sides of the dorsal fin. A total of seven dolphins with Grade 1 or Grade 2 fins were only photographed from the left or right side. Using only images with Severity Grade 1 fins provides the most robust dataset and minimised violations of the assumption that all marks were correctly recorded and those animals did not lose their identifying marks.

Estimates of Nhat, which is the estimated total number of marked individuals in the population, ranged from 119 to 135 for Grade 1 fins depending on whether they had been photographed from the Left, Right or Both sides and was 165 overall. When including Grade 2 fins in the models this increased to 139-170 with a figure of 201 for all images combined. The proportion of dolphins with Severity Grade 1 identifiable marks ranged from 0.4 for Left and Right sides to 0.8 for Both together. The abundance estimate varied from 149 ± 28, CV = 0.19 (95% CI =93-204) for both sides using only Grade 1 images to 174 ± 37, CV = 0.21 (95% CI =101-247) for both sides of both Grade 1+2 images combined. Data from Severity Grade 1 fins from the left side and right side were combined as an inverse variance weighted average. These two values were combined to give a final best estimate of **197 ± 24** with a **CV 0.12** and **95% Confidence Intervals of 150 to 243**.

We also derived an abundance estimate using the survey data combined with additional photo-id data obtained opportunistically during the survey period on 10 occasions. This "enhanced estimate" resulted in an estimate of 228 ± 21, CV = 0.09 (95% CI = 187-270). The estimate is higher than the "robust" estimate of 197 ± 24, but interesting the CV is smaller.

The abundance estimate from this survey was very similar to those previously derived from the same sites. The current estimate is 8 individuals or only 4% greater than that reported in 2014 and all estimates are within 95% Confidence Intervals of each other. These data suggest that the number of bottlenose dolphins using the West Connacht Coast SAC since the first abundance estimate in 2009 is stable.

Although we successfully derived a robust abundance estimate of bottlenose dolphins in the West Connacht Coast SAC, the survey was not without its challenges. If an abundance estimate is the primary objective we recommend more survey effort is concentrated between Cleggan and Killary Harbour in the Southern Component. We encountered no bottlenose dolphins in the Northern Component during this survey. We recommend using local knowledge to react to sightings rather than carry out surveys on pre-determined days.

If one of the objectives is also to explore how bottlenose dolphins use the entire West Connacht Coast SAC then the current survey design is appropriate, as it adequately covers the whole area, is repeatable across years and can be completed in one day.

1   Introduction

Bottlenose dolphins are widespread in Irish waters, occurring both inshore and offshore and in estuaries and bays (Wall *et al.*, 2013; Rogan *et al.*, 2018). Genetic studies have shown that there are three discrete genetic populations (Mirimin *et al.*, 2011; Louis *et al.*, 2014; Nykänen *et al.*, 2018). A small population is largely confined to the Shannon Estuary and adjacent waters; a coastal population (often referred to the Conamara-Mayo population) and an offshore population which ranges from Scotland to the Azores. Coastal and estuarine populations are thought to have diverged from pelagic populations associated with retreating glaciers exposing suitable habitats (Nykänen *et al.*, 2019; Louis *et al.*, 2021). The last glacial maxima facilitated divergence of the coastal populations in the Northeast Atlantic from the pelagic population around 15,000 years ago which coincides with the rising temperatures in the lower latitudes of the North Atlantic Ocean.

1.1   Previous studies of bottlenose dolphins in the survey area

Bottlenose dolphins have been associated with the Conamara area of Counties Galway and Mayo for many years. Fairley (1981) describes a large school of dolphins surrounding a yacht off Conamara and published a photograph, taken in 1975, of a bottlenose dolphin breaching off Ballinakill Bay. The first dedicated bottlenose dolphin study in this area was Ingram *et al.* (2001) who carried out four boat-based surveys between Cleggan and Killary Harbour and two in Broadhaven Bay in north Mayo. A total of three groups of bottlenose dolphins were encountered during two of the surveys, one each off Killary Harbour, Ballinakill Bay and Cleggan Head, but no dolphins were recorded in Co. Mayo. The waters off Conamara were surveyed on three occasions in August and September 2003 by Ingram & Rogan (2003) which included one encounter with bottlenose dolphins south of the entrance to the Killary.

A much more intensive study was carried out between September 2008 and September 2009 by Ingram *et al.* (2009). A total of 21 surveys were carried out, largely covering the same route as that followed during the present study in the Southern Component. A total of 11 encounters with bottlenose dolphins were reported on eight survey days. Group sizes ranged from 2-25 individuals with a median of 15. Encounters were distributed throughout the survey area from Clare Island in the north to Mannin Bay to the south but were concentrated within 1km of the mainland. Most (45%) in the southern section were in the mouth of the Killary. A minimum of 86 uniquely marked bottlenose dolphins were recorded and at least 5 calves/juveniles estimated to be at least 1 year old, but no neonates were recorded. Ingram *et al.* (2009) used these data to derive an abundance estimate (±SE) of 171±48 with 95% Confidence Intervals of 100-294 (CV=0.28). This was the first abundance estimate for this coastal population off Conamara. Of the dolphins recorded during 2009, ten were catalogued previously from Cork to Donegal, with five of them also seen during previous surveys off Conamara. This suggests these dolphins were wide ranging but also showed a degree of site fidelity to waters off Conamara. Ingram *et al.* (2009) suggested that while the dolphins range widely, the waters off Conamara appears to represent a suitable habitat for designation as a Special Area of Conservation for bottlenose dolphins.

The study of bottlenose dolphins off northwest Mayo was largely driven by research and monitoring associated with the Corrib Gas Field and landfall in Broadhaven Bay. Between 2001 and 2014, the Coastal and Marine Resources Centre (CMRC) at UCC carried out visual and acoustic monitoring of all marine mammal species in Broadhaven Bay and adjoining coastal waters. This included photo-identification of bottlenose dolphins (O'Cadhla *et al.*, 2003; Englund *et al.*, 2006; Coleman *et al.*, 2008; Visser *et al.*, 2009). Dedicated studies, in what is now the northern section of the West Connacht Coast SAC, started in 2008 when Oudejans *et al.* (2008) carried out 10 dedicated and 18 opportunistic vessel-based surveys from the port of Blacksod. Five encounters with bottlenose dolphins were recorded during 848km of dedicated effort and 3 encounters during 309km of opportunistic effort. They carried out 12 photo-identification sessions resulting in the capture of 113 individuals dolphins leading to a

catalogue of 90 individuals. Six of these individual dolphins were observed on multiple days of which two were reported on 10 and 8 days as part of a small group of three individuals, suggesting small groups of dolphins remained within the study area from May to July. A total of 11 mother-calf pairs were recorded on three occasions, of which six were neonates (Oudejans *et al.*, 2008). This study was extended into 2009 with three additional dedicated vessel-based surveys and one opportunistic survey. Bottlenose dolphins were encountered on 25% of 57 surveys with group sizes ranging from 10 to 75 individuals. This increased the number of individually recognisable bottlenose dolphins off south Mayo to 159 (Oudejans *et al.,* 2010). A discovery curve which is used to determine what proportion of the population has been photographed was still rising indicating not all dolphins using the area were photographed. A total of 19 individuals (11%) were photographed between 2008 and 2009 within Mayo, suggesting some degree of site fidelity but not as strong as that reported off Conamara. These data were combined with photo-id data from Conamara and showed at least 70 of these individuals (41%) were recorded in both study areas (Oudejans *et al.,* 2010). This showed for the first time that bottlenose dolphins off Conamara and Mayo were part of the same social group.

Nykänen *et al.* (2015) encountered 25 groups of bottlenose dolphins resulting in photo-id sessions during 13 boat-based surveys during summers 2013 and 2014. Local abundance estimates for northwest Conamara in 2013 was 56 (95% CI 34-90) and 83 (95% CI 49-140) in 2014. They combined estimates from three sites (including Donegal Bay) using Bayesian multi-site abundance theory to provide an estimate of 145 (CV=0.30, 95% CI = 111-239) in 2013 and 189 (CV=0.11, 95% CI = 162-232) in 2014. They concluded that these estimates are likely to better reflect the true abundance of coastal bottlenose dolphins than local site-based estimates. Of the individual identifications collected in 2013, 25 dolphins had been encountered during surveys before 2013, and 71 identifications of 109 individual dolphins identified in 2014. This demonstrates great site fidelity to these sites, certainly during summer months.

O'Brien (2009) carried out 20 dedicated vessel-based surveys of which six were in Clew Bay and 14 in Galway Bay, immediately to the north and south of the southern section of the West Connacht Coast SAC and 19 opportunistic surveys in Galway Bay between 2005 and 2007. A total of 48 individually recognisable bottlenose dolphins were recorded. O'Brien *et al.* (2009) showed that individual bottlenose dolphins are much wider ranging than previously thought with high re-sighting rates from all around the Irish coast. Individual dolphins recorded off the west coast were also recorded off west Kerry, Cork Harbour and north Antrim in Northern Ireland. Robinson *et al.* (2012) compared individual bottlenose dolphins photographed in Ireland, to those photographed off northeast Scotland and found five of 21 individuals were re-sighted between both jurisdictions.

1.1   West Connacht Coast SAC

The West Connacht Coast SAC (Side Code 002998) was designated in 2013 with bottlenose dolphins as the sole qualifying interest. This site consists of a substantial area of marine waters lying off the coasts of Cos. Mayo and Galway. Comprising two parts, in its northern component the site extends from the coastal waters off Erris Head westwards beyond Eagle Island and the Mullet Peninsula in Co. Mayo. From there it extends southwards immediately off the coast as far as the entrance to Blacksod Bay. In its southern component, the site stretches from Clare Island and the outer reaches of Clew Bay at Old Head and continues southwards off the Mayo coast to the Connemara coast near Clifden and Ballyconneely, Co Galway. Predominantly coastal in nature, the site extends westwards into Atlantic continental shelf waters up to approximately 7-11 km from the mainland, although in its southern component it remains mostly inshore of the main islands: Clare Island, Inishturk, Inishbofin and Inishshark (NPWS, 2015).

Following its designation, Nykänen (2016) carried out a study of the phylogeography, population structure, abundance and habitat use of the bottlenose dolphins including deriving a more robust abundance estimate. A mark-recapture method was applied to Bayesian inference and hierarchical log-linear likelihood to derive a multi-site abundance estimate of coastal bottlenose dolphins for the wider Connemara-Mayo-Donegal area during 2013 and 2014. The median estimate for the abundance of

bottlenose dolphins in the whole study area was 145 (95% HPDI = 111-239) in 2013 and 189 (95% HPDI = 162-232) in 2014. A discovery curve was beginning to level off towards the end of the survey period, suggesting that most of the well-marked individuals may have been photographed. Nykänen (2016) also reported high rates of movement between the different survey areas during the study. From a total of 59 well-marked bottlenose dolphins, fifteen (25%) were recorded in more than one of the study areas, with similar overlap between the Southern and he Northern Components (six dolphins), the Northern Component and Donegal Bay (two dolphins) and the Southern Component and Donegal Bay (four dolphins). Three out of the 59 well-marked dolphins (5%) were seen in all of the study areas.

This demonstrates once again the high mobility and connectivity between the West Connacht Coast SAC and adjacent areas spanning a distance of some 215 km (115 nmls). Nykänen *et al.* (2018) combined photo-id data and genetic methods to explore connectivity between bottlenose dolphins SACs within Ireland in greater detail and showed individual bottlenose dolphins were strongly spatially associated with specific MPAs (SACs).

The aims of the current survey were:

i)   to undertake a series of boat-based surveys of bottlenose dolphin in the West Connacht Coast SAC;

ii)   to design practical and repeatable survey routes in both the Northern and Southern components of the West Connacht Coast SAC;

iii)   to derive a robust and precise population estimate for bottlenose dolphins in the SAC using mark-recapture photo-identification based sampling;

iv)   to determine the associated Coefficient of Variation (CV) and 95% Confidence Intervals about the estimate and

v)   to examine site faithfulness for bottlenose dolphins in the West Connacht Coast SAC.

2   Methods

2.1. Survey area and Platform

Dedicated line transect surveys were carried out on fixed, pre-determined routes in the West Connacht Coast SAC. The route was designed to cover the areas surveyed by Nykanen *et al.* (2015) within the SAC. Areas outside the SAC were not surveyed. Vessels travelled between 8-12kts to ensure coverage of the survey sites could be completed within a day. The proposed survey design involved travelling along the coast and inside the islands at both sites as informed by previous work that suggested bottlenose dolphins were rarely found >3km offshore (Oudejens *et al.*, 2010; Nykanen *et al.*, 2015) and typically within 1km (Ingram *et al.*, 2009).

The survey area was divided into two discrete areas consistent with the boundaries of the West Connacht Coast SAC; namely the **Northern** and **Southern Components.** Both northern and southern components of the SAC were surveyed on the same day with two different teams. Transects were carried out by two persons in each team consisting of SB, MD, SL and SR.

Transects were only carried out in sea-state ≤3 with good visibility (>6km) and low swell (<1m). It was planned to carry out one survey each month from June to September 2021 inclusive with provision for three additional surveys across this period (i.e. a total of 7 full surveys in both the northern and southern components of the SAC).

