European Offshore Wind Deployment Centre

Environmental Research & Monitoring Programme

Improving understanding of bottlenose dolphin movements along the east coast of Scotland

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Interim Report 2019

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IMPROVING UNDERSTANDING OF BOTTLENOSE DOLPHIN MOVEMENTS ALONG THE EAST COAST OF SCOTLAND

Interim report: 2017 abundance estimate & 2018 surveys

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3 Executive Summary

The population of bottlenose dolphins off the east coast of Scotland has been studied since 1989 as part of a collaborative project between the University of Aberdeen Lighthouse Field Station and the Sea Mammal Research Unit at the University of St Andrews. The main distributional range of this population extends from the Moray Firth to the Firth of Forth, with around 50 % of the estimated total population regularly using the waters of St Andrews Bay and Tayside every summer. This project, supported by the European Offshore Wind Deployment Centre (EOWDC), aims to improve the understanding of movement patterns of bottlenose dolphins across the main population range by combining new photo-identification data collected during the years 2017 to 2019 around the Tay Estuary, with equivalent data collected in the Moray Firth by the University of Aberdeen's Lighthouse Field Station as part of a separate project. This report provides the estimate of the number of bottlenose dolphins using St Andrews Bay and the Firth of Tay in 2017, based on the data obtained during the field trips in 2017, and a summary of the photo-identification survey trips in that area conducted by the Sea Mammal Research Unit in 2018 .

The total number of bottlenose dolphins using the Firth of Tay and St Andrews Bay area in 2017 is estimated to be 130 (95% CI = 109-154). In 2018, twenty-one trips were conducted between May and September, resulting in a total of 47 bottlenose dolphin encounters with an average group size of 10 animals. Most of the encounters occurred between Broughty Ferry and the entrance to the Firth of Tay, and between Arbroath and Lunan Bay, with fewer encounters in St Andrews Bay and around Montrose. During the encounters, a total of 7,802 photographs containing one or multiple dorsal fins were taken. Each of these photographs were graded for their photographic quality, and the 1,880 best quality photographs have been preliminarily matched to the catalogue of known bottlenose dolphins in the east coast of Scotland population. A total of 92 different individuals has been positively identified so far; however, this number might change once the processing and dolphin identification is finalised as part of the annual protocol applied to all photo-ID data that are part of the Aberdeen/St Andrews Scottish east coast bottlenose dolphin project.

4 Introduction

The population of bottlenose dolphins off the east coast of Scotland has been studied since 1989 as part of a collaborative project between the University of Aberdeen Lighthouse Field Station and the Sea Mammal Research Unit at the University of St Andrews (e.g., Wilson et al., 1999, Wilson et al., 2004, Cheney et al., 2013, Arso Civil et al., 2018a), based on the ability to identify individual animals from photographs of the scratches, nicks and notches on their dorsal fins; a technique known as photo-identification. The main distributional range of this population extends from the Moray Firth to the Firth of Forth and studies have shown that since 2009 around 50 % of the estimated total population was present in the waters of St Andrews Bay and Tayside every summer (Arso Civil et al., in press) and the number of animals using this area is increasing (Arso Civil et al. 2018b). This project, supported by the European Offshore Wind Deployment Centre (EOWDC), aims to improve the understanding of movement patterns of bottlenose dolphins across the main population range by combining new photo-identification data collected during the years 2017 to 2019 around the Tay Estuary, with equivalent data collected in the Moray Firth by the University of Aberdeen's Lighthouse Field Station as part of a separate

project. This report provides the estimate of the number of bottlenose dolphins using St Andrews Bay and the Firth of Tay in 2017 and a summary of the photo-identification survey trips in that area conducted by the Sea Mammal Research Unit in 2018. All surveys were conducted under SNH licence no. 98465 to Philip Hammond.

5 Methods

5.1 Estimate of number of animals using the Firth of Tay and St Andrews Bay in 2017

Details of the surveys conducted in 2017 were presented in the interim report to EOWDC in 2018 (Arso Civil et al., 2018c). Based on these survey data, the total number of well-marked animals (i.e., dolphins with distinctive permanent marks on the dorsal fin) using the Firth of Tay and St Andrews Bay area in 2017 was estimated with robust design capture-recapture models (Kendall et al., 1997, Pollock, 1982) (for further details, see Arso Civil et al. (2018b)). Model structures and parameters were specified and run using the package RMark (Laake, 2013) in R (R Core Team, 2016), and program MARK (White and Burnham, 1999). To estimate the total number of bottlenose dolphins using this area, the estimated number of well-marked animals was divided by the proportion of well-marked animals amongst the total number of animals encountered, estimated as described by Arso Civil et al. (in press). These methods will be described fully in the Final Report.