2.1.1 Northern Component

The pre-determined survey route is shown in Figure 4 and covers the entire northern section of the SAC. The vessel attempted to remain within 500-1000m from shore throughout the survey. The total distance travelled was around 40-50 nmls (70-90km), depending on the state of the tide but not including any extra distance and time required to obtain photo-id images when bottlenose dolphins are encountered. The design attempted to provide good coverage of the whole northern section, while acknowledging the tendency for dolphins to hug the shore at this location (Oudejens *et al.*, 2015). The route is easily repeatable within and across years. If dolphins were observed towards the middle (open water), sections of the SAC, or information on dolphin presence outside the standard route was obtained, the vessel would break the track-line to investigate and return if possible within the time-frame of the survey, to this location once photo-id images have been obtained.
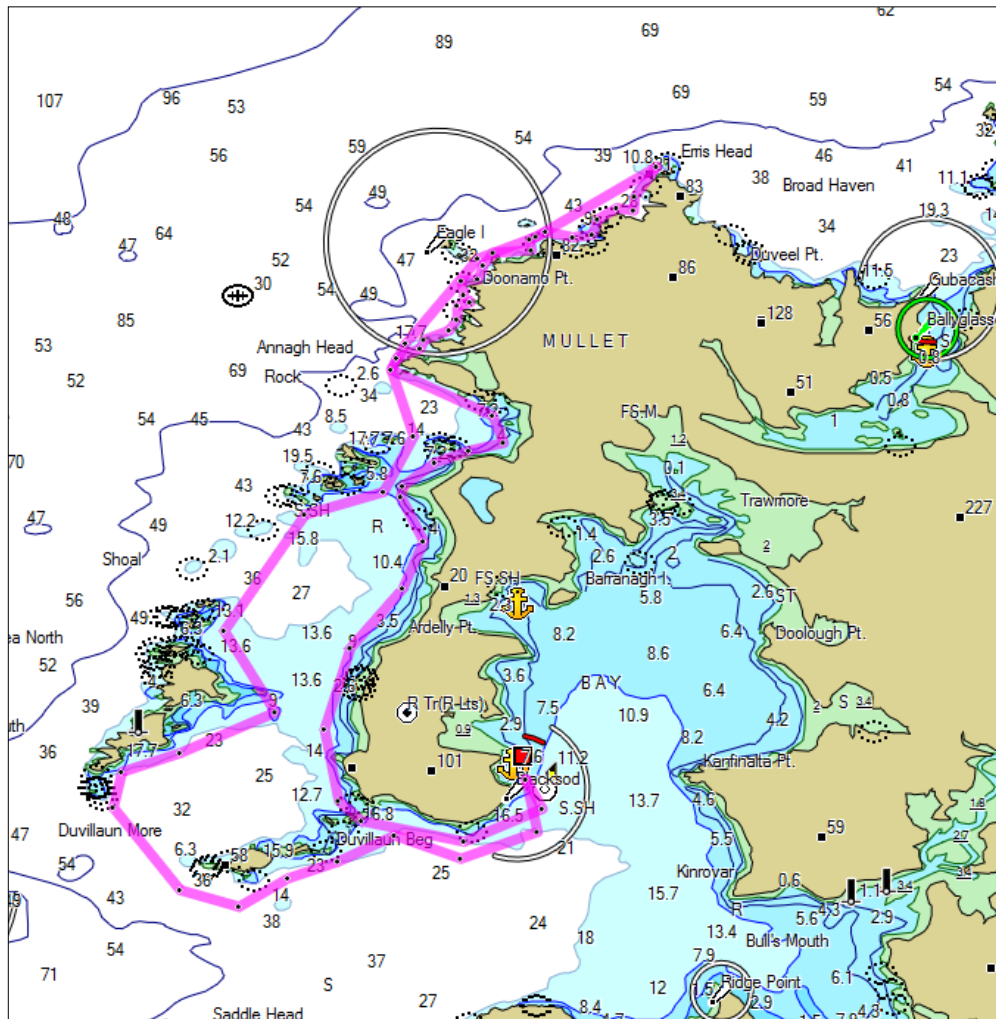
Figure 1 Pre-determined survey route for the Northern Component of the West Connacht Coast SAC

The survey vessel used was Kea Josh operated by Belmullet Boat Charters out of Blacksod, Co Mayo (https://belmulletboatcharters.wordpress.com). Keah Josh is a 12m catamaran built by South Boats and primarily used for carrying passengers to the islands. She has a P5 passenger boat licence allowing her to carry 12 passengers and 2 crew up to 30 miles offshore. She has a large aft deck area, a large wheelhouse and an elevated front deck. The aft deck is ideal for taking low level photos of dorsal fins.

The front deck provides an eye height of 1.0m above sea-level and the top of the wheelhouse a platform height of 2.5m for surveying. The boat is owned and operated by Seán Lavelle who is a native of west Mayo and has huge experience of the area. This vessel was big enough to accommodate two researchers to maintain social distancing throughout surveys, while providing good photo-id opportunities. One surveyor was located on the bow, and one on top of the wheelhouse with the skipper inside the wheelhouse. All surveys started from Blacksod at the tip of the Mullet peninsular and the route was surveyed anti-clockwise throughout. Effort was started as soon as the vessel cleared the harbour as the eastern boundary of the Northern Component of the SAC is at Blacksod.

2.1.2   Southern Component

The pre-determined survey route is shown in Figure 2 and covered the entire southern section of the SAC. The boat departed Cleggan and travelled anti-clockwise. The vessel remained within 500-1000m from shore throughout the survey. The distance was a minimum of 85 nmls (153 km), not including the extra distance required to obtain photo-id images when bottlenose dolphins were encountered. The design attempted to provide good coverage of the whole southern section while acknowledging the tendency for dolphins to hug the shore at this location. The route is easily repeatable within and across years. If dolphins are observed towards the middle (open water), sections of the SAC, or information on dolphin presence outside the standard route was obtained, the vessel would break the track-line to investigate and return if possible within the time-frame of the survey, to this location once photo-id images have been obtained.
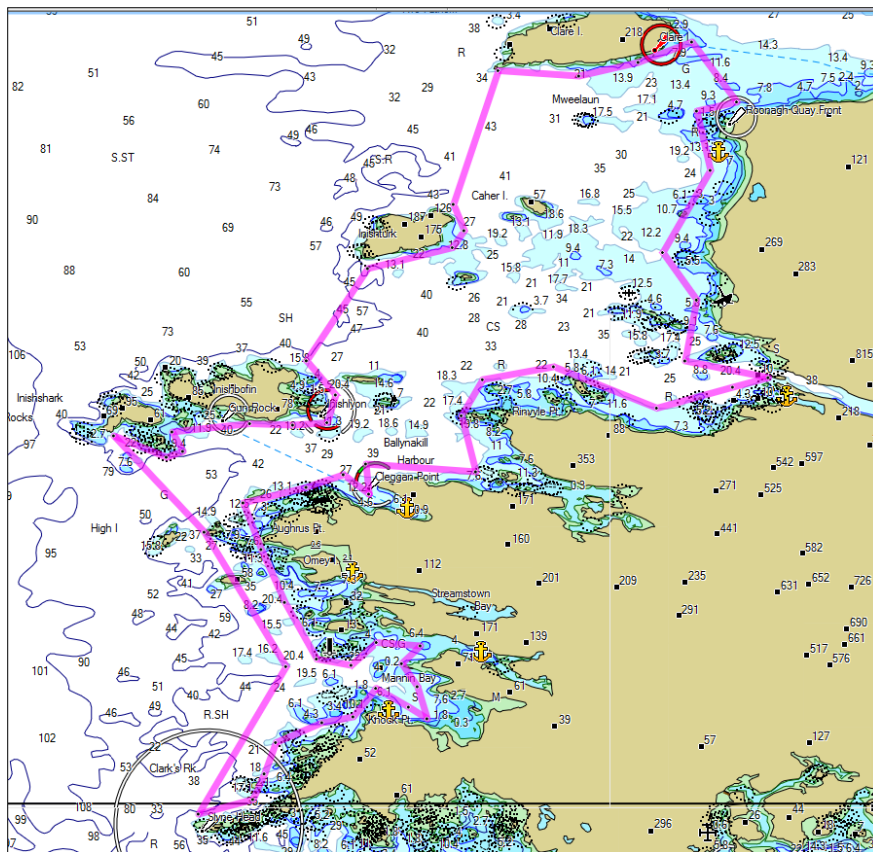
Figure 2 Pre-determined survey route for the Southern Component of the West Connacht Coast SAC.

The survey vessel used was Blue Water operated by Blue Water Fishing (https://seafishingireland.net). Bluewater is a 40 foot twin engine utility vessel primarily used for angling. She has a P5 passenger boat licence allowing her to carry 12 passengers and 2 crew up to 30 miles offshore. She has a large aft deck area clear of obstructions, a wheelhouse with seating for 5 plus the skipper and an elevated front deck. Bluewater has two 280HP engines, which gives her a top speed of 25 knots. The aft deck is ideal for taking low level photos of dorsal fins. The front deck provides an eye height of 1.5m above sea-level and the top of the wheelhouse a platform height of 2.5m for surveying.

The boat is owned and operated by John Brittain who has huge experience of the area. This vessel was big enough to accommodate two researchers to maintain social distancing throughout surveys, while providing good photo-id opportunities. One surveyor was located on the bow, and one on top of the wheelhouse with the skipper inside the wheelhouse. All surveys started from Cleggan and the route was surveyed anti-clockwise throughout. Effort was started as soon as the vessel cleared the harbour as the bay at Cleggan is included within the Southern Component of the SAC.

The route of the survey vessel and positions of dolphin schools encountered in both areas were stored on Garmin handheld GPS as well as any changes to environmental conditions. Map files from each survey are downloaded using Garmin MapSource® software and saved as a text file. These data were then used to create ArcView (Version 9) shape files of the survey track and location of all sightings recorded during each survey.

2.2   Photo-identification

Images of bottlenose dolphins suitable for photo-identification were collected with Canon DSLR cameras. Each survey team had a Canon D7Mark ii body, which is still considered one of the best cameras available for wildlife photography despite recent upgrades. D7Mark ii has GPS facility and can location stamp each image with latitude/longitude. Both Canon D7Markii were fitted with a 100-400mm Sigma lenses. Each team had a Canon D50 with Sigma 170-500mm lense. Extra lenses including a 100-500mm and a 75-300mm lense were also provided to each team to ensure they can capture images from animals close to, and at a distance from the survey vessel. These cameras can acquire images at 10.10 resolution and images were collected as jpg files. This equipment can collect up to 280 high resolution images (up to 4-5MB per image) on a 1.6GB card. Images were downloaded and sorted. Images to be processed were renamed using Imatch Phototools software.

All dolphin schools, defined as all dolphins within 100m radius of each other (Irvine *et al.*, 1981), encountered were approached slowly and their position at the start and end of each encounter recorded using a hand-held GPS. Group size, behaviour (using Baker *et al.,* 2017a) and the presence and numbers of calves were recorded. Behaviour was also noted. An attempt was made to photograph all dolphins in each school and to obtain images of both left and right sides of each dorsal fin. Photo-identification was only continued while there was no negative reaction to the photo-identification attempt occurred.

2.3   Matching

The IWDG followed a standard protocol for sorting and matching images (Baker, 2015). All images were reviewed and all those badly out of focus, missing dolphins etc. were deleted. Sorting and matching was consistent with previous NPWS funded (Berrow *et al.,* 2012b) and recent IWDG surveys in the Shannon Estuary (Baker *et al., 2017b, 2018a, 2019*). All dolphin images were sorted and graded from 1

to 3 following published criteria (Ingram 2000; Englund *et al.,* 2007; 2008: Berrow *et al.,* 2012; Baker *et al.,* 2017b, 2018, 2019).

Photo Quality Grade 1: Well-lit and focused shots taken perpendicular to the dorsal fin at close range;
Photo Quality Grade 2: More distant, less well-lit or slightly angled shots of dorsal fins
Photo Quality Grade 3: Poorly lit or out of focus shots taken at acute angles to the dorsal fin

Dorsal fins will be recorded as "left-side", "right-side" and "both sides" for each encounter. A unique catalogue of dorsal fins will be established for this project. Individual dolphins will be classified according to the extent of their natural marks, following Ingram (2000):

Severity Grade 1: Marks consisting of significant fin damage or deep scarring that can be considered permanent.
Severity Grade 2: Marks consisting of deep tooth rakes and lesions and minor cuts.
Severity Grade 3: Marks consisting of very superficial lesions or complete absence of them.

Photo-id matching was carried out by MD, with second checking by SL for quality assurance. Capture histories for Severity Grade 1: Left, Right and Both sides and Severity Grade 1+2 Left, Right and Both sides were created to derive mark-recapture abundance estimates.