5.2 2018 surveys in the Firth of Tay and St Andrews Bay

In 2018, surveys were conducted from three different small boat platforms depending on availability:

- Swordsman (a 7.4 m aluminium planing hull cruiser with 225 horse power (hp) outboard engine),
- Pier Pressure (a 10.0 m planing hull cabin RIB with 2 x 150 hp outboards),
- Terra Nova (a 12 m cabin rib with 2x300 hp outboards).

Surveys were designed to maximise our chances of encountering bottlenose dolphins and obtaining high quality photographs. Surveys started either from St Andrews harbour or Newport-on-Tay, depending on the tide and boat availability.

For the duration of each trip, the boat position and depth were recorded every minute using a Garmin GPS Map 551s GPS/Plotter/Sounder, and a Garmin eTrex GPS for backup. Approximately every 15 minutes, the position of the boat, the activity (i.e., searching for dolphins, in an encounter with dolphins, or off effort) and the weather conditions were manually logged into a survey effort data paper form. Surveys were conducted by at least three crew members: the skipper and two observers, one of which was experienced with photo-identification methods, with one to two additional observers joining the surveys.

Surveys were always initiated in favourable weather conditions (sea conditions between Beaufort 0 and 3). Photo-identification data were collected using a Canon EOS 50D or a Canon EOS 70D with a 70-200 mm f2.8 USM Canon lens. Standardised protocols were used at all times, taken from the long-running east coast of Scotland bottlenose dolphin project (Cheney et al., 2013) coordinated by the Lighthouse Field Station, University of Aberdeen, and the Sea Mammal Research Unit, University of St Andrews. This ensured all data were standardised with and could be incorporated into the established dataset for Scottish bottlenose dolphins curated at the Lighthouse Field Station. Three different photographers were used, Monica Arso Civil for two

trips, Emily Hague for four trips, and Marie Louis for the remaining 15 trips. During each encounter, data on group size, behaviour, and the presence of new born individuals and older calves were recorded, as well as data on water depth.

Photographs were graded for photographic quality following criteria adapted from Wilson et al. (1999) (see Appendix 1: Figure 6). Individuals in the best quality photographs (grade 3) were preliminarily matched to the catalogue of known bottlenose dolphins off the east coast of Scotland.

6 Results & Discussion

6.1 Number of animals using the Firth of Tay and St Andrews Bay in 2017

Processing of the photo-ID data collected in 2017 identified a total of 116 individual dolphins from 1,676 high quality photographs. The total number of bottlenose dolphins using the Firth of Tay and St Andrews Bay area in 2017 is estimated to be 130 (95% CI = 109-154).

The number of animals using St Andrews Bay and the Tay estuary since 2009 (Figure 1) has increased at an annual rate of 6.4% (p=0.0056), demonstrating that this area continues to be important for bottlenose dolphins of the east coast of Scotland, at least during the summer months (Arso Civil et al., 2018b). It is important that surveys continue annually in this area to monitor whether the trend for increased use of this part of the population's range continues.