Severity Grade 1 fin "left" side and "right" side (BDWC21-006L_T3_S4_South_20210702)

Severity Grade 2 fin "right" and side Severity Grade 3 fin "left"

2.4 Mark-Recapture Modelling

Mark-recapture modelling was carried out using the software programs MARK and CAPTURE (Version 6.2, Build 9200) by JO'B. All datasets were prepared and input into a closed model incorporating heterogeneity in capture probability (Chao M(th)) (Chao *et al.,* 1992). Multiple sample capture-recapture abundance estimates were generated based on the following assumptions of closed populations following Ingram (2000);

   i.   the population is closed during sampling period
   ii.   animals do not lose their identifying marks during sampling period
   iii. all marks are correctly recorded in each capture
   iv.   each animal has an equal and constant probability of being captured.

The Akaike Information Criterion (AIC) values were calculated in the program MARK for each model to assess best fit (Akaike, 1974). The key parameters of the models are S (probability of survival), gamma" (probability of emigration), gamma' (probability of an emigrated animal staying outside the study area), and N (population size within the study area). Together, these were used to obtain overall population estimates, using a biased corrected estimate, the delta method recommended by Wilson *et al.* (1999) after taking account of the (weighted) mean proportion of well-marked animals and some measure of survival/migration obtained from the model.

The program CAPTURE derives confidence intervals under the assumption that the number of individuals not captured in the population is log normally distributed, resulting in the upper estimate being larger than if assumed to be normally distributed. The estimates of the marked population varied depending on which set of dorsal fin images were used. Estimates of abundance were calculated using left side, right side, and both side identifications. Bottlenose dolphins with Severity Grade 1 and 2 marks were used and not those with Severity Grade 3. Model results showed the *CAPTURE* model M(th) for a closed population incorporating capture probability heterogeneity (Chao *et al.,* 1992) provided the best fit (i.e., lowest AIC value). The estimated total number of marked individuals in the population (Nhat) was calculated by the model. We calculated estimates using dolphins re-captured from the left side of the dorsal fin (Left), dolphins recaptured from the right side of the dorsal fin (Right), and dolphins recaptured from both sides of the dorsal fin (Both). We calculated all estimates using Photo Quality Grade 1 and 2 only.

In addition to the abundance estimates derived using data collected during the current contract we combined these data with additional photo-id images collected during other projects or opportunistically within the study area and period, to explore the effects of these extra datasets on abundance estimates.

3   Results

3.1   Survey Effort and Sightings

A total of seven surveys were completed at both sites simultaneously between June and August 2021. A total of 358 nmls (663km) of survey effort was carried out in the Northern Component and 596 nmls (1104km) in the Southern Component, making a total of 955 nmls (1,767km). Surveys were carried out in good sea conditions.

Table 1   Survey effort and sighting data for bottlenose dolphin surveys in the West Connacht Coast SAC during 2021.

Survey Day	Date	Total effort (nmls)		Total effort (%) in sea-state ≤2		Number of BND sightings Southern Component	Number of BND sightings Northern Component
		North	South	North	South		
1	1 June	52.4	99.4	58.6	100	1 (1)	1 (2)[1]
2	18 June	58.2	89.8	90.2	100	5 (79)	0
3	2 July	50.6	69.7[2]	94.5	100	5 (36)	0
4	15 July	46.9	78.2[2]	93.7	97.1	3 (61)	0
5	19 July	55.4	90.1	92.7	93.7	0	0
6	19 August	51.4	83.3	89.9	0	3 (44)	1 (5)[3]
7	25 August	43.4	85.8	51.2[4]	93.8	0	0
Total		358	596			**17 (221)**	**2 (7)**

[1] Unident. Dolphin species (probably bottlenose dolphin but only surfaced twice)

[2] GPS signal lost in places during survey

[3] After survey had been completed

[4] Poor sea conditions, with 48.8% carried out in seastate ≥3

All survey effort on Survey 1-4 and Survey 6 in the Northern Component, and all survey effort in the Southern Component the Southern Component, were carried out in sea-state ≤3. Only on Survey 7 in the Northern Component was sea-state >3 for any period, resulting in 11.5% of effort in sea-state 4 and no dolphins were observed. During Survey 1 in the Northern Component, 41.4% of effort was carried out in sea-state 3. Overall the proportion of survey effort in the Northern Component carried out in sea-state 0 was 24.8%, 21.2% in sea-state 1 and 34.4% in sea-state 2. Conditions were better in the Southern Component with overall 14.5% of effort was conducted in sea-state 0, 54.7% in sea-state 1 and 28.6% in sea-state 2 (Table 1).
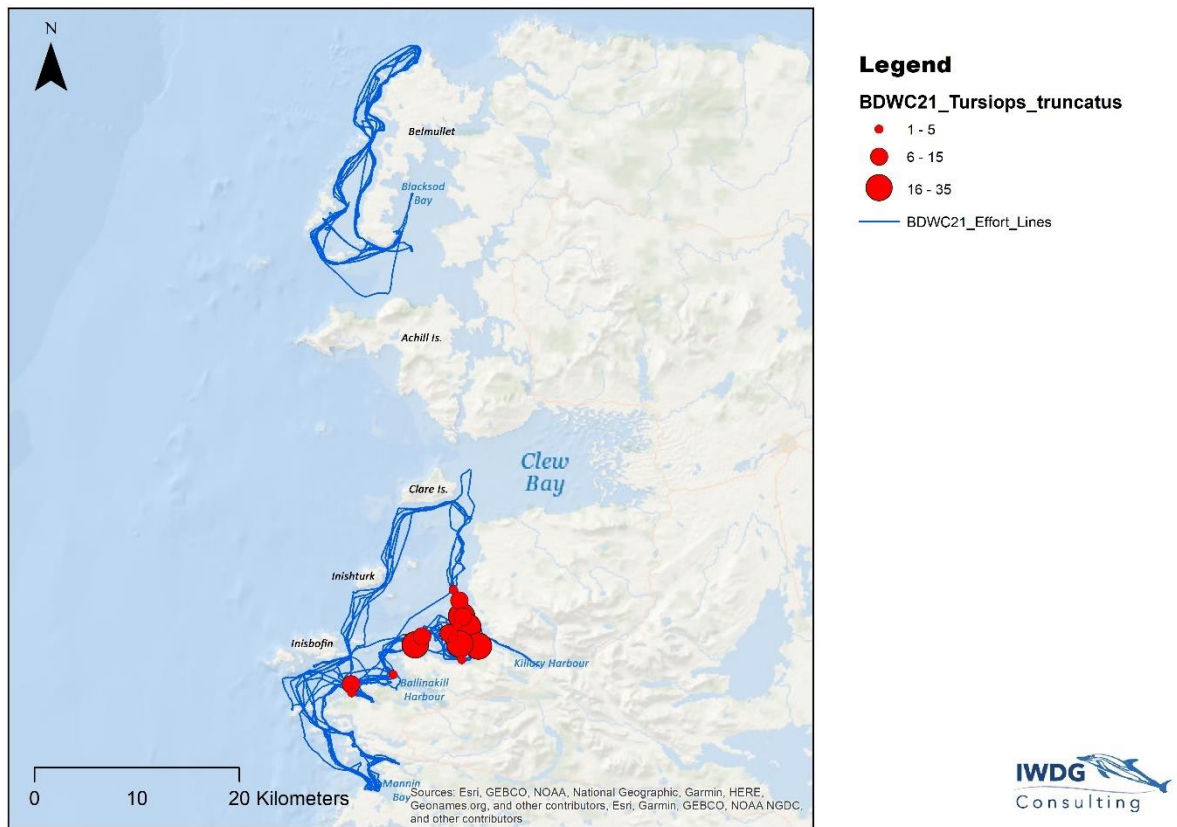
Figure 3   Map of survey track-lines and on effort sightings of bottlenose dolphins during surveys of the West Connacht Coast SAC during 2021.
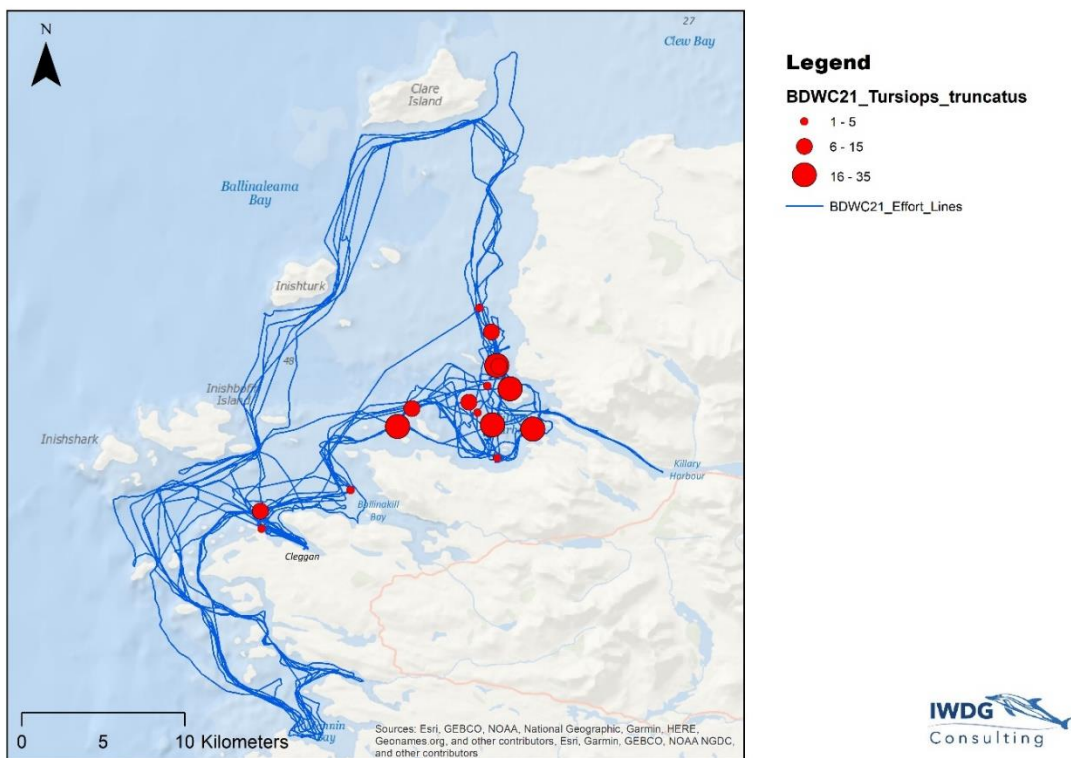
Figure 4   Map of survey track-lines and sightings of bottlenose dolphins in the Southern Component of the West Connacht Coast SAC during 2021.

On one survey in the Northern Component (Survey 3) the trackline near the southern boundary towards the end of the survey was broken following a report of bottlenose dolphins off Slievemore on Achill Island (see figure 3). No dolphins were located and the survey vessel travelled directly back to the port at Blacksod. In addition, one survey in the Southern Component (Survey 5) the track was broken to travel from north of Killary Harbour to Inishboffin following a report from the ferry of bottlenose dolphins. No dolphins were found and after further discussion with the ferry skipper they were most likely common dolphins. The north and northwest part of the survey route was not surveyed as there was no time to return to the trackline.

Bottlenose dolphins in the Southern Component were exclusively observed in the mouth of Killary Harbour with one sighting in the mouth of Ballinakill Bay and two off Cleggan (Figure 4).

3.2 Images obtained for photo-identification

The primary objective for locating bottlenose dolphins was to obtain images suitable for photo-identification for use in mark-recapture modelling. Once an individual or group was encountered we attempted to obtain good images both sides of the dorsal fin from all dolphins present. Only one group of 5 dolphins were observed within the Northern Component, but this was after the survey had finished. Images suitable for photo-identification were obtained of this group from land and two individuals previously recorded in the Southern Component were identified from these images. These data were used in the enhanced abundance estimates which included with extra images but not in the robust estimate. No further analysis of data from the Northern Component was possible.

Table 2 Number of dolphins identified each survey and cumulative total of individually recognisable dolphins within the West Connacht Coast SAC during 2021.

Survey Day	Number of BND observed	Number of individual dolphins identified	Cumulative number of dolphins identified	Number of BND observed	Number of individual dolphins identified	Cumulative number of dolphins identified
	Southern Component			Northern Component		
1	1	0	0	0	0	0
2	79	60	64	0	0	0
3	36	18	77	0	0	0
4	61	39	96	0	0	0
5	0	0	96	0	0	0
6	44	42	114	5[1]	2	2
7	0	0	114	0	0	2
Total	**181**	**163**	**114**	**5**	**2**	**2**

[1] photographed after the survey had been completed

Using mean group size estimates in the Southern Component, a total number of 181 individuals were encountered and from these 163 (91%) dolphins could be identified individually (Table 2). From these

a total of 114 individual dolphins were catalogued including fin Severity Grades 1-3, which were used to build individual capture histories. In addition 18 calves were observed, including 3 neonates, but these were not included in the mark-recapture modelling.

Table 3 Number of dolphins identified during each survey and the cumulative total of individual dolphins photographed in each Fin Severity Grade (1-3) during 2021.