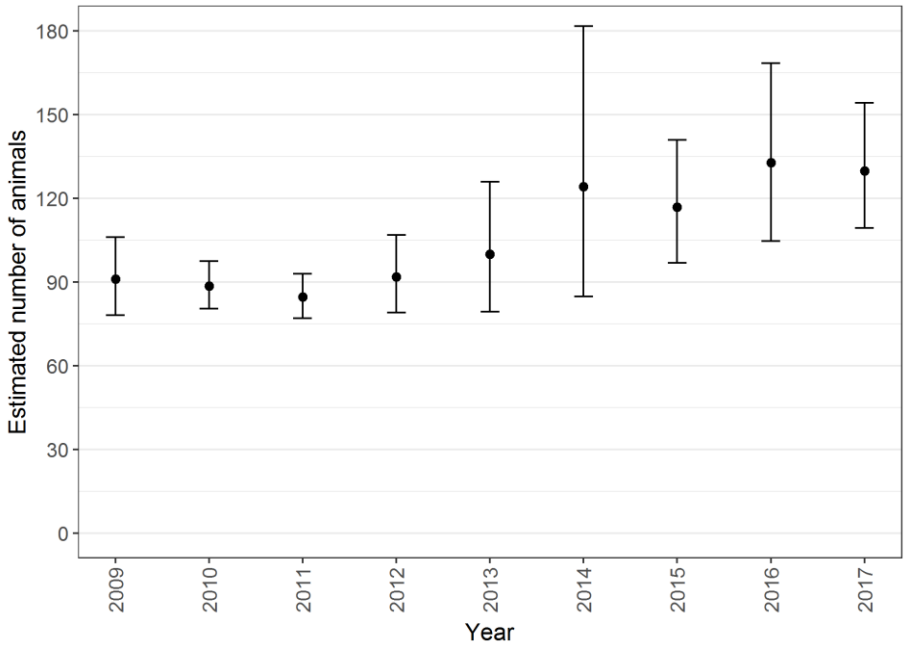

Figure 1. Estimated total number of bottlenose dolphins using the Firth of Tay and St Andrews Bay area in 2017 compared to estimates for 2009 to 2016. Error bars are 95% confidence intervals. From Arso Civil et al. (2018b).

6.2 Survey effort in 2018

We conducted a total of twenty-one boat-based photo-identification trips between 2 May and 28 September 2018 (Table 1, Appendix 1), with surveys occurring in all months. This period of sampling was the same as in previous years and is the same period during which sampling takes place in the Moray Firth. Boat tracks and

location of encounters with bottlenose dolphins and other cetaceans are shown in Figure 2 to Figure 5. From any of the starting locations, surveys generally covered the area between Newport-on-Tay out to the entrance of the Firth of Tay, and from there to St Andrews and/or Arbroath. On ten occasions the surveys extended to Lunan Bay and Montrose area, north of Arbroath, and on two occasions surveys extended south to Fife Ness (Figure 2 to Figure 5). On one occasion the conditions reached Beaufort 4 during an encounter with dolphins (in Trip 1719), affecting the quality of the photographs taken because of the difficulty to sight and follow animals in these conditions.

6.3 Number of animals encountered in 2018

Bottlenose dolphins were encountered on all except three trips, in 47 separate encounters (Table 1). Most encounters occurred between Broughty Ferry and the entrance to the Firth of Tay and between Arbroath and Lunan Bay, with fewer encounters in St Andrews Bay and around Montrose (Figure 2). Estimated group sizes during field observations ranged from 1 to 40 animals in the encountered groups, with a mean group size of 10 animals. The exact locations and estimated group sizes are given in Appendix 1: Table 2. Harbour porpoises were encountered on eighteen separate occasions, and an unidentified whale was seen on one occasion (Figure 2 to Figure 5).

6.4 Photographs taken and processed in 2018

In total, 7,802 photographs containing one or multiple dorsal fins were taken during the encounters with bottlenose dolphins, of which 1,880 were classified as grade 3. A total of 92 different individuals has been positively identified so far; however, this number might change once the processing is finalised (see below). In addition, two calves born in 2018 and six older calves were observed, identified by close association with their assumed mothers. Dolphin identifications from 2018 will be confirmed by additional experienced researchers in early 2019 to finalise the data for 2018, as part of the annual protocol applied to all photo-ID data that are part of the Aberdeen/St Andrews Scottish east coast bottlenose dolphin project.

Table 1. Summary of survey time and encounters with bottlenose dolphins in St Andrews Bay and Firth of Tay in 2018.

Trip	Month	Date	Survey Time (hrs)	No. of Enc.	Time on Enc. (hrs)	Group size	Mean group size
1677	May	02/05/2018	7.57	1	0.62	3	3
1678	May	07/05/2018	5.32	1	0.27	2	2
1681	May	14/05/2018	7.37	4	2.35	2-20	8
1682	May	23/05/2018	7.12	3	2.37	7-15	12
1684	May	28/05/2018	6.75	2	2.40	5-18	11
1686	June	07/06/2018	8.30	3	2.22	4-20	10
1687	June	11/06/2018	5.78	1	0.97	14	14
1690	June	22/06/2018	5.57	3	2.55	5-15	9
1691	June	25/06/2018	6.25	3	2.27	2-20	9
1695	July	04/07/2018	7.12	1	1.57	25	25
1696	July	10/07/2018	7.65	4	3.63	4-40	13
1699	July	18/07/ 2018	7.38	0	0.00	-	-
1701	July	19/07/2018	4.95	3	2.52	8-15	10
1702	July	24/07/2018	7.35	5	3.08	1-24	8
1706	August	03/08/2018	8.10	3	2.58	9-15	12
1707	August	07/08/2018	8.20	1	0.20	3	3
1711	August	20/08/2018	6.88	2	1.10	5-12	8
1714	August	30/08/2018	7.27	2	0.82	1-7	4
1716	September	04/09/2018	7.43	0	0.00	-	-
1717	September	18/09/2018	6.30	0	0.00	-	-
1719	September	28/09/2018	7.57	5	2.57	4-28	12
Total			**146.2**	**47**	**34.07**	**1-40**	**10**