Survey Number	Number of individual dolphins identified	Cumulative number of dolphins identified	Number of individual dolphins identified	Cumulative number of dolphins identified	Number of individual dolphins identified	Cumulative number of dolphins identified
	Severity Grade 1 fin		Severity Grade 1+2 fin		Severity Grade 1+2+3 fin	
1	0	0	0	0	0	0
2	44	44	52	52	64	64
3	9	49	12	60	16	77
4	26	63	34	77	38	96
5	0	63	0	77	0	96
6	30	76	34	92	36	114
7	0	76	0	92	0	114

As the number of individual dolphins photographed increased throughout the survey the number of new dolphins identified decreases as the population in the survey area is photographed. We can plot the total number of dolphins photographed after each survey (cumulative number of dolphins, see Table 2) against the number of unique individuals dolphins recorded.

Number of individually recognisable dolphins   Number of individually recognisable dolphins

5a. Grade 1 fins   5b. Grade 1+2+3 fins
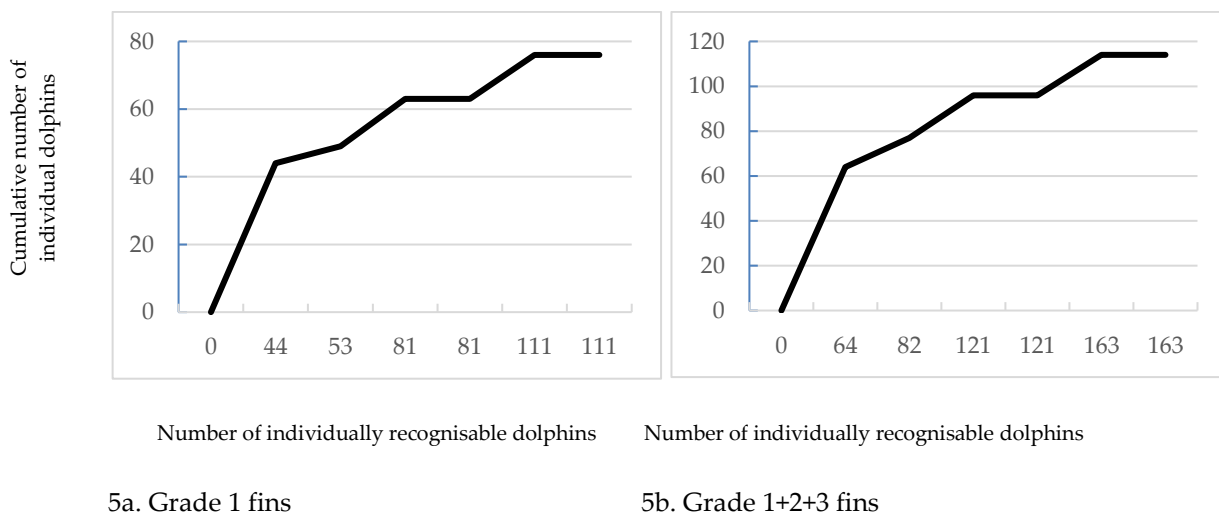
Figure 5a-b Discovery curves of individually recognisable bottlenose dolphins in the southern section of the West Connacht Coast SAC during 2021.

This is known as a Discovery Curve and gives an insight into how much of the identifiable (marked) population has been photographed. If all dolphins with marked fins are photographed (captured) then

it doesn't matter how many more surveys are carried out as no more new individuals will be photographed. At this point the curve will have plateaued out. Data for fin Severity Grade 1 to 3 are presented in Table 3.

Discovery curves of the number of new dolphins recorded as the total number of individually recognisable dolphins increased are shown in Figure 5a for Severity Grade 1 fins only and for Severity Grades 1-3 (Fig. 5b). Although there was some evidence that these discovery curves are starting to plateau out, it's still likely that new dolphins will be photographed with more effort suggesting not all dolphins in this survey area have been captured.

3.3   Bottlenose dolphin abundance estimates

A total of 78 individual dolphins were used in the mark-recapture models. Of these 69 (88%) were of Severity Grade 1 and photographed from both sides of the dorsal fin. A total of seven dolphins with Grade 1 or Grade 2 fins were only photographed from the left or right side (Table 4).

Table 4   The number of marked dolphins used in the CAPTURE model

Fin Severity Grade	Both	Left Only	Right Only
Grade 1	69	5	2
Grade 2	9	2	5
Total	78	7	7

Table 5   Model data used to estimate abundance of marked dolphins from CAPTURE model for West Connacht Coast SAC during 2021 (n= number of animals captured for estimate)

Fin Severity Grade	Dorsal Fin side	AIC	n	Nhat	Standard Error	95% Confidence Intervals
Grade 1	Both	26.4	103	119	25.5	101-205
	Both + Left only	33.4	101	135	22.2	90-182
	Both + Right only	26.5	103	134	25.3	101-204
	All	0.8	110	165	32.4	121-253
Grade 1+2	Both	22.1	118	139	23.2	108-202
	Both + Left only	-8.4	126	170	29.5	129-249
	Both + Right only	-8.4	126	171	30.1	130-252
	All	-35.0	133	201	36.3	150-297

The sample size of identified individuals was high and this is reflected by relatively low AICs (Table 5). The number of Severity Grade 2 fins were small (n=9) and therefore the AICs were quite consistent across all the models (Table 5). Here we present results from the analysis of Severity Grade 1 and

Severity Grade 1+2 images to estimate abundance. Using only images with Severity Grade 1 fins provides the most robust dataset and minimises violations of the assumption that all marks were correctly recorded and those animals do not lose their identifying marks. See Appendix I for capture histories of each individual dolphin.

Estimates of Nhat, which is the estimated total number of marked individuals in the population, ranged from 119 to 135 for Severity Grade 1 fins depending on whether they had been photographed from the Left, Right or Both sides and was 165 overall. When including Severity Grade 2 fins in the models this increased to 139-170 with a figure of 201 for all images combined (Table 5).

Table 6   Model outputs which includes estimates of θ (the proportion of dolphins with identifiable marks (Severity Grade 1 and Grade 1+2).

Fin Severity Grade	Dorsal Fin side	Nhat	Proportion of animals with marks (θ)	Abundance estimate	SE	Coefficient of variation	95% Confidence Interval
G1	Both + Left	135	0.4	304.43	60.44	0.20	186-423
	Both + Right	134	0.4	335.00	67.18	0.20	203-467
	Both	119	0.8	148.75	28.21	0.19	93-204
G1+2	Both + Left	170	0.5	375.79	56.03	0.15	266-486
	Both + Right	171	0.4	427.50	80.14	0.19	270-585
	Both	139	0.8	173.75	37.34	0.21	101-247

The proportion of dolphins with Severity Grade 1 and 2 identifiable marks is shown in Table 6. This ranged from 0.4 to 0.8 depending on which side of the dorsal fin was used. The variance of each estimate was calculated using the delta method recommended by Wilson *et al.* (1999) where:

$$\text{Var } N = N2 \, (\text{varNhat/Nhat2} + 1 - \theta/n\theta)$$

Where: N = estimated total population size
Nhat = estimate of the subset of marked individuals
θ = estimated proportion of animals with Severity Grade 1 marks in the population
var = SE2

The estimated abundance of marked individuals is increased according to the estimated proportion of marked individuals in the population (Table 6). An estimate of 0.8 was used for estimates using both sides of the dorsal fin. The abundance estimate varied from 149 ± 28, CV = 0.19 (95% CI =93-204) for both sides Severity Grade 1 images to 174 ± 37, CV = 0.21 (95% CI =101-247) for both sides of Severity Grade 1+2 images.

Data from Severity Grade 1 fins from the left side and right side were combined as an inverse variance weighted average, assuming independence following the recommendations described by Wilson *et al.* (1999). Data from the combined (right, left, and both) average uses the data in right and left twice in the weighted average (once each and then both in the "both" category).

These two values were combined to give a final estimate of **197 ± 24, CV = 0.12 (95% CI = 150 to 243)**.

3.4 Bottlenose dolphin abundance estimates with extra field data

Images of bottlenose dolphins were obtained outside the scheduled fieldwork carried out during this survey, but within the survey period. John Brittain who runs regular fishing charters out of Cleggan, Co Galway encountered bottlenose dolphins on seven occasions between 31 May and 21 September 2021, and obtained images suitable for photo-identification on five occasions (Table 7). On one occasion he encountered a group of 10 bottlenose dolphins in Cleggan Harbour the day after the first survey (Survey 1: 1 June) on which we had not encountered any bottlenose dolphins (Table 2). Bottlenose dolphins were also encountered within the northern site on two occasions during fieldwork associated with the Atlantic Marine Energy Test Site (AMETS) (Berrow *et al.*, 2021) and opportunistically on one occasion by Gemma O'Connor out of Blacksod, Co Mayo (Table 7). Also included in this analysis are images taken from land after a boat-based survey (Survey 6: Northern Component) had been completed as part of the present study.

Table 7 Additional photo-id data for bottlenose dolphin collected within the West Connacht Coast SAC during 2021.

Date	Recorder/Project	Group size	Number of images obtained	Number of individual dolphins identified	
Northern Component					
14-Apr	Simon Berrow/AMETS	15	625	5	
26-May	Gemma O'Connor	12	10	6	
01-Jul	Simon Berrow/AMETS	2	22	0	
19-Aug	Simon Berrow/BDWC21	5	252	4	
Southern Component					
02-Jun	John Brittain/Blue Water	10	99	4	
23-Jun	John Brittain/Blue Water	10	8	3	
30-Jun	John Brittain/Blue Water	10	104	13	
14-Jul	John Brittain/Blue Water	5	18	4	
03-Sep	John Brittain/Blue Water	15	216	3	
21-Sep	John Brittain/Blue Water	12	133	5	

Abundance estimates using this additional data were carried out following the same methodology as before (see Section 3.3). As the accuracy of group size estimates could not be checked and no effort was made during these casual encounters to collect images from both sides of the dorsal fin, we used estimates on the proportion of animals with marks (θ) from Table 5.

Table 8 Model data used to estimate abundance of marked dolphins from CAPTURE model for additional datasets (n= number of animals captured for estimate)

Fin Severity Grade	Dorsal fin side	AIC	n	Nhat	SE	95% CI
Severity Grade 1+2	Both	366.3	174	147	18.5	122-196

The results from the Mark model are presented in Tables 8 and 9. The output of the inverse variance weighted average, and assuming independence following the recommendations described by Wilson *et al.* (1999) for (right, left, and both), resulted in an estimate of **228 ± 21, CV = 0.09 (95% CI = 187-270).**

Table 9   The proportion of dolphins with identifiable marks (Severity Grade 1 and Grade 1+2).

Severity Grade	Nhat	Proportion of animals with marks (θ)	Abundance estimate	SE	CV	95% CI
G1+2	147	0.8	184	24	0.13	137-231

3.5   Juveniles and calves

A total of 18 adult-calf pairs were recorded during the surveys (see Appendix II). A total of 11 calves were recorded across five separate groups during three of the surveys in the Southern Component. A total of five juveniles were also recorded and two neonates. Adult to calf ratios ranged from a high of 25% for a small group of 4 individuals to 4.2% in a group of 24 individuals. Ratios of 15.0, 15.2 and 16.8% calves in groups of 20, 46 and 48 were also recorded.

3.6   Site fidelity

Bottlenose dolphins in the West Connacht Coast SAC have been shown to demonstrate high levels of site fidelity especially over short summer field seasons. During the present study we photographed the same individuals in the Southern Component, and largely within the same area off Killary Harbour on many occasions. Individual dolphins with Severity Grade 1 fins were photographed twice on 16 occasions, three times on 8 occasions and one on four occasions (Table 10). Those with less severe grade fins were photographed less frequently.

Given only images of individual bottlenose dolphins were only obtained on four surveys (Table 2), these recapture rates are high. The mean re-capture rate was 1.5 for Severity Grades 1 and 2 fins and 1.4 for Severity Grade 3. The re-sighting rate using the formula in Nykänen *et al.* (2015) was 0.4 for Severity Grade 1 and 2 fins and 0.3 for Severity Grade 3 fins.

Table 10   Number of times dolphins with different severity grade fins were photographed during surveys (n=7) of the West Connacht Coast SAC during 2021.

Number of times photographed	Grade 1 fins	Grade 2 fins	Grade 3 fins	Total (%)
1	48	13	9	70 (67%)
2	16	3	3	22 (21%)
3	8	3	1	12 (11%)
4	1	0	0	1 (1%)

This population have been photographed between the Northern and Southern Components during the present survey and outside the west Connacht Coast SAC during 2021 demonstrating the connectivity between the Northern and Southern Components but also the wide range of this population . There have been sightings of some very distinctive individual dolphins, e.g. WCBD21-018 (Figure 6a), also known locally as "Half-fin". This dolphin was photographed survey days 2, 3 and 6 in the Southern Component of the SAC, with subsequent casual sightings within the same week off the Mullet peninsula and in Broadhaven Bay in Mayo. A group including WCBD21-076 was recorded in the West Connacht Coast SAC on survey 6 (19 August 2021; Figure 6b) and were also photographed off Kilkee, Co Clare on 20 April 2021 (Figure 6b).

Figure 6a   WCBD21-018, also known as "Half-fin" on Survey 2 (18 June) and opportunistically off Blacksod Pier on the 29 May 2021 by Gemma O'Connor

Figure 6b   Bottlenose dolphin Catalogue Number WCBD21-076 recorded off Kilkee, Co Clare on 20 April 2021 and on Survey 6 (19 August)

In order to explore site fidelity between years we must compare images collected during the current survey with those collected in previous years. We have identified at least eight sources/surveys which collected images of individually identified bottlenose dolphins from the area of interest (Table 12). Some of these studies date back over 20 years to 2001 (Ingram *et al.*, 2001), while others were carried out in the same time period as the current study (Berrow *et al.*, 2021). The photo-identification catalogue derived during these surveys was shared with researchers involved in previous studies of these two areas to explore site fidelity. To date only a comparison with the current catalogue and images contained within the IWDG Coastal Catalogue and data collected from AMETS from 2020-21 has been carried. Only two dolphins from the present study were also in the IWDG Coastal Catalogue and eight in the AMETS (se Appendix IV). A full analysis will be carried out once we have received feedback from colleagues who managed the other relevant catalogues.

In addition O'Brien (2009) carried out 20 dedicated vessel-based surveys of which six were in Clew Bay and 14 in Galway Bay, immediately to the north and south of the southern section of the West Connacht Coast SAC and 19 opportunistic surveys in Galway Bay between 2005 and 2007. A total of 48 individually recognisable bottlenose dolphins were recorded. O'Brien *et al.* (2009) showed that individual bottlenose dolphins are much wider ranging than previously thought with high re-sighting rates from all around the Irish coast.

Table 12   Bottlenose dolphin Photo-id Catalogues obtained from within the West Connacht Coast SAC.

Data Holders	Duration of study	Number of individual dolphins	Reference
UCC/Heritage Council	July-Sep 2001	16	Ingram *et al.* (2001)
UCC/NPWS	July-Sep 2003	20	Ingram & Rogan (2003)
Dúlra Research/Heritage Council	May–Sep 2008	113	Oudejens *et al.* (2008)
UCC/NPWS	Sep 2008-Sep 2009	149	Ingram *et al.* (2009)
Dúlra Research/NPWS	2008-2009	201	Oudejens *et al.* (2010)
IWDG Coastal Catalogue	2008-2016	c.250	IWDG (unpubl.)
UCC/NPWS	2013-2014	173/360	Nykänen (2016)
AMETS/SEAI	2009-2021	65	Berrow *et al.* (2021)

3.7   Additional sightings

In addition to Bottlenose dolphins, there were sightings of at least five other species of marine mammals (4 cetacean, 1 seal) were recorded. Species diversity was consistent between both Northern and Southern Components of the SAC, with at least four extra species at each site, but abundance was higher in the Northern Component (86 individuals; Table 13a) compared to the Southern Component (43 individuals; Table 13b).

Table 13a   Number of sightings (individuals) of other marine mammal species recorded during surveys in the Northern Component of the West Connacht Coast SAC during 2021

Survey	Harbour porpoise	Common dolphin	Minke whale	Grey seal
1	1 (1)	-	2 (3)	3 (3)
2	2 (2)	-	1 (2)	6 (6)
3	4 (6)	1 (8)	-	7 (9)
4	-	-	-	-
5	6 (16)	6 (16)	-	3 (4)
6	1 (5)	-	-	2 (3)
7	-	-	-	-
Overall	**14 (30)**	**7 (24)**	**3 (5)**	**21 (25)**

Table 13b   Number of sightings (individuals) of other marine mammal species recorded during surveys in the Southern Component of the West Connacht Coast SAC during 2021

Survey	Harbour porpoise	Common dolphin	Risso's dolphin	Grey seal
1	-	-	-	1 (1)
2	-	-	-	3 (3)
3	-	-	-	-
4	-	1(3)	-	-
5	-	-	-	1 (1)
6	1 (4)	1 (5)	-	1 (1)
7	1 (1)	2 (20)	1 (2)	1 (2)
Overall	**2 (5)**	**4 (28)**	**1 (2)**	**7 (8)**

The most consistently recorded species was grey seal (*Halichoerus grypus*) present on four of the seven surveys in the Northern Component and on five of the seven surveys in the Southern Component. It was more abundant in the Northern Component. Both short-beaked common dolphin (*Delphinus delphis*) and Harbour porpoise were recorded at both sites with more sightings in the Northern Component, especially of Harbour porpoise. Two sightings of minke whale (*Balaenoptera acutorostrata*) were recorded in the north and none to the south, while one sighting of Risso's dolphin (*Grampus griseus*) was recorded in the Southern Component but none in the Northern Component.

In addition to these marine mammals, there were four sightings of ocean sunfish (*Mola mola*), three during Survey 4 of the Southern Component, and one sighting of a basking shark (*Cetorhiunus maximus*) in the Northern Component on 19 July.

Harbour porpoise and common dolphins are widespread along the western seaboard with harbour porpoise typically more abundant closer to the coast with common dolphins occurring more offshore (Kavanagh *et al.*, 2011; Berrow *et al.*, 2021). Minke whales are also typically offshore but were observed within the islands in the Northern Component on three occasions, once off Blacksod. Ingram *et al.* (2009) also reported a sighting of Risso's dolphin south of Inishbofin/Inishshark during dedicated bottlenose dolphin transects as well as two sightings of harbour porpoises.

A number of SACs with grey seal as qualifying interests lie within, or adjacent to, the West Connacht Coast SAC. These include Duvillaun Islands SAC (Site Code 000495) and Inishkea Islands SAC (Site Code 000507) in the Northern Component and Inishbofin and Inishshark SAC (Site Code 000278) and Slyne Head Islands SAC (Site Code 000328) in the Southern Component. Thus we might expect regular sightings of this species during the current survey. See Appendix III for maps of additional sightings.

4 Discussion

During the present survey of bottlenose dolphins in the West Connacht Coast SAC we encountered bottlenose dolphins on 4 of the seven surveys in the Southern Component and none, on effort in the Northern Component. Despite the low overall encounter rate we successfully obtained images of 114 individual dolphins of which 78 Severity Grade 1 and 2 were used in the models. This is a good sample size to input into mark-recapture modelling at this site. However with more encounters there are increased opportunities to capture more images and improve the accuracy of model outputs. In order to increase encounter probability and inform survey design for future monitoring, we explore the encounter rates within the survey area as a whole and within both the Northern and Southern components, which make up the West Connacht Coast SAC.

4.1 Encountering bottlenose dolphins within the survey areas

Encounter rates with bottlenose dolphins in the Southern Component was good with dolphins encountered and photographed on four of the seven surveys (57%) but was very poor in the Northern Component (Table 2). No encounters were recorded on effort in the Northern Component and only one off effort during seven dedicated vessel-based surveys. In order to explore the presence of bottlenose dolphins within the study area we interrogated the IWDG Cetacean Sightings database (https://iwdg.ie/browsers/sightings.php) during the survey period and used local knowledge to log additional sightings of bottlenose dolphins during the survey period.

There were 17 bottlenose dolphin sightings collected from the survey area and adjacent waters, in addition to those nine encounters presented in Table 8 which yielded photo-id data. Nine of these sightings were in the Southern Component and two of these were likely to be the same groups reported in Table 8. One coincided with a dolphin encounter during the first survey on 1 June and in the same location, while another was the day before Survey 3, on which we successfully encountered bottlenose dolphins in the same location (Table 14). Other casual sightings were Ballyconneely and Roonagh Point in Clew Bay.

There were nine bottlenose dolphins sightings in the Northern Component between 18 June and 28 September in addition to the four presented in Table 8. Of these eight incidental sightings, four within the study area and four off north Mayo within Broadhaven Bay. Two sightings off Blacksod were made just 4-7 days after the first survey during the present study and two 3-4 days before survey 4 (15 July), one of which was within the Northern Component and one in Broadhaven Bay (Table 14). One sighting on 18 June in the Southern Component site coincided with Survey 2, on which we also encountered large numbers of bottlenose dolphins in the same area, while two sightings were just one and three days before surveys 3 and 4, on which both we also encountered bottlenose dolphins. Mean estimated group size from these casual sightings was slightly higher in the Northern Component (14) compared to the Southern Component (12) but the range (6-30) was less than in the Southern Component (3-50) (Table 14).

There were nine bottlenose dolphins sightings in the Northern Component between 18 June and 28 September in addition to the four presented in Table 8. Of these eight incidental sightings, four within the study area and four off north Mayo within Broadhaven Bay. Two sightings off Blacksod were made just 4-7 days after the first survey during the present study and two 3-4 days before survey 4 (15 July), one of which was within the Northern Component and one in Broadhaven Bay (Table 14). One sighting on 18 June in the Southern Component site coincided with survey 2, on which we also encountered large numbers of bottlenose dolphins in the same area, while two sightings were just one and three days before surveys 3 and 4, on which both we also encountered bottlenose dolphins. Mean estimated group size from these casual sightings was slightly higher in the Northern Component (14) compared to the

Southern Component (12) but the range (6-30) was less than in the Southern Component (3-50) (Table 14).

Table 14 Casual sightings of bottlenose dolphins within, and adjacent to, the study area between June and September 2021. Those sightings not validated by the IWDG were reported to Gemma O'Connor (GO'C) with accompanying video.

Date	Group size	Location	IWDG ID No.	Observer
Northern Component				
5 June	15	Blacksod	37841	Belmullet Boat Charter
6 June	10+	Blacksod Bay	-	Evonne Meers (to GO'C)
8 June	30	Portglais, Broadhaven Bay	37742	Gemma O'Connor
28 June	10	Portglais, Broadhaven Bay	38042	Gemma O'Connor
9 July	6	Blacksod Bay	38063	Martin Ruthland
12 July		Glengad, Broadhaven Bay	-	Brian Wilson (to GO'C)
13 July	12	Frenchport, Mullet	38608	Anthony Irwin
4 Aug	15	Portglais, Broadhaven Bay	38609	Simon Sweeney
Southern Component				
18 June[1]	12	Killary Harbour	37818	Vincent Kane
23 June	50	Aughrus Point Connemara	37848	Siofra Quigley
27 June	6	Doonlaughan Bay Ballyconneely	38040	John Brophy
30 June	3	Omey Island	37939	Siofra Quigley
1 July[2]	9	Renvyle	37960	Fiacc O'Brolchain
5 July	8	Killary Harbour	38023	Vincent Kane
12 July	5	Roonagh Point Clew Bay	38102	Peter Barrett
25 July	3	Silver Strand Nr. Cloonamanagh	38267	Mary Browne
28 Sep	5	Inishbofin	38643	John Brittain

[1] on the same day as survey
[2] the day before survey

Encounter rates reported by Oudejens *et al.* (2008; 2010) in the Northern Component were also relatively low. During 10 dedicated and 18 opportunistic boat-based surveys in the Northern Component, Oudejans *et al.* (2008) recorded 14 bottlenose dolphin sightings of which only three were during dedicated surveys. Almost one-half of all sightings, including land-based observations were recorded on the south side of the Mullet peninsular between Blacksod and Fallmore, with bottlenose dolphins reported in all months except October. Overall, Oudejens *et al.* (2010) encountered bottlenose dolphins on 7 out of 25 (28%) of dedicated vessel-based surveys and 7 out of 32 (22%) of opportunistic surveys within the Northern Component and eight of 21 (38%) dedicated vessel-based surveys in the Southern Component area. Interestingly Oudejens *et al.* (2010) suggested that although encounters with bottlenose dolphins were not as frequent off Mayo compared to Conamara, the mean group size tended to be much larger, though there is great inter-annual variability.

These reports show that dolphins were frequently seen in the Southern Component throughout the summer but does suggest encounters with bottlenose dolphins in the Northern Component are more in frequent and Broadhaven Bay to the area to the northwest of the Northern Component boundary is frequently used by dolphins. It is likely groups transiting between the two areas tend to pass through the Northern Component and their residency time is less than in the Southern Component resulting in fewer encounters during pre-planned surveys.

4.2   Encountering bottlenose dolphins within the West Connacht Coast SAC

Bottlenose dolphins were not distributed evenly throughout the Southern Component during the current survey but clustered around Killary Harbour and in the waters immediately to the south. Large areas of the SAC surveyed had no bottlenose dolphin encounters. These data are consistent with previous surveys.

Previous studies of bottlenose dolphins in these areas have highlighted the importance of Killary Harbour and Ballinakill Bay (Ingram *et al.,* 2001). Small groups of 3 and 5 dolphins were reported in July 2001 and one of 8 individuals off Cleggan Head in September 2001. Two individually identified dolphins were re-encountered off Killary on subsequent surveys, which were the only re-sightings throughout the study (Ingram *et al., 2001*). One group of 20 bottlenose dolphins was encountered at the mouth of Killary Harbour in September 2003 (Ingram & Rogan, 2003). A single dolphin from this group was also recorded in 2001. Bottlenose dolphins off Conamara and Mayo are highly mobile. Oudejans *et al.* (2010) reported a group of 20 individuals resighted within two days in 2009 travelling a minimum of 100km in 4 days while a second group of 35 individuals travelled at least 50km off north Mayo within six hours.