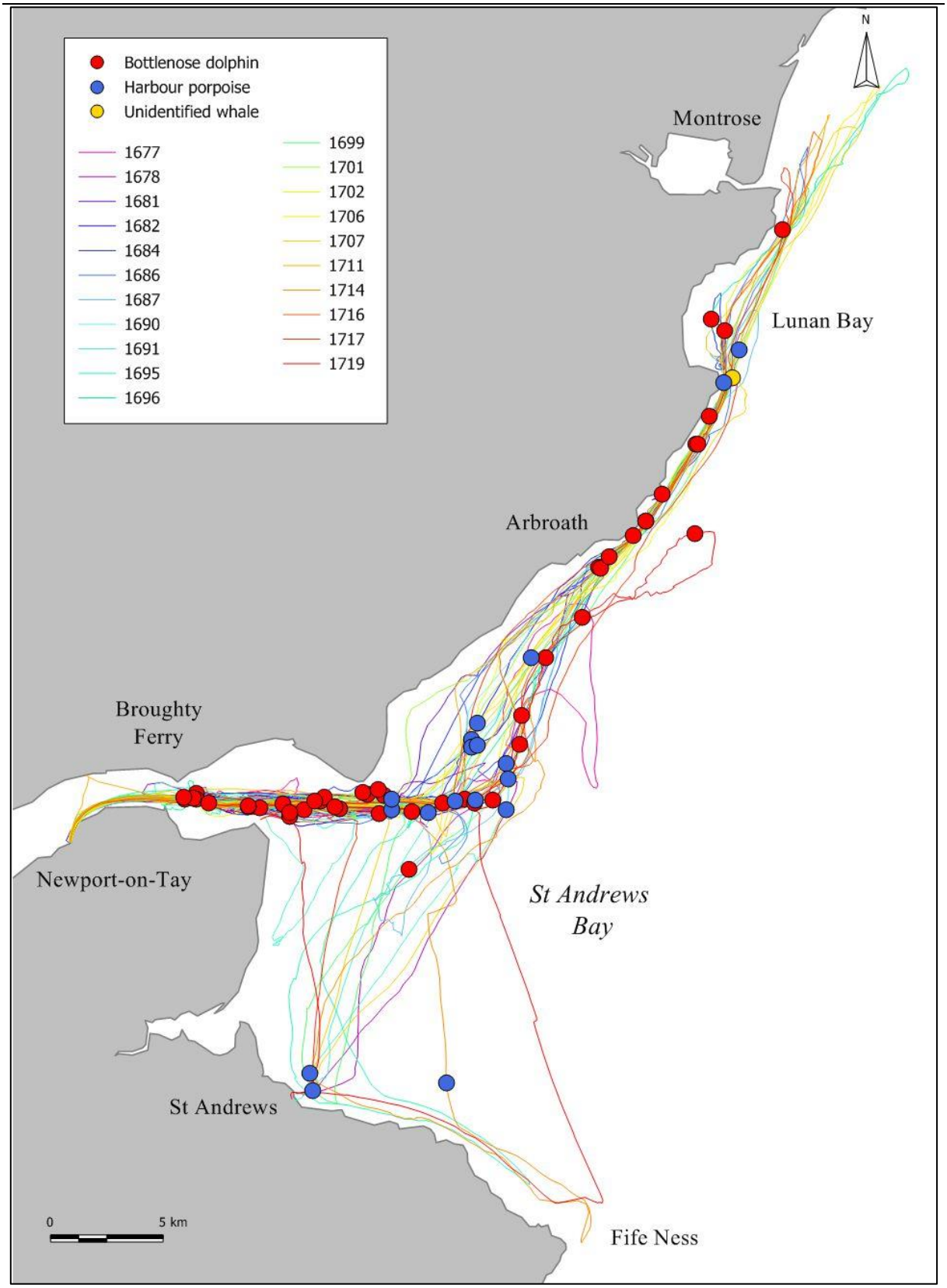

Figure 2. Survey effort in 2018 (lines coloured by trip) and bottlenose dolphin (red dots), harbour porpoise (blue dots), and unidentified whale (yellow dot) encounters.