Nykänen et al. (2015) encountered eight groups of dolphins during seven day long surveys in the Southern Component, between June and August 2013 and six during six surveys in 2014. All sightings in the Southern Component were in Killary Harbour and north to Roonagh Quay despite considerable survey effort in the southern half of the Southern Component between Inishboffin/Inishark and Manin Bay. They reported only one encounter in the Northern Component between June and July 2013. During 2014 a locally based experienced researcher (M. Oudejens) encountered 7 groups in the Northern Component in 2014 during five surveys. All encounters were to the southern tip of the Mullet Peninsula and in Blacksod Bay.

It may be more efficient to survey only the waters between Cleggan and Killary Harbour. It is interesting to note that although no images were obtained off the Northern Component the abundance estimate was still similar to previous studies which combined images from the two sites. Individual bottlenose dolphins range widely between the two parts of the SAC. It is likely that some individuals are less mobile than others which will influence capture probability which does violate one of the assumptions in mark-recapture modelling (that each animal has an equal and constant probability of being captured). Encounter rates in the waters between Cleggan and Killary Harbour were high. More frequent shorter visits to these waters may yield as much, if not more photographic opportunities to estimate abundance. If these smaller scale surveys were carried out each year this would enable life-history parameters such as calving rate and survival, inter-calf interval etc to be explored.

4.3   Site fidelity

Sighting rate can be calculated as the mean individual sighting rate (Ingram *et al.,* 2009) or the number of times an animal is encountered / total number of encounters (Nykänen *et al.* 2015).

Ingram *et al.* (2009) reported a mean re-sighting rate of 1.64 during dedicated surveys carried out between September 2008 and September 2009 within the southern section of the West Connacht Coast

SAC including 32 individuals only recorded once to five individuals seen on 4 surveys. The mean re-capture rate was 1.4-1.5 during the present survey depending on the severity of the fin grade used.

The re-sighting rate of identified individual dolphins across the whole study area in 2013 varied from 0 to 0.36 with an average of 0.06. In 2014 the re-sighting rate was twice as high, averaging at 0.12 and ranging from 0 to 0.45 (Nykänen *et al.* 2015). The average site-specific re-sighting rate was highest in Donegal (0.44), followed by Conamara (0.09) and lowest for Mayo (0.01). The average re-sighting rates for 2014 were 0.20 in Mayo, 0.15 in Donegal Bay and 0.16 in Conamara. The re-sighting rate from Conamara from the current study was 0.4 for Severity Grade 1 and 2 fins and 0.3 for Severity Grade 3 fins. These are similar to that reported from Donegal in 2013 and for the whole study area in 2013. This suggests a high site fidelity of dolphins in the Southern Component during June to August 2021. There were no data from the Northern Component with which to carry out a similar comparison.

4.4 Bottlenose dolphin abundance estimates

Bottlenose dolphin estimates from the current survey are very similar to those derived previously. From the first estimate in 2009 to the latest in 2014 there was only a difference of 18 dolphins. The current estimate is 8 individuals or only 4% greater than that reported by Nykänen (2016) for 2014 and only 13% greater than that reported for 2019 by Ingram *et al.* (2009). All estimates are within 95% Confidence Intervals of each other (Table 15).

Interestingly if additional images obtained casually are used in the estimate then the estimate increased by 16% but the CV decreased (Table 15). Whether this is a more robust estimate is difficult to tell but it does demonstrate the effect of even a relatively small number of additional capture events on the final estimate.

Table 15 Abundance estimates of bottlenose dolphins in the West Connacht Coast SAC.

Year	Estimate	Coefficient of Variation	95% Confidence Intervals	Reference
2021	**197±24**	**0.12**	**150-243**	**This study**
2021	**228±21**	**0.09**	**187-270**	**This study (enhanced)**
2014[1]	189	0.11	162– 232	Nykänen (2016)
2013[1]	145	0.30	111–239	Nykänen (2016)
2009[2]	171±48	0.28	100-294	Ingram *et al.* (2009)

[1] using a multi-site Bayesian approach including Donegal Bay

[2] data only from the southern section of the West Connacht Coast SAC

Nykänen (2016) used a Bayesian approach to estimate abundance as she surveyed four sites, including the Southern and Northern Components, but also Donegal Bay and included one encounter in Killala Bay. Nykänen *et al.* (2020) recommended that multi-site sampling design and estimation approach was more appropriate when animals are moving non-randomly in and out of the area within the sampling (survey) period, standard closed models can result in biased estimates because capture probabilities are variable and relate to animals that are not always in the area of interest as it accounts for heterogenous capture probabilities. This does not apply to the data presented here as all images used in mark-recapture modelling were obtained from the same site (Southern Component).

The CV of the estimate in the current study was low (0.12) and consistent with Nykänen (2016) who used a multi-site approach. The higher abundance estimate from the current survey compared to the 2013 estimate (Table 15) may in part be explained by the larger number of individual dolphins with (69) used in the model compared to Nykänen (2016) who used 59 well-marked individuals in their estimates. For the 2014 estimate they used 91 well-marked individuals but most of these were photographed in Donegal Bay. Ingram *et al.* (2009) used a total of 47 well marked fins in their abundance estimate which is quite similar to that reported here but with a higher CV. These data suggest that the number of bottlenose dolphins using the West Connacht Coast SAC since the first abundance estimate in 2009 is stable.

4.3   Recommendations

Although we were successful in deriving an abundance estimate of bottlenose dolphins in the West Connacht Coast SAC with a low CV, the survey was not without its challenges. This is the first time meeting reporting obligations for this qualifying interest within this SAC has been put out to contract. One of the aims was to design a repeatable survey design to facilitate long-term monitoring.

1. If an abundance estimate is the primary objective we recommend more survey effort (days) is concentrated between Cleggan and Killary Harbour in the Southern Component and no survey effort is carried out elsewhere.
2. Encountering bottlenose dolphins in the Northern Component to collect images suitable for photo-id is challenging as dolphins appear to occur less frequently here compared to the Southern Component. Surveys on pre-determined survey days are always likely to have difficulty in locating dolphins. We recommend using local knowledge and current sighting networks to identify the presence of bottlenose dolphins ahead of each survey. This creates logistical challenges in accessing local charter boats and may involve the use of a RIB to access the dolphins quickly to collect images suitable for photo-id and survey the whole of the Northern Component.
3. If the objective is to explore how bottlenose dolphins use the West Connacht Coast SAC then the current survey design is appropriate as it can be completed in one day at each site and adequately surveys the whole area.
4. Consideration should be given to soliciting images of bottlenose dolphins from local researchers on an ad hoc basis during a survey year, providing they aim to collect images of all the dolphins in the group. This can be enhanced by local training by the survey team at the start of the survey. This will enable more images to be available for capture histories and improve the abundance estimates.

5   Acknowledgements

6 Bibliography & Relevant Literature

Akaike, H. (1974) A new look at the statistical model identification. *IEEE transactions on automatic control* **19.6,** 716-723.

Baker, I. (2015) *Researcher's guide to protocols for fieldwork and data entry (third edition).* Shannon Dolphin and Wildlife Foundation, p 32.

Baker, I., O'Brien, J., McHugh, K. & Berrow, S. (2017a) An Ethogram for Bottlenose Dolphins (*Tursiops truncatus*) in the Shannon Estuary, Ireland. *Aquatic Mammals* **43(6),** DOI 10.1578/AM.43.6.2017.

Baker, I., O'Brien, J., McHugh, K, Ingram, S. & Berrow, S. (2017b) Social structure of a bottlenose dolphin (*Tursiops truncatus*) population is distinguished by age, area and female-male associations. *Marine Mammal Science* **34(2),** 458-487.

Baker, I., O'Brien, J., McHugh, K, & Berrow, S. (2018) Female reproductive parameters and population demographics of bottlenose dolphins (*Tursiops truncatus*) in the Shannon Estuary, Ireland. Marine Biology **165(15)**, https://doi.org/10.1007/s00227-017-3265-z

Berrow, S.D. & Holmes, B. (1999) Tour boats and dolphins: A note on quantifying the activities of whalewatching boats in the Shannon estuary, Ireland. *Journal of Cetacean Research and Management* **1(2),** 199-204.

Berrow, S., O'Brien, J., Groth, L., Foley, A. & Voigt, K. (2012) Abundance estimate of bottlenose dolphins (*Tursiops truncatus*) in the Lower River Shannon candidate Special Area of Conservation, Ireland. *Aquatic Mammals* **38(2),** 136-144**.**

Berrow, S. Daly, M. & O'Brien, J. (2021) *Marine Mammal Monitoring of the Atlantic Marine Energy Test Site, 2020-2021.* Unpublished final report for SEAI for the AFLOWT Project.

Blázquez, M., Baker, I., O'Brien, J.M. & Berrow, S.D. (2020) Population Viability Analysis and Comparison of Two Monitoring Strategies for Bottlenose Dolphins (*Tursiops truncatus*) in the Shannon Estuary (Ireland) to Inform Management. *Aquatic Mammals* **46(3),** 307-325, DOI 10.1578/AM.46.3.2020.307.

Chao, A., Lee, S.M. and Jeng, S.L. (1992) Estimating population size for capture-recapture data when capture probabilities vary by time and individual animal. *Biometrics* **48**, 201-216.

Coleman, M., Phillpot, E., O'Donovan, M., Denniston, H., Walshe, L., Haberlin, M. & Englund, A. (2009) *Marine Mammal Monitoring in the waters of Broadhaven Bay 2008. Project Report to RSK Environment Limited Group.* Coastal and Marine Resources Centre, University College, Cork. pp68.

Englund, A. Coleman, M., & Collins, C. (2006) *Marine Mammal Monitoring in Broadhaven Bay: June – September 2005. Project Report to RSKENSR Group Plc.* Coastal and Marine Resources Centre, University College, Cork. pp40`.

Englund, A., Ingram. S. & Rogan, E. (2007) *Population status report for bottlenose dolphins using the Lower River Shannon SAC, 2006-2007.* Unpublished report to the National Parks and Wildlife Service.

Englund, A., Ingram, S. & Rogan, E. (2008) *An updated population status report for bottlenose dolphins using the Lower River Shannon SAC in 2008.* Unpublished final report to the National Parks and Wildlife Service. Department of Zoology, Ecology and Plant Science, University College Cork 35pp.

Fairly, J.S. (1981) *Irish Whales and Whaling.* Blackstaff Press, Belfast.

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

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

Ingram, S.N. & Rogan, E. (2003) *Bottlenose dolphins (Tursiops truncatus) in the Shannon estuary and selected areas of the west coast of Ireland.* Unpublished report to the National Parks and Wildlife Service. December 2003.

Ingram, S., Kavanagh, A., Englund, A. & Rogan, E. (2009). *Site assessment of the waters of northwest Connemara. A survey of bottlenose dolphins (Tursiops truncatus).* Unpublished final report to the National Parks and Wildlife Service, Ireland, pp33.

Irvine, A.B., Scott, M.D., Wells, R.S. & Kaufmann, J.H. (1981) Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. *Fishery Bulletin* **79 (4),** 671-688.

Kavanagh, P., Fielding, M., Scally, L., Berrow, S., Hunt, J. & Kennedy, R. (2011) *Environmental Aspects of Developing Ireland's Atlantic Marine Energy Test Site (AMETS).* Proceedings of the 9th European Wave and Tidal Energy Conference. Southampton (UK) 5-9th September 2011.

Louis, M., Viricel, A., Lucas, T., Peltier, H., Alfonsi, E., Berrow, S., Brownlow, A., Covelo, P., Dabin, W., Deaville, R., de Stephanis, R., Gally, F., Gauffier, P., Penrose, R., Silva, M.A., Guinet, C. & Benoit S-B. (2014) Habitat-driven population structure of bottlenose dolphins, *Tursiops truncatus*, in the North-East Atlantic. *Molecular Ecology* **23**, 857-874.

Louis, M., Galimberti, M., Archer, F., Berrow, S., Brownlow, A., Fallon, R., Nykänen, M., O'Brien, J., Roberston, K.M., Rosel, P.E., Simon-Bouhet, B., Wegmann, D., Fontaine, M.C., Foote, A.D. & Gaggiotti, O.E. (2021) Selection on ancestral genetic variation fuels repeated ecotype formation in bottlenose dolphin. *Sci. Adv.* **7 (44),** eabg1245. DOI: 10.1126/sciadv.abg1245

Mirimin, L., Miller, R., Dillane, E., Berrow, S.D., Ingram, S., Cross, T.F. & Rogan, E. (2011) Fine-scale population genetic structuring of bottlenose dolphins using Irish coastal waters. *Animal Conservation* **14(4),** 342-353.

NPWS (2015) *Conservation Objectives: West Connacht Coast SAC 002998. Version 1.* National Parks and Wildlife Service,

Department of Arts, Heritage and the Gaeltacht.

Nykänen, M., Ingram, S. and Rogan, E. (2015). Abundance, distribution and habitat use of Bottlenose dolphins in the west and north-west of Ireland. *Unpublished final report to the National Parks and Wildlife Service, Ireland,* pp39.

Nykänen, M. (2016). Phylogeography, population structure, abundance and habitat use of bottlenose dolphins, *Tursiops truncatus*, on the west coast of Ireland. PhD Thesis, University College Cork.