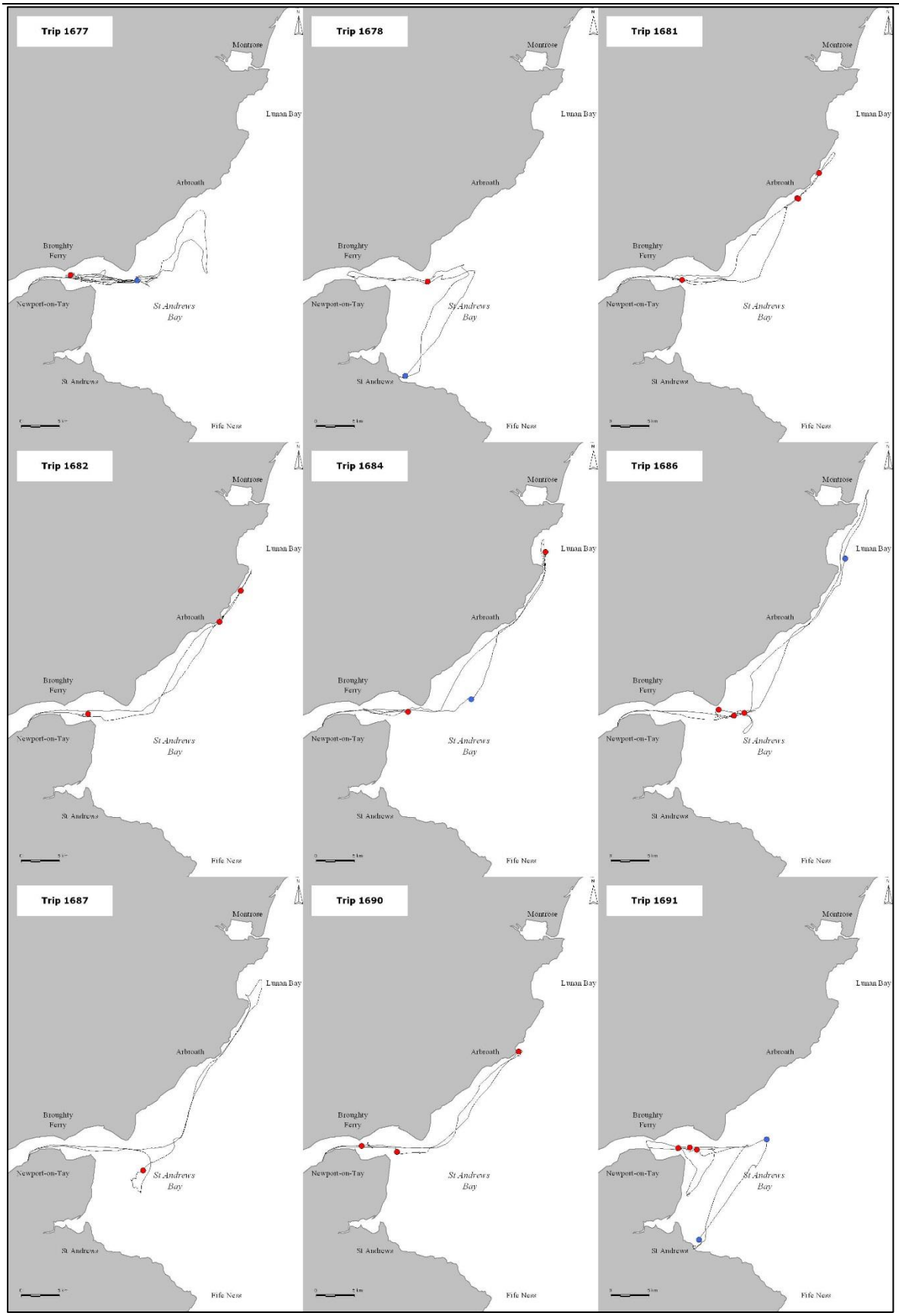

Figure 3. Survey effort (grey line), bottlenose dolphin (red dots) and harbour porpoise (blue dots) encountered on each of the trips conducted in May and June 2018.

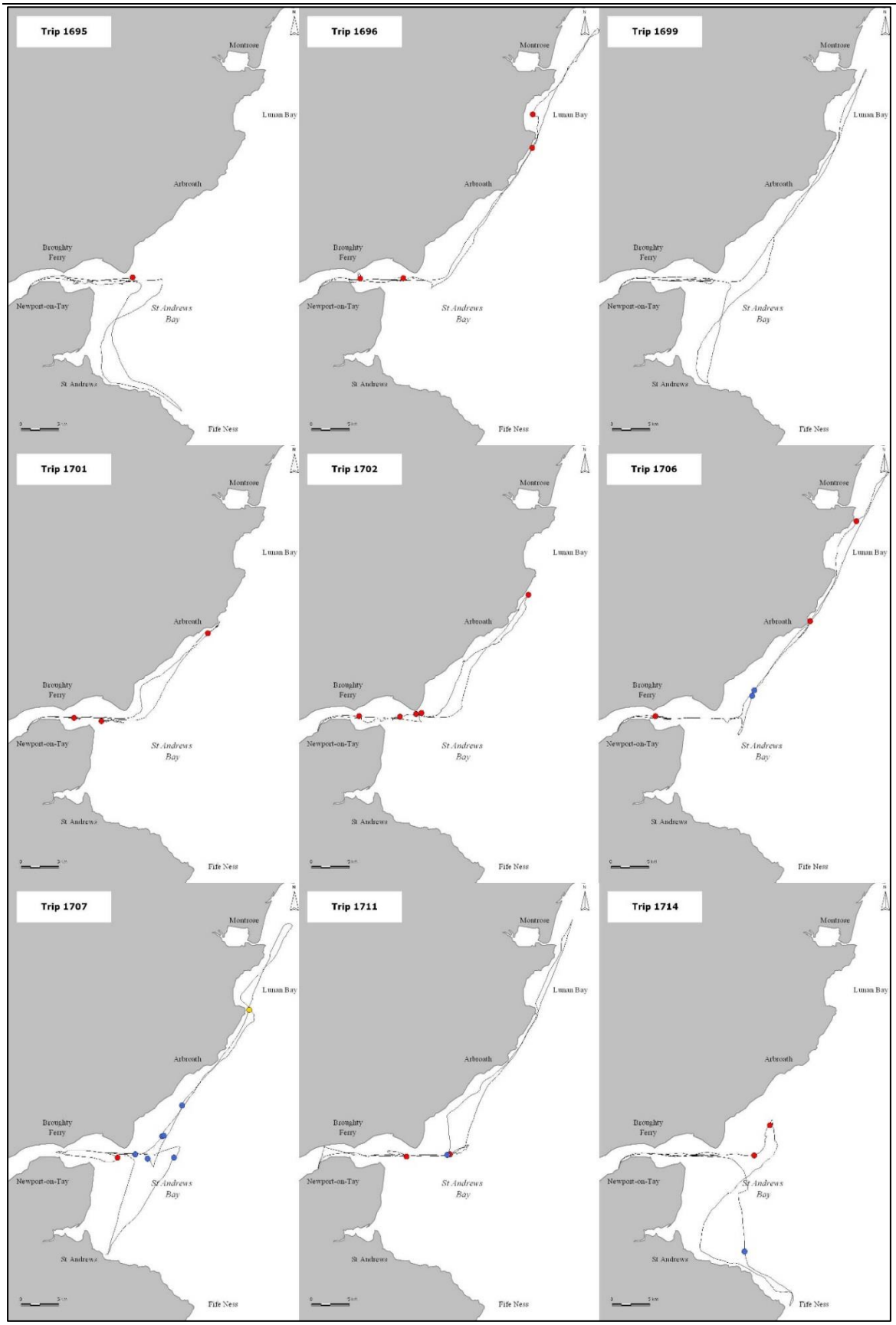

Figure 4. Survey effort (grey line), bottlenose dolphin (red dots), harbour porpoise (blue dots), and unidentified whale (yellow dot) encountered on each of the trips conducted in July and August 2018.