Nykänen, M., Louis, M., Dillane, E., Alfonsi, E., Berrow, S., O'Brien, J., Brownlow, A., Covelo, P., Dabin, W., Deaville, R., de Stephanis, R., Gally, F., Gauffier, P., Ingram, S.N., Lucas, T., Mirimin, L., Penrose, R., Rogan, E., A. Silva, M.A., Simon-Bouhet, B. & Gaggiotti, O.E. (2018) Fine-scale population structure and connectivity of bottlenose dolphins, *Tursiops truncatus*, in European waters and implications for conservation. *Aquatic Conservation* DOI: 10.1002/aqc.3139.

Nykänen M, Dillane E, Englund A, Foote, A.D., Ingram, S.N., Louis, M., Mirimin, L., Oudejens, M. & Rogan, E. (2018) Quantifying dispersal between marine protected areas by a highly mobile species, the bottlenose dolphin, *Tursiops truncatus*. *Ecol Evol*. **8**, 9241–9258.

Nykänen, K. Kaschner, W. Dabin, A. Brownlow, N. J. Davison, R. Deaville, C. Garilao,K. Kesner-Reyes, M. T. P. Gilbert, R. Penrose, V. Islas-Villanueva, N. Wales, S. N. Ingram, E. Rogan, M. Louis & A. D. Foote (2019) Postglacial colonization of northern coastal habitat by bottlenose dolphins: A marine leading-edge expansion? *J. Hered.* **110**, 662–674.

Nykänen, M., Oudejans, M.G., Rogan, E., Durban, J.W., & Ingram, S.N. (2020) Challenges in monitoring mobile populations: Applying bayesian multi-site mark–recapture abundance estimation to the monitoring of a highly mobile coastal population of bottlenose dolphins. *Aquatic Conserv Mar Fresh Ecosyst*. **30**, 1674– 1688.

O'Brien, J. (2009) *The inshore distribution and abundance of small cetaceans on the west coast of Ireland: Site assessment for SAC designation and an evaluation of monitoring techniques.* Galway-Mayo Institute of Technology, Unpublished PhD Thesis, pp 1-226.

O'Brien, J.M., Berrow, S.D., Ryan, C, McGrath, D., O'Connor, I., Pesante, P., Burrows, G., Massett, N., Klötzer, V. & Whooley, P. (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(1),** 71-76.

O'Cadhla, O., Englund, A., Philpott, E., Mackay. M. & Ingram, S. (2003) *Marine Mammal Monitoring in the waters of Broadhaven Bay & northwest Mayo: 2001-2002.* Unpublished report to Enterprise Energy Ireland, Ltd. Coastal and Marine Resources Centre, University College, Cork. pp74. .

Oudejens, M., Ingram, S. & O'Cadhla, O. (2008) *Bottlenose Dolphins in Northwest Ireland: a study to determine population size, habitat use and site fidelity in the coastal waters of County Mayo.* Unpublished report to the Heritage Council. pp28.

Oudejans, M., Ingram, S., Englund, A., Visser, F. & Rogan, E. (2010). *Bottlenose dolphins in Connemara and Mayo 2008-2009. Movement patterns between two coastal areas in the west of Ireland.* Unpublished report to the National Parks and Wildlife Service, Ireland, pp29.

Oudejans, M.G., Visser, F., Englund, A., Rogan, E. & Ingram, S.N. (2015). Evidence for Distinct Coastal and Offshore Communities of Bottlenose Dolphins in the North East Atlantic. *PLoS ONE* **10(4)**

Robinson, K.P., O'Brien, J.M., Cheney, B., Mandleberg, L., Eisfeld, S., Ryan, C., Whooley, P., Oudejans, M.G., O'Donovan, M., Berrow, S.D., Costa, M., Haberlin, D., Stevick, P.T. & Thompson, P.M. (2012) Discrete or not so discrete: Long distance movements by coastal bottlenose dolphins in UK and Irish waters. *Journal of Cetacean Research and Management* **12(3),** 365-371.

Rogan, E., Englund, A. & Ingram, S. (2013). Spatial and temporal habitats used by bottlenose dolphins (*Tursiops truncatus*) and other cetaceans on the west coast of Ireland – 2012. *Report to the National Parks and Wildlife Service, Ireland,* pp12.

Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S. & Jessopp, M. (2018). *Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017.* Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp.

Shane S.H. (1990) Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. In: Reeves RR (ed.) *The bottlenose dolphin.* Academic, San Diego, pp 245–265.

Wall, D., Murray, C., O'Brien, J., Kavanagh, L., Wilson, C., Glanville, B., Williams, D., Enlander, I., Ryan, C., O'Connor, I., McGrath, D., Whooley, P. & Berrow, S. (2013) *Atlas of the distribution and relative abundance of marine mammals in Irish offshore waters: 2005 – 2011.* Irish Whale and Dolphin Group. 58 pp. ISBN 0-9540552-7-6.

Visser, F., Coleman, M., Denniston, H., O'Donovan, M., Walshe, L., Ponzo, A. & Cronin, M. (2009) *Marine Mammal Monitoring in the waters of Broadhaven Bay 2009. Progress Report to RSK Environment Limited Group.* Coastal and Marine Resources Centre, University College, Cork. pp61.

Wilson, B., Thompson, P. & Hammond, P.S. (1999) Estimating size and assessing trends in a coastal bottlenose dolphin population. *Ecological Applications* **9(1),** 288-300.

Appendix I: Capture histories of individual bottlenose dolphins (Severity Grade 1 to 3 are presented but only Grade 1 and 2 were used in abundance estimates)

NPWS Cat No	Fin Grade	Photo Grade L	Photo Grade R	S1	S2	S3	S4	S5	S6	S7	No. captures
	(1-3)	(1-3)	(1-3)								
BDWC01	1	2	2	0	1	0	0	0	0	0	1
BDWC02	1	2	2	0	1	0	0	0	0	0	1
BDWC03	1	1	1	0	1	0	0	0	0	0	1
BDWC04	1	2	1	0	1	0	0	0	0	0	1
BDWC05	1	1	1	0	1	0	1	0	0	0	2
BDWC06	1	1	1	0	1	1	1	0	0	0	3
BDWC07	1	1	1	0	1	0	0	0	1	0	2
BDWC08	1	1	1	0	1	0	0	0	1	0	2
BDWC09	1	2	0	0	1	0	0	0	0	0	1
BDWC10	1	1	1	0	1	0	1	0	0	0	2
BDWC11	1	1	1	0	1	1	1	0	0	0	3
BDWC12	1	1	2	0	1	0	0	0	1	0	2
BDWC13	1	1	1	0	1	1	0	0	0	0	2
BDWC14	1	1	1	0	1	0	1	0	0	0	2
BDWC15	1	1	1	0	1	0	1	0	1	0	3
BDWC16	1	3	3	0	1	0	0	0	0	0	1
BDWC17	1	1	1	0	1	0	1	0	1	0	3
BDWC18	1	1	1	0	1	0	1	0	1	0	3
BDWC19	1	2	1	0	1	0	1	0	1	0	3
BDWC20	1	1	1	0	1	0	1	0	1	0	3
BDWC21	1	2	2	0	1	0	0	0	0	0	1
BDWC22	1	2	1	0	1	0	0	0	0	0	1
BDWC23	1	1	1	0	1	1	1	0	1	0	4
BDWC24	1	1	1	0	1	0	1	0	0	0	2
BDWC25	1	2	2	0	1	0	0	0	0	0	1
BDWC26	1	1	1	0	1	0	0	0	1	0	2
BDWC27	1	3	1	0	1	0	0	0	0	0	1
BDWC28	1	1	2	0	1	0	0	0	0	0	1
BDWC29	1	1	1	0	1	0	0	0	0	0	1
BDWC30	1	1	0	0	1	0	0	0	0	0	1
BDWC31	3	2	0	0	1	0	0	0	0	0	1
BDWC32	1	1	2	0	1	0	1	0	1	0	3
BDWC33	1	1	2	0	1	0	0	0	0	0	1
BDWC34	1	1	1	0	1	0	0	0	0	0	1
BDWC35	1	1	1	0	1	0	0	0	0	0	1
BDWC36	1	1	1	0	1	0	0	0	1	0	2
BDWC37	1	1	2	0	0	0	1	0	0	0	1
BDWC38	1	1	1	0	1	0	0	0	0	0	1
BDWC39	1	1	1	0	1	0	1	0	0	0	2
BDWC40	2	2	1	0	1	0	0	0	0	0	1

NPWS Cat No	Fin Grade	Photo Grade L	Photo Grade R	S1	S2	S3	S4	S5	S6	S7	No. captures
	(1-3)	(1-3)	(1-3)								
BDWC41	1	2	1	0	1	0	0	0	1	0	2
BDWC42	1	2	1	0	1	0	0	0	0	0	1
BDWC43	1	1	1	0	1	0	0	0	1	0	2
BDWC44	3	2	0	0	1	0	0	0	0	0	1
BDWC45	2	1	0	0	1	0	0	0	0	0	1
BDWC46	2	1	1	0	1	0	1	0	1	0	3
BDWC47	2	0	1	0	1	0	0	0	0	0	1
BDWC48	1	1	0	0	1	0	0	0	0	0	1
BDWC49	1	2	0	0	1	0	0	0	0	0	1
BDWC50	2	1	0	0	1	0	0	0	0	0	1
BDWC51	2	1	1	0	1	0	0	0	0	0	1
BDWC52	1	1	1	0	0	0	1	0	1	0	2
BDWC53	2	0	1	0	1	0	0	0	0	0	1
BDWC54	1	1	1	0	0	0	1	0	0	0	1
BDWC55	1	1	0	0	0	0	1	0	0	0	1
BDWC56	1	2	1	0	0	0	1	0	0	0	1
BDWC57	1	2	2	0	0	0	1	0	0	0	1
BDWC58	2	1	1	0	0	1	1	0	0	0	2
BDWC59	2	1	1	0	0	0	1	0	1	0	2
BDWC60	1	1	1	0	0	1	0	0	0	0	1
BDWC61	3	1	2	0	0	1	0	0	0	0	1
BDWC62	2	1	2	0	0	1	0	0	0	0	1
BDWC63	3	1	2	0	0	1	0	0	0	0	1
BDWC64	1	1	2	0	0	0	1	0	1	0	2
BDWC65	2	1	1	0	0	1	1	0	1	0	3
BDWC66	1	1	1	0	0	1	0	0	0	0	1
BDWC67	1	2	1	0	0	1	0	0	0	0	1
BDWC68	1	2	1	0	0	1	0	0	0	0	1
BDWC69	1	0	2	0	0	0	1	0	0	0	1
BDWC70	1	1	1	0	0	1	0	0	0	0	1
BDWC71	1	1	2	0	0	0	1	0	0	0	1
BDWC72	2	0	2	0	0	0	1	0	0	0	1
BDWC73	1	0	2	0	0	0	1	0	0	0	1
BDWC74	1	1	1	0	0	0	1	0	1	0	2
BDWC75	1	1	1	0	0	0	1	0	0	0	1
BDWC76	1	1	2	0	0	0	0	0	1	0	1
BDWC77	1	1	1	0	0	0	0	0	1	0	1
BDWC78	1	1	2	0	0	0	0	0	1	0	1
BDWC79	1	3	1	0	0	0	0	0	1	0	1
BDWC80	1	2	1	0	0	0	0	0	1	0	1
BDWC81	1	1	1	0	0	0	0	0	1	0	1
BDWC82	1	1	1	0	0	0	0	0	1	0	1
BDWC83	1	1	2	0	0	0	0	0	1	0	1
BDWC84	1	1	1	0	0	0	0	0	1	0	1

NPWS Cat No	Fin Grade	Photo Grade L	Photo Grade R	S1	S2	S3	S4	S5	S6	S7	No. captures
	(1-3)	(1-3)	(1-3)								
BDWC85	1	1	2	0	0	0	0	0	1	0	1
BDWC86	3	1	1	0	1	0	0	0	1	0	2
BDWC87	3	2	1	0	1	0	0	0	0	0	1
BDWC88	2	1	2	0	1	0	1	0	0	0	2
BDWC89	1	3	2	0	1	0	0	0	0	0	1
BDWC90	3	1	1	0	1	0	1	0	0	0	2
BDWC91	1	3	2	0	0	0	1	0	0	0	1
BDWC92	1	3	2	0	1	0	0	0	0	0	1
BDWC93	1	1	1	0	0	0	0	0	1	0	1
BDWC94	3	1	1	0	0	0	0	0	1	0	1
BDWC95	3	1	1	0	0	1	1	0	1	0	3
BDWC96	3	1	2	0	1	1	0	0	0	0	2
BDWC97	3	1	0	0	1	0	0	0	0	0	1
BDWC98	3	1	1	0	0	0	1	0	0	0	1
BDWC99	2	0	1	0	0	0	1	0	0	0	1
BDWC100	3	1	0	0	1	0	0	0	0	0	1
BDWC101	1	1	2	0	0	0	0	0	1	0	1
BDWC102	1	1	1	0	0	0	0	0	1	0	1
BDWC103	2	0	1	0	0	0	0	0	1	0	1
BDWC104	1	3	2	0	0	0	1	0	0	0	1
BDWC105	3	0	2	0	1	0	0	0	1	0	2
BDWC106	3	1	0	0	1	0	0	0	0	0	1
BDWC107	3	0	1	0	0	0	0	0	1	0	1
BDWC108	3	2	1	0	0	0	1	0	1	0	2
BDWC109	2	1	2	0	0	0	0	0	1	0	1
BDWC110	3	2	2	0	1	0	0	0	0	0	1
BDWC111	3	0	2	0	1	0	0	0	0	0	1
BDWC112	3	2	1	0	0	0	0	0	1	0	1
BDWC113	3	2	0	0	0	1	0	0	0	0	1
BDWC114	3	0	1	0	0	1	0	0	0	0	1
TOTAL				0	64	18	39	0	42	0	163