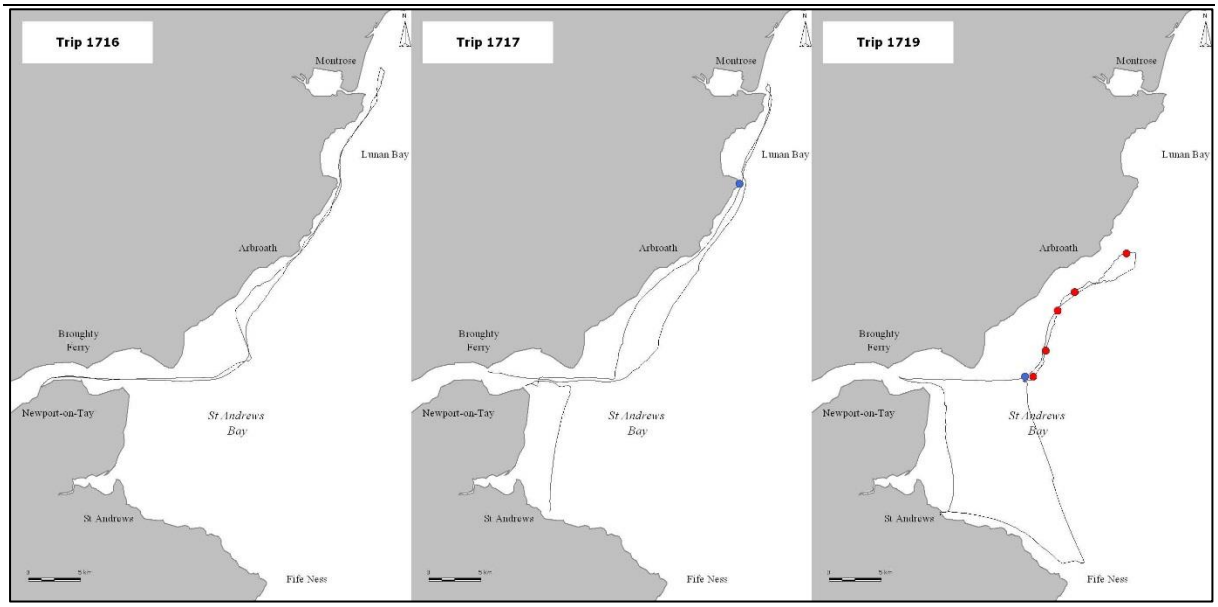

Figure 5. Survey effort (grey line), bottlenose dolphin (red dots) and harbour porpoise (blue dots) encountered on each of the trips conducted in September 2018.

7 Outlook

Results from analyses of the photo-identification data, including an estimate of the number of dolphins using the Firth of Tay and St Andrews Bay in 2018 will be included in the final report in 2020. As planned, photo-identification data will be collected between May and September 2019, during adequate weather windows. We will aim for a total of 20 one-day sampling trips in the southern part of the population's range, primarily around the Firth of Tay and St Andrews Bay. Sampling may extend as far north as Lunan Bay (Montrose). As in previous years, it is not planned to sample in the Aberdeen-Stonehaven area in 2019.

8 Acknowledgements

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10 Appendix 1

Table 2. Location, date and number of bottlenose dolphin individuals encountered per group in 2018.

Location					
Latitude	**Longitude**	**Date**	**Trip**	**Encounter**	**Number of individuals**
56.45834	-2.85508	02/05/2018	1677	3994	3
56.45136	-2.72309	07/05/2018	1678	3995	2
56.45299	-2.80875	14/05/2018	1681	4006	6
56.55050	-2.56587	14/05/2018	1681	4007	2
56.57958	-2.52056	14/05/2018	1681	4008	20
56.54981	-2.56452	14/05/2018	1681	4009	5
56.45330	-2.81740	23/05/2018	1682	4010	7
56.56329	-2.54119	23/05/2018	1682	4011	15
56.59977	-2.49662	23/05/2018	1682	4012	15
56.45606	-2.76504	28/05/2018	1684	4018	5
56.64505	-2.47638	28/05/2018	1684	4019	18
56.45895	-2.73139	07/06/2018	1686	4023	7
56.45562	-2.67705	07/06/2018	1686	4024	20
56.45198	-2.69905	07/06/2018	1686	4025	4
56.42889	-2.70087	11/06/2018	1687	4026	14
56.45609	-2.86325	22/06/2018	1690	4041	8
56.44962	-2.78757	22/06/2018	1690	4042	15
56.56898	-2.53228	22/06/2018	1690	4043	5
56.45461	-2.79248	25/06/2018	1691	4044	2

Location					
Latitude	Longitude	Date	Trip	Encounter	Number of individuals
56.45385	-2.81693	25/06/2018	1691	4045	20
56.45250	-2.77724	25/06/2018	1691	4046	5
56.45838	-2.71963	04/07/2018	1695	4056	25
56.45617	-2.85459	10/07/2018	1696	4057	4
56.45751	-2.76218	10/07/2018	1696	4058	5
56.61084	-2.48678	10/07/2018	1696	4059	5
56.64997	-2.48599	10/07/2018	1696	4060	40
56.45450	-2.84576	19/07/2018	1701	4078	15
56.55470	-2.55885	19/07/2018	1701	4079	8
56.45128	-2.78701	19/07/2018	1701	4080	8
56.45668	-2.85702	24/07/2018	1702	4081	5
56.45606	-2.76912	24/07/2018	1702	4082	3
56.45953	-2.73498	24/07/2018	1702	4083	1
56.59965	-2.49508	24/07/2018	1702	4084	24
56.46083	-2.72342	24/07/2018	1702	4085	7
56.56894	-2.53244	03/08/2018	1706	5002	9
56.68564	-2.43463	03/08/2018	1706	5003	15
56.45666	-2.86377	03/08/2018	1706	5004	12
56.45288	-2.75156	07/08/2018	1707	5005	3
56.45369	-2.75500	20/08/2018	1711	5012	12
56.45720	-2.66148	20/08/2018	1711	5013	5
56.45580	-2.65441	30/08/2018	1714	5025	7
56.49080	-2.62083	30/08/2018	1714	5026	1
56.45690	-2.64128	28/09/2018	1719	5035	7
56.47954	-2.62227	28/09/2018	1719	5036	28
56.51406	-2.60404	28/09/2018	1719	5037	4
56.53020	-2.57775	28/09/2018	1719	5038	8
56.56404	-2.49660	28/09/2018	1719	5039	12

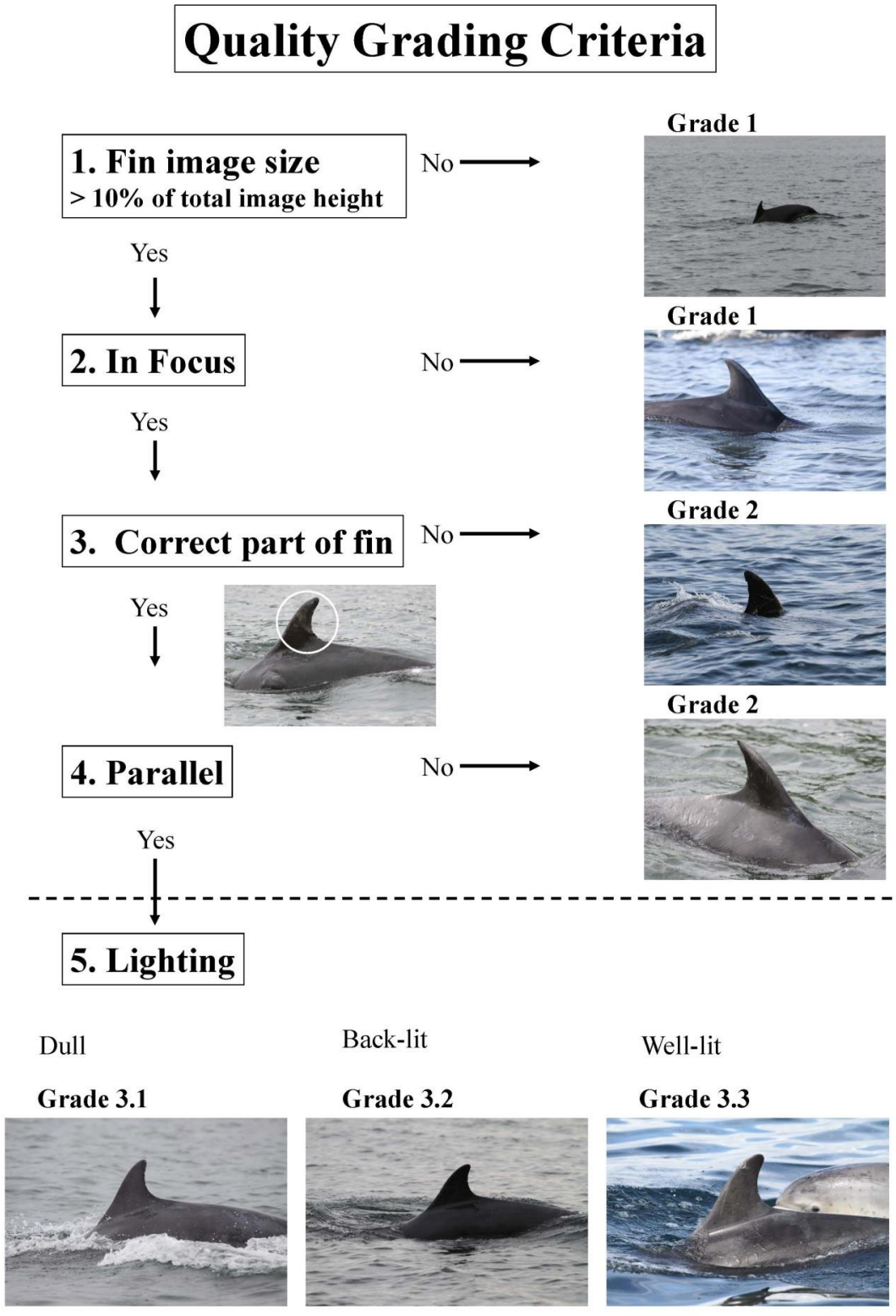

Figure 6. Criteria for grading pictures based on photographic quality, adapted from Wilson et al. (1999).