Appendix II: Adult-calf pair associations

Adult ID Catalogue number	Calf ID Catalogue Number	Age Class
1	C001	Calf
2	C002	Calf
7	C007	Calf
17	C017	Calf
18	C018	Neonate
19	C019	Calf
20	C020	Neonate
22	C022	Juvenile
31	C031	Calf
32	C032	Calf
47	C047	Calf
79	C079	Calf
84	C084	Juvenile
85	C085	Juvenile
98	C098	Juvenile
99	C099	Juvenile
101	C101	Calf
104	C104	Calf
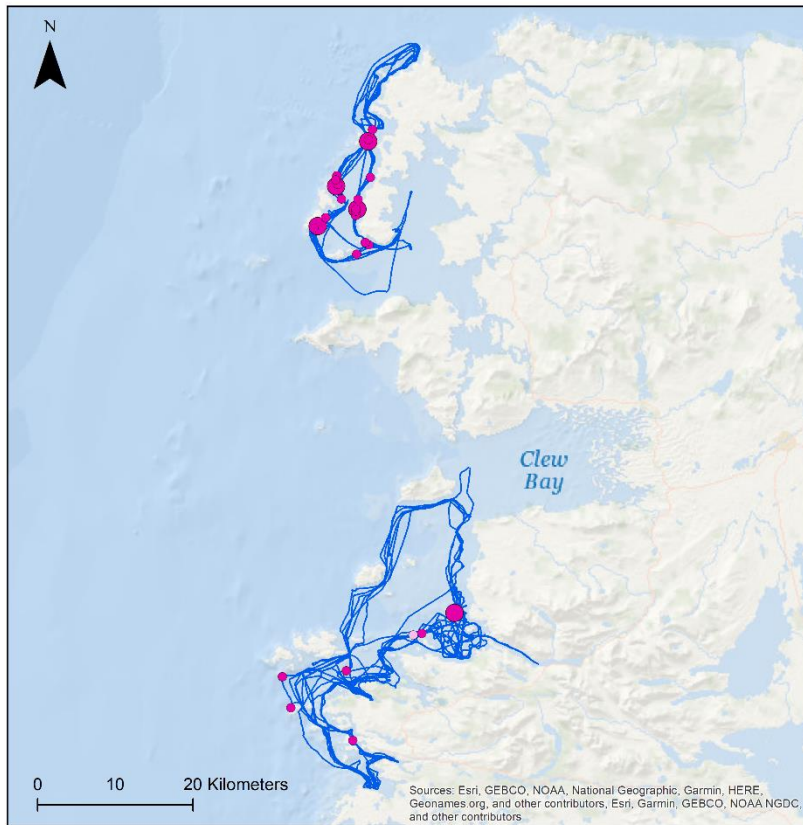
Grey seal
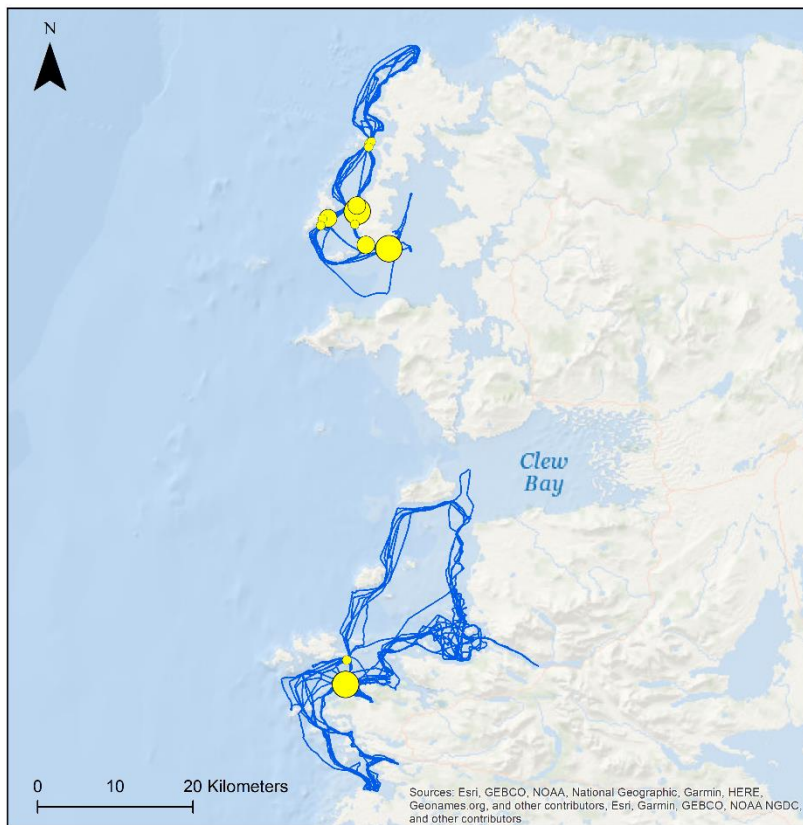
Harbour porpoise
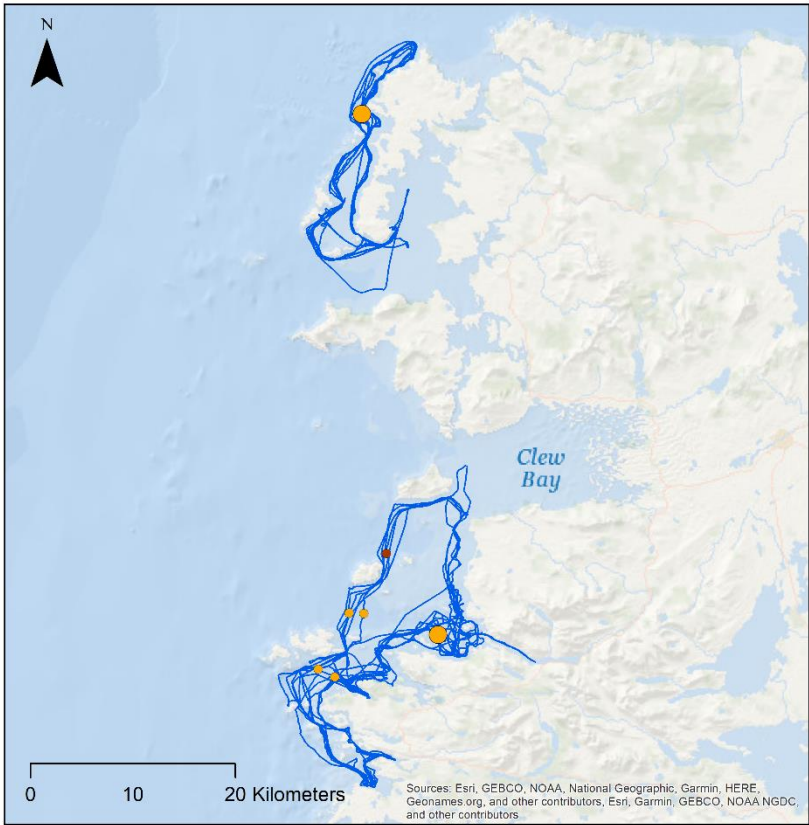
Common and Risso's dolphin
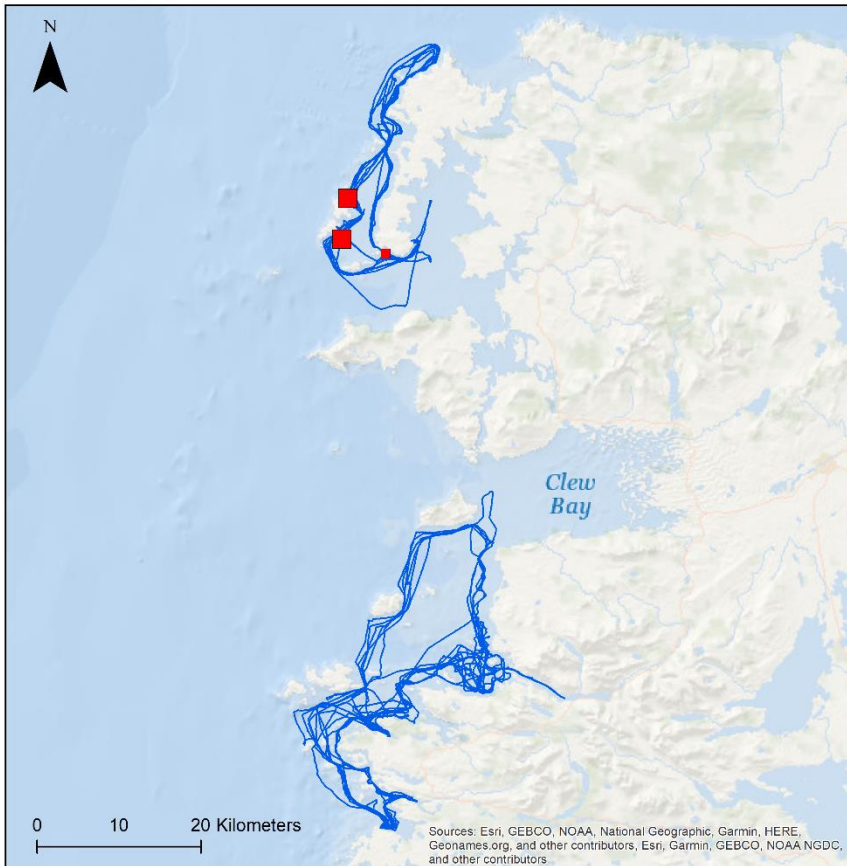
Minke whale

Appendix IV: Site fidelity of individual bottlenose dolphins in the West Connacht Coast SAC

BDWC21 Cat No	Fin Grade (1-3)	Heritage Council	NPWS	Heritage Council	NPWS	NPWS		NPWS	SEAI
		UCC 2001	UCC 2003	Dúlra 2008	UCC 2009	Dúlra 2008_2009	IWDG	UCC 2013_2014	AMETS 2020_2021
BDWC01	1								
BDWC02	1								
BDWC03	1								
BDWC04	1								
BDWC05	1								
BDWC06	1								
BDWC07	1								
BDWC08	1								
BDWC09	1								1
BDWC10	1								
BDWC11	1								
BDWC12	1								
BDWC13	1								
BDWC14	1								
BDWC15	1								
BDWC16	1								
BDWC17	1								
BDWC18	1								
BDWC19	1								
BDWC20	1								
BDWC21	1								
BDWC22	1								
BDWC23	1								
BDWC24	1								
BDWC25	1								
BDWC26	1								
BDWC27	1								1
BDWC28	1								
BDWC29	1								
BDWC30	1								
BDWC32	1								
BDWC33	1								
BDWC34	1								1

BDWC35	1								
BDWC36	1								
BDWC37	1								1
BDWC38	1								
BDWC39	1								
BDWC41	1								
BDWC42	1								
BDWC43	1								
BDWC48	1								
BDWC49	1								
BDWC52	1								
BDWC54	1								
BDWC55	1								
BDWC56	1								
BDWC57	1								
BDWC60	1								
BDWC64	1								
BDWC66	1								
BDWC67	1								
BDWC68	1								
BDWC69	1								
BDWC70	1								
BDWC71	1						1		
BDWC73	1								
BDWC74	1								1
BDWC75	1								
BDWC76	1								
BDWC77	1								
BDWC78	1								
BDWC79	1								
BDWC80	1								
BDWC81	1								1
BDWC82	1								1
BDWC83	1								
BDWC84	1								
BDWC85	1								
BDWC89	1								
BDWC91	1								
BDWC92	1								
BDWC93	1								
BDWC101	1								
BDWC102	1								
BDWC104	1						1		
BDWC40	2								
BDWC45	2								
BDWC46	2								
BDWC47	2								

BDWC50	2								
BDWC51	2								
BDWC53	2								
BDWC58	2								
BDWC59	2								
BDWC62	2								
BDWC65	2								
BDWC72	2								
BDWC88	2								
BDWC99	2								
BDWC103	2								
BDWC109	2								
BDWC31	3								
BDWC44	3								
BDWC61	3								1
BDWC63	3								
BDWC86	3								
BDWC87	3								
BDWC90	3								
BDWC94	3								
BDWC95	3								
BDWC96	3								
BDWC97	3								
BDWC98	3								
BDWC100	3								
BDWC105	3								
BDWC106	3								
BDWC107	3								
BDWC108	3								
BDWC110	3								
BDWC111	3								
BDWC112	3								
BDWC113	3								
BDWC114	3								
TOTAL		0	0	0	0	0	2	0	8